University of Fort Hare
Together in Excellence

DEVELOPMENT OF A STRATEGY TO PROMOTE PRENATAL PHYSICAL ACTIVITY PARTICIPATION AMONG WOMEN IN BUFFALO CITY MUNICIPALITY, SOUTH AFRICA

BY

OKAFOR UCHENNA BENEDINE

201006014

Submitted in fulfilment of the requirements for the degree of

Doctor of Nursing

in the

Faculty of Health Sciences

at the

University of Fort Hare

Supervisor: Prof DT Goon Date: March, 2022

DELCARATION

PLAGIARISM:

"I **OKAFOR Uchenna Benedine**, student number 201006014 hereby declare that I am fully aware of the University of Fort Hare's policy on plagiarism and I have taken every precaution to comply with the regulations.

Signature: ……  ……"

ETHICS:

"I **OKAFOR Uchenna Benedine**, student number 201006014 hereby declare that I am fully aware of the University of Fort Hare's policy on research ethics and I have taken every precaution to comply with the regulations. I have obtained the ethical clearance certificate from the University of Fort Hare's Human Research Ethics Committee and my reference number is the following: Ref#2019=06=009=OkaforUB

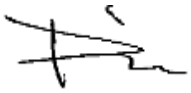
Signature: ……  ……"

DEDICATION

This Thesis is dedicated to my husband, Prof **Chukwuemeka Okafor** for his unending sacrifices and support shown to me throughout this journey.

CERTIFICATION

This thesis entitled **"Development of a strategy to promote prenatal physical activity participation among women in Buffalo City Municipality, South Africa"** meets the regulations governing the award of the degree of Doctor of Nursing of the University of Fort Hare and is approved for its contribution to scientific knowledge.

Signature of the Supervisor:……  …… Date: 19 March 2022

ACKNOWLEDGEMENTS

To God Almighty who made everything good in his time.

I appreciate my supervisor Prof DT Goon for his academic mentoring, encouragement and understanding. I learned a lot about academic scholarly writing from you.

To my loving husband, Prof Chukwuemeka Okafor for his unquantifiable financial and moral support towards accomplishing this feat.

To the South African Medical Research Council under the auspices of the Bongani Mayosi National Health Scholars Programme for their scholarship; and the Govan Mbeki Research and Development Center, University of Fort Hare, South Africa for the supervisory-linked bursary.

To my children, Mesoma and Munachi for their companionship throughout this journey.

To Miriam for her constant prayers and support.

To Mrs Nozikolo Nelani, who stood with me throughout this journey and would always respond to my request without objections.

To my family, friends, and colleagues: Mrs Amaka Asoegwu, Mrs Chetachukwu Okoye, Mrs Kosisochukwu Igwenagu, Dr Uloma Obi, Dr A Okeyo, Mr Ikemefuna Obi and Dr Zongho for all their support. I also appreciate the assistance of Dr Hlulani Mabasa.

To the Eastern Cape Department of Health for permission to conduct the study in the selected facilities.

ABSTRACT

Background

Research has proven that prenatal physical activity practice is associated with multiple health benefits; however, most women in South Africa rarely participate in prenatal physical activity. In contrast to more developed countries, there is dearth of research focusing specifically on prenatal physical activity and exercise among South African women. Nevertheless, in order to effectively, and strategically promote such prenatal activity, such information is important to plan for an intervention strategy.

Aim

The main aim of this study was to assess the level, patterns, and associated factors of prenatal physical activity; beliefs, knowledge, attitudes, perceived benefits, and sources of information women received during pregnancy; and, furthermore, to develop an effective and relevant intervention strategy to facilitate the participation in this particular activity in Buffalo City Municipality, Eastern Cape, South Africa.

Methods

The study was a mixed-method, cross-sectional study design with both quantitative and qualitative data collection and analyses. The sequential explanatory design was adopted to merge and mix different datasets to be collected and analysed. The quantitative data involved a convenient sample of 1082 pregnant women in 12 randomly selected primary healthcare clinics offering antenatal health services in Buffalo City, Eastern Cape. The Pregnancy Physical Activity Questionnaire was interviewer-administered to women at each antenatal health clinic on pre-specified days, in a designated room allocated to the primary researcher by the health facility manager. The descriptive statistics were frequency distribution, percentages, mean and standard deviation. Furthermore, the bivariate and multivariate analyses were performed on two categories of participants, namely inactive or active, to determine the factors affecting prenatal physical activity behaviour. Furthermore, multiple logistic regression analyses were used to assess associations between physical activity and the predictor variables during pregnancy. Adjusted odds ratios with 95% confidence interval were applied to estimate factors associated with physical activity levels, and the associations between prenatal physical activity levels and socio-demographic, lifestyle, and obstetrics characteristics were determined using a chi-squared analyses. The significance level was set

at $p = 0.05$. In addition, a qualitative descriptive approach was applied, using semi-structured face-to-face interviews with 15 purposively selected pregnant women, as well as 17 midwives offering antenatal health-care services to pregnant women in the 12 selected healthcare clinics. Qualitative data were analysed using a thematic content analysis.

To develop the physical activity strategy for the promotion of prenatal physical activity practice, three frameworks were applied, namely the Strength, Weakness, Opportunity and Threat (SWOT), the Political, Economic Growth, Socio-Cultural, Technological, Laws and Environmental (PESTLE), and, lastly, the Build, Overcome, Explore and Minimise (BOEM) analytical frameworks. To facilitate the validation of the strategy, the findings were additionally analysed, after which, appropriate intervention strategies promoting prenatal physical activity were developed by again using the SWOT and PESTLE analytical strategic frameworks. This process involved a purposive sampling of seven experts with knowledge of and a proven academic and scholarly background in prenatal physical activity and maternal health. Next, the developed physical activity strategy was presented to various stakeholders, which included six primary healthcare managers, two midwives, and pregnant women purposively selected in each of the 12 chosen antenatal health clinics for the validation process. The stakeholders discussed, deliberated on, and provided comments and opinions of the feasibility and implementation of the developed prenatal physical activity for promotion of physical activity practices in the Eastern Cape Province.

Results

The findings of this particular study demonstrated low levels of prenatal physical activity among pregnant women, and, further indicated that the most preferred form of activity was light-intensity and household activities. Only 278 of the women (25.7%) met recommendations for prenatal activity (≥150 min moderate intensity exercise per week). The average time spent in moderate–vigorous physical activity was 151.6 min (95% CI: 147.2–156.0). Most of the women participated in light exercises with a mean of 65.9% (95% CI: 64.8–67.0), and 47.6% (95% CI: 46.3–48.9) participated in household activities. The majority of the women did not receive physical activity advice during prenatal care sessions (64.7%). Lower age (<19 years) (adjusted odd ratio (AOR) = 0.3; CI: 0.16–0.76), semi-urban residence (AOR = 0.8; CI: 0.55–1.03), lower educational level (AOR = 0.5; CI: 0.20–0.71), unemployment (AOR = 0.5; CI: 0.29–0.77) and nulliparity (AOR = 0.6; CI: 0.28–1.31) were negatively associated with prenatal physical activity, while prenatal physical activity was

positively associated with starting physical activity in the first trimester (AOR = 1.9; CI: 1.06–3.31) compared to other trimesters. In addition, the pregnant women were aware of the safety (88.2%) and benefits of physical activity for both mother and baby (79.6%), improved labour and delivery (93.1%), promote energy (89.0%), and should be discontinued when tired (76.6%). However, they also held the contradictory belief that pregnancy is "a time to rest" (56.5%). Furthermore, the most common sources of information about prenatal physical activity were the media, television, the radio and Internet-based websites (70.2%). Most women affirmed that prenatal physical activity reduced infant weight (61.4%), lessen moodiness (90.4), decreased risk of gestational diabetes mellitus (92.9%), pregnancy-induced hypertension (92.5%), and complications at birth (97.8%), while common negative perceptions included musculoskeletal discomfort (82.7%), and back pain (85.7%). The majority of women indicated that prenatal physical activity improved self-image (95.7%), sleep patterns (94.2%), and respiratory function (95.8%). The results from the quantitative data revealed that the major modifiable barriers to prenatal physical activity were tiredness (73.3%), lack of advice from healthcare professionals (nurses/midwives) (64.7%), low energy (64.5%), and non-accessibility to physical activity facilities (63.0%). The results were confirmed in the qualitative data, based on the Ecological Model, in which women also mentioned tiredness, work and household responsibilities, a lack of motivation, and the lack of physical activity advice and information on the relevant recommendations and guidelines. Overall, 62.4% women had high knowledge regarding prenatal physical activity; and half of the women showed a positive attitude toward it (50.1%). Whilst participants had knowledge of other types of antenatal exercises, 80.9% of the women had no knowledge of swimming exercise. Negative attitudes towards physical activity included the feeling of tiredness (67.7%), lack of interest (64.8%), and inadequate information on physical activity (59.5%). In addition, the study highlighted that midwives rarely educate and counsel pregnant women about prenatal physical activity during scheduled antenatal visits, which was attributed largely to the shortage of midwives handling many responsibilities at clinics. Nevertheless, the midwives did express a willingness to provide effective physical activity education and counselling on prenatal physical activity, if supported by relevant training and workshops. Furthermore, they further recommended the use of the Mom Connect application, which is a technological device designed by the National Department of Health, to distribute relevant information about maternal and child health.

The prenatal physical activity strategies developed to address the above-mentioned and other barriers associated with prenatal physical activity include the use of scientific and technological innovations to provide basic information on prenatal physical activity to pregnant women by means of Mom Connect, and, by collaborating with the various cell-phone and network companies in South Africa. Another strategy was to integrate prenatal physical activity training into the curricula of the existing higher institutions of learning that provide teaching of maternal health in the Eastern Cape Province. Additional strategies included the documentation and subsequent clarification of misconceptions about the safety concerns often associated with prenatal physical activity by making the documents accessible to all women at the clinics in the form of a small pamphlet or booklet. Lastly, stakeholders suggested that the government offer periodic prenatal physical activity campaigns, which should be presented in local community town halls and clinics and by other stakeholders to address the current lack of awareness and effectively eliminate misrepresentations and falsehoods around the safety of prenatal physical activity within geographical setting of the Eastern Cape Province.

Conclusion

Despite the advantages of prenatal physical activity practices, most pregnant women in South Africa do not participate in moderate-intensity physical activity. Notably, while women perceive prenatal physical activity as beneficial to both mother and baby, such theoretical knowledge is not easily translatable into practice. The predominant sources of information on prenatal physical activity are the television, the radio, and other media, which may be potentially misleading or contradictory to evidence-based physical activity practice. Furthermore, tiredness, a lack of time, work and household responsibilities, and a lack of motivation were major modifiable barriers to prenatal physical activity by the women. In addition, pregnant women rarely receive information on prenatal physical activity. Consequently, to address the needs of the pregnant women as highlighted in this study, a prenatal physical activity intervention strategy was developed and validated by key stakeholders to promote prenatal physical activity and exercise practice among women, taken in account the local context.

Keywords: Physical activity, exercise, intervention strategy, pregnant women, Eastern Cape, South Africa

PREAMBLE

The format of this thesis follows the recommendations for a PhD by manuscript, as presented in the Department of Nursing Science, Faculty of Health Sciences, University of Fort Hare, South Africa. The thesis is submitted as a collection of nine published research articles. These publications are combined with introductory and synthesis chapters to form a thesis. The protocol of the thesis has been published in the **International Journal of Environmental Research and Public Health**.

Each chapter provides a brief introduction and concludes with a summary of the main findings for emphasis and flow. Where possible, excessive repetition is avoided for ease of reading; however, some content appears in the introductory chapters and again in the manuscripts.

The introductory chapter, Chapter One, provides the background to prenatal physical activity, and, in particular, perspectives on prenatal physical activity in South Africa. This chapter then presents the rationale and clarifies the problem statement. Lastly, it describes the overall aim and specific objectives of the study, and its significance.

Chapter Two provides a literature review of the physical activity levels, beliefs, sources of information, perceived benefits, barriers, and attitudes of pregnant women towards physical activity and exercise, furthermore; it reviews intervention strategies for the promotion of prenatal physical activity and exercise. Subsequently, two articles on the literature review were published as follows: firstly, the review article published in the **BMC Pregnancy and Childbirth** journal examined the levels and types of physical activity, factors affecting physical activity, beliefs about and benefits of prenatal activity, advice or counselling on prenatal physical activity in Africa; secondly, the next article published in the **Healthcare** journal was a scoping review on prenatal physical activity advice and the counselling by the healthcare providers.

Chapter Three describes the methodology of the study, providing details of the quantitative and qualitative methods used to accomplish the objectives of the study.

Chapters Four to Ten presented the published articles for each of the research objective. Each chapter provides introductory material explaining how each publication is integrated into the content. As previously stated, each chapter concludes with a summary that describes its main

findings in relation to the objectives and overall aim and demonstrates the linkages to the study as a whole.

All publications were first-authored by the candidate, as per the rules for first authorship. Articles in each chapter are described as such, with details of the journals. The journals are peer-reviewed and approved by the Department of Higher Education and Training (DHET). The background, literature review, methods, main findings and discussion are presented in each of the articles.

Next, Chapter Four presents an article published in the **International Journal of Environmental Research and Public Health** that examines prenatal physical activity level and its associated factors among pregnant women in Buffalo City Municipality, Eastern Cape Province.

Chapter Five presents an article published in the **Journal of Multidisciplinary Healthcare**, which explores the beliefs, perceived benefits and sources of information on physical activity during pregnancy among pregnant women in the Eastern Cape Province.

Chapter Six then presents an article published in the **Medicine** journal, which explores women's perspectives on modifiable constraints to physical activity during pregnancy by applying the Ecological Model to women living in the Eastern Cape Province.

Chapter Seven presents a manuscript accepted for publication in the **Frontiers in Public Health**, which assesses the barriers to physical activity participation among pregnant women using a mixed-method approach.

Chapter Eight presents a manuscript accepted for publication in the **Pakistan Journal of Medical Sciences**, which assesses the knowledge, attitudes and practices of pregnant women to prenatal physical activity.

Chapter Nine presents an article published in the **Nigerian Journal of Clinical Practice**, which explores midwives' perspectives on providing prenatal physical activity counselling during pregnancy in the Eastern Cape Province.

Chapter Ten presents an article published in the **Healthcare** journal, which describes the development and validation of prenatal physical activity intervention strategy in Buffalo City Municipality, South Africa.

Finally, Chapter 11 provides a summary and synthesis of the findings and outlines the implications and recommendations, for policy and programme interventions (based on the results). The limitations of the study are discussed and future research directions are suggested.

References for the study (Introductory Chapters One, Two and Three, and the Synthesis Chapter Eleven) appear at the end of the thesis in Chapter 11. The American Psychological Association (APA) referencing style has been used for this material. Moreover, each article includes references used in that particular article, which is presented in the relevant journal-specified. A summary of the research objectives, research methods and inclusion in the thesis is provided in Table 1 at the end of Chapter 1.

PEER-REVIEWED PUBLICATIONS EMANATING FROM THIS THESIS

Manuscripts published:

1. Okafor UB, Goon DT. Physical activity level during pregnancy in South Africa: A facility-based cross-sectional study. *International Journal of Environmental Research and Public Health*, 2020; 17(21): 7928. https://doi:10.3390/ijerph17217928.

2. Okafor UB, Goon DT. Physical activity in pregnancy: Beliefs, benefits and information seeking practices of pregnant women in South Africa. *Journal of Multidisciplinary Healthcare*, 2021. https://doi.org/10.2147/JMDH.S287109.

3. Okafor UB, Goon DT. Applying the Ecological Model to understand pregnant women's perspectives on the modifiable constraints to physical activity during pregnancy: A qualitative research study. *Medicine*, 2020, 99 (49), (e23431). http://dx.doi.org/10.1097/MD.0000000000023431.

4. Okafor UB, Goon DT. Providing physical activity advice during pregnancy: A qualitative study of nurses' perspectives. *Nigeria Journal of Clinical Practice*, 2021, 24:718-28. DOI:10.4103/njcp.njcp_486_20.

5. Okafor UB, Goon DT. Development and validation of prenatal physical activity intervention strategy for women in Buffalo City Municipality, South Africa. *Healthcare*, 2021, 9(11):1445. https://doi.org/10.3390/healthcare9111445.

6. Okafor UB, Goon DT. Physical activity and exercise during pregnancy in Africa: A review of the literature. *BMC Pregnancy and Childbirth*, 2020, 20: 732 https://doi.org/10.1186/s12884-020-03439-0.

7. Okafor UB, Goon DT. Physical activity advice and counselling by healthcare providers: A scoping review. *Healthcare*, 2021, 9:609. https://doi.org/10.3390/healthcare9050609.

Manuscripts accepted:

8. Okafor UB, Goon DT. Uncovering barriers to prenatal physical activity and exercise among South African pregnant women: A cross-sectional, mixed-methods analysis. *Frontiers in Public Health*, 2022.

9. Okafor UB, Goon DT. Efficacy and positive outcome of physical activity in pregnant women. *Pakistan Journal of Medical Sciences*, 2022.

Thesis protocol publication:

Okafor UB, Goon DT. Developing a physical activity intervention strategy for pregnant women in Buffalo City Municipality, South Africa: Study Protocol. *International Journal of Environmental Research and Public Health*, 2020, 17, 6694; doi:10.3390/ijerph17186694.

Conference presentations:

1. Okafor UB, Goon DT. Developing a physical activity intervention strategy for pregnant women in Buffalo City Municipality, South Africa: Study Protocol. A Virtual Conference organized by Govan Mbeki Research and Development Center, University of Fort Hare for Postgraduates on 24 – 26 November 2020.

2. Okafor UB, Goon DT. Applying the Ecological Model to understand pregnant women's perspectives on the modifiable constraints to physical activity during pregnancy: A qualitative research study. A Virtual Conference organized by Govan Mbeki Research and Development Center, University of Fort Hare for Postgraduates on 24 – 26 November 202

ACRONYMS

ACOG	American College of Obstetrics and Gynaecology
ACSM	American College of Sport Medicine
APA	American Psychological Association
BCM	Buffalo City Municipality
BMI	Body Mass Index
BOEM	Build, Overcome, Explore and Minimize
CDC	Centers for Disease Control and Prevention
CPD	Continuing Professional Development
COVID-19	Corona Virus Disease 2019
CI	Confidence Interval
DoH	Department of Health
DHET	Department of Higher Education and Training
DVDs	Digital Video Discs
EC	Eastern Cape
GDM	Gestational Diabetes Mellitus
GBD	Global Burden of Disease
IOC	International Olympic Committee
IOM	The Institute of Medicine
LTPA	Leisure Time Physical Activity
METs	Metabolic Equivalent of Task
NICE	National Institute for Health and Clinical Exercise
NCDs	Non-Communicable Diseases
OR	Odds Ratio
PA	Physical Activity
PAGAC	Physical Activity Guidelines Advisory Committee Report
PESTLE	Political, Economic, Sociological, Technological, Legal and Environmental
PHC	Primary Health Care
PPAQ	Pregnancy Physical Activity Questionnaire
RANZCOG	Royal Australian and New Zealand College of Obstetrics and Gynaecology

SANC	South Africa Nursing Council
SDT	Self-Determination Theory
SPSS	Statistical Package for Social Sciences
SWOT	Strength, Weakness, Opportunities and Threat
TEE	Total Energy Expenditure
TPB	Theory of Planned Behaviour
TTM	Transtheoretical Model
UFH HREC	University of Fort Hare Human Research Ethics Committee
WHO	World Health Organization

TABLE OF CONTENTS

LISTS OF TABLES

LISTS OF FIGURES

SUPPLEMENTARY FILES

CHAPTER ONE
INTRODUCTION

1.1 BACKGROUND AND JUSTIFICATION OF THE STUDY

Physical activity participation during pregnancy is important for the health of mother and baby; since pregnancy is a unique and vulnerable stage in a woman's life (Mottola *et al*., 2019; Ojukwu *et al*., 2018), which may bring about changes in lifestyle and behaviour, including participation in regular prenatal physical activity (Lawan *et al*., 2018; Davenport *et al*., 2018a; Davenport *et al*., 2018b; Mottola *et al*., 2019). Proper and essential antenatal care services, and regular exercise are foundational aspects to providing safe maternity care and ensuring improved neonatal outcomes (Sujindra *et al*., 2018). Since it is an incontestable fact that engagement in regular physical activity and exercise helps to maintain a healthy life and prevent complications in pregnancy (Artal, 2015), interventions that promote prenatal physical activity are crucial.

Research has established that physical inactivity is a global health issue. This is supported by data from the 2018 Global Burden of Disease study indicating that, compared to 2007, physical inactivity was a risk factor accounting for more than 1 million deaths, and an increase in mortality rate to 22% (GBD 2017 Risk Factor Collaborators, 2018). Similarly, the causes of deaths by major non-communicable diseases (NCDs) and cancers, such as ischaemic heart disease, ischaemic stroke, type-2 diabetes mellitus, as well as cancer of the colon, rectum, and breast are attributable to physical inactivity (GBD 2017 Risk Factor Collaborators, 2018). In addition, recent evidence demonstrates that physical inactivity is also a risk factor for the diagnosis of serious illness and death due to COVID-19 (Hamer, Kivimaki, Gale & Batty, 2020). Viewed from the economic perspective, physical inactivity contributes to the loss of billions of dollars, directly and indirectly (Ding *et al*., 2016). Notably, the World Health Organization (WHO) has launched the Global Action Plan on Physical Activity and Health 2018-2030 to reduce global physical inactivity by 15% by 2030 (WHO, 2018); and, as a policy action, it seeks to incorporate physical activity into both health and social services (WHO, 2018).

Maternal health is a global health priority (WHO, 2017) and, as modifiable health risk factors, physical activity and exercise are sacrosanct to reducing maternal morbidity (Watson *et al*., 2016). In light of this study, it is important to distinguish between the terms "physical

activity" and "exercise". While physical activity is defined as "any bodily movement produced by skeletal muscles that requires energy expenditure" (WHO, 2017), exercise, a subset of physical activity, is 'a planned, structured and repetitive activity' (Herold *et al*., 2019). While they have different connotations, these terms are sometimes used interchangeably, since both concepts are used to maintain general health and to achieve therapeutic health outcomes (Okafor & Goon, 2020a). In particular, in a primary healthcare setting participation in exercise is advocated for and encouraged in patients, based on the concept of "Exercise is Medicine", a well-known global slogan to encourage healthcare professionals to promote physical activity in their patients (Russell, 2013).

As previously mentioned, prenatal physical activity and exercise promote clinical and metabolic health in both mother and baby (Roland *et al*., 2021). Moreover, the benefits of participating in physical activity and exercise during pregnancy are widely reported in the literature. Research indicates that prenatal physical activity and exercise reduce pregnancy delivery complications (Perales & Artal, 2017; Mottola *et al*., 2018; Davenport *et al*., 2018a), such as the risk of gestational weight gain (Dipietro *et al*., 2019; Ruchat *et al*., 2018), gestational diabetes mellitus (Wang *et al*., 2017; Camargo *et al*., 2021; Yu *et al*., 2018; Aune *et al*., 2017; Du *et al*., 2019), caesarean delivery and postpartum recovery time (Davenport *et al*., 2019; Takami *et al*., 2018; Rajabi, Maharlouei & Rezainzadeh, 2018; Owe *et al*., 2016), and, lastly, lowers the risk of pre-eclampsia in expectant women (Davenport *et al*., 2018; Catov *et al*., 2018; Thompson *et al*., 2017; Raguema *et al*., 2020). Further benefits include improved maternal body composition (Ferrari *et al*., 2018), foetal birth weight (Davenport *et al*., 2018), and a lowered risk of preterm delivery (Davenport *et al*., 2018; Huang, Fan & Ding, 2019; Magro-Malosso, Saccone & Mascio, 2017). Concerning foetal health in particular, physical activity has been shown to improve neonatal body composition, and facilitate neuro-behavioural maturation and placental function (Neilsen *et al*., 2017; Collings *et al*., 2020; Vézina-Im, Nicklas & Baranowski, 2018; Barakat *et al*., 2015).

Additionally, research evidence has shown that being physically active during pregnancy not only reduces fatigue, stress, anxiety, and depression (Davenport *et al*., 2018a; Vargas-Terrones *et al*., 2019; Nakamura *et al*., 2019; Szegda *et al*., 2018; Kolomanska, Zarawski & Mazur-Bialy, 2020), but also lowers back and lumbopelvic pain (Patricia *et al*., 2019; Shiri *et al*., 2018; Davenport *et al*., 2019) and enhances better quality of sleep (Baker *et al*., 2018; Tan *et al*., 2020). Recently, maternal physical activity has been linked to improved

breastfeeding outcomes (Nguyen *et al*., 2019). Similarly, another study has demonstrated that physically inactive women are likely to experience perineal tears in comparison to more active participants (Silva-Jose *et al*., 2021). Consequently, the advantages of regular prenatal physical activity and exercise, as clearly outlined above, demonstrate that physical activity plays a crucial role in the health status of women, both during and after the postpartum stage. In addition, the ascribed benefits suggest the need to encourage pregnant women to be physically active, and to further design and implement physical activity interventions specifically tailored for pregnant women in order to promote the uptake of physical activity during pregnancy. Unfortunately, such initiatives are glaringly absent within the South African context.

Notwithstanding the advantages of prenatal physical activity participation, several studies have reported a considerable decline in prenatal physical activity and exercise in both developed (Bauer *et al*., 2018; Schmidt *et al*., 2017) and developing (Hailemariam *et al*., 2020; Todorovic *et al*., 2020; Watson *et al*., 2017; Lawan *et al*., 2018) countries with varying degrees of participation shaped by context-specific paradigms. In other words, pregnant women rarely meet the recommendations of various bodies and institutions, which stipulate that women without any medical or obstetric complications should engage in moderate-to-vigorous physical activity and exercise for 150 min per week or at least 20-30 min each day (Evenson, Mottola & Artal, 2019; Mottola *et al*., 2018). These institutions include the following bodies: the American College of Obstetricians and Gynaecologists (ACOG) (2020); the U.S. Department of Health and Human Services (US DHHS) (2018); the World Health Organization (WHO); the Joint Canadian Society for Exercise Physiology (CSEP)/Society of Obstetricians and Gynaecologists of Canada (SOGC) (Mottola *et al*., 2019); the Royal Australian and New Zealand College of Obstetrics and Gynaecology (RANZCOG) (2016); the International Olympic Committee (IOC) (Bo *et al*., 2018); the Department of Health & Social Care, UK (2019); and, lastly, the American College of Sport Medicine (ACSM) (Liguori *et al*., 2022). In fact, research shows that the physical activity of women declines, or completely cesses, as their pregnancies progress (Pathirathna *et al*., 2019; Walasik *et al*., 2020; Swift *et al*., 2017; Kolomanska, Zarawski & Mazur-Bialy, 2019). Subsequently, current estimates have shown that less than 15% of pregnant women are physically active for a minimum of 150 minutes during the week (Mottola *et al*., 2018).

Furthermore, a previous study in South Africa has reported that 44% of pregnant women were physically inactive during pregnancy (Muzigaba, Kolbe-Alexander & Wong, 2014). Consequently, the declined levels of prenatal physical activity strongly suggest the need to investigate the constraining factors thereof, and, in turn, develop educational strategies to highlight the importance of such physical activity and exercise. In addition, it is important that strategies be developed to encourage and promote physical activity and limit sedentary behaviour during pregnancy. However, this kind of information is sparsely available in the South African context.

Several reasons have been advanced for the low level of or decline in physical activity participation among women across different geographical regions, worldwide. The most commonly reported barriers to prenatal physical activity include lack of motivation (Bauer *et al*., 2018; Koleilat *et al*., 2016; Babbar & Chauhan, 2015), limited knowledge and education on the benefits/types of safe prenatal physical activity (Watson *et al*., 2016; Bauer *et al*., 2018; Koleilat *et al*., 2021), and lack of time in which to be physically active (Watson *et al*., 2016; Bauer *et al*., 2018; Sytsma *et al*., 2018; Koleilat *et al*., 2021). Seemingly, the lack of knowledge and skills affects the level of prenatal practice due to women's fear of harming themselves or their baby. Other barriers to prenatal physical activity and exercise are related to cultural and religious beliefs (Ojukwu *et al*., 2018; Chasan-Taber, 2012). These include a lack of support from partners and families (Leppanen *et al*., 2014; Koleilat *et al*., 2021) and family/work responsibilities or other commitments (Leppanen *et al*., 2014; Sujindra *et al*., 2018). Additionally, the benefits associated with physical activity suggest the need to identify the modifiable determinants of prenatal physical activity. The literature has shown that insufficient physical activity and exercise are associated with several sociodemographic and obstetric variables. These include women's level of education (Galliano *et al*., 2019; Gaston & Vamos, 2013; Baenia-Garcia *et al*., 2021; Lindqvist *et al*., 2016; Hailemariam *et al*., 2020), their socioeconomic status (Galliano *et al*., 2019), marital status (Gaston & Vamos, 2013; Hailemariam *et al*., 2020), body mass index (Lindqvist *et al*., 2016), whether they have experienced a previous miscarriage (Broberg *et al*., 2015), their age (Hailemariam *et al*., 2020), and employment status (Hailemariam *et al*., 2020).

Unfortunately, available literature is inconsistent about the influence of the above factors on physical activity during pregnancy. Therefore, it is crucial to understand the factors affecting prenatal physical activity as a component of providing quality antenatal and obstetric

healthcare services to this particular population. However, this requires an empirical understanding of the context-specific factors affecting the low and non-participation of women in physical activity during pregnancy in the Eastern Cape.

Prenatal healthcare providers are the gatekeepers to provide accurate information at antenatal health facilities that help effect positive behavioural changes and, consequently improve the physical activity levels of pregnant women (Coll *et al*., 2017; Grenier *et al*., 2021). As midwives are trained to provide maternal healthcare, they are well-suited to develop, manage, implement or assist in behaviour change initiatives or programmes (Zinsser *et al*., 2020).

Undeniably, there is evidence of improvements in the physical activity pattern of pregnant women receiving lifestyle counselling within the context of routine care (Hoffmann *et al*., 2019). However, healthcare providers rarely provide such advice and counselling (Whitaker *et al*., 2016; Hopkinson *et al*., 2018; Vanstone *et al*., 2017; Watson *et al*., 2015). Furthermore, even when advice and counselling are provided, they are limited, conflicting and misleading (Grenier *et al*., 2019; Whitaker *et al*., 2016; Hopkinson *et al*., 2018). This is attributable to fact that prenatal care providers lack the knowledge and the requisite skills to effectively perform this task and only have limited resources and time (De Vivo & Mills, 2019; McParlin *et al*., 2017; Lee *et al*., 2018). Of course, due to lack of information, many women would rather turn to family, friends or the media for advice regarding prenatal physical activity. Consequently, understanding the sources of information within the specific context of pregnant women in the Eastern Cape, where no empirical evidence currently exists, is important to guide physical activity healthcare interventions.

Compared to other regions of the world, there are only a few published studies on prenatal physical activity and exercise among women in Africa (Hjorth *et al*., 2012; Adeniyi, Ogwumike & Osinike, 2014; Muzigaba, Kolbe-Alexander & Wong, 2014; Mbada *et al*., 2014; Makinde *et al*., 2014; Watson *et al*., 2018; Brunnete *et al*., 2012), and South Africa inclusive (Brunette *et al*., 2012; Watson *et al*., 2017; Watson *et al*., 2018; Maputle *et al*., 2018). In Africa, pregnancy is considered a time of confinement (Okafor & Goon, 2020b), and many women's levels of exercise decrease over the course of the pregnancy due to tiredness or being unwell (Brunette et al., 2012). However, as a preventative or therapeutic measure to reduce pregnancy complications and optimise maternal and foetal health, physical activity and exercise are two of the plausible recommended options for all healthy pregnant women (Ferraro, Gaudet & Adamo, 2012; Reyes, 2018). Therefore, the main aim of this

study was to assess prenatal physical activity and its correlates during pregnancy, and further develop a viable intervention strategy for prenatal physical activity and exercise participation among women in Buffalo City Municipality, in the Eastern Cape Province, South Africa.

1.2 PROBLEM STATEMENT

Pregnant women are insufficiently active in Africa (Hailemariam *et al*., 2020; Watson *et al*., 2017; Lawan *et al*., 2018), and, only few studies have objectively measured prenatal physical activity in Africa (Hjorth *et al*., 2012; El-Sham & El-Fatal, 2017; El-Rafie, Khafagy & Gamal, 2016; Shady *et al*., 2017, Gehan *et al*., 2015, Daniel, Nwaogwu & Ezeugwu, 2015; Watson *et al*., 2018). In addition, low prenatal physical activity and exercise have been reported in other regions of the world (Bauer *et al*., 2018; Schmidt *et al*., 2017; Todorovic *et al*., 2020). Consequently, there is a global call to prioritise physical activity participation levels in the general population (WHO, 2017), which means that it is necessary to study the status of such activity in different demographic groups and the factors related to its practice. Therefore, research into prenatal physical activity is crucial at this stage because pregnancy in a woman's life may affect her future health. Nonetheless, these women are often encouraged to reduce their levels of physical activity or to even stop working because of the belief that this type of activity may reduce placental circulation and, consequently, increase the risk of disorders such as miscarriages, preterm deliveries, and intrauterine growth retardation (Poyatos-Leon *et al*., 2016). Therefore, the possible adverse pregnancy health outcomes associated with being physically inactive could have long-standing effects on the healthcare systems.

As previously highlighted, while various bodies and institutions have set clear guidelines and recommendations, and the literature is clear about the benefits of prenatal physical activity, anecdotal evidence indicates pregnant women in Buffalo City Municipality seldom participate in physical activity or exercise. Factors influencing this trend may include ignorance, false or unscientific beliefs about prenatal physical activity and pregnancy, a general lack of awareness of relevant guidelines, as well as lack of support and encouragement from the healthcare providers. Watson *et al*.'s (2015) study involved urban South African pregnant women reported that health professionals rarely provided them with advice and counselling about prenatal physical activity and exercise. As mentioned, while international studies have been done to guide interventions and promotion of prenatal physical activity with varying degrees of participation, underpinning reasons both for and

against it, very little information exists that is relevant to the South African context in the Eastern Cape. The few studies that have investigated prenatal physical activity in South Africa failed to utilise a large sample with a heterogeneous population (Watson *et al*., 2016; Watson *et al*., 2017; Watson *et al*., 2018; Brunnete *et al*., 2012; Muzigaba, Kolbe-Alexander & Wong, 2014; Maputle *et al*., 2018). In addition, these studies were not designed to develop a prenatal physical activity participation intervention strategy. Therefore, there is need to conduct an empirical study exploring the dynamics of prenatal physical activity among pregnant women in the Buffalo City Municipality in order to inform maternal physical activity healthcare interventions. This is relevant and important in keeping with the ethos of primary healthcare paradigm of "health promotion and prevention rather than treatment". Such information will potentially add to the body of knowledge on maternal health, and further guide physical activity interventions tailored for pregnant women in South Africa.

1.3 MAIN OBJECTIVE OF THE STUDY

The overall aim of the study was to assess prenatal physical activity participation and its correlates during pregnancy, and further develop an intervention strategy for prenatal physical activity and exercise participation among women in the Buffalo City Municipality, Eastern Cape, South Africa.

1.3.1 Specific Objectives

The objectives of the study are categorised into three phases as follows:

1.3.1.1 Empirical Investigations

i. To assess the prenatal physical activity level, patterns and their correlates among women.

ii. To examine the beliefs, perceived benefits and sources of information on prenatal physical activity and exercise of women.

iii. To examine the barriers of prenatal physical activity and exercise among pregnant women.

iv. To assess the knowledge, attitudes and practices about prenatal physical activity and exercise among expectant mothers.

v. To explore the attitudes, knowledge and practices of midwives toward prenatal physical activity education and counselling in the Eastern Cape.

1.3.1.2 Intervention Strategy

i. To develop intervention strategies to enhance the understanding and promotion of prenatal physical activity and exercise, and to mitigate the barriers associated with women's participation in the activities.

1.3.1.3 Validation of Intervention Strategy

i. To validate the intervention strategies to promote prenatal physical activity and exercise practice of women.

1.4 RESEARCH QUESTIONS

The following research questions were framed based on the objectives stated above.

i. What are the levels, patterns and associated factors of prenatal physical activity and exercise of women in the Buffalo City Municipality, in the Eastern Cape?

ii. What are the beliefs, perceived benefits, and available sources of information on prenatal physical activity and exercise of women in the above-mentioned context?

iii. What are the barriers of prenatal physical activity and exercise of women in Buffalo City Municipality, in the Eastern Cape?

iv. What knowledge of, attitudes and practices towards prenatal physical activity and exercise do women have within the above-mentioned setting?

v. What attitudes, knowledge and practices do midwives have toward prenatal physical activity education and counselling in the Eastern Cape?

vi. What context-specific intervention strategy would be relevant to enhance the understanding and promotion of prenatal physical activity and exercise, and to mitigate the barriers associated with prenatal physical activity and exercise participation among women in Buffalo City Municipality, in the Eastern Cape?

1.5 JUSTIFICATION OF THE STUDY

There is a dearth of information about prenatal physical activity and exercise among South African women. Moreover, there is no known study investigating the level, patterns, associated factors, beliefs, perceived benefits, knowledge and attitudes, and barriers of prenatal physical activity among women in Eastern Cape. In addition, the perspectives of

midwives regarding prenatal physical activity and exercise have never been explored. Therefore, it is important to examine the phenomenon of prenatal physical activity among women in the Eastern Cape, as the findings would highlight the need for context-specific interventions to improve prenatal physical activity practices. It is envisaged that this study will add to the body of knowledge concerning the development of intervention strategy for prenatal physical activity and exercise among women within the South African context.

1.6 DELIMITATION OF THE STUDY

The study is delimited to pregnant women, attending antenatal care in selected health facilities in Buffalo City Municipality in the Eastern Cape Province. In this case, variables of interest are the level, patterns, determinants, beliefs, benefits, sources of information, knowledge and attitudes of pregnant women towards prenatal physical activity and exercise. In addition, the attitudes, knowledge and practices of midwives toward prenatal physical activity education and counselling, and consequently, interventions strategies to promote prenatal physical activity and exercise participation.

1.7 THEORETICAL FRAMEWORK: THEORY OF PLANNED BEHAVIOUR

Pregnancy is a unique, dynamic, and life-changing phase in a woman's life. Inevitably, the physiological and physical changes accompanying it affects the lifestyle behaviour of the woman. However, how women accommodate and react to the pregnancy-related behaviour(s) is influenced and shaped by a complexity of multiple factors operating on a continuum of personal, social and environmental dynamics. For instance, the participation or non-participation of pregnant women in physical activity is underpinned by multidimensional factors. In this regard, understanding the social, cognitive and behavioural variables affecting the prenatal physical and exercise practice of women is crucial for designing intervention strategies to mitigate the barriers and sustain healthy behaviour in pregnant women. For this reason, the Theory of Planned Behaviour (TPB) developed by Godin (1994) and Ajzen (2011) is an appropriate and relevant principle to understand, explain, and predict the physical activity behaviours of pregnant women in this study. Arguably, the relevance of behavioural change theories is to clarify critical element of a complex problem (Davies *et al*., 2014).

For clarification, the above-mentioned theory is based on the assumptions that it can predict an individual's intention to engage in a behaviour at a specific time and place (Ajzen, 1991);

that individual behaviour is driven by behavioural intention; and, lastly, that behavioural intentions are consequently influenced by an individual's attitude to behaviour, subjective norms, and perceived behavioural control (Ajzen, 1991). In addition, the key component of this model is behavioural intent, which is influenced by the attitude to what the likelihood behaviour will have the expected outcome and the subjective evaluation of the risks and benefits of a particular outcome (Conner & Armitage, 1998). Building on the perspective that the stronger the behaviour intention is, the more likely the behaviour will be performed, the TPB illustrates that behavioural achievement depends on both motivation (intention) and ability (behavioural control). This particular theory, therefore, distinguishes between three types of beliefs: namely, behavioural, normative, and control (Ajzen, 1991). Furthermore, the TPB comprises six constructs that collectively represent an individual's actual control over their behaviour, which are presented as follows:

- **Attitudes** are "the overall evaluation of an individual's performance of a behaviour" (Lee *et al*., 2016). Attitude, therefore, explains the degree to which a person views, favourably or unfavourably, the behaviour of interest as well as how they view the (possible) outcomes of a specific behaviour (Ajzen, 1991).

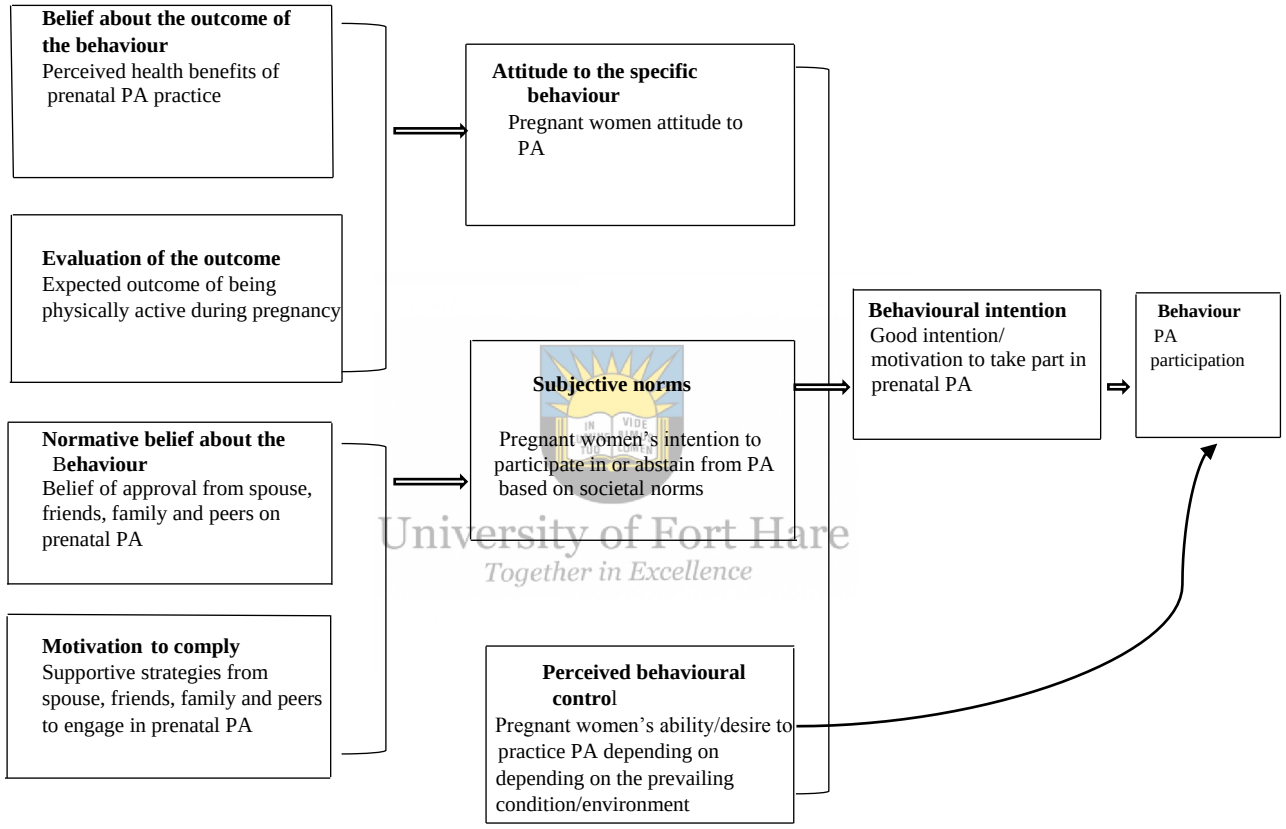
- The **behavioural intention,** on the other hand, refers to the motivational factors that influence a given behaviour; and, as stated earlier, the stronger the intention to perform the behaviour, the more likely it is that the behaviour will be performed (Conner & Armitage, 1998).

- The **subjective norms** entail an individual's own assessment of the social pressure to perform or not perform the target behaviour (Clayton & Griffith, 2008; Lee *et al*., 2016). This has to do with the belief of whether most people would approve or disapprove of a particular behaviour. Moreover, it pertains to a person's beliefs concerning how other individuals may perceive him/her engaging in the behaviour (Ajzen, 1991).

- **Social norms** define the customary codes of behaviour prevalent in a group of people or a larger cultural context; therefore, they are considered normative, or standard, in a group of people (Ajzen, 1991).

- **Perceived behavioural controls** are the perceived intentions and the resulting behaviours of the individual. Put differently, it is an individual's perception of the ease or difficulty of performing a particular behaviour of interest (Ajzen, 1991). In addition, how the individual perceived his/her ability to perform or engage in a behaviour is dependent on the situation(s) and action(s) (Ajzen, 1991).

Shown in Figure 1.1 is Ajzen's Theory of Planned Behaviour as propounded and developed (Ajzen, 1985).



PA: Physical Activity

Figure 1.1. The Theory of Planned Behaviour (Ajzen, 1985).

1.7.1 Application of the Theory to the Study

The TPB clearly proposes a model of how human action is guided to predict the occurrence of a specific behaviour. As it posits, the behaviour undertaken by an individual must be intentional, and shaped by attitudes, subjective norms, and perceived behavioural control. As mentioned previously, a multiplicity of factors influences a pregnant woman's decision to engage in or abstain from physical activity. These include pregnancy-related symptoms such

as vomiting, nausea, or fatigue in the first trimester, and/or an enlarged uterus causing lower back pain in later trimesters, as well as psychological needs. Other constraining barriers include a lack of knowledge, negative beliefs, and concerns about the safety of the prenatal physical activity, cultural norms, lack of social support, inadequate or lack of prenatal physical counselling or advice from prenatal care providers, and a lack of resources.

Amidst these challenges, a pregnant woman at the other side of the pregnancy continuum is further confronted with the perceived benefits of prenatal physical activity participation. In this context, the operationalisation of the TPB is able to define and explain the multidimensional factors shaping the level, patterns, associated factors, beliefs, perceived benefits, knowledge and attitudes, and barriers to prenatal physical activity among pregnant women in Eastern Cape Province. Consequently, from a theory of change perspective, if pregnant women exhibit a positive attitude to prenatal physical activity, such positive behaviour can be reinforced by providing them with the needed support to address their barriers to physical activity involvement. In this regard, relevant support strategies involving spouses, friends/peers, and family members are crucial to motivate and encourage pregnant women to engage in physical activity. Again, the above conceptual framework illustrates that the positive attitudes of pregnant women to prenatal physical activity, good subjective norms (spouse, relatives/friends, healthcare providers), and the pregnant women's perceived behavioural control influence the intention to engage in physical activity and could eventually influence the pregnant woman's behaviour towards prenatal physical activity.

Furthermore, this particular theory will highlight and define what context-specific intervention strategy will prove effective in improving prenatal physical activity practices within the above-mentioned setting. The strength of such an approach is that the application of the TPB will provide a formative theory around which to design such effective prenatal physical intervention strategies to improve physical activity levels, and ensure better healthy maternal outcomes (Okafor & Goon, 2020a). From the above, it is clear that this study is underpinned by the theoretical constructs and orientations of TPB, which postulates that to predict a pregnant woman's intention to participate in prenatal physical activity and exercise, it is important to establish her attitude and belief in physical activity and exercise (Okafor & Goon, 2020a).

1.8 SOCIO-ECOLOGICAL MODEL OR FRAMEWORK

Another theoretical framework relevant to this study in understanding the development of prenatal physical activity interventions is the Socio-Ecological model or framework. The socio-ecological model is used to determine factors influencing the lifestyle behaviour of individuals, and the model is widely used to understand interrelations between personal, social and environmental determinants (McLeroy *et al*., 1988). The model posits that appropriate changes in the social environment support behavioural changes in individuals and behaviour based on four layers: intrapersonal, interpersonal (group) processes, institutional factors, and environmental/societal (Timmermans *et al*., 2020). In addition, this model emphasises the importance of the social and organisational contexts of individual health-related behaviours, with an underlying assumption that change created in the social environment would support related change in individual health behaviours (Trego & Wilson, 2021).

1.9 OPERATIONAL DEFINITION OF KEY TERMS

Physical activity: Any body movement that works your muscles and requires more energy than resting; for instance, walking, running, dancing, swimming, yoga, and gardening.

Light-to-moderate physical activity: In this study, light-moderate physical activity means physical activity that normally makes the person tired but not exhausted (e.g., walking, housework, gardening, and golf).

Moderate physical activity: Moderate physical activity is defined as physical activity that normally leaves the person exhausted but not breathless (e.g., brisk walking, easy swimming, dancing, and cycling).

Vigorous physical activity: Vigorous physical activity is defined as physical activity that normally makes the heart beat rapidly and leaves the person breathless (e.g., jogging, vigorous swimming, cycling and aerobics).

Structured physical activity: Structured physical activity is a type of physical activity that is controlled and repetitive and is aimed at improving or maintaining physical fitness (Caspersen *et al*., 1985; Stefani, Mascherini & Galanti, 2017). Structural physical activity consists of sports and instructional programmes in dance, gymnastics, swimming, etc.

Unstructured physical activity: Unstructured physical activity is any activity of daily living performed with no intention of improving or maintaining physical fitness. In this study, unstructured physical activities include housework, climbing stairs, gardening, and walking.

Exercise: A subcategory of physical activity that is planned, structured, repetitive, and has the purpose to improve or maintain physical fitness, where physical fitness is a set of attributes that are either skill or health-related (Caspersen *et al*., 1985). In this study, physical activity and exercise is used interchangeably to refer to the same thing since a pregnant woman engages in both for improvement of maternal outcomes.

Sedentary behaviour: In this study, sedentary behaviour includes activities like sitting, reading books/magazines, watching television, listening/playing music, sweeping the floor, talking on the phone, or playing computer games.

Total energy expenditure: this refers to the total number of calories burned by the human body in one day, and is attuned to the amount of activity (sedentary, moderate, or strenuous).

Pregnancy: Pregnancy is the period in which a foetus develops inside a woman's womb or uterus.

Pregnant woman: A female who is carrying a baby (foetus) in her uterus, also known as an expectant mother.

Antenatal care: This is also known as prenatal care; a type of preventative healthcare that provides regular check-ups allowing doctors or midwives to treat and prevent potential health problems throughout the course of a pregnancy and promotes healthy lifestyles that benefit both mother and child.

Intervention study: An intervention or strategy designed to produce behaviour changes or improve health status among pregnant women/individuals.

Strategy: A strategy is defined as the plans made to reach a long-term aim (Nickols, 2016). In this study, the term "strategies" refer to intervention strategies that will be used to promote physical activity participation by pregnant women.

Metabolic Equivalent (MET): The amount of oxygen consumed at rest, sitting quietly in a chair, approximately 3.5 ml 02/kg/min (12 kcal/min for a 70-kg person). Metabolic equivalent is a straight forward procedure for expressing the energy cost of physical activities as a multiple of the resting metabolic rate.

1.10 SUMMARY OF CHAPTER ONE AND OVERVIEW OF THE DISSERTATION

Chapter One presented an introduction and contextual background of the nature and scope of this particular study. With this in mind, it provided a background of the benefits of prenatal physical activity within the context of maternal health for mother and baby. Thereafter, it linked the context with the rationale and problem statement, the main aim and specific objectives, the research questions, and the significance of the study.

Chapter Two, covered the literature review on the level, patterns and associated factors of prenatal physical activity and exercise; the beliefs perceived benefits and sources of information on prenatal physical activity and exercise; the barriers to prenatal physical activity and exercise participation; and the knowledge and attitude of pregnant women towards prenatal physical activity and exercise. The knowledge and practices of healthcare providers towards prenatal physical activity and exercise participation were discussed.

Chapter Three contained a description of the methodology of the study, highlighting the research design, population, sample, research tools, data collection procedure, and the study's data analysis.

Chapters Four to Ten presented the manuscripts, which addressed each of the specific objectives of the study, and showed how each has contributed to the overall aim of the study.

Finally, Chapter Eleven synthesised the findings and provided new insights regarding their implications for the overarching aim of the study. Limitations of the study were discussed, and suggestions made for future research in the field. Table 1.1 provides a summary of how each research objective was addressed in this thesis.

Table 1.1: Summary of Research Objectives, Research Methods and Inclusion in the Thesis

CHAPTER IN THESIS	Research Objective	Methodology & data collection tool	Study population	Design, sampling strategy and size	Type of data	Data analysis
CHAPTER FOUR	To assess the prenatal physical activity level, patterns and their determinants among women in the Eastern Cape	Positivist: Survey questionnaire	Pregnant women attending antenatal care	Descriptive, cross-sectional study of conveniently sample of 1082 pregnant women	Quantitative	Descriptive statistics: means, frequency counts and percentages Inferential statistics: Crude and adjusted logistic regression (95% CI; $p< 0.05$)
CHAPTER FIVE	To examine the beliefs, perceived benefits and sources of information on prenatal physical activity and exercise of women.	Positivist: Survey questionnaire	Pregnant women attending antenatal care	Descriptive, cross-sectional study of conveniently sample of 1082 pregnant women	Quantitative	Descriptive statistics: means, frequency counts and percentages
CHAPTER SIX	To explore the modifiable barriers to prenatal physical activity among women in the Eastern Cape.	Interpretivist: Semi-structured interviews	Pregnant women attending antenatal care	Descriptive, explorative study of purposively sample of 17 pregnant women	Qualitative	Thematic content analysis
CHAPTER SEVEN	To assess the barriers to physical activity participation	Positivist and Interpretivist: Sequential Explanatory Mixed-Methods	Pregnant women attending antenatal care	Cross-sectional, Mixed-methods study: 1082 (convenient), and 15 purposively sample of pregnant women.	Quantitative and Qualitative	Descriptive statistics: means, frequency counts and percentages (quantitative), and thematic content analysis (qualitative).
CHAPTER EIGHT	To assess the knowledge, attitudes and practices about prenatal physical activity and exercise of pregnant women in	Positivist: Survey questionnaire	Pregnant women attending antenatal care	Descriptive, cross-sectional study of conveniently sample of 1082 pregnant women	Quantitative	Descriptive statistics: means, frequency counts and percentages Inferential statistics: Crude and adjusted

	the Eastern Cape. Cape					logistic regression (95% CI; p< 0.05)
CHAPTER NINE	To explore the attitudes, knowledge and practices of midwives toward prenatal physical activity education and counselling in the Eastern Cape.	Interpretivist: Semi-structured interviews	Midwives	Descriptive, explorative study of purposively sample of 15 midwives	Qualitative data	Thematic content analysis
CHAPTER TEN	To develop and validate intervention strategies to enhance the understanding and promotion of prenatal physical activity and exercise, and mitigate the barriers associated with women's participation in these in the Eastern Cape.	SWOT, PESTLE, BOEM analysis based on empirical findings from Phase 1.	Academic experts, (prenatal physical activity and maternal health), gynaecologists, obstetricians, midwives/professionals nurses, exercise physiologists, health team facility managers, midwives and pregnant women.	Descriptive content analysis of the developed prenatal physical activity strategy of purposively sample of 7 academic and professional experts, and key stakeholders (6 health facility managers, 24 midwives, 24 pregnant women).	Qualitative data	Thematic content analysis based on the PESTLE/SWOT analysis

CHAPTER TWO
LITERATURE REVIEW

2.1 SEARCH METHODS

This study reviews the available literature on the physical activity levels, beliefs, sources of information, perceived benefits, barriers, attitudes of pregnant women towards physical activity and exercise. The review also covers the perspectives of healthcare providers or professionals regarding prenatal physical activity advice and counselling to pregnant women. In addition, it focuses on prenatal physical activity intervention strategies to promote physical activity and exercise during pregnancy. To accomplish this, electronic databases searched were Google Scholar, Science Direct, Scopus, EMBASE, ERIC, Medline, and Web of Science, EBSCO host, PubMed, BIOMED Central, and African Journals Online. The basic search phrases were: "Physical activity during pregnancy" OR "Exercise during pregnancy" OR "Prenatal physical activity" OR "Prenatal exercise" OR "Physical activity levels during pregnancy" OR "Physical activity patterns during pregnancy" AND "Barriers to physical activity during pregnancy". Other search terms included "Knowledge, attitude and practices of physical activity during pregnancy" OR "Perceived benefits of physical activity during pregnancy" OR "Information sources on physical activity during pregnancy" OR "Beliefs about physical activity during pregnancy" OR "Healthcare provider's advice and counselling on physical activity during pregnancy" AND "Intervention strategies to promote maternal physical activity and exercise". Specifically, the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) search framework for scoping reviews was applied to retrieve original research articles on the prenatal physical activity and exercise practices of healthcare providers with pregnant women, published between 2010–2020, and available in English." In addition, only peer-reviewed and relevant documents published in English, and mostly articles published between January 1, 2017, and April 30, 2021 were retrieved for review.

2.2 PRENATAL PHYSICAL ACTIVITY LEVELS, PATTERNS, AND DETERMINANTS

Physical activity and exercise participation during pregnancy are beneficial to the health of the mother and baby. The concepts of "physical activity" and "exercise" are sometimes used interchangeably to refer to one component. However, these terms are not necessarily the same. Firstly, physical activity is defined as 'any bodily movement produced by skeletal

muscles that require energy expenditure (WHO, 2017). Quantifiably, other authors view it as "all muscle-induced bodily movements leading to an increase in energy expenditure above ~1.0/1.5 MET (metabolic equivalent of task; 1 MET = 3.5 ml·kg–1·min–1 (4.184 KJ kg–1·hr–1)" (Herold *et al*., 2019; Gronwald & Budde, 2019; Herold *et al*., 2019). Evidently, physical activity also includes sports, occupational and domestic activities. In contrast, exercise is a 'planned, structured and repetitive activity' (Herold *et al*., 2019; Gronwald & Budde, 2019; Herold *et al*., 2019) and can be defined as a subset of physical activity. However, these two terms have one commonality, namely that both can be used to improve or maintain general health and to achieve therapeutic health outcomes (Okafor & Goon, 2020a). Clearly, viewed from public and clinical perspectives, physical activity intervention could serve as a general term encompassing both physical activity and exercise (Gronwald & Budde, 2019).

Pregnancy is a unique phase in the life of a woman, heralding dramatic physiological and psychological body experiences. Certainly, lifestyle behaviour changes are inevitable, often shaped by different context-specific factors. Maternal health is considered a global health priority (WHO, 2018) and the focus has now shifted from the direct causes of maternal morbidity to addressing the modifiable health risk factors, under which physical activity is included (Watson *et al*., 2016). Notably, physical inactivity is the fourth leading risk factor for non-communicable diseases (NCDs), and has contributed to an increased mortality rate of 22% from 2007 to 2017 (GBD 2017 Risk Factor Collaborators, 2018). This increase in mortality is linked to major non-communicable diseases (NCDs) and cancers; namely, ischaemic heart disease, ischaemic stroke, type-2 diabetes mellitus, cancers (colon, rectum, and breast) attributable to physical inactivity (GBD 2017 Risk Factor Collaborators, 2018). Furthermore, non-communicable diseases are the leading cause of early death in low-and middle-income countries (WHO, 2021), such as South Africa.

In the World Health Organization's 2018 country profile report, NCDs accounted for 51% of the total deaths in South Africa in 2016 while physical inactivity is estimated at 37% (WHO, 2021). Again, a recent study states that physical inactivity is 'a risk factor for diagnosis, serious illness, and death associated with COVID-19' (Hamer, Kivimaki, Gale & Batty, 2020). Furthermore, it is also linked to serious economic loss of billions of dollars, directly and indirectly (Ding *et al*., 2016). Given the negative health outcomes associated with inactivity, the World Health Organization launched the Global Action Plan on Physical

Activity and Health 2018-2030, which aims to reduce global physical inactivity by 15% by 2030 (WHO, 2018). It is, therefore, imperative that physical activity be considered a priority of the maternal health agenda in clinical, community and primary healthcare settings in order to promote prenatal physical activity and exercise among women.

2.2.1 Prenatal Physical Activity Levels

Promoting prenatal physical activity levels of women is a cardinal agenda for some countries. Consequently, some institutions and organisations have developed physical activity recommendations and guidelines for pregnant women. Examples of guidelines in this regard include those of the American College of Obstetricians and Gynaecologists (ACOG) (2020), the U.S. Department of Health and Human Services (US DHHS) (2018), the World Health Organization (WHO), the Joint Canadian Society for Exercise Physiology (CSEP)/Society of Obstetricians and Gynaecologists of Canada (SOGC) (Mottola *et al*., 2019), and the Royal Australian and New Zealand College of Obstetrics and Gynaecology (RANZCOG) (2016). Others are the International Olympic Committee (IOC) (Bo *et al*., 2018), the Department of Health & Social Care, UK (2019), ACSM (Liguori *et al*., 2022), and the Spanish Society of Obstetrics and Gynaecology (SEGO), which replicates the ACOG guidelines (Obsteticia, 2018). For apparently healthy women, under the guidance of their health care provider, moderate-intensity physical activity using both aerobic and muscle conditioning activities is recommended. The guidelines recommended at least 150 min/wk spread throughout the week (Mottola *et al*., 2019; US DHHS, 2018) or at least 20 to 30 min/d (American College of Obstetrics and Gynaecology, 2020). The guidelines also provide specific recommendations on the length, intensity, and types of physical activity, and are widely supported by systematic reviews that indicate the safety and efficacy of physical activity during pregnancy (Grenier *et al*., 2021). However, a previous study has argued that not all physical activity guidelines for pregnant women are based on high-quality evidence (Sui *et al*., 2013). Therefore, the need to evaluate the suitability of international physical activity guidelines for pregnant women across countries, and, in particular, for pregnant women in South Africa is warranted.

Despite the different positive recommendations and guidelines regarding prenatal physical activity, less than 15% of pregnant women are physically active for the recommended weekly minimum of 150 min (Mottola *et al*., 2019), while research has further indicated that pregnant women rarely participate in physical activity. Building on this view point, some

international studies have found that 53-75% of such women do not meet the recommended quota of moderate physical activity per week (Lindqvist *et al*., 2016; Richardsen *et al*., 2016; Australian Institute of Health and Welfare, 2019); and furthermore, the levels of prenatal physical activity among women in both developed and developing countries have had varying outcomes. For instance, in a cross-sectional study among pregnant women in Serbia, 27.2% of participants partook in insufficient leisure-time physical activities (Todorovic *et al*., 2020).

In addition, of the 1584 American women studied in North Carolina and Colorado, merely 9% met the ACOG guidelines (Badon *et al*., 2016), while 20% pregnant women out of 10, 038 nulliparous women in the USA reported no leisure-time physical activity during pregnancy (Catov *et al*., 2018). Furthermore, in Sweden, 27.3% of pregnant Swedes, women (Meander *et al*., 2021), 13.6% of Nigerians (Lawan *et al*., 2018), 20% of Norwegians (Owe *et al*., 2009), and 34.3% of Singaporeans actually (Padmapriya *et al*., 2016) met the recommended physical activity guidelines during pregnancy. Similarly, the physical activity levels of pregnant Chinese women in Shenzhen, Tianjin, and Guangzhou indicate their rates as 22.6%, 11.1%, and 18.5%, respectively (Zhang *et al*., 2014; Liu & Luo, 2016; Yan *et al*., 2017). Yet, other studies reporting low levels of physical activity among pregnant women indicate even lower rates, notably, in Ethiopia, only 8.4% of pregnant women met the international recommended guideline for prenatal physical activity (≥150 min moderate-intensity exercise per week) (Hailemarian *et al*., 2020). Similarly, a study of physical activity levels of pregnant Polish women showed low (light) physical activity (< 600 METs) (9.12%), moderate physical activity (600-1500 METs) (8.8%), while no woman displayed a vigorous level of physical activity (Antosiak-Cyrak & Demuth, 2019). In addition, in India, only about 10.7% (Anjana *et al*., 2016) and 7.2% (Ana *et al*., 2021) of pregnant women met the recommended guidelines. Again, other previous studies in Ireland, Spain, and the USA indicate that only 21%, 20%, and 16%, respectively of pregnant women, exercised according to the ACOG guidelines (Fairley, Dundas & Leyland, 2011; ACOG, 2013; Han, Middleton & Crowther, 2012).

In contrast to more developed countries, little data exist on the physical activity levels of South African women during pregnancy. For instance, Watson *et al*.'s (2017) study involving pregnant Black South African women reported low and declining levels of physical activity during pregnancy. Definitely, the different methods for measuring the prenatal physical activity, as well as the types and intensities may explain the varying levels of physical

activity across the above-mentioned countries. A recent Indian study has reported an elevated level of high-intensity physical activity (96.8%) based on a self-reported measure (Dishani *et al*., 2020), which may be prone to misclassifications associated with social desirability and response bias (da Silva *et al*., 2018), and, most probably, include an overestimation of the prevalence of prenatal physical activity (Guérin *et al*., 2018).

On a global scale, most pregnant women do not meet recommended physical activity guidelines, despite the numerous advantages it offers. Obviously, pregnant women seldom participate in physical activity; in fact, they may reduce their levels or even completely cease participation during their pregnancies. While there are no documented evidence of medical or obstetric complications during prenatal physical activity practice, and pregnant women are encouraged to exercise, the proportion of women engaging physical activity and exercise during pregnancy is still remarkably low (Bull *et al*., 2020). As previously highlighted, the rates of prenatal physical activity in women are rather concerning when one considers the evidence supporting both maternal and foetal benefits of physical activity. For this reason, the health benefits of prenatal physical activity underscore the need to study the correlates or determinants of such low levels of physical activity and sedentary behaviours during pregnancy. Such information would be crucial to inform the development of intervention strategies to improve physical activity participation and limit sedentary behaviour during pregnancy.

2.2.2 Patterns of Prenatal Physical Activity

Wojtyla *et al*.'s (2020) recent study of pregnant Polish women reported sedentary and light-intensity physical activity as the predominant types of physical activity in the third trimester; in addition, it established that household and caregiving tasks constituted the most daily energy expenditure, while most women reported restricted exercise during pregnancy. Similarly, other studies conducted in groups of German (Schmidt *et al*., 2017), Nigerian (Mbada *et al*., 2019; Mbada *et al*., 2014), Chinese (Yin *et al*., 2019; Xiang *et al*., 2019), Ethiopian (Hailemarian *et al*., 2020; Gebregiabher *et al*., 2019), Serberian (Todorovic *et al*., 2020), and Brazilian (Santos *et al*., 2016; Nascimento *et al*., 2015) pregnant women have reported light-intensity, household/caregiving and occupational activities as the most common types of physical activity performed by women during pregnancy.

Furthermore, a study comparing the physical activity of pregnant Taiwanese women during each trimester found that occupational activity decreases significantly across the different trimesters (54.0%, 52.8%, and 43%), while household and caregiving activities significantly increased as the pregnancies advanced (Lee *et al*., 2016). Moreover, Walasik *et al*.'s (2020) study involving 9000 pregnant women in Poland further reported that the most common types of activity performed by the women were walking, marching and brisk walking, and home gymnastics. In a longitudinal study, Coll *et al*. (2017) analysed the most popular types of activity performed by pregnant Brazilian women and related changes throughout an 11 year period (2004 to 2015). The findings of the study reported walking as the most common physical activity, followed by cycling, and weight training. Similarly, in South Africa, previous studies have reported 76.9% and 80.0% prevalence rates of household chores and walking, respectively (Watson *et al*., 2017; Brunette *et al*., 2012) among pregnant women. This evidence may indicate that walking is the most preferred physical activity among pregnant women. This line of thought could be explained by the fact because of fear of injury, and walking as a convenient inexpensive Human bipedalism adaptation for consistent and reliable locomotion. In addition, perhaps, women feel safer and more comfortable doing household activities than engaging in occupational or sporting activities (Gebregiabher *et al*., 2019). In another perspective, a literature review study has further shown that walking offers a plethora of maternal and foetal benefits and is relatively easy to perform (Connolly *et al*., 2018). Previous research by Waston *et al*. (2016) indicated that pregnant women in South Africa considered physical activity as every-day activities, such as occupational and household tasks. In addition, this particular study also showed that participating women perceive certain occupational, household, and recreational tasks as too vigorous, and, consequently, unsafe, while the safety or benefits thereof were informed by the advice they received from family and friends, or simply by listening to their own bodies (Watson *et al*., 2016).

It is discernible from the above-cited studies that pregnant women tend to engage mainly in low-intensity activities. Nevertheless, the recent *2018 Physical Activity Guidelines Advisory Committee Report* (PAGAC) (Bull *et al*., 2020) stipulates that all pregnant and postpartum women without contraindications should perform a variety of regular prenatal and postpartum physical activities, and incorporate not only aerobic and muscle-strengthening types, but also gentle stretching exercises which may be prove beneficial to them. In addition, the 2018 report further encourages women who, before pregnancy, habitually engaged in a vigorous-

intensity aerobic activity or who were physically active to continue their physical activities prenatally and during their postpartum period (Bull *et al*., 2020). Therefore, judging from the above postulation, healthcare providers are challenged to provide relevant and accurate information pertaining to the importance and types of physical activity pregnant women should undertake. The strength of such an approach is that prenatal health settings, in which pregnant women attend routine antenatal care, present an ideal opportunity for such care providers to make freely available the necessary prenatal advice and counselling.

2.2.3 Determinants of Prenatal Physical Activity

The participation in physical activity during pregnancy or otherwise in all domains of activity is associated with socio- demographics, maternal, obstetrics, and prenatal characteristics. Generally, the determinants or correlates of physical activity during pregnancy are classified into two categories. Firstly, is the non-modifiable (cannot be changed) correlates of physical activity, such as demographic, personal health, and pregnancy characteristics (Gaston & Cramp, 2011; Coon, Hafdahl & Mehr, 2011). Conversely, the second category is the modifiable theoretical correlates, that is, those variables that could change by instituting interventions (Gaston & Cramp, 2011; Coon, Hafdahl & Mehr, 2011).

In De Vivo *et al*.'s (2016) meta-analytical study that was based on the Theory of Planned Behaviour, it was found that intention (readiness to be physically active) and perceived behavioural control (perceived ease of difficulty performing the physical activity) were both positively associated with prenatal physical activity. In addition, in Thompson, Vamos and Daley's (2017) systematic review, which centred on health behaviour theory, demonstrates that most of the modifiable theoretical correlates of physical activity performance can explain the barriers to physical activity. Other correlates include the normal discomforts of pregnancy and non-health-related issues, such as a lack of motivation or self-efficacy (Garland *et al*., 2019). Again, the correlates of physical activity during pregnancy indicate that non-modifiable correlates have predominantly weak effects, in contrast to the modifiable theoretical ones, which were associated with greater effects (Garland *et al*., 2019). Furthermore, Garland *et al*.'s (2019) review indicated that the demographic correlates of higher education and higher income were positively linked to prenatal physical activity. Conversely, pregnancy characteristics mainly associated with prenatal physical activity included fewer previous pregnancies, earlier gestational age, and fewer discomforts.

Previous studies on the correlates of prenatal physical activity have reported mixed or inconsistent findings. In contrast to studies which found a positive association between certain variables and physical activity, an alternative perspective has suggested the opposite, or has not even found an association. For example, some studies have found higher education (Baena-Garcia *et al*., 2021; Lindqvist *et al*., 2016; da Silva *et al*., 2017; Sytsma *et al*., 2018; Grebregziabher *et al*., 2019), higher income (Lee *et al*., 2016; Lynch *et al*., 2012; Gaston & Vamos, 2013; da Silva *et al*., 2017; Sytsma *et al*., 2018), and multiparity (Lee *et al*., 2016; Lynch *et al*., 2012; Hailemarian *et al*., 2020) are positively associated with physical activity during pregnancy. Furthermore, marital status (single women) (Hailemarian *et al*., 2020; da Silva *et al*., 2018; Grebregziabher *et al*., 2019), pre-pregnancy physical activity (Román-Gálvez *et al*., 2021; Bacchi *et al*., 2016; St-Laurent *et al*., 2019), and high pre-pregnancy body mass index (Lindqvist *et al*., 2016) variables were positively associated with leisure-time prenatal physical activity in all the above cited studies.

Likewise, in Mendinueta *et al*.'s (2020) study, the number of previous children was positively associated with light-to-moderate physical activity in both trimesters and negatively predicted role of moderate-to-vigorous physical activity during the second trimester. Another study of pregnant women seeking information about pregnancy (Merkx *et al*., 2017) indicated that women who receive physical activity advice and counselling from health providers (Systma *et al*., 2017) are more likely to have an elevated level of prenatal physical activity. In contrast, a previous study among pregnant women in Singapore found nausea in the first trimester was associated with decreased leisure-time physical activity (Padmapriya *et al*., 2015).

As expected, pregnant women with higher education and incomes are able to better appreciate the importance of prenatal physical activity, while possessing the resources to engage in or initiate such activities. Likewise, women with more children are more likely to possess greater maternal METs because of the energy expended on childcare and having less time for relaxation (Lee *et al*., 2016) since raising many children requires a higher level of activity (Grebregziabher *et al*., 2019). Again, overweight and obese pregnant women trying to control their weight gain and glycaemic levels are more likely to undertake prenatal physical activity, since maternal physical activity is proven to lower gestational weight gain (Collings *et al*., 2020; Galliano *et al*., 2019) and the risk of gestational diabetes mellitus (GDM) (Collings *et al*., 2020; Galliano *et al*., 2019) in this particular group. Therefore,

understanding the socio-economic correlates of prenatal physical activity is important to inform strategies to encourage healthy pregnant women to be physically active during pregnancy.

In contrast to the above-mentioned research, other studies have reported the opposite pattern of the determinants of physical activity during pregnancy. They reported parity (Davenport *et al*., 2018), pre-pregnancy BMI (da Silva *et al*., 2018; Seneviratne *et al*., 2015), and low educational levels (Todorovic *et al*., 2020; Amezcua-Prieto *et al*., 2013; Hailemarian *et al*., 2020) as being negatively associated with prenatal physical activity. Furthermore, other studies have found that a high level of pre-pregnancy physical activity (Merkx *et al*., 2017), a higher income (Todorovic *et al*., 2020; Domingues *et al*., 2016), and a higher level of education (Román-Gálvez *et al*., 2021) are linked to a decreased level of leisure-time physical activity during pregnancy. Likewise, age is associated with prenatal physical inactivity. Evidently, some studies have reported that younger women are more prone to being physically inactive compared with older mothers (Grebregziabher *et al*., 2019; Catov *et al*., 2018). Contrastingly, a study conducted on 299 pregnant women in Ethiopia found that participants in the age group of 26-35 years have a greater risk of being sedentary during pregnancy (Hailemarian *et al*., 2020). Another correlate of prenatal physical activity is miscarriage during pregnancy. In this case, research by Grebregziabher *et al*. (2019) further reported that pregnant women with a history of miscarriage presented with odds 8.05 times higher of becoming physically inactive during pregnancy in comparison to those without the history of miscarriage. The authors further stated that because of the fear of harming the baby during physical activity and avoiding another miscarriage and poor foetal growth, coupled with the prenatal care providers' advice for the women to refrain from physical activity, are likely reasons for being prenatally inactive (Grebregziabher *et al*., 2019). In addition, pregnant women who had been advised by health providers to stop prenatal exercising were less active in comparison to those who were encouraged to undertake physical activity (Grebregziabher *et al*., 2019). Consequently, this evidence underscores the urgent need for health care provider advice during antenatal consultations or visits within community and clinical settings to promote women's prenatal physical activity.

As mentioned previously, not all research on the determinants of prenatal physical activity demonstrates either a significant positive and negative association in relation to the characteristics studied regardless of physical activity domain.

Other studies have indicated a different perspective. For instance, some studies found no association for smoking (da Silva *et al*., 2018), marital status (Gaston & Vamos, 2013; Santos *et al*., 2014), alcohol use (da Silva *et al*., 2018), and leisure-time physical activity before pregnancy (da Silva *et al*., 2018), history of preterm birth miscarriage (da Silva *et al*., 2018), and nausea (Todorovic *et al*., 2020) as well as overall physical activity during pregnancy. Furthermore, Todorovic *et al*.'s (2020) study did not find any association between parity and pre-pregnancy BMI in terms of leisure-time physical activity among Serbian women. Similarly, a recent study among pregnant Spanish women suggests that maternal age, BMI, marital and working status, and previous miscarriages were not associated with physical activity guidelines compliance (Baena-Garcia *et al*., 2021). As expected, women with children are likely to have less time for leisure-time physical activity, while those with higher BMIs may live a sedentary lifestyle and continue doing so during pregnancy (Bacchi *et al*., 2016). Pregnant women with previous miscarriages are likely to entertain the fear of possible harm coming to the baby and another miscarriage; presumably, they may avoid exercise during pregnancy. Therefore, in light of the evidence reported in the literature, providing maternal health education about the safety of prenatal physical activity may be the key to changing prenatal physical activity behaviours.

The discrepancies or inconsistencies in the literature regarding the sociodemographic and maternal or obstetric variables associated with prenatal physical activity may be attributed to social inequalities, varying cultural socioeconomic differences, and the constructs of physical activity that are performed across different settings (da Silva *et al*., 2018). Notably, the social determinants may influence the health profile of a given population and define their health-related behaviours (da Silva *et al*., 2018). Clearly, most of the available evidence of correlates of prenatal physical activity are based on self-reported measures, focused solely on leisure-time physical activity, and, are mostly from high-income countries. Therefore, research determining the levels and correlates of physical activity during pregnancy in low-and middle-income countries such as South Africa is warranted, since a considerable proportion of total physical activity pertains to commuting, performing household chores, and occupational engagements (Watson *et al*., 2017).

Furthermore, the level of physical activity during pregnancy and its association with sociodemographic, maternal, and obstetric characteristics, as well as maternal and foetal outcomes, is widely documented in high-income countries; thus, some of these countries have already developed guidelines on the recommended level of prenatal physical activity. The evidence presented has shown that the determinants of physical activity in pregnancy would provide insights for developing strategies to promote a physically active lifestyle among women. Nevertheless, sparse data exists on the correlates of physical activity in pregnant South African women.

2.3 HEALTH BENEFITS OF PRENATAL PHYSICAL ACTIVITY AND EXERCISE

As previously established, there are numerous advantages to prenatal physical activity and exercise. Physical activity during pregnancy provides physiological, psychological, as well as physical and mental benefits, which are linked to clinical maternal and infant outcomes. In support of the *2008 Physical Activity Guidelines Advisory Committee* (PAGAC) *Report*, the most recent 2018 report (*2018 Physical Activity Guidelines Advisory Committee Report*) concludes that generally "regular physical activity participation in healthy pregnant women probably reduces the risk of gestational diabetes, possibly reduces the risk of preeclampsia, and appears to improve mood both during and after pregnancy". Therefore, the importance of early initiation of physical activity during pregnancy has been clearly advocated (Mottola *et al*., 2018) to promote prenatal physical activity. Specifically, this section describes the scientific evidence of the benefits of prenatal physical activity participation pertaining to the cardiometabolic health, maternal and clinical outcomes, physical and mental health, as well as the neonatal delivery outcomes and body composition.

2.3.1 Maternal Cardiometabolic Health

Scientific evidence has shown that prenatal physical activity is associated with several cardiometabolic health markers. These include reduce gestational weight gain (Collings *et al*., 2020; Galliano *et al*., 2019; Dipietro *et al*., 2019; Ruchat *et al*., 2018; da Silva *et al*., 2017; Mizgier *et al*., 2018; Straughen *et al*., 2018), and risk of gestational diabetes mellitus (GMD) (Collings *et al*., 2020; Straughen *et al*., 2018; Galliano *et al*., 2019; Wang *et al*., 2017; Camargo *et al*., 2021; Yu *et al*., 2018; Aune *et al*., 2017; da Silva *et al*., 2017; Du *et al*., 2019) in overweight and obese pregnant women. Furthermore, a recent meta-analysis study has demonstrated that prenatal exercise in overweight and obese pregnant women reduced

gestational their weight gain by 1.14 kg, while their risk of gestational diabetes decreased by 29% (Du *et al*., 2019). From the evidence presented above, it is important to counsel pregnant women to engage in physical activity, as this will help them control weight gain and improve their glycaemic control (Galliano *et al*., 2019). To further illustrate this point, a previous study has shown that morbidly obese pregnant women are more likely to abstain from physical activity or exercise to prevent GDM (Artal, 2015); nevertheless, the prevention thereof depends on the intensity of physical activity (Artal, 2015). Moreover, prenatal physical activity lowers preeclampsia (Collings *et al*., 2020; Davenport *et al*., 2018; Catov *et al*., 2018; Thompson *et al*., 2017; Raguema *et al*., 2020; Straughen *et al*., 2018).

2.3.2 Maternal and Clinical Outcomes

Prenatal physical activity and exercise present various benefits and reduce pregnancy complications and delivery (Perales & Artal, 2017; Mottola *et al*., 2018; Davenport *et al*., 2018a), the risk of caesarean delivery, as well as postpartum recovery time (Davenport *et al*., 2019; Takami, Tsuchida, Takamori, Aoki & Ito, 2018; Rajabi, Maharlouei & Rezainzadeh, 2018; Owe *et al*., 2016). In addition, a study by Nguyen *et al*. (2018) indicates that maternal physical activity also improves breastfeeding outcomes (Nguyen *et al*., 2018). The above evidence suggests the need to encourage and promote physical activity participation among pregnant women to improve maternal health outcomes. However, research aimed at determining the prenatal physical activity and maternal outcomes is scarce among pregnant women in South Africa.

2.3.3 Physical and Mental Health

There are physical and mental benefits of prenatal physical activity participation. Global statistics indicate that 10% of pregnant women and 13% of mothers suffer from mental health disorders, especially depression (WHO, 2021), during the postpartum period. Research has established that physical activity and mental health are interrelated (White *et al*., 2017). This is also true of regular prenatal physical activity, which is associated with a reduction in the level of anxiety and blood pressure values in expectant mothers (Yan *et al*., 2020). Similarly, other studies have shown that physical activity is associated with lowered levels of anxiety symptoms (Jayakody *et al*., 2014), greater life satisfaction, better quality of life, and improved physical and mental health (Broberg *et al*., 2017; Davenport *et al*., 2018a). Furthermore, physical activity is used to treat mild to moderate symptoms of anxiety and to promote psychological well-being (Broberg *et al*., 2017; Davenport *et al*., 2018b; Kvam *et*

al., 2016). Several studies have also shown that physically active pregnant women are less likely to develop fatigue, stress, anxiety, and antenatal depression (Davenport *et al*., 2018a; Vargas-Terrones *et al*., 2019; Nakamura *et al*., 2019; Szegda *et al*., 2018; Kołomańska, Zarawski & Mazur-Bialy, 2020). These results, although some are based only on a small number of trials, suggest that prenatal physical activity may potentially protect against depression. Therefore, it could be used as a therapeutic measure to prevent mental health problems in pregnant women and postpartum mothers. However, further studies exploring the relationship between prenatal physical activity and depression are warranted, especially in the context of South Africa. Such data would provide useful information to and clinical guidance of health care professionals on how to design interventions to reduce the risk of antenatal depression, which is predictive of postnatal depression in women (Ogbo *et al*., 2018).

As previously stated, regular physical activity lowers back pain/lumbopelvic pain, a common condition that affects approximately 60% of pregnant women (Patricia *et al*., 2019; Shiri *et al*., 2018; Davenport *et al*., 2019), promotes better quality of sleep (Baker *et al*., 2018; Tan *et al*., 2020) and improves cardiorespiratory fitness (Mottola *et al*., 2018). In addition, a recent study has found that physically inactive women are likely to experience perineal tears compared to their active counterparts (Silva-Jose *et al*., 2021). As earlier highlighted, pregnant women need encouragement and support to engage in physical activity in order to derive the physical and mental health benefits accruable from it.

2.3.4 Neonatal Delivery Outcomes and Body Composition

Other benefits of prenatal physical activity and exercise participation include improved maternal body composition (Ferrari *et al*., 2018), foetal birth weight (Straughen *et al*., 2018; da Silva *et al*., 2017; Pastorino *et al*., 2019; Davenport *et al*., 2018), and a lowered risk of preterm delivery (Aune *et al*., 2017; da Silva *et al*., 2017; Straughen *et al*., 2018; Davenport *et al*., 2018; Huang, Fan & Ding, 2019; Magro-Malosso, Saccone & Mascio, 2017). Moreover, the unborn baby may benefit from prenatal physical activity since it has been proved to improve neonatal body composition, neuro-behavioural maturation, and placental function (Neilsen *et al*., 2017; Collings *et al*., 2020; Vezina-Im *et al*., 2018; Barakat *et al*., 2015), as well as improved acid-base balance after birth (Baena-Garcia *et al*., 2019). Furthermore, a recent study has reported that prenatal physical activity lowers cord-blood leptin concentrations (a valid biomarker of birth total fat mass) (Clapp & Kiess, 1998) among active women compared to inactive pregnant women (Collings *et al*., 2020).

A sedentary behaviour is often characterised as an activity using a very low level of energy, close to the basal metabolic rate, without significantly increasing energy expenditure (Hawkins *et al*., 2017; Fazzi *et al*., 2017; Huberty *et al*., 2016). As indicated by Garland (2017), a sedentary lifestyle, before and after pregnancy, is associated with negative maternal health and poor neonatal outcomes. In addition, a recent multicentre randomised controlled trial of 112 pregnant women with placental tissue, sedentary time in early-to middle pregnancy was associated with the expression of placental genes linked to lipid transportation, while physical activity was hardly related to transporter mRNAs. Therefore, strategies aiming at reducing sedentary behaviours during pregnancy could modulate placental gene expression, which may help to prevent unfavourable fetal/maternal pregnancy outcomes (Acosta- Manzano *et al*., 2021). Therefore, promoting prenatal and postpartum physical activity participation is crucial in reversing the above-mentioned outcomes and ensuring better health for the mother and baby. To buttress this view, the new WHO 2020 guidelines on physical activity and sedentary behaviour strongly recommend that 'pregnant and postpartum women should limit the amount of time spent being sedentary' and further comment that 'replacing sedentary time with physical activity of any intensity (including light-intensity) provides health benefits' (Bull *et al*., 2020). However, few studies exist on the effect of sedentary time on physical activity outcomes in the context of South Africa. One available study by Watson *et al*. (2017) reported that women spent an average of five hours per day sitting.

As mentioned, the scientific evidence on the potential maternal and foetal health outcomes of physical activity during pregnancy amplifies the need to initiate interventions that encourage and promote physical activity among pregnant and postpartum women. However, the exact relationship between prenatal physical activity and pregnancy outcomes remains debatable. View in this context, factoring in the type, duration and intensity of physical activity would help to shed more light on the role of prenatal physical activity in improving pregnancy outcomes (Krepota, Sadowska & Biernat, 2018). Therefore, research investigating the effects of several types, intensities, doses, and timing of physical activity across the various domains of activity, such as leisure-time, occupational, household, and transport in relation to maternal outcomes, would contribute to the existing knowledge on the topic and inform clinical and public health practice (DiPietro *et al*., 2019). Nevertheless, there is a paucity of research on the safety and benefits of vigorous-intensity physical activity compared to light-to-moderate-

intensity physical activity, while the former is likely to be discouraged by some prenatal healthcare providers (DiPietro *et al*., 2019).

2.4 SOURCES OF INFORMATION ON PRENATAL PHYSICAL ACTIVITY AND EXERCISE

During pregnancy, women seek information that would prepare them for their maternal responsibilities (Kamali *et al*., 2018). Consequently, pregnant women are likely to look for pregnancy-related information from different sources. Of course, this caveat presents various opportunities for providing them with antenatal formal education by the prenatal care healthcare providers (Grimes, Forster & Newton, 2014). In a study by Kamali *et al*. (2018) on health information needs of 400 pregnant women, it was reported that 62.5% of participating women required information about prenatal exercise. This indicates the importance that women attach to pregnancy-related physical activity.

However, because of the lack of knowledge of and support from healthcare providers this particular topic may explain why pregnant women often rely on their personal beliefs or other unreliable sources for information during pregnancy. Furthermore, physical activity restriction (Wojtyla *et al*., 2020) is the most notable behaviour at the beginning of a pregnancy, while this tendency increases as the pregnancy progresses (Schmidt *et al*., 2017; Lindqvist *et al*., 2017; Hailemarian *et al*., 2020).

As physical activity levels decrease, there is an increase in the concomitant proportion of women leading sedentary lifestyles. Obviously, the reasons for the decrease in physical activity levels over the course of pregnancy is attributed to varying factors, such as the increase in physical discomforts and pelvic girdle pain as pregnancy progresses (Lardon *et al*., 2018; Owe *et al*., 2009; Poston *et al*., 2013; Walasik *et al*., 2020). Nonetheless, and given the importance of prenatal physical activity and health outcomes, pregnant women need to be provided with reliable and adequate advice and counselling tailored to their trimester.

Due to the lack of information on prenatal physical activity received by pregnant women from healthcare providers, pregnant women predominantly rely on books, the Internet, and social media as their sources of information (Walker *et al*., 2020; Willcox *et al*., 2015; Dalhaug & Haakstad, 2019). This suggests that women rarely receive advice and counselling about prenatal physical activity and exercise from healthcare providers (Grenier e*t al*., 2021; Mercado et al., 2017; Findley *et al*., 2020; Flannery *et al*., 2018; De Vivo & Mills, 2019;

Hayman *et al*., 2020; Blankenship *et al*., 2020). However, in some instances, the healthcare providers lack the knowledge and skills to offer prenatal physical activity advice and counselling (De Vivo & Mills, 2019; Watson, Oddie & Constantinou, 2015; Alahmed & Lobelo, 2019; Kime, Pringle, Zwolinsky & Vishnubala, 2020). Whilst there are studies on this particular topic in other countries, the available study conducted among South African medical practitioners' reports that only 19% of participants provide information about physical activity during prenatal visits (Watson, Oddie & Constantinou, 2015). This evidence highlights the need to empower and educate healthcare providers in this regard since women may be motivated to engage in prenatal physical activity and exercise if healthcare providers are knowledgeable and can offer accurate and scientific, evidence-based information. In addition, since antenatal healthcare professionals, and, midwives in particular, are the main source of information of expectant women, the lack of available information would suggest that pregnant women have no alternative than to seek information or advice on prenatal physical activity from other sources (friends, family, magazines, and Internet). Unfortunately, they are then in danger of receiving misleading and conflicting information. Some studies have shown that Internet-based physical activity advice often lacks accuracy, and may sometimes be misleading (Narasinmhulu *et al*., 2016; Huberty *et al*., 2013; Gao, Larsson & Lou, 2013; Sayakhot & Carolan-olah, 2016; Cannon *et al*., 2020). In a recent systematic review study which summarise the evidence from studies evaluating health information needs, sources of information and barriers to accessing health information of women during pregnancy across 14 countries reports the most common information needs among women during pregnancy were information about unborn child, nutrition, and labour/delivery. The most frequent information source used by women during pregnancy was health professionals followed by informal source (family and friends), and Internet, while the most prominent barriers to information access include feeling ashamed or embarrassed to talk about pregnancy-related issues, long waiting times at clinic to see a health provider, and lack of adequate information resources (Ghiasi, 2021).

Consequently, there is an urgent need to train healthcare providers to deliver evidence-based advice about prenatal physical activity. According to Dacey *et al*. (2014), while the evidence supports the benefits of physical activity in pregnancy, few physicians integrate exercise into their antenatal schedules or plans, simply because of the lack of training. Therefore, it is possible that including non-prenatal healthcare providers to help with patient-provider communication and assist with patient care (Syed e*t al.*, 2021) may be beneficial.

Furthermore, it may prove essential to include other healthcare professionals such as exercise physiologists, physiotherapists, certified fitness professionals to provide the relevant information to avoid placing too many demands on gynaecologists, obstetricians, nurses, and midwives (Tinius, Cahill & Cade, 2017). Furthermore, involving other above-mentioned exercise specialists in prenatal physical activity programmes and social support within a community could be a feasible strategy to help promote prenatal physical activity in women.

Another alternative strategy to promote prenatal physical activity is to provide women access to adequate education and resources regarding prenatal and postpartum physical activity. Ideally, this information and should come from their healthcare providers rather than any other source since prenatal care providers are opportune to engage and support pregnant women to improve their health behaviours during antenatal visits. However, pregnant women rarely receive physical activity advice and counselling, and, even when the information is provided, it is either contradictory or misleading due to healthcare providers' lack of knowledge and skills. Furthermore, only a small number of studies have explored the role of healthcare providers and other sources of information in modifying the physical activity behaviour of pregnant women. In fact, the only study conducted in the South African context focused on medical practitioners who operate a different model of care. However, the perspectives of midwives offering antenatal health care to women remains unexplored. Similarly, the information pertaining to the sources of pregnant women's advice on prenatal physical activity and which advice they choose to act upon, is important to guide interventions for improving the already existing healthcare support (Findley *et al*., 2020).

2.5 BARRIERS TO PRENATAL PHYSICAL ACTIVITY AND EXERCISE

Historically, participation in prenatal physical activity has been a problematic issue because of safety concerns. However, recent studies have found no adverse effects of regular, moderate-intensity prenatal physical activity and exercise (2018 Physical Activity Guidelines Advisory Committee). As previously highlighted, despite the clear benefits of such participation and the significant risks of sedentary behaviour, the reported physical activity levels of pregnant women remain low. There are various reasons why most pregnant women do not attain the recommended levels of physical activity, and these barriers are multi-dimensional and vary from one geographical setting to another. The Ecological Model, which postulates that physical activity behaviour is an interplay of multiple factors operating at the intrapersonal (e.g., self-efficacy), interpersonal/social (e.g., social support), and physical

environmental (e.g., access to facilities) levels (McLeroy *et al*., 1988) provides a discernible, analytical, contextual, and thematic understanding of the barriers influencing physical activity participation during pregnancy. Therefore, in this section, the barriers to prenatal physical activity will focus on the intrapersonal, interpersonal, and environmental barriers postulated by the Ecological Model framework.

2.5.1 Intrapersonal Barriers

Of all the studies that have explored the barriers to prenatal physical activity, the most commonly reported relate to intrapersonal barriers (Coll *et al*., 2017; Harrison *et al*., 2018; Koleilat *et al*., 2021). The various studies seeking to understand the barriers to physical activity during pregnancy have reported the lack of time and energy, fatigue, pain and swelling, lack of childcare, medical restrictions, safety concerns, and lack of sufficient related knowledge (Koleilat *et al*., 2021; Connelly *et al*., 2015; Alaglan *et al*., 2020; Harrison *et al*., 2018; Vanstone *et al*., 2017; Walasik *et al*., 2020) on an intrapersonal level. This is supported by Coll *et al*.'s (2017) systematic review, which reports mother-child safety concerns, pregnancy-related symptoms and limitations, time constraints, and a lack of motivation.

Furthermore, common misconceptions about physical activity during pregnancy include the beliefs that physical activity may cause miscarriages, restrict foetal growth, cause preterm birth, and musculoskeletal injury (Garland, 2017; Vanstone *et al*., 2017). Moreover, cultural beliefs about physical changes during pregnancy, coupled with a lack of knowledge about physical activity are additional reasons cited as barriers to prenatal participation in physical activities (Janakiraman *et al*., 2021; Schafer *et al*., 2019; David, 2016). Another systematic review by Harrison *et al*. (2018) has also affirmed that the most frequent barriers within the intrapersonal domain were fatigue, lack of time, pregnancy discomforts such as nausea, pain, and awkwardness due to weight gain and increasing size as the pregnancy progressed, as well as women's safety concerns for themselves and their babies.

Notably, providing pregnant women with the knowledge on how to safely partake in physical activity and exercise, and the prenatal physical activity recommendations are crucial factors to consider when developing relevant interventions since research has indicated that women are unclear about such recommendations and their safety (Connelly *et al*., 2015). Additionally, they report receiving little to no advice from their health providers regarding

physical activity (Grenier *et al*., 2021). In this context, maternal health care providers, by the nature of their professions, play a pivotal role in providing prenatal physical activity advice and counselling.

A recent survey of the Active Pregnancy Foundation of 445 pregnant and post-natal women indicated that 50% were physically inactive during lockdown than prior to it (Active Pregnancy Foundation, 2020). Similarly, the Sport England study on the general adult population showed decreased levels of physical activity during lockdown, which indicate pregnant populations were disproportionately affected by these measures (Sport England, 2020). One of the neighbourhood-related disparity during COVID-19 is limited options for exercise (Taylor *et al*., 2019; Wolfson & Leung, 2020). The stress and anxiety associated with the COVID-19 also affected the physical activity levels of Black women living in segregated settings (Carvalho *et al*., 2021).Therefore, online workouts was used by the fitness industry, and, now provides women access to professional, pregnancy-specific exercise sessions (Atkinson *et al*., 2020). Bonnevie *et al*. (2021) indicated that using a highly targeted digital intervention can be a potentially effective method of delivering pregnancy-related health information to Black women, even during a global pandemic. This approach has the potential of reaching to women outside the traditional realm of health advertising in a cost-effective manner, and during a time women have less physical in-person contact with their healthcare providers and are spending more time online (Bonnevie *et al*., 2021). This further stressed the importance of digital media campaign to increase access to virtual physical activity or simply pregnancy-related health information.

2.5.2 Interpersonal Barriers

On the interpersonal level, many studies have reported a lack of advice, information and social support from family or friends, and work responsibilities as the most common barriers to participation in prenatal physical activity and exercise (Coll *et al*., 2017; Harrison *et al*., 2018; Koleilat *et al*., 2021; van Mulken, McAllister & Lowe, 2016; Ekelin *et al*., 2018). In addition, women report having received conflicting advice from friends and peers about such activity (Koleilat *et al*., 2021). Van Mulken *et al*. (2016) conducted a study that indicated pregnant women were discouraged from physical activity participation by colleagues, their gyms and families. The message they received was to "slow down" since their current activities could likely harm the baby. Likewise, in Walasik *et al*.'s (2020) study, almost 40% of pregnant women were advised to stop exercising because of perceived harm to the baby's

health, while 12.6% of pregnant women admitted to feeling discriminated against by society when exercising. This highlights that societal stigmatisation during pregnancy could also negatively influence pregnant women's physical activity behaviour.

Therefore, evidence-based scientific advice on prenatal physical and exercise is necessary to dispel the ignorance and false society's belief about the safety of prenatal physical activity. As indicated in the literature already reviewed, such attitudes are based on a lack of related factual information, safety concerns, and certain cultural underpinnings associated with prenatal physical activity. In contrast to negative view concerning the safety of physical activity during pregnancy, an alternative perspective from a recent meta-analysis study indicates that even vigorous-intensity exercise in the third trimester of pregnancy appears safe for most healthy pregnancies (Beetham *et al*., 2019). This suggests that it is safe for pregnant women, without pregnancy complications to participate in physical activity during pregnancy. As such, pregnant women should be encouraged to do so, regardless of the trimester.

2.5.3 Physical Environmental Barriers

Physical and environmental barriers are known to affect prenatal physical activity in different geographical settings. This has been clearly articulated in Coll *et al*.'s (2017) review, encompassing both quantitative and qualitative studies, which highlights external factors such as adverse weather conditions, inadequate and limited accessibility to physical activity facilities, financial costs, and lack of specific programmes of LTPA for pregnant women as the most common environmental barriers to physical activity participation during pregnancy. These researchers further advocate safe and low-cost LTPA facilities to create an environment that promotes physically active behaviour among pregnant women. Other options to promote prenatal physical activity include the provision of organised group physical activity classes for pregnant women at community health centres and prenatal care clinics as well as walking as a low-cost activity since it is free and requires little skill (Coll *et al*., 2017; Koleilat *et al*., 20121). Furthermore, a study by Koleilat *et al*. (2021) reports weather conditions (hot, wet or cold) to be a barrier to prenatal physical activity. Similarly, Harrison *et al*. (2018) conducted a systematic review that emphasises a lack of access and unfavourable weather as the most frequently cited interpersonal barriers to physical activity participation during pregnancy.

2.5.4 Facilitators of Prenatal Physical Activity

Several factors may act as enablers or motivators to promote physical activity participation during pregnancy. In this regard, studies have shown that pregnant women are concerned about maternal and neonatal health (Sui, Turnbull & Dodd, 2013) and stress about the well-being of their unborn baby as the primary motivating factor for them to exercise and be active. Furthermore, other factors that may act as motivators include striving to manage gestational weight gain (Weir *et al*., 2010) and returning to pre-pregnancy body weight and shape (Flannery *et al*., 2019). The above reasons underscore the importance of facilitating the readiness to perform prenatal physical activity action. However, pregnant women require support and encouragement to sustain this behaviour. Additionally, social support plays an enabling role in physical activity (Flannery *et al*., 2018; Lee *et al*., 2016). Partners, family members or friends and other sources of information such as social media or the Internet serve as influencers of physical activity during pregnancy (Flannery *et al*., 2018; Flannery *et al*., 2019). Therefore, providing interventions that are sensitive to cultural contexts and support the social environment within the family sphere of pregnant women, is key to promoting their engagement in prenatal physical activity; and this kind of a strategy would help to address the perceived cultural beliefs of pregnant women in different cultural settings.

The importance of prenatal physical activity accentuates the need to more fully understand the perceived barriers that keep pregnant women from participating in physical activity (leisure-time activities or structured exercise programmes). Moreover, it is also necessary to understand the pregnant women's attitudes to prenatal physical activity participation as well as facilitating factors that may be used to design effective physical activity interventions to improve their prenatal behaviour related to physical activity. The literature on barriers to physical activity during this life stage indicates that women display a strong internal focus on their health and well-being and that of their babies (Harrison *et al*., 2018). This kind of information is important for prenatal care healthcare providers when designing prenatal physical activity interventions. However, despite the array of studies engaging pregnant women in discussions of perceived barriers to physical activity and exercise during pregnancy, no such studies have been conducted among women attending antenatal healthcare within the context of South Africa's Eastern Cape Province. It is crucial to understand the constraining factors affecting prenatal physical activity and exercise among women in this setting so as to inform context-specific interventions that can effectively address identified barriers and promote physical activity participation during pregnancy.

2.6 KNOWLEDGE, ATTITUDES AND PRACTICES OF PRENATAL PHYSICAL ACTIVITY AND EXERCISE

The knowledge, attitudes and practices of pregnant women regarding prenatal physical activity varies in different settings. Some studies have reported that most pregnant women perceive physical activity during pregnancy as beneficial to their health in terms of preventing chronic diseases and unhealthy weight gain (Janakiraman *et al*., 2021; Duke *et al*., 2020). Conversely, a study by Janakiraman *et al*. (2021) among pregnant women in Ethiopia has reported that although pregnant women have adequate knowledge of and a positive attitude to physical activity, their actual practice of such is limited since they participated in antenatal exercises according to the recommended guidelines. The study further demonstrates that having a higher level of education, being a government employee, taking part in pre-pregnancy exercise, and receiving advice or counselling (OR=4.53) on prenatal physical activity and exercise are significantly associated with the knowledge and practice of prenatal physical activity and exercise. Another study, which was done among pregnant Saudi women, has demonstrated that the majority of participants possess a high level of knowledge of the types and amount of recommended prenatal physical exercise. However, this study also indicates that less than half of the women were either walking (26%) or exercising (42%) adequately as per the 150 min weekly physical activity recommendation. Furthermore, factors that significantly predicted adequate exercise among the women were age (OR=1.79), number of pregnancies (OR=2.41), attitude towards exercise (OR=2.71), and self-rated health (OR=2.50).

Another study by Abdullah *et al.* (2019) reported that women's knowledge of prenatal exercise was less than average and that they were doubtful of the positive effects thereof. This can be attributed to inadequate antenatal education which the women received. The lack of information on physical activity during pregnancy suggests the need for healthcare workers to provide proper education on the topic as related to the maternal health of women. Consequently, if pregnant women are equipped with adequate information on prenatal physical activity they would benefit from it and perhaps change their attitude and practices regarding prenatal physical activity.

Furthermore, Harrison *et al.*'s (2018) systematic review study based on pooling of the data from 11 quantitative studies indicated that most pregnant participants reported having

positive attitudes towards physical activity; identifying it as important (0.80, 95% CI 0.52-0.98), beneficial (0.71, 95% CI 0.58-0.83) and safe (0.86, 95% CI 0.79-0.92). Similarly, various previous studies using Likert scales to rank attitudes have also reported positive attitude to physical activity during pregnancy (Guelfi *et al*., 2015; Halse *et al*., 2015; Poston *et al*., 2013). Different reasons could shape women's attitudes to prenatal physical activity. Possibly, the perceptions, personal beliefs, cultural and normative beliefs would mediate the intentions of pregnant women to change their behaviour.

The Transtheoretical Model (TTM) (Prochaska, Johnson & Lee, 2009) and the Theory of Planned Behaviour (TPB) (Thompson, Vamos & Daley, 2017) are two different theoretical models for behaviour change. The TPB started as the Theory of Reasoned Action in 1980 to predict an individual's intention to engage in a behaviour at a specific time and place. Interventions based on the TTM or stages of change can promote the physical activity behaviour among women (Pirzadeh *et al*., 2015). The TTM has been widely used to describe and understand exercise behaviour, such as adoption and maintenance of physical activity (Han *et al*., 2017). The TTM seeks to understand the stages individuals progress through, and the cognitive and behavioural processes they use while changing health behaviours (Cassidy, 1997). The model postulates that individuals engaging in a new behaviour move through the stages of Precontemplation (not intending to make changes or denying the need for change), Contemplation (seriously considering making changes), Preparation (making small changes), Action (actively engaging in exercise for less than six months), and Maintenance (exercising regularly for at least six months) (Lee *et al*., 2006; Marcus *et al*., 1992; Cassidy, 1997). However, the unique nature of, and circumstances of individuals entails navigating through these stages is not usually linear; people can use different strategies and techniques depending on their goals and motivation to engage in physical activity and exercise (Lee *et al*., 2006). Notably, many individuals make several attempts at behaviour change before their goals are realized.

Liu *et al*. (2018) posits self-efficacy is "individuals' belief in their own ability to organise and execute the course of action required to achieve given goals and resist the temptation to relapse". Individuals with high self-efficacy for a particular tasks are likely to persist in the face of challenges to achieve their goal and would experience more positive emotions related to the tasks (Bandura, 1977). Individuals tend to adopt new behaviour, if they perceive the benefits outweigh the consequences (Lui *et al*., 2018). The cognitive and behavioral

processes as second-higher order model in the process of changes are used to sustain improvements in physical activity (Lui *et al*., 2018). The TTM can provide useful guidance to develop a prenatal physical strategy to promote and create awareness of the importance of regularly engaging in physical activity and exercise during pregnancy. Moreover, prenatal healthcare providers, can refer to TTM studies as sources to understand the need to encourage pregnant women to participate in physical activity and exercise by improving their level of processes of change.

Social Cognitive Theory (SCT) (Bandura, 1997), and the Self-Determination Theory (SDT) (Deci & Ryan, 2000), have been developed to aid our understanding of physical activity readiness through beliefs, attitudes, and intentions to implement the desirable health behaviour. For instance, the Transtheoretical Model posits that individuals with great intentions and external support would have better potential to change. However, various theories that have been previously utilised in physical activity research to explain and predict physical activity during pregnancy only focused on the intrapersonal domain factors, including the commonly used TPB (Thompson, Vamos & Daley, 2017). Therefore, studies applying health behaviour theories are necessary to explain pregnant women's readiness for physical activity and its correlates, not only globally, but also, and more specifically, within the South African context of prenatal practice.

The Health Belief model (HBM) is another health enhancing models to promote health behaviour. The HBM posits that people would execute health-related behaviours when they have positive expectations and realize a factor's threats and believe that those behaviours could protect them from incidence of these threats (Glanz, Rimer & Viswanath, 2008). The HBM-based education could be used to enhance active physical activity during pregnancy. Thus, the theoretical underpinnings of this study is that providing prenatal physical activity and exercise education and counselling to pregnant women about the threats of inactivity and benefits of physical activity would lead to protecting them from those threats by increasing moderate to severe intensity physical activity.

As the literature reports, despite women's understanding of the health benefits of prenatal physical activity and exercise and positive attitudes towards it, such knowledge is very rarely translated into practice. Therefore, research is needed to examine antenatal physical activity and exercises, attitudes to such activities, and why some pregnant women do not engage in prenatal physical activity against the relevant socio-economic, cultural, and educational

backgrounds of pregnant women in the Eastern Cape Province to design effective maternal health interventions that will sufficiently address the issue of inactivity among pregnant women in the setting.

2.7 PRENATAL PHYSICAL ACTIVITY AND EXERCISE ADVICE AND COUNSELLING BY HEALTHCARE PROVIDERS

Prenatal care providers are key role players in providing physical activity and exercise advice and counselling to pregnant women. When implemented, physical activity counselling by healthcare workers has been found to successfully assist women make healthy behaviour changes, which includes physical activity. According to a scoping review on physical activity advice and counselling by healthcare providers, healthcare providers seldom or rarely perform prenatal physical activity counselling (Okafor & Goon, 2021). The review and other studies have identified the most common barriers to prenatal physical activity counselling including lack of time, and inadequate skills and training to advise or counsel pregnant women on prenatal physical activity during their antenatal consultations (Okafor & Goon, 2021; Tinus *et al*., 2021; Bahri *et al*., 2021; Whitaker *et al*., 2016; De Vivo & Mills, 2019; McParlin *et al*., 2017; Issakainen, Schwab & Lamminpaa, 2020). Consequently, the providers expressed the desire for further training to improve their knowledge and counselling skills on prenatal physical activity. In this regard, there is a need to prioritise physical activity counselling in maternal and clinical settings to encourage women to initiate and engage in prenatal physical activity that will ensure improved health outcomes. Crucially, in order to improve and support both maternal and foetal health, interventions supporting prenatal care providers to effectively offer adequate counselling pertaining to the importance, prescription, and guidelines are necessary (Mottola *et al*., 2018). While the need for such has been established, less is known regarding healthcare providers' physical activity advice and counselling during pregnancy. Therefore, this present study aimed to explore the relevance of physical activity and exercise education and counselling to midwives in the Eastern Cape of South Africa.

2.7.1. Midwives' awareness on the benefits of physical activity and exercise physiology training levels

Midwives, as prenatal healthcare providers, play an important role in antenatal healthcare consultation. An individual patient data meta-analysis of 16,185 pregnant women reported that antenatal lifestyle interventions that focused on optimising physical activity decreased

gestational weight gain and improved health outcomes including decreasing the odds of gestational diabetes mellitus by 24% and gestational hypertensive disorders by 15% (Bailey *et al*., 2020). Therefore physical activity is recommended to all women except in those for whom physical activity is contraindicated (Mottola *et al*., 2019; ACOG, 2020; Harrison, Brown & Hayman, 2016). However, one of the reasons while many pregnant women fail to achieve the recommended level of physical activity relates to concerns about exercise safety (Lucas *et al*., 2016; Haakstad *et al*., 2018) and lack adequate advice from healthcare professionals (Bondarianzadeh, Yeatman & Condon Paoloni, 2007; Sinikovic *et al*., 2009) which propel women to seek alternative sources of information on physical activity. It is important pregnant women are provided with the scientific information about prenatal physical guidelines regarding the intensities and duration of physical activity during pregnancy in order to enhance or maintain health. As such, midwives and other healthcare professionals in antenatal care service ought to provide pregnant women with evidence-based advice and support that promotes regular physical activity and exercise.

Evidently, midwives acknowledged being responsible for advising and supporting women about prenatal physical activity (Arrish, Yeatman & Williamson, 2017; De Vivo & Mills, 2019; McLellan *et al*., 2019). However, studies across countries have shown that midwives have insufficient knowledge or awareness on the current exercise physiology training levels regarding the benefits of physical activity during pregnancy, For instance, a study to examine the current level of understanding held by midwives regarding the National Institute for Health and Clinical Excellence (NICE) physical activity guidelines in the UK; and to further investigate the physical activity guidance given to women during pregnancy by midwives, revealed midwives seems to have over and misplaced confidence in their knowledge of physical activity recommendations during pregnancy (Hopkins *et al*., 2018). The finding from this study further suggests a discordant scenario between current guidelines and knowledge of the midwives; therefore, midwives appears to be over cautious in providing prenatal physical activity advice (Hopkins *et al*., 2018). Yet, in another study cross-sectional study of 375 midwives in UK, midwives seemingly have the necessary knowledge about the need and importance of physical activity advice for obese pregnant women and recognised it as part of their role; however, perceive they lack necessary skills and resources, and therefore, do not plan or prioritise the discussion regarding physical activity with obese pregnant woman (McParlin *et al*., 2017). Another study among 107 midwives in Norway reported most midwives provide advice on prenatal physical activity and exercise, at least at

the first meeting (Haakstad, Mjonerundu & Dalhaug, 2020). Other studies have also reported that midwives lack counselling skills which have a significant role in educating and influencing pregnant women to adopt regular physical activity and exercise behaviour (Lindqvist *et al*., 2014; Heslehurst *et al*., 2013; Wahedi, 2016; Kothe *et al*., 2019). In addition, other studies have reported lack of training, knowledge, confidence, and time, resources as barriers to effective physical activity promotion by midwives (De Vivo & Mills, 2019; Arrish, Yeatman & Williamson, 2017). Furthermore, deficits in communication skills training has been identified in Iranian practising midwives (Alimoradi *et al*., 2013) and less than 5% of a given curriculum in a medical school being allocated to communication skills training in several countries including Iran, United Kingdom and Netherlands (Zamani, Motamedi & Farajzadegan, 2015). However, some of these challenges could be addressed by training. Physical activity training package improves midwives knowledge and confidence (Basu *et al*., 2014; de Jersey *et al*., 2018). In this context, it is crucial to empower both future and practising midwives to acquire the necessary knowledge, and confidence in discussing prenatal physical activity and pre-registration midwifery education programmes and post registration continuing professional development on prenatal physical activity and exercise. This is particularly concerning because pre-and post-registration midwives are usually not prepared for physical activity management interventions (Arrish, Yeatman & Williamson, 2017) as part of the antenatal healthcare agenda in the midwifery model of care in most countries in the world. According to Bahri Khomami *et al*. (2021) "undergraduate midwifery curricula usually lack sufficient lifestyle content to provide emerging midwives and obstetrical nurses with the knowledge, skills, and confidence to effectively assess and support healthy lifestyle behaviours in pregnant women", which include prenatal physical activity and exercise. In this regard, physical activity and exercise content could be integrated into the midwifery undergraduate theory and practice training, including their post-registration training as continuing professional development (CPD) (Arrish, Yeatman & Williamson, 2016; Kessler & Phillippi, 2015). To counteract the lack of knowledge and training as a potential impediment to providing effective exercise advice and guidance, midwives, in UK advocated for online CPD training on physical activity, infusion of prenatal activity into the curricula training of midwives, and the assigning of a specialist lead midwife trained on current exercise physiology to lead and update other community midwives with resources and current evidence (De Vivo & Mills, 2019). Adopting such stance could promote more awareness among midwives concerning the risks associated with physical activity before and during pregnancy.

Midwives are at vantage point in optimising prenatal physical activity and exercise as part of the antenatal healthcare in clinical settings. Therefore, strategies to address midwifery barriers to the provision of prenatal physical activity and exercise that operate at the individual, system and policy levels is imperative to improving health outcomes for the mother and baby. Such strategies include practising midwives are provided with undergraduate and postgraduate training to be empower them adequate and relevant knowledge, skills and confidence to communicate with and support women with evidence-based scientific advice on physical activity and exercise in order to effect desirable physical activity behaviour change. There are variations in the undergraduate and postgraduate midwifery training between countries; notwithstanding, incorporating physical activity and exercise curricula in the pre-midwifery and post-midwifery training is advocated. In Africa, the current midwifery curricula prioritises managing high-risk pregnancies over providing women with evidence-based physical activity advice as part of the antenatal healthcare. There is need to close this training gap, if prenatal physical activity and exercise is to be promoted in antenatal consultations. Research on midwives' awareness and current exercise physiology training levels regarding the benefits of physical activity, and current state of their medical education to physical activity and its relevance for educating current medical corps on physical activity beneficence in the medical education in Africa is limited. Some midwives have an inadequate level of evidence-based prenatal physical activity knowledge and confidence to provide prenatal physical activity advice and counselling. This is particularly absent in the African context, where health resources are constrained. There is, however, a need for exploration of midwives' needs in terms of providing prenatal physical activity beneficence in the medical education in Africa.

2.8 INTERVENTION STRATEGIES FOR THE PROMOTION OF PRENATAL PHYSICAL ACTIVITY AND EXERCISE

The health behaviours of pregnant women have important implications for pregnancy and birth, as well as lifetime health outcomes for both mother and child (Bird *et al*., 2017; da Silva *et al*., 2017; Baidal *et al*., 2016). Notably, low physical activity is one of the common maternal health behaviours associated with adverse health outcomes (Poston *et al*., 2016; Vezina-Im, Nicklas & Baranowski, 2018). However, regardless of the widely reported health benefits of prenatal physical activity and exercise, interventions on which type of physical activity is best to achieve the desired health outcomes is still a challenge. This is

understandable since prenatal physical activity is a complex behaviour, shaped by physical and psychological changes. In this regard, it then entails understanding the reasons pregnant women fail to achieve the recommended physical activity guidelines relevant to them. In addition, physical activity intervention strategies to address the barriers to such participation during pregnancy could be most achievable and effective if specifically tailored to the context and individual needs of individual women. However, there is no one intervention most sufficient, and achievable, rather, a combination of interventions seem to work the best.

In the global context of decreasing physical activity during pregnancy across nations, effective strategies are needed. Hence, the ultimate goal of whatever physical activity strategy is implemented is to effect a change in behaviour and attitude to prenatal physical activity; incorporating behaviour change techniques into interventions may be helpful in improving physical activity levels during pregnancy (Currie *et al*., 2013). Furthermore, behaviour change techniques such as goal setting, planning, and education would help shape the knowledge of pregnant women in terms of its importance and the need for prenatal physical activity practice, and appear most effective when delivered through face-to-face feedback concerning goal achievement (Currie *et al*., 2013). However, effective implementation of physical activity interventions suggest that prenatal care providers' understanding of the common barriers, enablers and among pregnant women is required to ensure that they can precisely focus on their education and evidence-based behaviour change strategies (Harrisson *et al*., 2018).

A recent systematic review by James *et al*. (2020) identified individual interviews, group interviews, access to information through brochures or multimedia supports, and use of smartphone applications for personal training and general information, as interventions to promote physical activity during pregnancy. The latest of these recommendations on lifestyle interventions during pregnancy supports providing individualised advice and counselling on ways of increasing women's physical activity level rather than a generic approach (Hill, McPhie & Moran, 2017), since studies have indicated that pregnant women prefer personalised information (Lee *et al*., 2016; Lindqvist, Persson & Mogren, 2018). Seemingly, individual interventions are the most common and are frequently reinforced by reminders during routine consultations, or through emails or informative brochures (James *et al*., 2020). Dodd *et al*. (2014) in their randomised trial study, have demonstrated that an individualised intervention incorporating two telephonic reminders increased physical activity participation

in overweight and obese pregnant women. Furthermore, compared to standard care, supervised programmes have proved more effective for overweight and obesity during pregnancy to maintain physical activity levels and control gestational weight in late pregnancy (Flannery *et al*., 2019; Bisson *et al*., 2015).

Another physical activity intervention strategy entails designing a community-based intervention in which pregnant women can interact and share their challenges and concerns (Koleliat *et al*., 2021). Likewise, pregnant women advocated the inclusion of exercise brochures and videos (James *et al*., 2020; Koleliat *et al*., 20201. Similarly, previous studies in South Africa have emphasised the utilisation of instructional resources, such as posters, brochures, and Digital Video Discs (DVDs) as part of an intervention strategy to promote physical activity in antenatal clinics (Muzigaba, Kolbe-Alexander & Wong, 2014; Watson *et al*., 2016). This evidence suggests that pregnant women are aware of what they require to help them exercise; therefore, interventions should be tailored to accommodate their needs or concerns regarding the barriers to physical activity during pregnancy. In the light of the above, educating prenatal care providers about the benefits of prenatal physical activity and encouraging them to extend their counselling to include discussing safe exercise with the pregnant women, including their family members or spouses might further engender their physical activity behaviour and promote better health outcomes. Discernibly, there is increasing demand by policymakers, healthcare providers, and pregnant women for evidence-based guidance on how best to implement prenatal physical activity, considering the needs, preferences, and choices of the pregnant woman (Roland *et al*., 2021). Consequently, it is crucial to explore contextually relevant interventions that may address the physical activity behaviour of pregnant women and encourage them to undertake leisure-time physical activity and promote moderate-intensity activities.

2.9 SUMMARY OF THE LITERATURE REVIEW

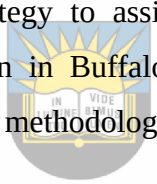
As mentioned earlier, this chapter focused on literature review and addresses gaps in the research by primarily exploring pregnant women's physical activity levels, beliefs, sources of information, perceived benefits, barriers, knowledge, attitudes, and practices concerning physical activity and exercise. The review also highlighted the perspectives of healthcare providers about prenatal physical activity advice and counselling during antenatal care. Furthermore, the literature review covered prenatal physical activity intervention strategies to promote physical activity and exercise during pregnancy across studies in different regions.

Included in this chapter were two published literature review manuscripts on physical activity and exercise during pregnancy in Africa (Supplementary File 1: https://doi.org/10.1186/s12884-020-03439-0), as well as physical activity and counselling by healthcare providers (Supplementary File 2: https://doi.org/10.3390/healthcare9050609).

As earlier highlighted, there is a plethora of research evidence demonstrating that prenatal physical activity improves maternal and neonatal outcomes. Accordingly, initiatives to promote physical activity during pregnancy are advocated. The literature also provided clear evidence on the health benefits of activity during pregnancy which have been reported in relation to numerous outcomes, such as reduced pregnancy and delivery complications, gestational weight control, gestational diabetes mellitus control, reduced caesarean delivery and postpartum recovery time, and preeclampsia. Furthermore, physical activity seems to improve maternal body composition, foetal birth weight, and lower the risk of preterm delivery. Additionally, other benefits include reducing fatigue, stress, anxiety and depression, lower back pain and lumbopelvic pain enhancing sleep quality, improving breastfeeding outcomes, and reducing perineal tears.

The degree to which the above-mentioned benefits are effective varies considerably, depending on the types of physical activity, duration, and the intensity. Nonetheless, despite the benefits derived from prenatal physical activity, and recommendations from various bodies that pregnant women should accumulate 150 min per week or 20-30 min of moderate-intensity physical activity per day, pregnant women rarely engage in physical activity; and their physical activity levels declined with advancing pregnancy. Seemingly, the evidence on the low physical activity levels among pregnant women and the barriers to the practice thereof points to the need to provide pregnant women with context-specific physical activity interventions to increase their awareness of the benefits in terms of health and well-being (Chan *et al*., 2019). The strength of such an approach is that a previous study has viewed pregnancy as a 'teachable moment', in which women can be motivated to modify their physical activity behaviour (Phelan, 2010). However, scant data exist about the levels, patterns, and reasons for the non-participation of pregnant women in physical activity and exercise in the Eastern Cape Province of South Africa. Concerning the barriers to prenatal physical activity, available evidence has shown that intrapersonal themes are the barriers and facilitators to physical activity during pregnancy most often reported as reasons for being physically inactive during pregnancy. In this regard, more research is needed to understand

the prenatal physical activity behaviour of women and design context-specific intervention strategies to address their barriers, attitudes, and enablers, accordingly, since it is important to modify the physical activity behaviour of pregnant women to prevent adverse maternal outcomes associated with inactivity during pregnancy. As stated earlier, designing the best intervention to encourage and promote pregnant women to engage in physical activity is a challenging task. Therefore, physical activity intervention strategies could work better if targeted to address the individual physical activity needs of the pregnant women. Such strategies should incorporate behaviour change techniques such as goal setting, planning, and education, and appear most effective when delivered on individualised approach, utilise brochures or multimedia supports for training and information. Furthermore, providing community-based interventions where pregnant women can freely interact and share their challenges and concerns (Koleliat *et al*., 2021) is desirable. Gleaned from the literature, research on prenatal physical activity is scarce in Africa, and notably, in the South African context. Consequently, this present study has attempted to justifiably fill this gap and to further develop an intervention strategy to assist in the promotion of physical activity participation among pregnant women in Buffalo City Municipality of the Eastern Cape Province. Chapter Three describes the methodology used in the study.



CHAPTER THREE
RESEARCH METHODOLOGY

3.1 INTRODUCTION TO THE CHAPTER

This chapter provides a perspective on the design and methodologies used to execute the empirical part of the study. It outlines the following in all phases of the research process: namely the research study design; setting; population; sample size and method of sampling; data collection and tools; data analysis; and, lastly, the related ethical considerations. Separate procedures were used to assess the reliability and validity of the quantitative data and results and the credibility and trustworthiness of the qualitative data and findings.

3.2 STUDY SETTING

This study was conducted within Buffalo City Municipality in the Eastern Cape Province of South Africa, situated on the East Coast. This Eastern Cape Province was created in 1994 and includes areas from the former Xhosa homelands of the Transkei and Ciskei, as well as parts of the Cape Province. The Eastern Cape Province is one of the poorest provinces in South Africa (Statistics South Africa, 2011). The Buffalo City Municipality has a total population of 884,000 or 12.2% of the total population of the Eastern Cape. It is estimated that 460,000 (51.99%) of the total population are females, while 424,000 (48.01%) are males (Statistics South Africa, 2011). The most spoken language in the Eastern Cape is isiXhosa (78.8%), followed by Afrikaans (10.6%), and English (5.6%) (Statistics South Africa, 2011). Furthermore, the province consists of two metropolitan municipalities and six districts, namely the Buffalo City and Nelson Mandela Bay Metropolitan Municipalities and the districts of Alfred Nzo, Amathole, Chris Hani, Joe Gqabi, OR Tambo and Sarah Baartman, respectively (Statistics South Africa, 2011). The study was conducted at the antenatal health units of 12 primary healthcare centres in Buffalo City Municipality District, in the Eastern Cape Province, South Africa. The Buffalo City Metropolitan Health District is made up of two provincial hospitals (Frere and Cecilia Makhiwane), two district hospitals (Bhisho and Grey), five community health centres; 72 primary health clinics as well as 12 mobile health services (Eastern Cape Socio Economic Consultative Council, 2017). Some of these health facilities are in urban and semi-urban settings. The basic antenatal healthcare services are free of charge, and offered exclusively from the community health centres and primary health clinics. Pregnant women attend these health facilities regardless of ethnicity, geographical

residence and socio-economic status (Okafor & Goon, 2020a). Figure 1 shows the map of Buffalo City Metropolitan Municipality, East London, Eastern Cape Province.

Source: https://municipalities.co.za/map/7/buffalo-city-metropolitan-municipality

Figure 3.1: Map of Buffalo City Metropolitan Municipality

3.3 STUDY DESIGN

A research design entails a blueprint for conducting a study that maximises control of factors which could interfere with the validity of its findings (Grove, Burns & Gray, 2013). To counteract invalid results, this study incorporated a mixed-methods, cross-sectional study design with both involving quantitative and qualitative data collection and analysis. A mixed-methods research design seeks to understand the contexts, perspectives, and cultural influences of the reality of a phenomenon (Kaur, 2016). Therefore, since health-related behaviours are complex phenomena (Tariq & Woodman, 2013), their examination requires multiple data perspectives to assess the magnitude of the problem being studied, as well as understand the construct and context of it through qualitative approach (Kaur, 2016). This approach allows the researcher to better understand, interpret, and contextualise the experiences of participants. Furthermore, this study adopted a sequential explanatory mixed method (quantitative and qualitative), predominantly quantitative study of pregnant women

attending antenatal healthcare facilities in Buffalo City Municipality, Eastern Cape. Qualitatively, a subset of pregnant women participated in individual in-depth semi-structured interviews to augment quantitative data. The qualitative research was used to provide in-depth information on the beliefs, perceived benefits, and barriers to prenatal physical activity among women in the Eastern Cape which might not have being listed in the quantitative questionnaire, thereby also granting the women an opportunity to express their views, qualitatively, without limitation. In addition, "the mixed methods study design combines the strengths of both quantitative and qualitative approaches to answer research questions' (Othman, Steen & Fleet, 2021). Put differently, qualitative data supplemented the quantitative data in providing additional useful information on prenatal physical activity for the study. Therefore, data collection method utilised questionnaire and interviews to facilitate the triangulation of data.

The quantitative and qualitative data were collected and analysed separately to produce two sets of findings. Thereafter, the findings were combined and compared according to a triangulation technique suggested in previous studies (Farmer *et al*., 2006; O'Cathain, Murphy & Nicholl, 2010). Applying the principles of explanatory sequential mixed methods study design (Creswell & Plano Clark, 2011) both the quantitative and qualitative results were merged and interpreted as a comprehensive summary of the total findings (Creswell & Plano Clark, 2011). According to Othman, Steen and Fleet (2021), a mixed methods study where data collection is in two phases is "a powerful approach to identify and enhance the study strengths, provide richness of data, and increase validity and trustworthiness of findings". Figure 3.2 presents the mixed methods design flow chart.

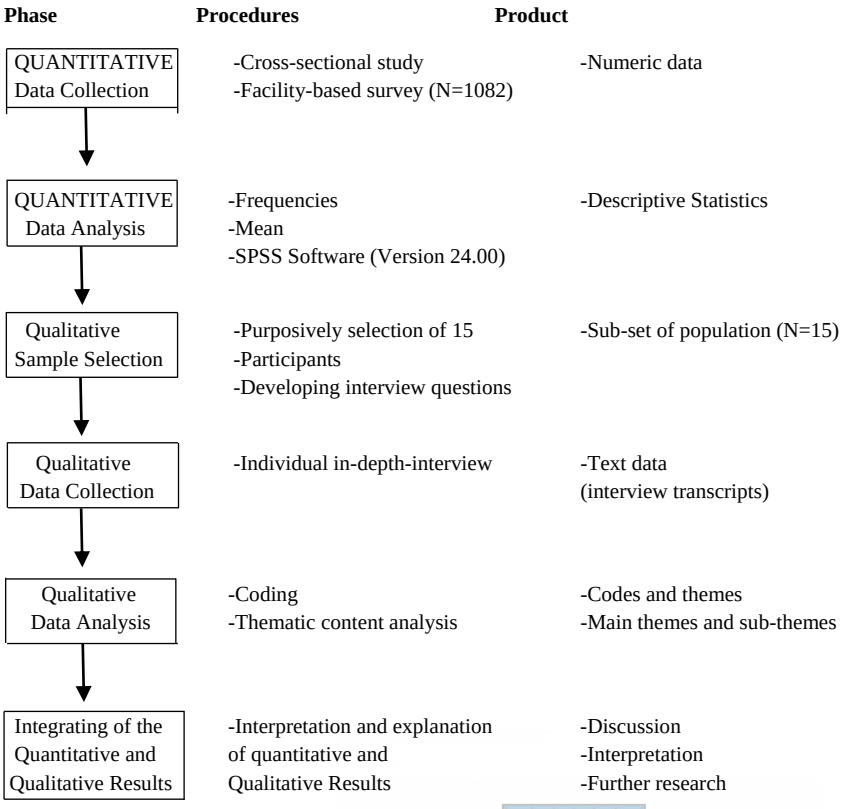


Figure 3.2. Chart flow of the mixed methods of the study

3.4 QUANTITATIVE APPROACH

3.4.1 Study Population

In the quantitative research section, the population used was all the pregnant women in Buffalo City Municipality of Eastern Cape Province. The target population was all pregnant women who attend primary health clinics in Buffalo City Municipality for antenatal health services. The accessible population was all pregnant women attending the primary health clinics in Buffalo City Municipality who meet the eligibility criteria on the day of data collection.

3.4.2 Sample Size Determination and Sampling Procedure

3.4.1.1 Pregnant Women

Pregnant women attending antenatal appointments were approached and the aim and nature of the study was explained to them; after that those who were willing and eligible to participate in the study were conveniently selected in view of the need to save cost and facilitate accessibility.

Sarmah, Hazarika and Choudhury's (2013) formula was applied to an infinite population to calculate the sample size at a confidence level of 95% with the precision level of ±3%, and at a prevalence of prenatal physical activity or exercise practice of 50% (p = 0.5) as follows:

p = 0.5 and hence q = 1 − 0.5 = 0.5; e = 0.03; z = 1.96

So, $n_0 = \frac{(1.96)2\,(0.5)(0.5)}{(0.3)2} = 1067 = 1067$

In order to account for possible attrition and to protect against possible data loss, 10% was added as non-response; therefore, the final sample size was 1215 pregnant women. Of these, 42 participants failed to meet the eligibility criteria, while 26 declined to participate in the study. In addition, 65 had incomplete information in their medical records and were also excluded from the study. Finally, a total of 1082 pregnant women were included in the study.

3.4.3 Sampling of Primary Health Clinics

Of the 72 primary health centres, only primary health clinics providing antenatal services in Buffalo City Municipality were sampled. Therefore, applying a table of random numbers procedure, 12 primary health clinics out of the 72 health facilities were selected to participate in this study. This probability sampling method was applied to afford all the primary health clinics offering antenatal services equal chance of selection, regardless of their geographical setting (urban/semi-urban). Personal communication with a health facility manager by the primary researcher indicated that, on average, these health primary clinics register five to six new pregnant women who visit the primary health clinics per day. Therefore, approximately, 17000 pregnant women attend the 12 selected primary health clinics for antenatal services annually (Okafor & Goon, 2020c). Then, via the proportional allocation method, the sample size within each primary health clinic was set equal to be proportional to the number of pregnant women assigned to each setting. Shown in Figure 4.3 is the selection process.

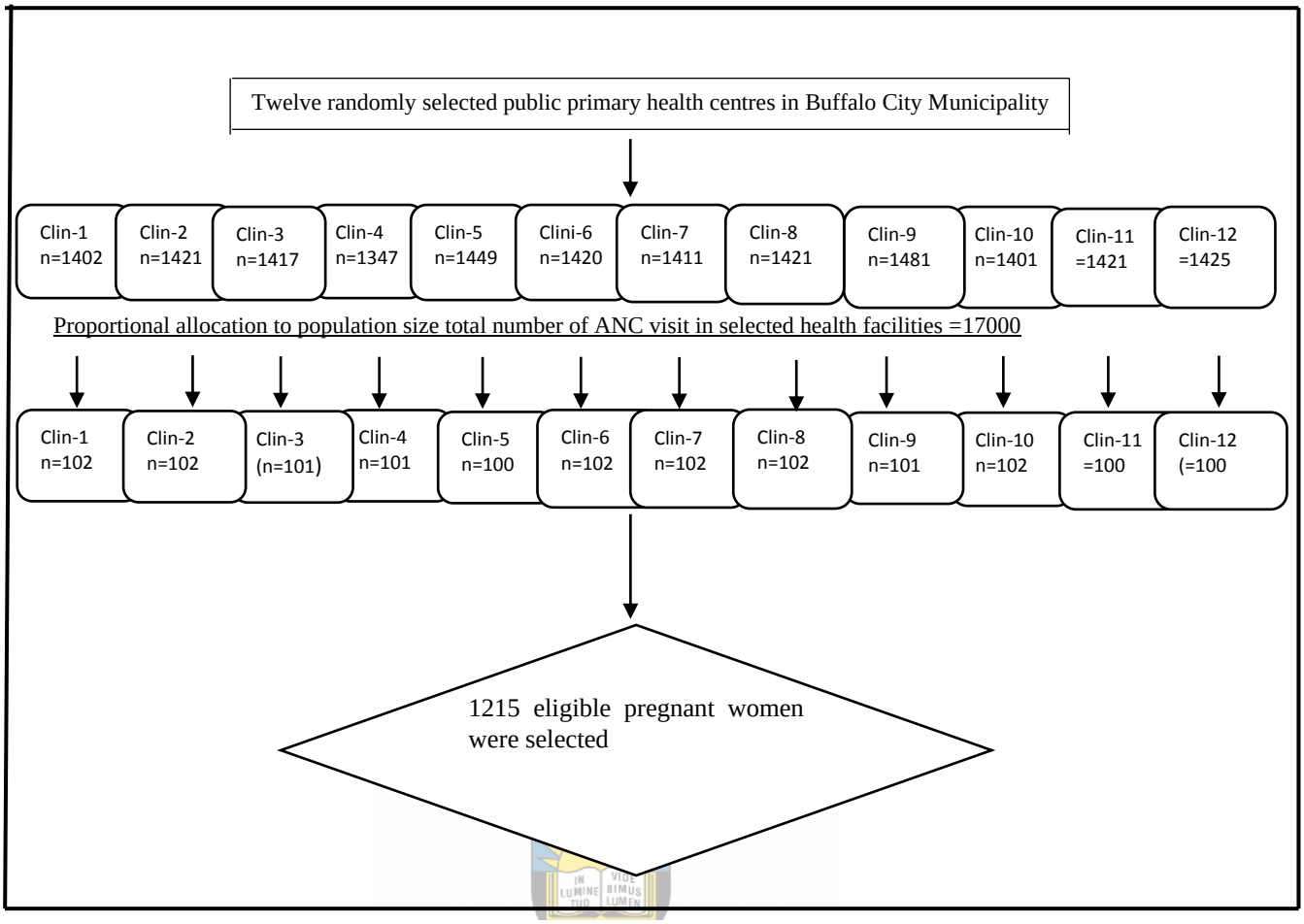


Figure 3.3: Diagrammatical flow chart of sampling procedures of the participants in each selected health facility

3.4.4 Inclusion and Exclusion Criteria

The target population included all pregnant women attending antenatal clinics at the primary healthcare centres within the Buffalo City Municipality. Potential participants were included in the study as follows: participants had to be 18 years of age or older, were receiving antenatal care, having a single pregnancy (not multiple ones), and could read or understand IsiXhosa, Afrikaans, or English. Furthermore, pregnant women with disabilities or reasons to cease exercise at the time of recruitment, such as "persistent excessive shortness of breath that does not resolve on rest, severe chest pain, regular and painful uterine contractions, vaginal bleeding, persistent loss of fluid from the vagina indicating rupture of the membranes, and persistent dizziness or faintness that does not resolve on rest" (Mottola *et al*., 2018), were excluded from this study.

3.4.5 Preparation for Data Collection

The researcher visited the data collection sites before the actual data collection period to familiarise herself with the research sites, arrange dates and times for data collection, and to build rapport with health facility managers in-charge of antenatal primary health clinics in the selected clinics for the study. On the agreed date, the researcher arrived early to prepare the sitting space. The common spaces used were either the clinic room that was not in use at the time of the data collection or in the nurses' home sitting room. Both spaces were quiet and there were no interruptions experienced during the data collection process. Some participants were requested to participate in the study while waiting for their consultation, while other participants were administered the questionnaire after being seen by a health practitioner. Each participant was interviewed in a private consulting room where the participant was given a letter explaining the purpose, benefits and the nature of the questions. The eligibility criteria was explained to the participants and they screened for it accordingly. The purpose of the research study was carefully explained to each participant prior to signing the consent form. A questionnaire was self-administered to one participant at a time to ensure confidentiality and to facilitate interpretation of the items. The researcher was assisted by a trained research assistant, who were recruited from Department of Nursing Science, University of Fort Hare.

3.4.6 Quantitative Data Collection

3.4.6.1 Pilot Study

The items on the questionnaire pertaining to the "beliefs, sources of information, perceived benefits, knowledge and attitude and barriers to physical activity and exercise during pregnancy" instrument was developed based on the literature (Evenson & Bradley, 2010; Da Costa & Ireland, 2013; Hurst *et al*., 2017; Mbada *et al*., 2014; Sujindra *et al*., 2015; Harrison *et al*., 2018) to answer the research objectives two, three and four of the study, and, was based on the key outcome measures and explanatory variables. It was first pilot tested on 20 pregnant women to establish how clear and concise participants found the questionnaire. Feedback from this pilot study was then used to improve the wording and rephrasing some of the questionnaire items. Subsequently, the participants of the pilot study were excluded from the main study. In addition, two experts in the field of physical activity and maternal health were contacted who ascertained the content and face validity of the questionnaire, and

thereafter revisions were made. The reliability of the questionnaire was checked, and the Cronbach's alpha value was estimated as 0.69.

3.4.6.2 Demographic, Obstetric and Lifestyle Behaviour

Data collection took place at each health facility offering antenatal services from July to October 2019. A structured and pretested questionnaire was developed by the researcher and self-administered to all study participants by the researcher and research assistants. The questionnaire was prepared in English. A face-to-face interview was employed to gather information on age, residence, ethnicity, marital status, level of education, employment status, religion, family support and behavioural and lifestyle characteristics, such as current exposure to alcohol and smoking. In addition, information on parity, mode of pregnancy delivery and pregravid body mass index of the pregnant women was obtained from available antenatal records. Additional information included details pertaining to antepartum haemorrhages, chronic illness, physical activity advice from health providers and pre-pregnancy physical activity. The Institute of Medicine's (IOM) (2009) recommended body mass index (BMI) cut-off values were used to classify underweight (<18.5 kg/m^2), normal weight (18.5–24.9 kg/m^2), overweight (25.0–29.9 kg/m^2) and obese (>30.0 kg/m^2) pregnant women.

Secondary outcome measures included a structured questionnaire about beliefs, attitudes, perceived benefits, barriers to uptake and sources of information related to prenatal physical and exercise. This was developed based on an extensive literature review (Bauer *et al*., 2018; Flannery e*t al*., 2018; Haakstad *et al*., 2018; Koleilat, Vargas & Kodjebacheva, 2016; Sytsma *et al*., 2018; Mbada *et al*., 2014; Sujindra *et al*., 2018; Evenson & Bradley, 2010; Da Costa & Ireland, 2013; Hurst *et al*., 2017; Mercado *et al*., 2017), which was cross-checked by exercise scientist experts to ensure the completeness of relevant content and face validity.

3.4.6.3 Main Outcome Measure: Prenatal Physical Activity

The primary outcome measure was active and inactive prenatal physical activity participation of women in the Eastern Cape Province. Therefore, physical activity was measured by the Pregnancy Physical Activity Questionnaire (PPAQ) (Chasan-Taber *et al*., 2004) to answer research objective one of this study. The PPAQ solicits information on how much time participants spend on a range of 32 activities in different categories, including household and caregiving (13 activities), occupational (five activities), sports and exercise (eight activities),

transportation (three activities) and inactivity (three activities) domains. In addition, the type, intensity, duration, and frequency of physical activity was recorded as hours and minutes per day. The PPAQ was interviewer-administered to the participants at the selected health facilities during an antenatal visit, which took approximately 20 to 25 minutes to complete. Based on the data collected and analysed, the metabolic equivalent of task (MET) of each activity was categorised as sedentary (<1.5 METs), low or light (from 1.5 to ≤3.0 METs), moderate (3.0–6.0 METs), and vigorous intensity (>6.0 METs) Chasan-Taber *et al*., 2004).

3.4.6.4 Validity and Reliability

The Pregnancy Physical Activity Questionnaire tool has been validated in various countries (Chasan-Taber *et al*., 2004; Adeniyi, Ogwumike & Osinike, 2014; Chandonnet *et al*., 2012; Chen *et al*., 2012) and is a reliable instrument and accurate measure of broad range of physical activity during pregnancy (Chasan-Taber *et al*., 2004; Chandonnet *et al*., 2012). The instrument has been validated for seven days of testing with accelerometer measurements in a group of 54 pregnant women twice with two weeks interval, and demonstrated acceptable evidence of validity (Chasan-Taber *et al*., 2004; Chandonnet *et al*., 2012). The authors have reported a strong reproducibility between two administrations of the questionnaire for total physical activity (0.78), highest for moderate intensity activity (0.82), and ranged from 0.78 to 0.81 for light, sedentary and vigorous activity.

3.4.6.5 Data Analysis

Two aspects of statistical analysis were applied to the quantitative data collected. Firstly, descriptive statistics was used to summarise the quantitative data by means of frequency distribution, percentages, mean and standard deviation (SD). In addition, the Centers for Disease Control and Prevention's (CDC) (2020) recommendations were applied such that the women participants were categorised as "inactive" (reporting 0–149 min of exercise per week) and "active" (reporting 150 min or more of physical activity per week based on the combined moderate-vigorous minutes per week).

Secondly, all bivariate and multivariate analyses were performed on two categories of participants, namely inactive or active, to determine the factors affecting prenatal physical activity behaviour. Furthermore, the associations between prenatal physical activity levels and socio-demographic, lifestyle and obstetrics characteristics were determined using Chi-squared analysis. In addition, the odds ratio (OR) and corresponding confidence interval (CI)

of 95% were then calculated. Lastly, a logistic multiple regression analysis with an automatic variable selection procedure, was used to determine the factors that predict the women's prenatal physical activity levels. The significance level was set at $p \leq 0.05$. The Statistical Package for Social Sciences (SPSS) (Version 24.0, IBM SPSS, Chicago, IL, USA) was used to perform all statistical analyses.

3.5. QUALITATIVE APPROACH

A qualitative approach was used in order to assess the barriers to, knowledge attitudes and practices about prenatal physical activity among pregnant women. A qualitative approach was used to strengthen the data that was collected through questionnaire with pregnant women in quantitative research. In addition, a qualitative approach was applied to achieve the research objective five of the study, which seek to explore the attitudes, knowledge and practices of midwives toward prenatal physical activity education and counselling. The findings of the qualitative research were used to support the existing body of theory and research (de Vos *et al*., 2011). In this study, an explorative, descriptive and contextual research design was used in order to explore and describe the barriers to, knowledge attitudes and practices regarding prenatal physical activity among pregnant women, and, the attitudes, knowledge and practices of midwives toward prenatal physical activity education and counselling in order to develop the intervention strategy to promote prenatal physical activity and exercise practice. In explorative research, pregnant women and midwives were narrators of their experiences. The depth, breadth, richness and complexity of engaging in physical activity during pregnancy in was explored in Buffalo City Municipality. The participants narrated their experiences in depth and breadth, providing their wealth of experiences on their own regarding barriers to prenatal physical activity and exercise.

A qualitative descriptive approach was deemed relevant to gaining insight into the factors that determine behaviour within the context of prenatal physical activity participation. The descriptive research design allow the researcher observed and listened to participants to ensure clear, accurate and precise descriptions related to the prenatal physical activity and exercise practice, barriers and counselling. Description involved the collection of qualitative data through semi-structured individual interviews with a pregnant woman and midwife. The understanding, views and perceptions related to the practice and barriers of pregnant women, and, the perspectives of midwives about prenatal physical activity and exercise education and

counselling were analysed which lay inform the development and description of the main theme, themes and sub-themes from interview transcripts.

Contextually, midwives as participants in this research were interviewed within their environmental setting, that is, at the clinics where they render antenatal services. They expressed their feelings, experiences and the reality of what is happening in the provision of education and counselling of prenatal physical activity and exercise.

In quantitative research, the design method was discussed, that is, the population, sample, data collection method and analysis; therefore, this section will indicate how the qualitative research procedure was conducted.

3.5.1 Study Population

In this study, the population were pregnant women who were attending antenatal health clinics and midwives offering antenatal healthcare services in Buffalo City Municipality in Eastern Cape Province.

3.5.2 Sampling, Sample size and Sampling Criteria of Pregnant Women

Twenty-four pregnant women attending antenatal healthcare appointments in the selected health clinics were purposively selected to participate in the qualitative interviews. Two pregnant women per selected primary health clinic who met the criteria were selected for interview. However, because of interview data saturation, 15 pregnant women comprised the sample size of the qualitative study. The criteria for inclusion and exclusion was applicable to the pregnant women sampled in the quantitative research previously described in section **3.4.4.**

3.5.3 Sampling, Sample size and Sampling Criteria of Midwives

Similarly, 24 midwives offering antenatal healthcare services to pregnant women at antenatal health clinics in Buffalo City Municipality were purposively sampled to solicit their perspectives of the provision of prenatal physical activity education and counselling to pregnant women. Two midwives per selected primary health clinic who met the criteria were selected for interview. However, because of interview data saturation, the sample size was 17 midwives. Only those who had been practising as midwives for more than a year and were able to read and write in English were selected to participate in the study.

3.5.4 Sampling of Clinics

Sampling of the clinics was done as described in the quantitative research approach in section 3.4.3

3.5.5 Data Collection Procedure

3.5.5.1 Pregnant Women

Data was collected using a semi-structured, in-depth face-to-face interviews with the participants. The in-depth interviews were conducted to gather a broad range of different information from pregnant women regarding the practice and barriers of prenatal physical activity and exercise. Before the start of the interview, some pleasant rapport was developed between the researcher and participant by the researcher greeting and first talking about other issues unrelated to the research in question. The researcher then, began by explaining to the participant about the interview. The researcher introduced herself and explained to the participant the aim and nature of the study as well as the procedure for the interview. The data collection process was stopped when saturation was reached. This was after 15 of the eligible participants (n=24) had been interviewed. There is no one-size-fits-all method to reach data saturation, which means that the interviews yielded no new data, themes, coding and provided sufficient information to replicate the study. The interviews, which lasted between 45 and 60 minutes on average, were conducted in a quiet room provided by the health facility manager. This ensures a non-threatening, comfortable and free environment, which encouraged freedom of speech. Permission was obtained from the participants to audio-record the interviews. The researcher applied her listening and observation skills throughout the research study by maintaining eye contact during the interview and asking the participant for clarity where necessary. The participants were not provided with the interview guide; however, they were given the opportunity to freely express their views or opinions**,** beyond the items in the interview guide, on the beliefs, attitudes, perceived benefits, barriers and sources of information on prenatal physical activity and exercise.

The researcher employed different techniques to encourage the participant to talk during the interview. The researcher asked different probing questions arising from the participant's answers for clarity, and utilised minimal verbal responding by nodding her head as a sign of response to what the participant is saying "Yeah, I am listening", "yes", "continue". In addition, the researcher asked follow-up questions, repeated the participants statement and

reframed the questioning throughout the interview to enable the participants clarify facts and consolidate some of the information or restructure some of the questions. At times, the participants were refer back to the answers they have already provided (reflection) for more expansion. Also full attention was provided to the participants throughout the interview to help them focus on their experiences related to their beliefs, attitudes, perceived benefits, barriers, and sources of information on prenatal physical activity and exercise, including prenatal physical activity education and counselling. In paraphrasing, the participant's words were stated in another form but with the same meaning to allow the participants to provide more information from the question. Furthermore, non-verbal communication such as vocalisation, facial expression and bodily gestures were observed and transcribed for analysis. Additionally, the participants were encouraged during the interview to tell more about the different perspectives of prenatal physical activity practice and barriers thereto. The researcher also observed some quietness while the participant is talking to allow her to think and continue narrating her experiences without interruption. Lastly, field notes were written to describe the participant in the observed setting regarding the manner of speaking, physical appearance, interacting style and anything that can be used to provide better insight into the study. The field notes were revisited, and transcribed verbatim during data analysis.

3.5.5.2 Midwives

A semi-structured face-to-face interviews were conducted with midwives offering antenatal healthcare services at the selected antenatal health clinics. The midwives were interviewed on their perspectives regarding prenatal physical activity education and counselling of women during antenatal visits at the clinics. The data collection process was stopped when saturation was reached. This was after 17 of the eligible participants (n=24) had been interviewed. The researcher provided the participants with an information sheet, an informed consent form and a demographic questionnaire (to elicit information on gender, ethnicity, workplace, years of practice, knowledge of current international guidelines and recommendations for prenatal physical activity). Consenting participants returned their signed consent form and completed demographic questionnaire to the researcher. Subsequently, they were contacted by phone concerning the date and time for their respective interviews. The midwives were interviewed in English, and each interview lasted between 35 and 45 minutes. Furthermore, they were conducted at the related health facilities (participants' places of work). The researcher also sought the permission of the midwives to audio-record the interviews, which were later

transcribed verbatim. The interview guide for the midwives focused on their perspectives regarding prenatal physical activity education and counselling in relation to:

- knowledge of prenatal physical activity guidelines and recommendation;
- counselling on general aspects of prenatal physical activity (benefits, contraindications, types of physical activity or exercises, intensity, duration, types of antenatal exercises or activities); and
- the barriers to and facilitators of prenatal physical activity.

While the interview guide was not provided to the midwives, they were all granted the opportunity to freely express their views regarding prenatal physical activity counselling, beyond the confines of the interview guide.

3.5.6 Data Analysis

The semi-structured face-to-face interviews were analysed by using the content analysis method, according to the steps described by Tesch in Creswell (2014). The interviews from the qualitative data were read through to ensure the researcher was given a sense of the overall whole. Next, a document with the most relevant and concise summaries of what was said on each topic was compiled. In addition, a list of all the topics and similarities were clustered together. Thereafter, they were coded, abbreviated, and the codes recorded next to the relevant sections of the text. The wording that most accurately described the topics was identified and turned into categories. Each identified category from the formulated topics was abbreviated and coded. Following this step, the primary analysis was performed by assembling the data material of each category in one place, after which the researcher and independent coder identified the data, which was then grouped according to the main theme, other related themes, and subthemes. Finally, the researcher and independent coder reached a consensus regarding the analysis and presentation of the findings.

3.5.7 TRUSTWORTHINESS

The term ‘trustworthiness or rigor’ in qualitative research refers to the degree of confidence in data, interpretation, and methods used to ensure the quality of a study (Polit & Beck, 2014). In this study, trustworthiness was maintained by applying the principles of credibility, transferability, dependability, and confirmability (Guba & Lincoln, 1994).

3.5.7.1 Credibility

Several techniques were employed to ensure credibility of the data. The researcher had enough time for data collection, engaged in prolonged interaction with the participants in each health facility; therefore, they developed trust in the researcher and felt free to talk. In this context, the researcher was able to make persistent observations on the participants and the whole environment. Structural coherence was maintained via peer member-checking, discussions, presentations, and reflective journaling to avoid unexplained inconsistencies between the data collected and its interpretations, and field notes taken. In addition, independent coder was involved in data analysis, and the researcher and supervisor revised and discussed interpretations to reach final agreement. These activities warrant triangulation. During the interviews, data collection was audiotaped and transcribed verbatim. The recorded information was repeatedly played back to facilitate accurate transcription of the participants' responses.

3.5.7.2 Transferability

The research findings should be applicable to other contexts or with other respondents. There was in-depth description of data from the interviews conducted. Measures of transferability include adequate sample size applicable to the research settings, a clear description of data collection and analysis, detailed description of the participants' demographic characteristics, and their views and experiences, which were presented with extracts or quotes. Lastly, the findings were presented, interpreted and discussed and implications for future research highlighted.

3.5.7.3 Dependability

The procedures to ensure dependability in this study include a dense description of the research method, maintenance of an audit trail regarding field notes of all activities that occur during the study and decisions pertaining to all aspects of the study, and peer-debriefings with a colleague. In addition, the study protocol was published. Thereafter, triangulation was applied by conducting semi-structured interviews where observations were made during data collection.

3.5.7.4 Confirmability

According to Polit and Beck (2014), confirmability means the congruence between two or more independent people about collected data's relevance, meaning, and accuracy. It is the neutrality or the degree in which the findings are consistent and could be repeated (Connelly, 2016). This research was supervised by a highly qualified supervisor. The outlined research design method was followed resulting to data collection which affirmed the findings from quantitative research. The themes were developed using the findings in Chapters Six and Nine, which relates to the barriers to prenatal physical activity practice, and perspectives on prenatal physical activity education and counselling by midwives, respectively. In addition, an audit trail of analysis and methodological memos of log was maintained. The study protocol was published. The notes were also reviewed by the supervisor to prevent biases from only one person's perspective on the research. The researcher also conduct member-checking with study participants. To maintain accuracy and validity, the transcriptions were cross-checked with the audio-recorded interviews, and, likewise, participants were provided with the interview transcripts and emergent themes for comments and confirmation regarding the accuracy and veracity of the interviews (participant audit).

3.6 ETHICAL CONSIDERATIONS

The research protocol was presented to the Department of Nursing Higher Degrees Committee (FHDC) and the University of Fort Hare for approval. Ethical approval was obtained from the University of Fort Hare's Human Research Ethics Committee (UFH HREC) (Ref#2019=06=009=OkaforUB) (Appendix A). Permission was also obtained from the Eastern Cape Department of Health (Appendix B) and all other health facilities which participated in the study. Signed informed consent was obtained from the pregnant women (Appendix C) and the midwives (Appendix D) before data collection. The informed consent stipulates the aim, nature of the study, how confidentiality and privacy would be maintained and how the rights of the participants be protected. Prior to data collection, the participants provided their written informed consent after being adequately informed about the data collection procedure before they consented to participate in the study. Also participants were allowed to withdraw from the study at any point of the research process without any prejudice or threats. They were made to understand that participation in the study is voluntary. The rights of participants to privacy and confidentiality of information were respected throughout the study. Participant's identities, their health facility and residences

were concealed or not published with the results. In addition, the research report findings were not linked to the participants. Participants were not required to write their names on the questionnaire; therefore, numbers/codes instead of names were used to identify the participants as a number was assigned to represent extracts and quotes of each participant. The confidentiality and anonymity of the participant's medical, obstetric and clinical information taken from the medical records was strictly maintained. Furthermore, their information and identity were not divulged to anyone and remain strictly confidential even after the study.

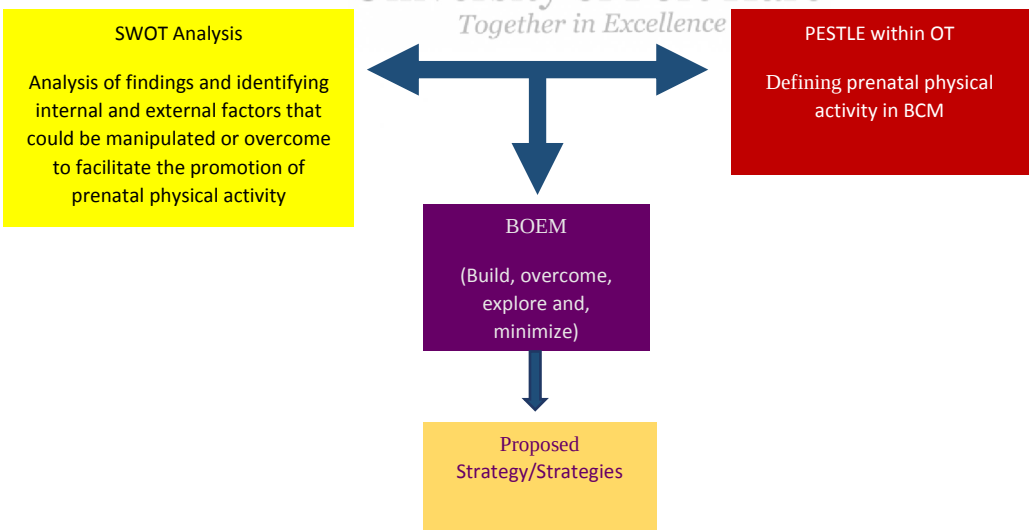
3.7 INTEGRATION OF QUANTITATIVE AND QUALITATIVE DATA

In this study, integration was achieved at all levels of the study (design, methods, analysis, interpretations and reporting). At the study design level, integration occurred by merging quantitative and qualitative datasets, that is, utilising explanatory sequential design, in which, the quantitative data collection and analysis inform the follow-up of qualitative phase. Integration at methods level was through connecting some participants who attended Phase 1 to continue to participate in phase two, the results from Phase 2 built on Phase 1 findings (building), and merging the findings of the two datasets together for meta-analysis. A narrative approach was used to integrate the quantitative and qualitative data by describing the two data sets side by-side to compare the findings. This integrative approach at all levels of the study served to provide comprehensive conclusions for findings of both datasets from comparing both results/findings to inform interventions to promote prenatal physical activity practice in the context of women in the Eastern Cape. Methodological triangulation approach helped to compensate for the limitations of using quantitative or qualitative alone by leveraging on the strengths of either one of the approaches in order to improve the credibility of the findings. The questionnaire open-ended and a semi-structured interviews were conducted.

3.8 DEVELOPMENT OF A PHYSICAL ACTIVITY INTERVENTION STRATEGY

Von Kodolistch *et al*. (2015) defines strategy as what one utilises to achieve a goal or goals. In other words, it is a plan of action to achieve a particular goal(s) that may be short or long term. In this study, an intervention strategy to promote prenatal physical activity participation in Buffalo City Municipality was developed, based on the empirical findings obtained from the study.

In order to develop the physical activity strategy for the promotion of prenatal physical activity practice among women in Buffalo City Municipality, the Strength, Weakness, Opportunity and Threat (SWOT), Political, Economic Growth, Socio-Cultural, Technological, Laws and Environmental (PESTLE) and Build, Overcome, Explore and Minimise (BOEM) analytical frameworks were applied. A SWOT analysis assesses the strengths (S) and weaknesses (W) as internal capabilities of an organisation/institution in contrast to opportunities (O) and threats (T) caused by the external environment. The SWOT strategy examines the internal factors that facilitate the achievement of a set goal, which are the 'strengths' or 'weaknesses'. However, another aspect of the SWOT strategy is the external factors that cannot be controlled, and are termed 'threats' or 'opportunities'. The SWOT analysis has been utilised to understand health-related problems (Aslan, Cinar & Ozen, 2014). Building on from the SWOT analysis, the PESTLE analytical tool was also applied to analyse a situation to avoid actions that will cause failure. In addition, the BOEM approach was used to develop a strategy by building on the identified strengths, overcoming the weaknesses, exploring the opportunities, and minimising the threats (Nunu *et al*., 2020), as associated with prenatal physical activity practice. The SWOT, PESTLE and BOEM strategies applied to develop prenatal physical activity strategies in the study (Figure 3.4).



OT= Opportunities and threats, BCM=Buffalo City Municipality

Figure 3.4: SWOT, PESTLE and BOEM Strategies

3.9 VALIDATION OF THE DEVELOPED INTERVENTION STRATEGY

The empirical findings of the study and the development of the prenatal physical activity strategy preceded the validation phase of the developed intervention strategy. Peggy, Chinnn and Kramer (2011) defines validation as a technique used to ascertain the credibility of empirical knowledge pertaining to a scientific model of a discipline. The authors further explained that a plausible way of validating empirical knowledge is by noting and sharing a view about what something is defined as and how consistently it works without formally testing the views using the research methods (Peggy, Chinnn & Kramer, 2011). This phase aimed to validate whether the developed strategy could be used effectively to address the gaps identified during the research. To further accomplish this objective, the relevant strengths and weaknesses of prenatal physical activity practice in the setting were identified, and interviews conducted with various experts in the field of maternal physical activity. In addition, published and/or unpublished data related to prenatal physical activity were consulted. An external assessment (or analysis) was used to identify the opportunities and threats (Gurel & Tat, 2017).

3.12.1 Experts' Analyses

The process of validation of the prenatal physical activity strategy involved expert analytical views or opinions. These experts were individuals with knowledge of and a proven academic and scholarly background in prenatal physical activity and maternal health. Hence, seven experts (gynaecologists, obstetricians, midwives/professional nurses, and exercise physiologists) were purposively selected to participate in the validation process. The first line of action was to present the findings of the study, the SWOT, the PESTLE, and the BOEM models, as well as the developed strategies to the experts. They read and critiqued the developed strategies based on contextual needs of the pregnant women in the setting. The expert then determined the applicability of the developed physical activity strategies in the promotion of prenatal physical activity in context of the Eastern Cape Province. Building on from the experts' feedback, the developed prenatal physical activity strategy was modified in preparation for validation by relevant key stakeholders (Appendix E).

3.12.2 Key Stakeholder Consultation

Following the above-mentioned steps, the developed physical activity strategy was presented to various stakeholders included in the validation phase; a group that was comprised of antenatal health clinic managers, antenatal midwives, and pregnant women. Six primary healthcare managers, 24 midwives and 24 pregnant women were purposively drawn from each of the 12 selected antenatal health clinics to participate in the validation process. Overall, 54 participants were included. The managers of antenatal healthcare facilities were included because they are responsible for supervising and ensuring proper implementation of any developed strategy in their respective health facilities. Similarly, pregnant women were also involved in the validation process since patient engagement may provide insights into possible relevant contextual interventions to address their individual needs to promote the uptake of prenatal activity (Okafor & Goon, 2020a). A checklist of the developed strategies was provided to the stakeholders with clear instructions soliciting their opinion of and information concerning the validation process.

Similar to the experts in the developing phase of the strategy, the empirical findings of the study and the developed strategies based on the SWOT/PESTLE analyses, were presented to the stakeholders. Expectedly, they were to discuss, deliberate on, and provide comments and opinions on whether the designed prenatal physical activity was feasible in the context of pregnant women. The feedback from the stakeholders was revised accordingly. The final line of action was the stakeholders' validation of prenatal physical activity strategy as a feasible strategy for implementation in Buffalo City Municipality.

3.10 SUMMARY OF CHAPTER THREE

This chapter described the following in detail: the study design; setting; population; sample and method of sampling; data collection and tools; validity and trustworthiness; ethical considerations and data analyses. The chapter was divided into three phases, according to the objectives, namely, the empirical phase, the strategy development, and, lastly, the validation of the developed strategies. Figure 3.4 presents the three phases.

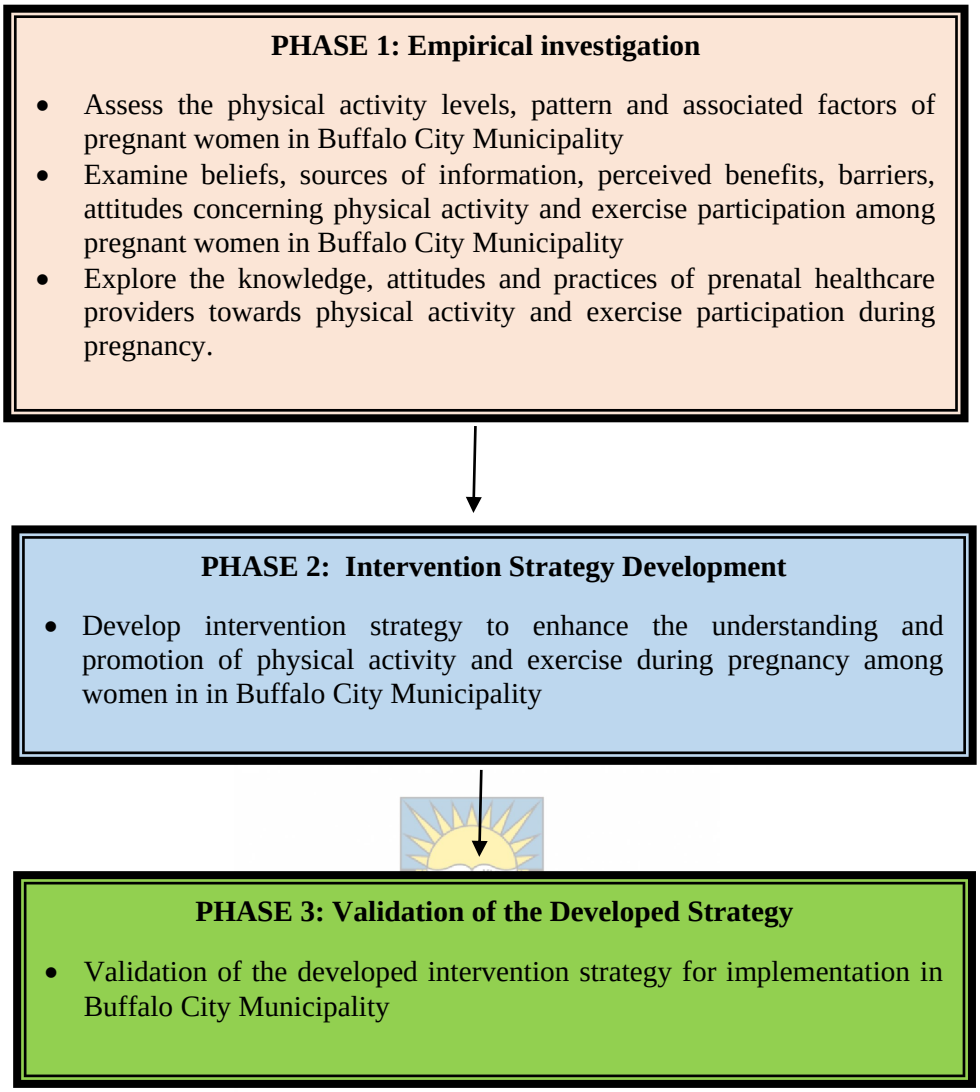


Figure 3.5: Research Phases of the Study

Chapter Four presents an article based on objective one, which examined prenatal physical activity levels and their associated factors among participants in the above-mentioned municipal district.

CHAPTER FOUR

PHYSICAL ACTIVITY LEVEL DURING PREGNANCY IN SOUTH AFRICA: A FACILITY-BASED CROSS-SECTIONAL STUDY

4.1 INTRODUCTION

The article presented in this chapter responded to specific objective one, and examined the physical activity level and associated factors among pregnant women in the Eastern Cape. Information on the factors influencing prenatal physical activity is important to guide interventions to promote physical activity. However, there is hardly any study undertaken to assess the level, types and intensity, and correlates of physical activity among pregnant women in the Eastern Cape Province, South Africa.

4.2 PUBLICATIONS DETAILS

Title:	Physical activity level during pregnancy in South Africa: a facility-based cross-sectional study
Authors:	UB Okafor, DT Goon
Ethics:	University of Fort Hare Health Research Ethics Committee approved the study protocol (Ref#2019 = 06 = 009 = Okafor UB)
Journal:	International Journal of Environmental Research and Public Health
Journal details:	Peer-reviewed (blinded) Journal approved and listed on the Department of Higher Education and Training (DHET)
Status:	Published: Okafor UB, Goon DT. Physical activity level during pregnancy in South Africa: A facility-based cross-sectional study. *International Journal of Environmental Research and Public Health*, 2020; 17(21): 7928. https://doi:10.3390/ijerph17217928
Impact factor	3.390

4.3 PUBLICATION RECORD

The article was submitted to the journal on the 27 September 2020, accepted on 26 October 2020 and published on 29 October 2020.

International Journal of
Environmental Research and Public Health

MDPI

Article

Physical Activity Level during Pregnancy in South Africa: A Facility-Based Cross-Sectional Study

Uchenna Benedine Okafor [1,*] and Daniel Ter Goon [2]

[1] Department of Nursing Science, University of Fort Hare, 50 Church Street, East London, 5201, South Africa
[2] Department of Public Health, University of Fort Hare, 5 Oxford Street, East London 5201, South Africa; dgoon@ufh.ac.za
* Correspondence: ucheysonic@gmail.com

Received: 27 September 2020; Accepted: 26 October 2020; Published: 29 October 2020

Abstract: Physical activity participation during pregnancy confers many maternal and foetal health benefits to the woman and her infant and is recommended by various health bodies and institutions. However, in South Africa, scant information exists about the physical activity status and its determinants among pregnant women. The aim of this study was to assess the physical activity level and associated factors among pregnant women. This cross-sectional study enrolled 1082 pregnant women attending public health facilities in Buffalo City Municipality, Eastern Cape, South Africa. Information on socio-demographic and maternal characteristics were obtained, and the Pregnancy Physical Activity Questionnaire was used to assess physical activity during pregnancy. Multiple logistic regression analyses were used to assess associations between physical activity and the predictor variables during pregnancy. Adjusted odds ratios with 95% confidence interval were applied to estimate factors associated with physical activity levels. Statistical significance was set at $p < 0.05$. Only 278 of the women (25.7%) met recommendations for prenatal activity (≥150 min moderate intensity exercise per week). The average time spent in moderate–vigorous physical activity was 151.6 min (95% CI: 147.2–156.0). Most of the women participated in light exercises with a mean of 65.9% (95% CI: 64.8–67.0), and 47.6% (95% CI: 46.3–48.9) participated in household activities. The majority of the women did not receive physical activity advice during prenatal care sessions (64.7%). Factors negatively associated with prenatal physical activity were lower age (<19 years) (adjusted odd ratio (AOR) = 0.3; CI: 0.16–0.76), semi-urban residence (AOR = 0.8; CI: 0.55–1.03), lower educational level (AOR = 0.5; CI: 0.20–0.71), unemployment (AOR = 0.5; CI: 0.29–0.77) and nulliparity (AOR = 0.6; CI: 0.28–1.31). However, prenatal physical activity was positively associated with starting physical activity in the first trimester (AOR = 1.9; CI: 1.06–3.31) compared to other trimesters. The findings of this study demonstrated low levels of physical activity during pregnancy in South Africa. The majority of women did not meet the recommendation of 150 min of moderate intensity activity per week. Light intensity and household activities were the most preferred form of activity. The factors affecting physical activity of women in this present study include lower age, semi-urban setting, low educational level, unemployment and nulliparity. In order to increase activity levels, future work should seek to improve knowledge, access and support for physical activity in pregnant women in South Africa. This should include education and advocacy regarding physical activity for professionals involved in maternal health provision.

Keywords: physical activity; pregnancy; determinants; South Africa

1. Introduction

The physical and psychological benefits of participation in regular physical activity during pregnancy are incontestably widely reported in the literature; they are also known to improve maternal health. As such,

specialised bodies and institutions such as the American College of Obstetricians and Gynaecologists (ACOG) [1], the U.S. Department of Health and Human Services (US DHHS) [2], World Health Organization (WHO) [3], the Joint Canadian Society for Exercise Physiology (CSEP)/Society of Obstetricians and Gynaecologists of Canada (SOGC) [4], Royal Australian and New Zealand College of Obstetrics and Gynaecology (RANZCOG) [5], International Olympic Committee (IOC) [6], Department of Health & Social Care, UK [7], Sports Medicine Australia [8], and the American College of Sports Medicine (ACSM) [9] recommend and encourage women, without contraindication, to engage in moderate-intensity exercise for 150 min per week. Scientific evidence has proven the risks of physical activity during pregnancy are rare [1]. However, the rate of prenatal activity is reportedly low, both in developed [10–12] and developing countries [13–18]. Put differently, few women meet the authoritative guidelines of physical activity during pregnancy, perhaps, due to varying factors.

The reasons for participation in physical activity during pregnancy are multifactorial, linked to demographics, perceived risk, and obstetric care advice. For instance, studies have found older, married [13,19], lower socioeconomic status and with multiple children [16], low educational level [14], and higher income [14,20] women are less likely to be active during pregnancy. Maternal or clinical demographic variables positively associated with physical activity in pregnancy include parity [16,21], history of miscarriage [21,22], nausea [15], habitual exercise before pregnancy [23], and a higher body mass index (BMI) [24]. Despite no scientific evidence associated with adverse outcomes (e.g., preterm birth, low birth weight, miscarriage and perinatal mortality) during or following prenatal physical activity [25–28], seemingly, some pregnant women and obstetric care providers still hold doubts concerning the safety of prenatal physical activity. These findings from the literature suggest participation in physical activity during pregnancy is an interplay of multiple factors operating at different levels of the dichotomous pregnancy spectrum.

The reasons for non-participation and types of prenatal activity varied across studies and different geographical settings. Therefore, understanding the factors influencing physical activity participation in pregnancy is important to guide physical activity intervention programmes. However, unlike in other continents or regions, few data exist on prenatal physical activity in Africa, and more specifically, in South Africa. Relatedly, studies assessing the prevalence and factors associated with physical activity in South Africa have largely focused on specific subpopulations, such as children [29–32], rural populations [32,33], health professionals [34,35], and Black women [33,36], whilst few studies [37–40] are on a special population of pregnant women, with unique pregnancy-related physical, physiological, and psychosocial characteristics. Of the few studies, none utilise large samples, with heterogeneous populations, and these studies were confined to only two provinces. Notably, there have been hardly any studies undertaken to assess the level, types and intensity, and correlates of physical activity among pregnant women in the Eastern Cape Province, South Africa. This study was designed to assess the prevalence of physical activity among pregnant women attending primary health centres in Buffalo City Municipality, Eastern Cape, South Africa, and the associated factors of physical activity during pregnancy.

2. Methods

2.1. Study Design, Setting, and Participants

This was a cross-sectional descriptive study conducted among pregnant women in 12 primary health centres in Buffalo City Municipality, in the Eastern Cape Province, South Africa. Buffalo City Municipality is situated on the East Coast of the Eastern Cape Province. The details of the study setting have been described in a recent publication [41]. Briefly, the municipality is economically, one of the poorest provinces among the nine provinces in South Africa. The Buffalo City Metropolitan Municipality accounts for a total population of 884,000, or 12.2% of the total population in the Eastern Cape Province. In total, 460,000 (51.99%) of the total population are females and 424,000 (48.01%) males [42]. Buffalo City Municipality has two provincial Hospitals (Frere and Cecilia Makhiwane

We solicited participants' participation on these different activities, and the type, intensity, duration and frequency of physical activity recorded as hours and minutes per day. To maximise the accuracy and ensure completeness of information, the PPAQ was interviewer-administered to the participants at 12 selected primary health centres during their antenatal visit and took approximately 20 to 25 min. The Metabolic Equivalent Task (MET) of each activity was categorised as sedentary (<1.5 METs), low or light (1.5– ≤3.0 METs), moderate (3.0–6.0 METs), and vigorous intensity (>6.0 METs) [45].

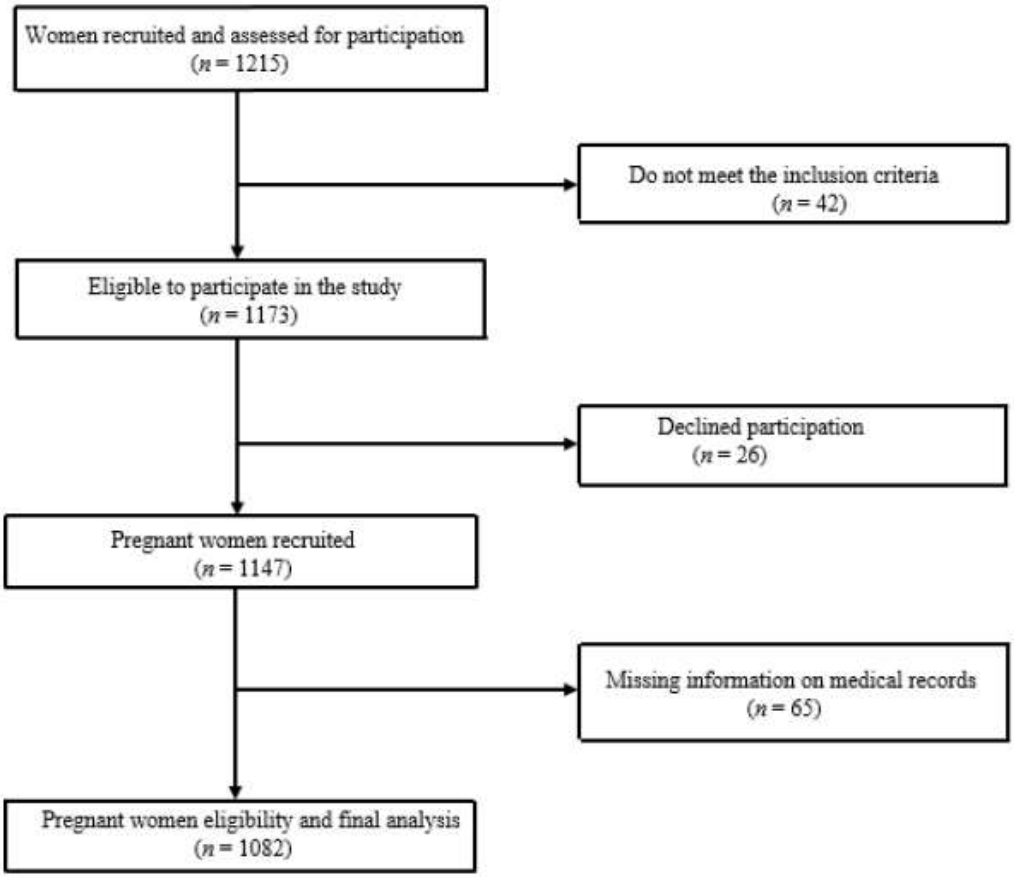


Figure 1. Flow diagram of sample selection and participation.

2.6. Covariates and Other Measurements

We developed a structured questionnaire to solicit information on socio-demographic, obstetrics and lifestyle behaviours of the participants. As with the PPAQ, this aspect of the questionnaire was interviewer-administered to obtain information on age, residence, ethnicity, marital status, level of education, employment status, religion, family support, and behavioural and lifestyle characteristics, which include, current exposure to alcohol and smoking. We categorised women as 'smokers', if they reported smoking any number of cigarettes during pregnancy, 'non-smokers' (reported not smoking), 'drinkers', as those who reported any use of alcohol during pregnancy, and 'non-drinkers' (reported no-drinking). Other information included whether participants had had antepartum haemorrhage in their first trimester, perceived health condition in pregnancy (women were asked how they perceive their general health: very good, good, or bad), whether participants received prenatal physical activity advice from health professionals, and had engaged in physical activity before and during pregnancy.

We obtained information on parity, mode of pregnancy delivery, and pregravid body mass index from the antenatal records of the participants.

hospitals), and two district hospitals (Bhisho and Grey hospitals). There are five community health centres, 72 primary health clinics, and 12 mobile health services [42]. In addition, all the community health centres and primary health clinics offer antenatal healthcare services freely to all pregnant women regardless of their geographical residence, ethnic, and socio-economic background. The community and primary health facilities deliver antenatal care services every working day. Personal communication with a health facility manager revealed that, on average, the clinics register 5–6 new pregnant women who visit the primary health centres per day. Therefore, annually, an estimated 17,000 pregnant women visit the 12 selected primary health clinics for antenatal services.

2.2. Sample Size Determination and Sampling Procedure

We applied the Sarmah et al. [43] formulae for an infinite population to calculate the sample size at a confidence level of 95%, with the precision level of ±3%, and at a prevalence of physical activity or exercise during pregnancy of 50% ($p = 0.5$) as follows:

$p = 0.5$ and hence $q = 1 - 0.5 = 0.5$; $e = 0.03$; $z = 1.96$

So, $n_0 = \frac{(1.96)2\ (0.5)(0.5)}{(0.3)2} = 1067 = 1067.$

However, adding 10% non-response, the final sample size was 1215 women, to account for possible attrition and to protect against possible data loss.

We applied a two-stage sampling technique to select pregnant women, regardless of the gestation period. Firstly, using a simple random procedure, 12 antenatal primary health centres were selected to participate in the study and, secondly, participants who meet the inclusion criteria were conveniently selected because of cost and easy accessibility, since the study was conducted at the health facilities. Pregnant women were included in the study if 18 years or older, receiving antenatal care, having a single pregnancy (not multiple ones), and could read or understand the IsiXhosa, Afrikaans or English languages. Women with disabilities or reasons to cease exercise at the time of recruitment, such as "persistent excessive shortness of breath that does not resolve on rest, severe chest pain, regular and painful uterine contractions, vaginal bleeding, persistent loss of fluid from the vagina indicating rupture of the membranes, and persistent dizziness or faintness that does not resolve on rest" [44], were excluded. Detailed information about the recruitment of the participants is shown in Figure 1.

2.3. Ethics

The University of Fort Hare Health Research Ethics Committee approved the study protocol (Ref#2019 = 06 = 009 = OkaforUB). In addition, permission was obtained from the Eastern Cape Department of Health and all the selected health facilities. Informed consent was obtained from the pregnant women prior to data collection.

2.4. Data Collection

Data collection was conducted between July to October 2019. To ensure the required sample size, data collection was carried out at each antenatal health clinic on pre-specified days, in a designated room allocated to the primary researcher by the health facility manager. All eligible pregnant women attending their antenatal care visits at selected health facilities during the study period were randomly approached to participate in the study, after signing an informed consent form.

2.5. Main Outcome Measure: Physical Activity

The Pregnant Physical Activity Questionnaire (PPAQ) [45] was used to assess the level, type and intensity of prenatal activity. The primary outcome measure was active and inactive participation of pregnant women in physical activity during pregnancy. The PPAQ is a validated and reliable tool, widely used across countries to measure prenatal physical activity [45–47]. The PPAQ is comprised of 32 physical activities, which include household and care-giving (13 activities), occupational (five activities), sports and exercise (eight activities), transportation (three activities), and inactivity (three activities).

We adopted the Institute of Medicine (IOM) recommended BMI cut-off values to classify underweight (<18.5 kg/m^2), normal weight (18.5–24.9 kg/m^2), overweight (25.0–29.9 kg/m^2), and obese (>30.0 kg/m^2) [48].

2.7. Data Analysis

Descriptive statistics, including mean and standard deviation (SD), median and inter-quartile range (IQR) or as proportions was applied. The Centers for Disease Control and Prevention (CDC) recommendations was used to classify women as 'inactive' (reporting 0–149 min of exercise per week), and 'active' (reported 150 min or more of physical activity) based on the combined moderate–vigorous minutes per week [49]. We applied bivariate and multivariate analyses to assess the factors affecting physical activity behaviour during pregnancy. The Chi-square was used to determine the associations between the physical activity levels and socio-demographic, lifestyle and obstetric characteristics. All the covariates associated with physical activity (that is, age, area of residence, marital status, educational level, employment status, parity, family support, mode of pregnancy delivery, antepartum haemorrhage, pre-pregnancy BMI, employment status, lifestyle behaviours, and physical activity before and during pregnancy) were included in the models. The odds ratio (OR) and corresponding confidence interval (CI) of 95% were calculated. A multiple logistic regression, using automatic variable selection procedure was applied to determine the factors that predict physical activity levels. Automatic variable selection procedures are statistical tools for choosing the best subset of predictor variables for a given response variable. The significance level was set at $p = 0.05$. The Statistical Package for Social Sciences (SPSS) (Version 24.0, IBM SPSS, Chicago, IL, USA) was used to perform all statistical analyses.

3. Results

3.1. Socio-Demographic, Obstetrics and Lifestyle Characteristics of Participants

Of the 1215 pregnant women recruited, 42 participants did not meet the eligibility criteria, 26 declined to participate, and 65 had incomplete information on medical records data so were excluded. Finally, 1082 participants were included in the analysis.

The mean age of study participants was 27.0 ± 6.2 years. The majority of the participants were aged 19–34 years (812; 75.1%), residing in an urban setting (48.3%), black (86.4%), never married (66.3%), and had attained Grade 7–12 educational (74.2%). In addition, the majority of the participants were unemployed (67.7%), Christian (89.1) and received family support (77.4%) (Table 1).

Table 1. Socio-demographic, obstetrics and lifestyle characteristics of participants.

Variables	Frequency	Percentage
Age (years)		
<19	118	10.9
19–34	812	75.1
>34	152	14.0
Residential area		
Rural	118	10.9
Semi-urban	441	40.8
Urban	523	48.3
Race		
Black	935	86.4
Coloured	147	13.6
Marital status		
Married	236	21.8
Never married	717	66.3
Cohabiting	129	11.9

Table 1. *Cont.*

Variables	Frequency	Percentage
Educational level		
Primary	84	7.8
Secondary	803	74.2
Tertiary	195	18.0
Employment status		
Unemployed	733	67.7
Employed	349	32.3
Religion		
Christian	964	89.1
Other	118	10.9
Family support		
Adequate	837	77.4
Moderate	223	20.6
No support	22	2.0
Parity		
Nulliparous	517	47.8
Primiparous	322	29.8
Multiparous	243	22.4
Delivery mode		
Vaginal	457	42.2
Caesarean section	87	8.1
Both	538	49.7
Antepartum haemorrhage		
Yes	69	6.4
No	1013	93.6
Perceived health condition		
Very Good	440	40.7
Good	631	58.3
Bad	11	1.0
Smoking status		
Yes	90	8.3
No	992	91.7
Alcohol use		
Yes	147	13.6
No	935	86.4
Pregravid body mass index (kg/m^2)		
Underweight (<18.5)	22	2.0
Normal weight (18.5–24.9)	917	84.8
Overweight (25.0–29.9)	143	13.2
Planned pregnancy		
Yes	351	32.4
No	731	67.6
Physical activity advice		
Yes	382	35.3
No	700	64.7
Physical activity before pregnancy		
Yes	378	34.9
No	704	65.1
Physical activity timing		
1st trimester	188	17.4
2nd trimester	114	10.5
3rd trimester	27	2.5
Never	753	69.6

Concerning the maternal-obstetric and lifestyle characteristics, most of the participants were nulliparous (47.8%), had no antepartum haemorrhage (93.6%); and had vaginal (42.2%) and both

vaginal and Caesarean section (49.7%) deliveries. The majority of the participants perceived their health as being in good condition (59.3%); an overwhelming majority had no chronic illness (93.5%), did not smoke (91.7%), nor drink alcohol (86.4%), and had normal pregravid BMI (84.8%). Of the 1082 women, 731 (67.7%) affirmed their pregnancy was not planned. The majority of the women had not received physical activity advice (700; 64.7%). In addition, 704 (65.1%) did not participate in physical activity before pregnancy, and the majority of the women (753; 69.6%) never participated in physical activity in any of the trimesters.

3.2. Physical Type and Intensity Levels

The women's physical activities were compared according to type and intensity of exercise (Table 2). Descriptive analysis of physical activity scores, as derived from the PPAQ scoring regarding the level of physical activity, showed the average time spent in moderate–vigorous physical activity was 151.6 min (95% CI: 147.2–156.0). The majority of the women did not engage in moderate–vigorous intensity physical activity (i.e., sport/exercise score from PPAQ), but were physically active in light activities including household/caregiving, occupational and transportation activities.

Table 2. Physical activity levels during pregnancy (minutes).

Activity Category	Mean	LCL	UCL	Minimum	Quartile 1	Median	Quartile 3	Maximum
Total energy expenditure	151.6	147.2	156.0	22.3	100.0	138.9	191.1	546.2
Total light	128.7	124.3	133.1	8.2	74.2	114.0	166.3	541.8
Subdivision by intensity								
Sedentary	22.9	21.9	24.0	0.0	7.4	18.9	31.9	88.2
Light	99.6	96.5	102.7	7.1	61.3	89.6	131.8	314.5
Moderate	28.3	25.9	30.7	0.0	2.5	12.2	37.6	378.0
Vigorous	0.8	0.6	1.0	0.0	0.0	0.0	0.8	40.5
Subdivision by type of activity								
Household/caregiving	73.8	70.6	77.0	0.0	35.0	65.3	92.8	413.0
Occupational	25.1	23.2	27.1	0.0	1.8	10.5	44.8	308.0
Sport/exercise	2.6	2.3	2.9	0.0	0.0	0.8	3.2	65.7
Transportation	23.1	21.5	24.6	0.0	3.4	14.0	35.0	157.5
Inactivity	27.0	25.8	28.2	0.0	14.0	18.9	41.5	98.0

LCL = Lower confidence level; UCL = Upper confidence level.

Likewise, Table 3 presents the summary of the contribution of each physical activity level to the total score. The results show that, on average, light physical activity contributed most to the total activity. The participants rarely performed vigorous-intensity activities. Besides levels of activity, the contribution was also determined according to type of physical activity, namely, household, occupational, sport/exercise and transportation. Household activity contributed most to the total activity followed by occupational and transportation, while sport/exercise had the lowest contribution level. The rest is accounted for by physical inactivity.

Table 3. Contribution of each type activity to the total activity score.

Activity Category	Mean	LCL	UCL	Minimum	Quartile 1	Median	Quartile 3	Maximum
Subdivision by intensity								
Light	65.9	64.8	67.0	8.5	53.1	65.9	80.2	100.0
Moderate	15.8	14.8	16.7	0.0	1.6	10.9	27.0	74.2
Vigorous	0.5	0.4	0.6	0.0	0.0	0.0	0.4	19.9
Subdivision by type of activity								
Household/caregiving	47.6	46.3	48.9	0.0	31.0	47.3	63.7	97.7
Occupational	16.0	15.0	17.0	0.0	1.2	9.2	28.5	78.7
Sport/exercise	1.7	1.5	1.9	0.0	0.0	0.6	2.1	31.2
Transportation	14.0	13.2	14.8	0.0	3.3	10.2	20.9	77.9
Inactivity	20.8	19.8	21.7	0.0	8.0	17.4	30.5	98.0

LCL = Lower confidence level; UCL = Upper confidence level.

3.3. Level of Physical Activity

Shown in Table 4 is the multivariate logistics regression analysis showing sociodemographic correlates of physical activity during pregnancy. The prevalence of moderate-intensity physical activity was 25.7% (278 out of 1082). The odds of exercise among women under 19 years of age was significantly lower than the odds of exercise among the over 34 years age group. Women aged 20–34 years were significantly less likely to exercise compared to women over 34 years age (Crude Odds Ratio (COR) = 0.1; CI: 0.07–0.21). Pregnant women who resided in semi-urban (COR = 0.5; CI: 0.41.0–0.69), were black (COR = 1.9; CI: 1.34–2.83), and married (COR = 2.5; CI: 1.63–3.81) were significantly more likely to be physically active. Unemployed women (COR = 0.3; CI: 0.26–0.45) had smaller odds of participating in physical activity during pregnancy.

Table 4. Multivariate logistics regression model of physical activity on sociodemographic characteristics.

Variables	Total (n = 1082)	Active (n = 278)	Inactive (n = 804)	COR (95% CI)	AOR (95% CI)
	n (%)	n (%)	n (%)		
Age (years)					
<19	118 (10.9)	14 (11.9)	104 (88.1)	0.1 (0.07–0.21) *	0.3 (0.16–0.76) *
19–34	812 (75.1)	168 (20.7)	644 (79.3)	0.3 (0.22–0.42) *	0.9 (0.57–1.40)
>34	152 (14.0)	96 (63.2)	56 (36.8)	1	
Residential area					
Rural	118 (10.9)	60 (50.8)	58 (49.2)	1.4 (0.97–1.88)	1.2 (0.78–2.00)
Semi-urban	441 (40.8)	111 (25.2)	330 (74.8)	0.5 (0.41–0.69) *	0.8 (0.55–1.03) *
Urban	523 (48.3)	107 (20.5)	416 (79.5)	1	
Race					
Black	935 (86.4)	233 (24.9)	702 (75.1)	1.9 (1.34–2.83) *	1.2 (0.71–2.12)
Other	147 (13.6)	45 (30.6)	102 (69.4)	1	
Marital status					
Married	236 (21.8)	75 (31.8)	161 (68.2)	2.5 (1.63–3.81) *	1.4 (0.84–2.49)
Never married	717 (66.3)	160 (22.3)	557 (77.7)	1.0 (0.74–1.38)	1.3 (0.79–2.12)
Cohabiting	129 (11.9)	43 (33.3)	86 (66.7)	1	
Educational level					
Primary	84 (7.8)	29 (34.5)	55 (65.5)	0.5 (0.28–0.72) *	0.4 (0.20–0.71) *
Secondary	803 (74.2)	181 (22.5)	622 (77.5)	0.4 (0.31–0.57) *	0.7 (0.45–0.95) *
Tertiary	195 (18.0)	68 (34.9)	127 (65.1)	1	
Unemployment status					
Unemployed	733 (67.7)	171 (23.3)	562 (76.7)	0.3 (0.26–0.45) *	0.5 (0.29–0.77) *
Employed	349 (32.3)	107 (30.7)	242 (69.3)	1	
Religion					
Christian	964 (89.1)	234 (24.3)	730 (75.7)	1.4 (0.93–2.04)	0.9 (0.53–1.39)
Other	118 (10.9)	44 (37.3)	74 (62.7)	1	
Family support					
Adequate	837 (77.4)	212 (25.3)	625 (74.7)	0.4 (0.28–0.59) *	1.0 (0.37–2.71)
Moderate	223 (20.6)	57 (25.6)	166 (74.4)	0.2 (0.09–0.28) *	0.7 (0.25–1.92)
No support	22 (2.0)	9 (40.9)	13 (59.1)	1	

COR = Crude Odds Ratio, AOR = Adjusted Odds Ratio, CI = Confidence Interval; * Statistically significant.

The obstetric and lifestyle correlates of physical activity during pregnancy (Table 5) indicate that nulliparous women who had vaginal and caesarean section, planned pregnancy, physical activity advice, physical activity before pregnancy, and practiced physical activity during first and second trimester, were significantly more likely to be active in moderate-intensity activity during pregnancy.

Table 5. Multivariate logistics regression model of physical activity on obstetric and lifestyle characteristics.

Variables	Total (n = 1082)	Active (n = 278)	Inactive (n = 804)	COR (95% CI)	AOR (95% CI)
	n (%)	n (%)	n (%)		
Parity					
Nulliparous	517 (47.8)	98 (19.0)	419 (81.0)	0.3 (0.24–0.44) *	0.6 (0.28–1.31) *
Primiparous	322 (29.8)	102 (37.3)	220 (68.3)	0.8 (0.54–1.06)	0.7 (0.45–1.03)
Multiparous	243 (22.4)	78 (32.1)	165 (67.9)	1	
Previous mode of delivery					
Vaginal	457 (42.2)	127 (27.8)	330 (72.2)	2.4 (1.89–3.16) *	1.7 (0.86–3.54)
Caesarean section	87 (8.1)	52 (59.8)	35 (40.2)	3.3 (2.31–4.69) *	1.7 (0.72–3.82)
Both	538 (49.7)	99 (18.4)	439 (81.6)	1	
Antepartum haemorrhage					
Yes	69 (6.4)	33 (47.8)	36 (52.2)	1.2 (0.72–1.91)	1.2 (0.66–2.05)
No	1013 (93.6)	245 (24.2)	768 (75.8)	1	
Perceived health condition					
Very Good	440 (40.7)	87 (19.8)	353 (80.2)	0.3 (0.21–0.48) *	0.2 (0.05–0.91)
Good	631 (58.3)	185 (29.3)	446 (70.7)	0.6 (0.39–0.81) *	0.4 (0.09–1.63)
Bad	11 (1.0)	6 (54.6)	5 (45.4)	1	
Chronic illness					
Yes	70 (6.5)	35 (50.0)	35 (50.0)	1.3 (0.79–2.09)	1.0 (0.54–1.68)
No	1012 (93.5)	243 (24.0)	769 (76.0)	1	
Smoking status					
Yes	90 (8.3)	26 (28.9)	64 (71.1)	0.5 (0.3–0.79) *	1.1 (0.55–2.14)
No	992 (91.7)	252 (25.4)	740 (74.6)	1	
Alcohol use					
Yes	147 (13.6)	48 (32.6)	99 (67.4)	0.6 (0.39–0.82) *	0.8 (0.53–1.27)
No	935 (86.4)	230 (24.6)	705 (75.4)	1	
Pregravid body mass index (kg/m^2)					
Underweight (<18.5)	22 (2.0)	4 (18.2)	18 (81.8)	0.1 (0.05–0.35) *	0.2 (1.07–1.11)
Normal weight (18.5–24.9)	917 (84.8)	200 (21.8)	717 (78.2)	0.9 (0.62–1.14)	0.9 (0.69–1.34)
Overweight (25.0–29.9)	143 (13.2)	74 (51.7)	69 (48.3)	1	
Planned pregnancy					
Yes	351 (32.4)	101 (28.8)	250 (71.2)	1.9 (1.48–2.47) *	1.2 (0.81–1.64)
No	731 (67.6)	177 (24.2)	554 (75.8)		
Physical activity advice					
Yes	382 (35.3)	116 (30.4)	266 (69.6)	2.1 (1.66–2.76) *	1.3 (0.92–1.72)
No	700 (64.7)	162 (23.1)	538 (76.9)	1	
Physical activity before pregnancy					
Yes	378 (34.9)	123 (32.5)	255 (67.5)	2.7 (2.1–3.51) *	1.3 (0.77–2.05)
No	704 (65.1)	155 (22.0)	549 (78.0)	1	
Physical activity gestational period					
1st trimester	188 (17.4)	62 (33.0)	126 (67.0)	3.2 (2.34–4.47) *	1.9 (1.06–3.31) *
2nd trimester	114 (10.5)	45 (39.5)	69 (60.5)	3.0 (2.03–4.37) *	2.0 (1.10–3.70) *
3rd trimester	27 (10.5)	15 (55.6)	12 (44.4)	1.3 (0.79–2.07)	1.0 (0.38–2.57)
Never	753 (69.6)	156 (20.7)	597 (79.3)	1	

COR = Crude Odds Ratio, AOR = Adjusted Odds Ratio, CI = Confidence Interval; * Statistically significant.

In order to determine the best fitting model, an automatic variable selection procedure was used. Automatic variable selection procedures are statistical tools for choosing the best subset of predictor variables for a given response variable. The estimated logistic regression model identified age, residential area, education, employment status, parity and timing of exercise as significant predictors of physical activity during pregnancy (Tables 4 and 5). The effects of these variables on physical activity indicated that women <19 years (AOR = 0.3; CI: 0.16–0.76), from a semi-urban area (AOR = 0.8; CI: 0.55–1.03), with primary level education (AOR = 0.5; CI: 0.20–0.71), unemployed (AOR = 0.5; CI: 0.29–0.77) and nulliparous (AOR = 0.6; CI: 0.28–1.31) were significantly less likely to participate in physical activity during pregnancy compared to older women, those from urban and rural areas,

with at least a secondary school education, employed and who were primiparous or multiparous, respectively. Conversely, women who started physical activity in their first trimester (AOR = 1.9; CI: 1.06–3.31) were significantly more likely to be physically active during pregnancy compared to women commencing physical activity in the second trimester. All other variables such as race, marital status, religion, family support, previous mode of delivery, antepartum haemorrhage, smoking and consuming alcohol during pregnancy, pregravid body mass index (kg/m^2), physical activity advice and physical activity before pregnancy were not associated with physical activity during pregnancy.

4. Discussion

To our knowledge, this is the first study to determine the prevalence of leisure-time physical activity participation during pregnancy and associated factors among pregnant women in the Eastern Cape Province of South Africa. Exploring the socio-demographic, behavioural, maternal and clinical factors affecting prenatal physical activity in this setting, where no previous information exist, might help in formulating policies that are key to improving maternal prenatal healthcare to this special population. From a clinical and health standpoint, physical activity participation during pregnancy confers many benefits and should be promoted, encouraged and sustained during, and even beyond pregnancy to avoid sedentary—and obesity—associated risks [16]. The interplay of socio-demographic, behavioural, maternal and clinical factors affecting physical activity during pregnancy warrant contextual understanding of the dimensionality of the factors at play to detect possible deficits and inform context-specific interventions. Contextual knowledge of factors influencing prenatal activity is a key component of the provision of quality antenatal and obstetric healthcare services for pregnant women. The findings of this study show few (25.7%) women engage in moderate-intensity physical activity. Conversely, 74.3% women do not meet the international physical activity recommendation of 150 min per week during pregnancy. The factors driving prenatal physical activity varies from one geographic setting to another.

A comparison of the rates of physical activity participation during pregnancy in this study with rates of physical activity in South Africa indicates a lower physical activity rate of 17.0% in Gauteng [39], whilst in Western province it was reported 44% and 12% women participated in light physical activity and moderate physical activity, respectively [40]. In the Watson longitudinal study of pregnant women in Gauteng province, 50.6% women were inactive in the second trimester and their physical activity decreased as pregnancy progressed [17]. Expectedly, it is thought that pregnant women in Africa and other low-income settings would exhibit relatively high physical activity, presumably because of the traditional gender-household role prescription for women, where women are to perform virtually all the household activities; however, this seems not be the case in our results. Notably, the low prenatal activity observed among women in this current study resonates with the global physical inactivity reported among pregnant women in both developed and developing countries. In addition, low prenatal physical activity have been reported in Nigeria (13.6%, 10.2%) [18,46], Ethiopia (21.9%, 8.4%) [13,21], Norway (14.6%) [50], China (11.1%) [23], and Brazil (20.1%) [16]. The lesser participation of women in moderate-intensity physical activity during pregnancy in this present study reflects the pattern of prenatal physical activity reported in low-income countries. Some studies have shown that low resources and lack of social support affect the level of physical activity practice among pregnant women in South Africa [37,40]. Clearly, the majority of the women (67.7%) in our study were unemployed, however received social support, but engage less in moderate-intensity physical activities. The issues of non-availability of facilities, resources, and lack of knowledge on physical activity and advice from healthcare providers are possible reasons for this low participation in moderate-intensity physical activity during pregnancy among women in this study. About 64.7% of the women reported receiving no physical activity advice from the healthcare providers. In addition, the wave of industrialisation and modernisation taking place in South Africa, particularly in urban areas, could serve as facilitators of physical inactivity. This partly explains the results of our finding. Since the post-apartheid era, the lifestyle behaviour of most South Africans has changed dramatically

as a result of the effects of modernisation and urbanisation which promote physical inactivity and associated health risks. Generally, there is low physical activity participation among the South African populations. The South Africa National Health and Nutrition Examination Survey reported that 46% of South Africans are physically inactive [51], and pregnant women are most at high risk of being inactive and sedentary [17].

From the clinical and public health perspective, there is a need to formulate policies and programmes regarding physical activity participation during pregnancy. In the South African context, a plausible strategy to promote women's awareness and knowledge on prenatal physical activity during pregnancy, and further encourage them to increase leisure-time physical activity, and engage in moderate-intensity physical activities is to utilise and promote the Ward-Based Outreach Teams in the community or women's groups to promote awareness regarding the health benefits of physical activity on maternal health. This is particularly very relevant and important because the Ward-Based Outreach Teams primary focus is to promote community health by providing door-to-door health screening services and to sensitise or create awareness on various health issues in the community and schools. Community beliefs could have considerable influence on physical activity during pregnancy; therefore, efforts to enhance leisure-time, and moderate-intensity physical activity during pregnancy should be intensified. Healthcare providers (nurses, midwives, gynaecologists, physicians) should encourage women to practice moderate physical activity during pregnancy, also reinforcing the contribution of maintaining daily activities to maternal health. Pregnancy is a phase in which women are willing to alter their lifestyle behaviour, if motivated to do so.

The finding of this study shows that household activities contributed most to the total activity performed by the women. The most activities performed were of light intensity, as only a few of the pregnant women participate in moderate-to-vigorous intensity physical activity. This finding mirrors an earlier nationally representative population-based survey of 26,339 individuals, in which less than half of South Africans were moderately or vigorously physically active [52]. Our finding is consistent with other previous studies in South Africa [17,39], which reported 76.9% and 80.0% prevalence rates of household chores and walking, respectively. Similarly, household and occupational activities were reported as the most preferred physical activity performed by women during pregnancy in China [53,54], Ethiopia [13,21], Taiwan [55], Nigeria [56], Portugal [57], Serbia [14], and Brazil [16]. Pregnant women often state that family and household obligations or fear of injuries prevent them from initiating and participating in physical activity [58]; as such, it is possible that most of the pregnant women will feel more comfortable and safer doing household activities than engaging in occupational or sporting activities during pregnancy [21]. This perhaps explains the reason for the highest amount of energy being expended on household, occupational and transportation activities among pregnant women currently. In a previous study of pregnant women in South Africa, women considered physical activity as an activity of daily living, such as occupational and household tasks. They, however, perceived certain occupational, household and recreational tasks as too vigorous and consequently unsafe; the safety or otherwise of vigorous activity during pregnancy was informed by advice from family and friends, or listening to their own bodies [37]. It might be possible that the women lack access, education and support for other physical activities, which explains why majority of the women are engaged in household activities. There is need for context-specific interventions to educate and encourage pregnant women to participate in moderate-intensity physical activity to achieve optimal maternal health outcomes.

The advocacy philosophy imbibed by the UK guidelines with a dictum 'every activity counts' emphasising the need for inactive pregnant women to make an effort to accumulate physical activity throughout the week [59], is something to learn from and apply in the South African context. In this regard, periodic workshops on prenatal physical activity, involving a multidisciplinary team (exercise physiologists, physiotherapists, gynaecologists, obstetricians) to provide talks on the importance of engaging in, and types of moderate-intensity activities for their health and the baby is advocated. Another possible intervention strategy is to involve other exercise specialists such as

exercise physiologists, physiotherapists and biokineticists (who practice exclusively in South Africa) to provide prenatal physical activity programmes, and social support within the community. By way of definition, biokineticists are exercise therapists that prescribe individualised exercise and physical activity for rehabilitation and promotion of health and quality of life [60]. In addition, utilising mHealth technology—MomConnect to promote awareness on prenatal physical activity and to encourage women to participate actively in household physical activities during pregnancy is a feasible option in South African context. The 'MomConnect' is a phone-based technological maternal health programme by the South African National Department of Health to support and encourage women to maintain and live healthy lifestyles during and after pregnancy, as well promote child health. The 'MomConnect' health promotion messages are freely available to the user. Research on exploring contextually relevant interventions to encourage pregnant women to increase leisure-time physical activity and promote moderate-intensity activities during pregnancy in this setting is desirable.

In the estimated multivariate logistic regression model, women whose age was <19 years (AOR = 0.3; CI: 0.16–0.76) were less likely to be actively engage in moderate physical activity during pregnancy compared to women 19–34 years. Conversely, in Hailemariam et al. [13] study in Ethiopia it was reported that women who were 26–35 years were 2.69 times more likely to be sedentary (AOR: 2.69, 95% CI: 1.07–6.78) compared with those in the age category of 16–25 years. Similar studies have reported age as a predictor of prenatal active practice [21,61].

Strangely, the finding of this study show that women residing in a semi-urban area (AOR = 0.8; CI: 0.55–1.03) are significantly less likely to engage in moderate physical activity compared to those who are in urban and rural settings. A recent study in Poland indicated that more pregnant women in urban than in rural areas performed physical activity during pregnancy [62]. The place of residence may have a relative influence on the extent of physical activity during pregnancy, based on safety issues, information, and infrastructural opportunities. However, these variables are out of the scope of the paper. Research exploring the factors influencing physical activity and place of residence during pregnancy would provide an insight on how best to tailor interventions to address environmental and cultural variables operating at the spectrum of prenatal activity promotion.

In this study, women with a low level of education were less likely to engage in moderate physical activity during pregnancy compared to women with a secondary level of education. This finding is similar to studies conducted in Ethiopia [13,21], Brazil [16], Serbia [14], Netherlands [63], and Nigeria [46]. In contrast, other studies found positive associations between high educational and physical activity levels [64–67]. We recognised lower levels of education in the present study. The majority of the participants have completed secondary education or have less than secondary level education (74.2%). This suggests that women with higher educational levels are better informed or have more access to knowledge about physical activity during pregnancy [21,23]. Women with lower education should be well-informed with the benefits of physical activity, and prenatal healthcare programmes should focus on prenatal physical activity to encourage women to engage in moderate-intensity physical activity for better maternal and foetal health outcomes. Providing such information to women during antenatal visits might change their attitude to prenatal physical activity and motivate them to, at least, participate in household physical activities. Women should be provided with pamphlets and possibly DVD's that contain information on prenatal physical activities, and posters displayed at the antenatal clinics, as these will help create awareness on prenatal physical activity. We postulate that non-formal prenatal physical activity advice that may be provided to the women at the antenatal clinics in South Africa may not be sufficient, lacking in content, because not all health providers possess adequate scientific knowledge on prenatal physical activity. Therefore, adopting a systematic or formalized clinic-based prenatal physical activity intervention guide is advocated and, in this context, the training of health providers on the types, intensity, duration and physical activity recommendations during pregnancy is important, in order to bridge their knowledge gap on the subject matter.

Our findings demonstrated that being unemployed was significantly associated with a lower likelihood of prenatal physical activity compared with those who are employed. Maternal employment influences physical activity participation during pregnancy. In this study, consistent with studies conducted in Ethiopia [13], Nigeria [46] and Netherlands [63], unemployed women were more likely to be physically active than employed women. It is plausible that unemployed women have enough time to stay at home, not having the economic power to hire a domestic helper; therefore, they themselves then perform most of the household/caring activities. This is not surprising because most of the women in this present study participate in light intensity and household activities. A combination of a lower education level and household income, in this case, unemployment, entails less chance of engagement in leisure-time physical activity because the women may be lacking the social and environmental resources and information as impetus to initiate and practice physical activity [68,69]. Therefore, addressing the social and environmental factors affecting their prenatal physical activity practice would help facilitate other efforts to encourage women to participate in prenatal physical activity of moderate-intensity to improve their health and that of the unborn baby.

Our study indicated that nulliparous women are significantly less likely to be physically active during pregnancy compared to those who are primiparous or multiparous, respectively. Similar to other studies, multiparous women exhibit more physical activeness than their nulliparous peers [13,70,71], whilst previous studies have found no statistically significant association between parity and physical activity during pregnancy [72,73]. In this regard, childcare interventions are necessary to encourage women to engage in physical activity together with their children to promote the uptake of moderate-intensity physical activity during pregnancy.

However, our finding demonstrated from the predictive model that pregnant women who commence physical activity in the first trimester are significantly more likely to be physically active during pregnancy compared to those who start later than the second trimester. This is concordant with a study in Poland [61], and USA [15] which found the odds of meeting physical activity recommendations, including both moderate and vigorous activities, to be higher among women in the first trimester compared to the third trimester. However, our finding is inconsistent with the findings from other previous studies, which indicated that women in the third trimester were more likely to meet the physical activity guideline compared to those in the first trimester [17,54,65,74,75]. Although the present study did not probe for the cessation of physical activity, notably, the decrease in physical activity in the second and the third trimesters of pregnancy can be attributed to women's mood changes and the unborn baby's foetal growth, which result in weight gain and discomforts such as fatigue, back pain, and sleeplessness [76,77]. Women should be encouraged to engage and sustain their prenatal activity throughout pregnancy, and beyond. This is particularly important and relevant to women with no pregnancy complications and contraindications; pregnant women, therefore, should be advised to undertake moderate-intensity physical activity, accumulating at least 150 min per week, as stipulated by international bodies.

5. Implications

Our findings have emphasised the need to tailor health promotion interventions in the promotion of moderate-intensity physical activity in the antenatal healthcare as part of the primary healthcare agenda. Healthcare providers should regard physical activity as a prescription, rather than an option to be observed. The findings highlight several factors associated with low level of prenatal physical activity among pregnant women in this setting, which call for a context-specific and multidisciplinary approach to the promotion of prenatal activity, particularly focusing on household and moderate-intensity activities. Understandably, the demographic correlates of prenatal physical activity provide useful information on the variables affecting prenatal physical activity; such information is relevant to inform interventions and to identify those who need intervention. For example, as in this case, interventions focusing on women with a low level of education and without employment are imperative. Stakeholders, such as the Eastern Cape Department of Health, research organizations, local NGOs working with

pregnant women, and faith-based organisations or societies should provide relevant and appropriate strategies that include educational interventions to address barriers to moderate physical activity during pregnancy. Notably, programs or pamphlets, posters showing information and instructions on physical activity during pregnancy are absent in the routine of the pregnant population in South Africa. As such, it is desirable that health policy makers, health providers, and stakeholders working with pregnant population prioritise physical activity for all pregnant women.

6. Limitations

One obvious limitation of the study is the use of a self-reported questionnaire, which could have inherent bias in the manner of responses, and the PPAQ questionnaire was not validated locally against objective methods; as such, we cannot draw conclusion on its measurement properties (reliability, criterion validity, construct validity, responsiveness) in the South African context. Therefore, future studies on the validity of the PPAQ in this population are warranted, and studies using objective measure, such as an accelerometer to evaluate physical activity during pregnancy. Furthermore, the PPAQ is reported to have insufficient construct validity in assessing total and vigorous physical activity scores in pregnancy, however, with low-to-moderate quality evidence [78]. In addition, the participants were pregnant women attending public health facilities in Buffalo City Municipality of the Eastern Cape; as such, this limited the generalisability of the findings to the entire Eastern Cape Province. Despite these limitations, our study provides useful information for future comparative studies on the factors, types and intensity of physical activity participation during pregnancy in the Eastern Cape Province of South Africa. We believe such information would be relevant in shaping maternal health interventions in the context of promotion of leisure-time physical activity, at least in this setting. Again, the prospective evaluation of physical activity using the PPAQ, a simple and short, reliable and valid tool, which has been used in several countries [47,79–84], and the large sample of pregnant women serve as unique strengths of the study. To the best of the author's knowledge, previous studies examining physical activity during pregnancy in South Africa have not utilised such a large population as ours. In addition, contrary to other previous published studies, our study involved all racial groups in the South African context with varying sociodemographic characteristics.

7. Conclusions

The findings of this study demonstrated low participation of women in moderate-intensity physical activity during pregnancy. The majority of the women did not meet the 150 min per week recommendations. Light intensity and household activities were the predominant forms of physical activity among pregnant women. The factors affecting physical activity of women in this present study included age, residential area, lower educational level, unemployment, nulliparity and trimester timing of exercise as significant predictors of physical activity during pregnancy. There exists a need to provide basic education to mothers, and a general advocacy campaign on the health benefits of moderate-intensity physical activity during pregnancy for optimal participation in prenatal activity should also be launched.

Author Contributions: Conceptualization and drafting of manuscript, U.B.O. and D.T.G. Data collection, U.B.O. Review and editing, D.T.G. Supervision, D.T.G. All authors have read and agreed to the published version of the manuscript.

Funding: UBO received a Doctoral Research Grant from National Research Foundation of South Africa.

Acknowledgments: This work is based on the research supported wholly by the National Research Foundation of South Africa. We thank the participants for participating in the study; the Eastern Cape Department of Heath for granting permission to conduct the study in selected health facilities in Buffalo City Metro Municipality District; and the Research Assistants for their assistance in data collection.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. American College of Obstetricians and Gynaecologists. Physical Activity and Exercise During Pregnancy and the Postpartum Period: ACOG Committee Opinion, Number 804. *Obstet. Gynaecol.* **2020**, *135*, e178–e188. [CrossRef] [PubMed]
2. U.S. Department of Health and Human Services. *Physical Activity Guidelines for Americans*; U.S. Department of Health and Human Services: Washington, DC, USA, 2018.
3. World Health Organization. WHO Homepage. Available online: www.who.int (accessed on 16 December 2019).
4. Mottola, M.F.; Davenport, M.H.; Ruchat, S.M.; Davies, G.A.; Poitras, V.; Gray, C.; Jaramillo Garcia, A.; Barrowman, N.; Adamo, K.B.; Duggan, M.; et al. No. 367-2019 Canadian Guideline for Physical Activity throughout Pregnancy. *J. Obstet Gynaecol Can.* **2018**, *40*, 1528–1537. [CrossRef] [PubMed]
5. The Royal Australian New Zealand College of Obstetricians and Gynaecologists (RANZCOG). Exercise during Pregnancy. 2016. Available online: https://ranzcog.edu.au/womens-health/patient-information-resources/exercise-during-pregnancy (accessed on 17 October 2020).
6. Bø, K.; Artal, R.; Barakat, R.; Brown, W.J.; Davies, G.A.L.; Dooley, M.; Evenson, K.R.; Haakstad, L.A.H.; Kayser, B.; Kinnunen, T.I.; et al. Exercise and pregnancy in recreational and elite athletes: 2016/2017 evidence summary from the IOC expert group meeting, Lausanne. Part 5. Recommendations for health professionals and active women. *Br. J. Sports Med.* **2018**, *52*, 1080–1085. [CrossRef] [PubMed]
7. Department of Health & Social Care. UK Chief Medical Officer's physical activity guidelines. 2019. Available online: https://assestts.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/832868/ukchief-medical-officersphysical-activity-guidelines.pdf (accessed on 17 October 2020).
8. Sports Medicine Australia. Sports Medicine Australia statement: The benefits and risks of exercise during pregnancy. *J. Sci. Med. Sport* **2002**, *5*, 11–19. [CrossRef]
9. Pescatello, L.S.; Arena, R.; Riebe, D.; Thompson, P.D. *ACSM's Guidelines for Exercise Testing and Prescription*, 9th ed.; American College of Sports Medicine: Baltimore, MD, USA, 2014; ISBN 9781609136055.
10. Di Fabio, D.R.; Blomme, C.K.; Smith, K.M.; Welk, G.J.; Campbell, C.G. Adherence to physical activity guidelines in mid-pregnancy does not reduce sedentary time: An observational study. *Int. J. Behav. Nutr. Phys. Act.* **2015**, *12*, 27. [CrossRef]
11. Bauer, C.; Graf, C.; Platschek, A.M.; Struder, H.K.; Ferrari, N. Reasons, motivational factors, and perceived personal barriers to engagement in physical activity during pregnancy vary within the BMI classes: The Prenatal Prevention Project Germany. *J. Phys. Act. Health* **2018**, *15*, 204–211. [CrossRef] [PubMed]
12. Schmidt, T.; Heilmann, T.; Savelsberg, L.; Maass, N.; Weisser, B.; Eckmann-Scholz, C. Physical exercise during pregnancy—How active are pregnant women in Germany and how well informed? *Geburtshilfe Frauenheilkd* **2017**, *77*, 508–515. [CrossRef]
13. Hailemariam, T.T.; Gebregiorgis, Y.S.; Gebremeskel, B.F.; Haile, T.G.; Spitznagle, T.M. Physical activity and associated factors among pregnant women in Ethiopia: Facility-based cross-sectional study. *BMC Preg. Childbirth* **2020**, *20*, 92. [CrossRef]
14. Todorovic, J.; Terzic-Supic, Z.; Bjegovic-Mikanovic, V.; Piperac, P.; Dugalic, S.; Gojnic-Dugalic, M. Factors associated with the leisure-time physical activity (LTPA) during the first trimester of the pregnancy: The cross-sectional study among pregnant women in Serbia. *Int. J. Environ. Res. Public Health* **2020**, *17*, 1366. [CrossRef]
15. Padmapriya, N.; Shen, L.; Soh, S.E.; Shen, Z.; Kwek, K.; Godfrey, K.M.; Gluckman, P.D.; Chong, Y.S.; Saw, S.M.; Müller-Riemenschneide, F. Physical activity and sedentary behaviour patterns before and during pregnancy in a multi-ethnic sample of Asian women in Singapore. *Matern. Child. Health J.* **2015**, *19*, 2523–2535. [CrossRef]
16. Nascimento, S.L.; Surita, F.G.; Godoy, A.C.; Kasawara, K.T.; Morais, S.S. Physical activity patterns and factors related to exercise during pregnancy: A cross sectional study. *PLoS ONE* **2015**, *10*, e0128953.
17. Watson, E.D.; Van Poppel, M.N.M.; Jones, R.A.; Norris, S.A.; Micklesfield, L.K. Are South African mothers moving? Patterns and correlates of physical activity and sedentary behaviour in pregnant black South African women. *J. Phys. Act. Health* **2017**, *14*, 329–335. [CrossRef] [PubMed]
18. Lawan, A.; Awotidebe, A.W.; Oyeyemi, A.L.; Rufa, A.A.; Oyeyemi, A.Y. Relationship between physical activity and health related quality of life among pregnant women. *Afr. J. Reprod. Health* **2018**, *22*, 80–89. [PubMed]

19. Zhang, J.; Savitz, D.A. Exercise during pregnancy among US women. *Ann. Epidemiol.* **1996**, *6*, 53–59. [CrossRef]
20. Domingues, M.; Santos, I.; Matijasevich, A.; Horta, B.L.; Hallal, P.C.; Coll, C. Changes in Leisure-Time Physical Activity from the Prepregnancy to the Postpartum Period: 2004 Pelotas (Brazil) Birth Cohort Study. *J. Phys. Act. Health* **2016**, *13*, 361–365.
21. Gebregziabher, D.; Berhe, H.; Kassa, M.; Berhanie, E. Level of physical activity and associated factors during pregnancy among women who gave birth in Public Zonal Hospitals of Tigray. *BMC Res. Notes* **2019**, *12*, 454. [CrossRef]
22. Put, W.M.; Chuang, S.; Chan, L.; Lin-Wai, C. Physical activity in pregnancy: Attitudes and practices of Hong Kong Chinese women. *Hong Kong J. Gynaecol. Obstet. Midwifery* **2015**, *15*, 38–147.
23. Zhang, Y.; Dong, S.; Zuo, J.; Hu, X.; Zhang, H.; Zhao, Y. Physical activity level of urban pregnant women in Tianjin, China: A cross-sectional study. *PLoS ONE* **2014**, *9*, e109624. [CrossRef]
24. Bacchi, E.; Bonin, C.; Zanolin, M.E.; Zambotti, F.; Livornese, D.; Donic, S.; Bonora, E.; Baldisser, G.; Ihnatava, T.; Di Sarra, D.; et al. Physical activity patterns in normal-weight and overweight/obese pregnant women. *PLoS ONE* **2016**, *11*, e0166254. [CrossRef]
25. Coll, C.V.; Domingues, M.R.; Gonçalves, H.; Bertoldi, A.D. Perceived barriers to leisure-time physical activity during pregnancy: A literature review of quantitative and qualitative evidence. *J. Sci. Med. Sport* **2017**, *20*, 17–25. [CrossRef]
26. Davenport, M.H.; Ruchat, S.M.; Poitras, V.J.; Jaramillo Garcia, A.; Gray, C.E.; Barrowman, N.; Skow, R.J.; Meah, V.L.; Riske, L.; Sobierajski, F.; et al. Prenatal exercise for the prevention of gestational diabetes mellitus and hypertensive disorders of pregnancy: A systematic review and meta-analysis. *Br. J. Sports Med.* **2018**, *52*, 1367–1375. [CrossRef] [PubMed]
27. Davenport, M.H.; Ruchat, S.M.; Sobierajski, F.; Poitras, V.J.; Gray, C.E.; Yoo, C.; Skow, R.J.; Jaramillo Garcia, A.; Barrowman, N.; Meah, V.L.; et al. Impact of prenatal exercise on maternal harms, labour and delivery outcomes: A systematic review and meta-analysis. *Br. J. Sports Med.* **2019**, *53*, 99–107. [CrossRef]
28. Davenport, M.H.; Kathol, A.J.; Mottola, M.F.; Skow, R.J.; Meah, V.L.; Poitras, V.J.; Jaramillo Garcia, A.; Gray, C.E.; Barrowman, N.; Riske, L.; et al. Prenatal exercise is not associated with fetal mortality: A systematic review and meta-analysis. *Br. J. Sports Med.* **2019**, *53*, 108–115. [CrossRef]
29. Micklesfield, L.K.; Pedro, T.M.; Kahn, K.; Kinsman, J.; Pettifor, J.M.; Tollman, S.; Norris, S.A. Physical activity and sedentary behaviour among adolescents in rural South Africa: Levels, patterns and correlates. *BMC Public Health* **2014**, *14*, 40. [CrossRef]
30. Van Biljon, A.; McKune, A.J.; DuBose, K.D.; Kolanisi, U.; Semple, S.J. Physical activity levels in urban-based South African learners: A cross-sectional study of 7348 participants. *South. Afr. Med. J.* **2018**, *108*, 126–131. [CrossRef]
31. Seme, Z.; de Villiers, A.; Steyn, N.P.; Senekal, M. Food choices, physical activity levels and other factors associated with weight gain in primary school educators. *J. Con. Sci.* **2017**, *2*. [CrossRef]
32. Tomaz, S.A.; Jones, R.A.; Hinkley, T.; Twine, R.; Kahn, K.; Norris, S.A.; Draper, C.E. Physical activity in early childhood education and care settings in a low-income, rural South African community: An observational study. *Rural Remote Health* **2019**, *19*, 5249. [CrossRef]
33. Oyeyemi, A.L.; Moss, S.J.; Monyeki, M.A.; Kruge, H.S. Measurement of physical activity in urban and rural South African adults: A comparison of two self-report methods. *BMC Public Health* **2016**, *16*, 1004. [CrossRef]
34. Kunene, S.H.; Taukobong, N.P. Level of physical activity of health professionals in a district hospital in KwaZulu-Natal, South Africa. *South. Afr. J. Physiother.* **2015**, *71*, 234. [CrossRef] [PubMed]
35. Skaal, L. Factors influencing health workers' participation in physical activity in one public hospital in South Africa: Do health workers have barriers to exercise? *Afr. J. Phy. Health Edu. Recreat. Dance* **2011**, *17*, 813–823.
36. Dickie, K.; Micklesfield, L.K.; Chantler, S.; Lambert, E.V.; Goedecke, J.H. Cardiorespiratory fitness and light-intensity physical activity are independently associated with reduced cardiovascular diseases risk in urban black South Africa women: A cross-sectional study. *Metabol. Syndr. Relat. Disord.* **2016**, *14*, 23–32. [CrossRef] [PubMed]
37. Watson, E.D.; Norris, S.A.; Draper, C.E.; Jones, R.A.; van Poppel, M.N.M.; Micklesfield, L.K. "Just because you're pregnant, doesn't mean you're sick!" A qualitative study of beliefs regarding physical activity in black South African women. *BMC Preg. Childbirth* **2016**, *16*, 174. [CrossRef] [PubMed]

38. Watson, E.D.; Brage, S.; White, T.; Westgate, K.; Norris, S.A.; Van Poppel, M.N.M.; Micklesfield, L.K. The influence of objectively measured physical activity during pregnancy on maternal and birth outcomes in urban black South African women. *Matern. Child. Health J.* **2018**, *22*, 1190–1199. [CrossRef]
39. Brunette, E.L.; Kotze, J.; Wood, P.S.; Du Toit, P.J.; Grant, C.C. An epidemiological study of physical activity patterns and weight gain in physically active and sedentary pregnant women in Tshwane, South Africa. *Afr. J. Phy. Health Edu. Recreat. Dance* **2012**, *18* (Suppl. S1), 132–143.
40. Muzigaba, M.; Kolbe-Alexander, T.L.; Wong, F. The perceived role and influencers of physical activity among pregnant women from low socioeconomic status communities in South Africa. *J. Phys. Act. Health* **2014**, *11*, 1276–1283. [CrossRef]
41. Okafor, U.B.; Goon, D.T. Developing a physical activity intervention strategy for pregnant women in Buffalo City Municipality, South Africa: A study protocol. *Int. J. Environ. Res. Public Health* **2020**, *17*, 6694. [CrossRef]
42. Eastern Cape Socio Economic Consultative Council. Buffalo City Metro Municipality Socio Economic Review and Outlook. 2020. Available online: https://www.ecsecc.org/documentrepository/informationcentre/buffalo-city-metro-municipality_44557.pdf (accessed on 14 September 2020).
43. Sarmah, H.K.; Hazarika, B.B.; Choudhury, G. An investigation on effect of bais on determination of sample size on the basis of data related to the students of schools of Guwahati. *Int. J. Appl. Math. Stat. Sci.* **2013**, *2*, 33–48.
44. Mottola, M.F.; Davenport, M.H.; Ruchat, S.; Davies, G.A.; Poitras, V.J.; Gray, C.E.; Jaramillo Garcia, A.; Barrowman, N.; Adamo, K.B.; Duggan, M.; et al. 2019 Canadian guideline for physical activity throughout pregnancy. *Br. J. Sport Med.* **2018**, *40*, 1339–1346. [CrossRef]
45. Chasan-Taber, L.; Schmidt, M.D.; Roberts, D.E.; Hosmer, D.; Markenson, G.; Freedson, P.S. Development and validation of a Pregnancy Physical Activity Questionnaire. *Med. Sci. Sports Exerc.* **2004**, *36*, 1750–1760. [CrossRef]
46. Adeniyi, A.F.; Ogwumike, O.O.; Osinike, C.I. Physical activity and energy expenditure: Findings from the Ibadan pregnant women's survey. *Afr. J. Reprod. Health* **2014**, *18*, 117–126.
47. Chandonnet, N.; Saey, D.; Almeras, N.; Marc, I. French Pregnancy Physical Activity Questionnaire compared with an accelerometer cut point to classify physical activity among pregnant obese women. *PLoS ONE* **2012**, *7*, e38818. [CrossRef] [PubMed]
48. Institute of Medicine and National Research Council. *Weight Gain during Pregnancy: Reexamining the Guidelines*; The National Academies Press: Washington, DC, USA, 2009.
49. Centers for Disease Control and Prevention. Healthy Pregnant or Postpartum Women. 2015. Available online: https://www.cdc.gov/physicalactivity/basics/pregnancy/index.htm (accessed on 10 September 2020).
50. Gjestland, K.; Bo, K.; Owe, K.M.; Eberhard-Gran, M. Do pregnant women follow exercise guidelines? Prevalence data among 3482 women, and prediction of low-back pain, pelvic girdle pain and depression. *Br. J. Sports Med.* **2012**, *47*, 515–520. [CrossRef] [PubMed]
51. Shisana, O.; Labadarios, D.; Rehle, T.; Simbayi, L.; Zuma, K.; Dhansay, A.; Reddy, P.; Parker, W.; Hoosain, E.; Naidoo, P.; et al. *South African National Health and Nutrition Examination Survey (SANHANES-1)*; HSRC Press: Cape Town, South Africa, 2013.
52. Mlangeni, L.; Makola, L.; Naidoo, I.; Chibi, B.; Sokhela, Z.; Silimfe, Z.M.; Mabaso, M. Factors associated with physical activity in South Africa: Evidence from a National Population Based Survey. *Open J. Public Health* **2018**, *11*, 516–525. [CrossRef]
53. Yin, Y.; Huang, Y.; Liu, X.; Luo, B. Assessment of physical activity status among pregnant women in southwestern China. *Front. Nurs.* **2019**, *6*, 135–141. [CrossRef]
54. Xiang, M.; Zhang, J.; Liang, H.; Zhang, Z.; Konishi, M.; Hu, H.; Nishimak, M.; Kim, H.; Tabata, H.; Shimizu, H.; et al. Physical activity and dietary intake among Chinese pregnant women: An observational study. *BMC Preg. Childbirth* **2019**, *19*, 295. [CrossRef] [PubMed]
55. Lee, C.F.; Chiang, I.C.; Lin, S.S.; Lin, H.M.; Hsu, C.J. Physical activity pattern and related factors among women during pregnancy. *Formos. J. Med.* **2012**, *16*, 103–111.
56. Mbada, C.E.; Adebayo, O.E.; Adeyemi, A.B.; Arije, O.O.; Dada, O.O.; Akinwande, O.A.; Awotidebe, T.O.; Alonge, I.B. Knowledge and attitude of Nigerian pregnant women towards antenatal exercise: A cross sectional survey. *Obstet. Gynecol.* **2014**, *1*, 8. [CrossRef]

57. Santos, P.C.; Abreu, S.; Moreira, C.; Santos, R.; Ferreira, M.; Alves, O.; Moreira, P.; Mota, J. Physical activity patterns during pregnancy in a sample of Portuguese women: A longitudinal prospective study. *Iran. Red Crescent Med. J.* **2016**, *18*, e22455. [CrossRef]
58. Marshall, E.S.; Bland, H.; Melton, B. Perceived barriers to physical activity among pregnant women living in a rural community. *Public Health Nurs.* **2012**, *30*, 361–369. [CrossRef]
59. Smith, R.; Reid, H.; Matthews, A.; Calderwood, C.; Knight, M.; Foster, C. Infographic: Physical activity for pregnant women. *Br. J. Sports Med.* **2018**, *52*, 532–533. [CrossRef]
60. Ellapen, T.J.; Strydom, G.L.; Swanwpoel, H.H.M.; Hammill, H.; Paul, Y. Biokineticist's: A South African Health Profession evolving from Physical Education and Sport. In *Sport and Exercise Science*; Merc, M., Ed.; InTech Open: London, UK, 2018; Available online: https://www.intechopen.com/books/sport-and-exercise-science (accessed on 16 July 2020).
61. Antosiak-Cyrak, K.Z.; Demuth, A. A study of physical activity levels of pregnant women using the Polish version of Pregnancy Physical Activity Questionnaire (PPAQ-Pl). *Ginekol. Pol.* **2019**, *90*, 250–255. [CrossRef]
62. Szubert, M.; Ilowiecka, M.; Wilczynski, J.; Bilinski, P.; Wojtyla, C. Health-related behaviors of pregnant women residing in urban and rural areas in Poland. *Int. J. Environ. Res. Public Health* **2020**, *17*, 4395. [CrossRef] [PubMed]
63. Merkx, A.; Ausems, M.; de Vries, R.; Nieuwenhuijze, M.J. Factors affecting perceived change in physical activity in pregnancy. *Midwifery* **2017**, *51*, 16–23. [CrossRef] [PubMed]
64. Sytsma, T.T.; Zimmerman, K.P.; Manning, J.B.; Jenkins, S.M.; Nelson, N.C.; Clark, M.M.; Boldt, K.; Borowski, K.S. Perceived Barriers to Exercise in the First Trimester of Pregnancy. *J. Perinat. Educ.* **2018**, *27*, 198–206. [CrossRef]
65. Da Silva, S.G.; Ricardo, L.I.; Evenson, K.R.; Hallal, P.C. Leisure time physical activity in pregnancy and maternal-child health: A systematic review and meta-analysis of randomized controlled trials and cohort studies. *Sports Med.* **2017**, *47*, 295–317. [CrossRef]
66. Mendinueta, A.; Esnal, H.; Arrieta, H.; Arrue, M.; Urbieta, N.; Ubillos, I.; Whitworth, K.W.; Delclòs-Alió, X.; Vich, G.; Ibarluzea, J. What accounts for physical activity during pregnancy? A study on the sociodemographic predictors of self-reported and objectively assessed physical activity during the 1st and 2nd trimesters of pregnancy. *Int. J. Environ. Res. Public Health* **2020**, *17*, 2517. [CrossRef] [PubMed]
67. Lindqvist, M.; Lindqvist, M.; Eurenius, E.; Persson, M.; Ivarsson, A.; Mogren, I. Leisure time physical activity among pregnant women and its associations with maternal characteristics and pregnancy outcomes. *Sex. Reprod. Healthc. J.* **2016**, *9*, 14–20. [CrossRef]
68. Sales-da-costa, R.; Werneck, G.L.; Lopes, C.S.; Faerstein, E. Associação entre fatores sócio-demográficos e prática de atividade física de lazer no Estudo Pró-Saúde. *Cad. Saude Publica* **2003**, *19*, 1095–1105. [CrossRef]
69. Cerin, E.; Leslie, E. How socio-economic status contributes to participation in leisure-time physical activity. *Soc. Sci Med.* **2008**, *66*, 2596–2609. [CrossRef]
70. Lee, C.F.; Hwang, F.M.; Lin, H.M.; Chi, L.K.; Chien, L.Y. The physical activity patterns of pregnant Taiwanese Women. *J. Nurs. Res.* **2016**, *24*, 291–299. [CrossRef]
71. Lynch, K.E.; Landsbaugh, J.R.; Whitcomb, B.W.; Pekow, P.; Markenson, G.; Chasan-Taber, L. Physical activity of pregnant Hispanic women. *Am. J. Prev. Med.* **2012**, *43*, 434–439. [CrossRef]
72. Evenson, K.R.; Savitz, D.A.; Huston, S.L. Leisure-time physical activity among pregnant women in the US. *Paediatr. Perinat. Epidemiol.* **2004**, *18*, 400–407. [CrossRef] [PubMed]
73. Chasan-Taber, L.; Schmidt, M.D.; Pekow, P.; Sternfeld, B.; Manson, J.A.; Markenson, G. Correlates of physical activity in pregnancy among Latina women. *Matern. Child. Health J.* **2007**, *11*, 353–363. [CrossRef] [PubMed]
74. De Haas, S.; Ghossein-Doha, C.; Van Kuijk, S.M.J.; Van Drongelen, J.; Spaanderman, M.E.A. Physiological adaptation of maternal plasma volume during pregnancy: A systematic review and meta-analysis. *Ultrasound Obstet. Gynecol.* **2017**, *49*, 177–187. [CrossRef] [PubMed]
75. De Vargas Nunes Coll, C.; Domingues, M.R.; Hallal, P.C.; da Silva, I.C.M.; Bassani, D.G.; Matijasevich, A.; Barros, A.; Santos, I.S.; Bertoldi, A.D. Changes in leisure-time physical activity among Brazilian pregnant women: Comparison between two birth cohort studies (2004–2015). *BMC Public Health* **2017**, *17*, 119.
76. Evenson, K.R.; Moos, M.K.; Carrier, K.; Siega-Riz, A.M. Perceived barriers to physical activity among pregnant women. *Matern. Child. Health J.* **2009**, *13*, 364–375. [CrossRef]
77. Cramp, A.G.; Bray, S.R. A prospective examination of exercise and barrier self-efficacy to engage in leisure-time physical activity during pregnancy. *Ann. Behav. Med.* **2009**, *37*, 325–334. [CrossRef]

78. Sattler, M.C.; Jaunig, J.; Watson, E.D.; Van Poppel, M.N.M.; Mokkink, L.B.; Terwee, C.B.; Dietz, P. Physical Activity Questionnaire for Pregnancy: A Systematic Review of Measurement Properties. *Sports Med.* **2018**, *48*, 2317–2346. [CrossRef]
79. Adanaş, A.G.; Taşan, H.A.; Tarhan, N.; Çakar, E.; Şenol, G.N.; Ankaralı, H.; Tandoğan, B. Reliability and validity of Turkish version of pregnancy physical activity questionnaire (PPAQ) in patients with gestational diabetes mellitus. *J. Obstet. Gynaecol.* **2020**, *40*, 176–181. [CrossRef]
80. Çırak, Y.; Yılmaz, G.D.; Demir, Y.P.; Dalkılınç, M.; Yaman, S. Pregnancy physical activity questionnaire (PPAQ): Reliability and validity of Turkish version. *J. Phys. Ther. Sci.* **2015**, *27*, 3703–3709. [CrossRef]
81. Krzepota, J.; Sadowska, D.; Sempolska, K.; Pelczar, M. Measuring physical activity during pregnancy—Cultural adaptation of the Pregnancy Physical Activity Questionnaire (PPAQ) and assessment of its reliability in Polish conditions. *Ann. Agric. Environ. Med.* **2017**, *23*, 640–643. [CrossRef] [PubMed]
82. Suliga, E.; Sobaś, K.; Król, G. Validation of the Pregnancy Physical Activity Questionnaire (PPAQ). *Med. Stud. Stud. Med.* **2017**, *33*, 40–45. [CrossRef]
83. Xiang, M.; Konishi, M.; Hu, H.; Takahashi, M.; Fan, W.; Nishimaki, M.; Ando, K.; Kim, H.K.; Tabata, H.; Arao, T.; et al. Reliability and Validity of a Chinese-Translated Version of a Pregnancy Physical Activity Questionnaire. *Matern. Child. Health J.* **2016**, *20*, 1940–1947. [CrossRef] [PubMed]
84. Han, J.-W.; Kang, J.-S.; Lee, H. Validity and Reliability of the Korean Version of the Pregnancy Physical Activity Questionnaire. *Int. J. Environ. Res. Public Health* **2020**, *17*, 5873. [CrossRef] [PubMed]

CHAPTER FIVE

PHYSICAL ACTIVITY IN PREGNANCY: BELIEFS, BENEFITS AND INFORMATION SEEKING PRACTICES OF PREGNANT WOMEN IN SOUTH AFRICA

5.1 INTRODUCTION

The article presented in this chapter responded to specific objective two, and examined the reasons beliefs, perceived benefits and sources of information on prenatal physical activity among women in attending health facilities in the Eastern Cape.

Unlike previously, scientific evidence has shown that prenatal physical practice confers numerous benefits to the mother and the child. Therefore, there is a clarion call from various institutional bodies for women to participate in physical activity during pregnancy. Despite the many advantages accruable from prenatal physical activity, seemingly, distorted beliefs and information about physical activity in pregnancy constitute a barrier to prenatal physical activity to some women. Understanding the beliefs, perceived benefits and sources of information about prenatal physical activity among pregnant women in the region may inform context-specific interventions to promote prenatal physical activity practice. This kind of information is lacking in South Africa.

5.2 PUBLICATIONS DETAILS

Title:	Physical activity in pregnancy: Beliefs, benefits, and information-seeking practices of pregnant women in South Africa
Authors:	UB Okafor, DT Goon
Ethics:	University of Fort Hare Health Research Ethics Committee approved the study protocol (Ref#2019 = 06 = 009 = OkaforUB)
Journal:	Journal of Multidisciplinary Healthcare
Journal details:	Peer-reviewed (blinded) Journal approved and listed on the Department of Higher Education and Training (DHET)
Status:	Published: Okafor UB, Goon DT. Physical activity in pregnancy: Beliefs, benefits and information seeking practices of pregnant women in South Africa. *Journal of Multidisciplinary Healthcare*, 2021. https://doi.org/10.2147/JMDH.S287109
Impact Factor	2.404

5.3 PUBLICATION RECORD

The article was submitted to the journal on 17 October 2020, and it was accepted on 20 November 2020 and published on 9 April 2021.

Journal of Multidisciplinary Healthcare

Dovepress
open access to scientific and medical research

Open Access Full Text Article

ORIGINAL RESEARCH

Physical Activity in Pregnancy: Beliefs, Benefits, and Information-Seeking Practices of Pregnant Women in South Africa

This article was published in the following Dove Press journal:
Journal of Multidisciplinary Healthcare

Uchenna Benedine Okafor [1]
Daniel Ter Goon [2]

[1]Department of Nursing Science, University of Fort Hare, East London, South Africa; [2]Department of Public Health, University of Fort Hare, East London, South Africa

Background: Notwithstanding the benefits of physical activity (PA) during pregnancy, anecdotal evidence suggests ignorance, unscientific beliefs, and lack of awareness about PA among pregnant South African women.

Aim: This study examined the beliefs, perceived benefits, and sources of information on PA during pregnancy.

Methods: A cross-sectional descriptive study was employed between June and September 2019 using an interviewer-administered questionnaire with 1,082 pregnant women. These women were attending antenatal primary health–care clinics in Buffalo City, Eastern Cape, South Africa. A self-designed questionnaire solicited information on beliefs, benefits, and sources of information regarding PA during pregnancy.

Results: A majority of the participants held positive beliefs concerning PA during pregnancy. They maintained that PA was safe for mother and fetus, improved labor and delivery (93.1%), promoted energy (89.0%), and should be discontinued when tired (76.6%). Most held negative convictions that PA during pregnancy increased body temperature (64.5%) and that pregnancy was a time to rest and refrain from PA (56.5%). Predominantl sources of information received about PA during pregnancy were television, the radio, and other media (70.2%). Most participants were aware of the benefits of PA during pregnancy —— reduction in infant weight (61.4%), lessening of moodiness (90.4), and decreased risk of gestational diabetes mellitus (92.9%), pregnancy-induced hypertension (92.5%), and complications at birth (97.8%), while common negative perceptions included musculoskeletal discomfort (82.7%), and back pain (85.7%). An overwhelming majority affirmed that PA improved self-image (95.7%), sleep patterns (94.2%), and respiratory function (95.8%).

Conclusion: Our findings suggested that women hold positive beliefs and perceive PA as beneficial to their health and the baby; however, they received most of their information from the Internet. Most women regarded pregnancy as a period to relax and rest. Interventions to promote PA during pregnancy are needed.

Keywords: physical activity, beliefs, perceived benefits, sources of information, pregnancy

Introduction

Historically, physical activity participation in pregnant women was frowned upon and discouraged. However, scientific evidence has proven that physical activity in pregnancy is beneficial for the mother and her unborn child. Benefits include reduced risk of excessive gestational weight gain,[1–4] gestational diabetes,[1,5,6] and preeclampsia.[7–10] Physically active pregnant women have lower rates of preterm birth, altered fetal growth,[11,12] miscarriage,[13] prolonged cesarean section and

Correspondence: Uchenna Benedine Okafor
University of Fort Hare, East London, South Africa
Email ucheysonic@gmail.com

submit your manuscript | www.dovepress.com
DovePress
http://doi.org/10.2147/JMDH.S287109

postpartum recovery,[14–16] and risk of injury for both mother and baby.[2] These findings reflect a confirmation of the safety of prenatal physical activity and help to clarify beliefs and misconceptions held by some individuals that physical activity during pregnancy is harmful to the baby. Moreover, physical activity during pregnancy improves the sleep of the mother.[17,18] Other benefits include reduced length of labor, delivery complications,[19] birth weight,[12] fatigue, stress, anxiety, depression,[13,20–23] and low-back pain.[7,9,24] A recent study showed that physical activity during pregnancy was associated with improved breastfeeding outcomes.[25] With these benefits, the guidelines recommend that pregnant women engage in physical activity.[26] However, low prenatal physical activity is shaped by multiple factors at play insociocultural, economic, political, and environmental contexts in different settings across countries.

The literature abounds with the manifold benefits of prenatal physical activity for maternal and fetal health;[27] therefore, determining beliefs about prenatal physical activity will provide useful information to inform the development of successful and appropriate intervention strategies.[28] However, beliefs and attitudes of women toward prenatal physical activity varies among cultures,[29] and understanding these variations across different cultures and settings is important to tailor context-specific physical activity interventions to promote optimal physical activity participation during pregnancy. In addition, providing pregnant women with accurate and sufficient advice on the type and prescription of physical activity during pregnancy might influence their attitude in terms of initiating and engaging in physical activity. Uunderstanding where women get advice on physical activity during pregnancy and what advice they act upon is necessary for improving the health-care support already in place.[30] Physical activity plays a significant role in maternal health; therefore, creating awareness of its benefits and contraindications may change women's negative attitudes toward physical activity and promote it for better maternal outcomes, which might decrease the burden of preventable pregnancy-related conditions on the health-care system.[31]

There is a dearth of research on physical activity in pregnancy in South Africa. Specifically, research seeking to understand beliefs about, sources of information, and perceived benefits of physical activity during pregnancy is lacking. The only known study involved a small, homogeneous sample of urbanized black South African women and did not represent other races, cultures, or communities.[32] Therefore, the present study aimed to examine the beliefs about and perceived benefits of physical activity during pregnancy, and to identify sources of information on physical activity among a diverse pregnant South Africanwomen attending antenatal health facilities in Eastern Cape province.

Methods

Design and Setting

This cross-sectional study was conducted on 1,082 pregnant women from June to September 2019 at 12 randomly selected primary health–care clinics offering antenatal health services in Buffalo City, Eastern Cape province. Buffalo City is one of four municipalities within Eastern Cape, and is located on the east coast of the Province. It has a population of 884,000, with women constituting around 48.01%. Eastern Cape is economically one of the poorest provinces in South Africa.[33] The municipality has two provincial hospitals two district hospitals,five community health centers, 72 primary-health clinics, and 12 mobile health services.[33] Antenatal health-care services are free for all women attending the community health centers and primary-health clinics. On average, these health centers register five to six newly pregnant women per day. An estimated 17,000 pregnant women visit the 12 selected primary-health clinics for antenatal services annually. The 72 primary-health centers were numbered, and using random number–generator software 12 centers were selected.

Sample-Size Determination and Sampling Procedure

Sarmah et al[34] formule was applied to calculate the sample size at a confidence level of 95%±3%, and with physical activity or exercise participation during pregnancy of 50% (p=0.5)s:

p = 0.5, hence q = 1–0.5=0.5; e = 0.03, and z = 1.96,

$$\text{so } n_0 = \frac{(1.96)^2(0.5)(0.5)}{(0.3)^2} = 1067 = 1067$$

At a 10% nonresponse rate, the final sample size was 1,215 women, accounting for possible attrition and data loss.

Participants were convenience-selected by the principal investigator during antenatal visits. Eligibility criteria were age: 18 years or older, receiving antenatal care, single pregnancy (not multiple), and ability to read or understand Xhosa, Afrikaans, or English. Conversely, women with

disabilities or preexisting health conditions limiting prenatal activity at the time of recruitment or with one or more contraindications for physical activity (severe chest pain, persistent shortness of breath, and vaginal bleeding) were excluded. Participants were interviewed in a quiet room provided by the facility manager.

Data Collection

Data were collected using an interview-administered questionnaire between July and October 2019. The questionnaire was interview-administered in order to maximize accuracy and ensure completeness of information from the participants. It focused on socio-demographic, obstetric, maternal, and lifestyle characteristics. Demographic variables comprised age (<19, 19–34, >34 years), residence (rural, semiurban, urban), ethnicity (black, colored), marital status (married, single, cohabiting), education (primary, secondary, tertiary), employment status (unemployed, employed), religion (Christian, other), and family support (adequate, moderate, none). Behavioral and lifestyle characteristics included current exposure to alcohol and smoking. Women were categorized as smokers if smoking cigarettes during pregnancy and nonsmokers if not smoking. Women who reported any alcohol use during pregnancy were classified as drinkers, while 'nondrinkers' were women reporting no drinking. Information on parity (nulliparous, primiparous, multiparous), mode of delivery (vaginal, cesarean section or both), and pregravid body-mass index (low <19.8, normal (19.8–<26), overweight 26–<30) was obtained from antenatal medical records. In addition, we solicited information on antepartum hemorrhage in their first trimester, perceived health in pregnancy (very good, good, bad) presence of any chronic illness, prenatal physical activity advice received from health professionals, and whether they engaged in physical activity before pregnancy.

Outcome measures were beliefs, benefits, and information-seeking practices of pregnant women about physical activity and exercise during the pregnancy questionnaire, which was developed based on information in the literature.[35–37] Women completed the questionnaire while waiting for their antenatal appointments. The questionnaire contained 19 items on beliefs on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree), and the questionnaire onperceived benefits of physical activity during pregnancy contained 17 item statements on a 5-point Likert scale ranging from 1 (strongly disagree) to 4 (strongly agree). Finally, participants indicated sources of information (friends, family, other women, health professionals, social media, television, radio, books, newspapers, magazines, other) on physical activity during pregnancy with the response options "often, rarely, and never".

The content and face validity of the questionnaire was ascertained by two experts in the field and revisions made. In addition, it was pilot-tested with 20 pregnant women to establish whether the questions seemed clear and concise to the participants. Samples from the pilot study were excluded from the main study. Additional revisions pertaining to wording were made to ensure clarity. The estimated Cronbach's α was 0.69.

Data Analysis

Data were analyzed using descriptive statistics, ie, frequency and percentage. Statistical analysis was conducted using SPSS 23.0 for Windows.

Results

Participants' mean age was 27.0±6.2 years. A vast majority of women were aged 19–34 years (75.1%), living in an urban location (48.3%), black (86.4%), had never married (66.3%), with secondary education (74.2%), unemployed (67.7%), Christian (89.1%), and had family support (77.4%). Nulliparous women comprised 47.8% of participants, 93.6% had had antepartum hemorrhage, 42.% vaginal, and 49.7% both vaginal and Cesarean section deliveries, perceived their health as good (59.3%), had no chronic illness (93.5%), did not smoke (91.7%) or drink alcohol (86.4%), and had normal pregravid body-mass index (84.0%). A majority had not received any physical activity advice or counseling (65.1%) and never participated in physical activity (69.6%) during pregnancy (Table 1).

Physical Activity and Exercise Beliefs

Key beliefs of participants concerning physical activity during pregnancy are presented in Table 2. These were mostly positive. For instance, 77.6% of participants disagreed and strongly disagreed with the statement that physical activity was not safe for the mother or fetus, reduced placental circulation (66.7%), could lead to abortion or miscarriage, preterm birth, and intrauterine growth retardation (75.1%), and was harmful (64.9%). A majority affirmed pregnant women should not exercise while lying on their back (75.5%) and held the view that standing in one place for a long time without

Table 1 Sociodemographic, Obstetric, and Lifestyle Characteristics of Participants

	n (%)
Age (years)	
<19	118 (10.9)
19–34	812 (75.1)
>34	152 (14.0)
Residence	
Rural	118 (10.9)
Semiurban	441 (40.8)
Urban	523 (48.3)
Ethnicity	
Black	935 (86.4)
Colored	147 (13.6)
Marital status	
Married	236 (21.8)
Never married	717 (66.3)
Cohabiting	129 (11.9)
Education	
Primary	84 (7.8)
Secondary	803 (74.2)
Tertiary	195 (18.0)
Employment	
Unemployed	733 (67.7)
Employed	349 (32.3)
Religion	
Christian	964 (89.1)
Other	118 (10.9)
Family support	
Adequate	837 (77.4)
Moderate	223 (20.6)
None	22 (2.0)
Parity	
Nulliparous	517 (47.8)
Primiparous	322 (29.8)
Multiparous	243 (22.4)
Delivery mode	
Vaginal	457 (42.2)
Cesarean section	87 (8.1)
Both	538 (49.7)
Antepartum hemorrhage	
Yes	69 (6.4)
No	1013 (93.6)
Perceived health	
Very good	440 (40.7)
Good	631 (58.3)
Bad	11 (1.0)
Smoking status	
Yes	90 (8.3)
No	992 (91.7)
Alcohol use	
Yes	147 (13.6)
No	935 (86.4)
Pregravid body-mass index (kg/m^2)	
Underweight (<18.5)	22 (2.0)
Normal weight (18.5–24.9)	917 (84.8)
Overweight (25.0–29.9)	143 (13.2)
Planned pregnancy	
Yes	351 (32.4)
No	731 (67.6)
Physical activity advice	
Yes	382 (35.3)
No	700 (64.7)
Physical activity before pregnancy	
Yes	378 (34.9)
No	704 (65.1)
Physical activity timing	
First trimester	188 (17.4)
Second trimester	114 (10.5)
Third trimester	27 (2.5)
Never	753 (69.6)

moving was not advisable in pregnancy (94.0%). Most pregnant women had a negative conviction that participation in physical activity during pregnancy increased body temperature (64.5%). Most participants did not support the notion that physical activity increased the risk of maternal musculoskeletal injuries and diversion of maternal oxygen and nutrients to skeletal muscle, rather than to the fetus (51.6%). However, a majority held positive beliefs: regular physical activity during pregnancy is permissible (87.4%), women not previously engaging in exercise can commence exercise during pregnancy (81.0%), and exercise improves labor and delivery (93.1%) and the health of the baby (93.1%) and promotes energy (89.0%). Interestingly, a majority held the positive view that it is not recommended to continue exercising when tired (76.6%), endorsed exercise at least three times per week (85%) However, 56.5% indicated that pregnancy was a time to just rest and refrain from physical activity.

Table 2 Beliefs About Physical Activity and Exercise During Pregnancy

	Responses				
	SA	A	N	D	SD
	n (%)	n (%)	n (%)	n (%)	n (%)
Not safe for mother or fetus	89 (8.2)	84 (7.8)	69 (6.4)	456 (42.1)	384 (35.5)
Reduces placental circulation	31 (2.9)	126 (11.6)	203 (18.8)	429 (39.6)	293 (27.1)
Leads to abortion or miscarriage, preterm birth, intrauterine growth retardation	49 (4.5)	248 (22.9)	81 (7.5)	490 (45.3)	214 (29.8)
Regular exercise during pregnancy is harmful	39 (3.6)	267 (24.7)	74 (6.8)	429 (39.7)	273 (25.2)
No exercise while lying on back during pregnancy	89 (8.2)	728 (67.3)	142 (13.1)	97 (9.0)	26 (2.4)
Avoid long periods of standing in one place without moving while pregnant	459 (42.4)	558 (51.6)	35 (3.2)	24 (2.2)	6 (0.6)
Physical activity increases body temperature	92 (8.5)	606 (56.0)	153 (14.1)	187 (17.3)	0 (0)
Physical activity increases the risk of maternal musculoskeletal injuries and diversion of maternal oxygen and nutrients to skeletal muscle, rather than to the fetus	81 (7.5)	279 (25.8)	164 (15.1)	461 (42.6)	97 (9.0)
Women can continue regular exercise during pregnancy	155 (14.3)	791 (73.1)	26 (2.4)	94 (8.7)	16 (1.5)
Women who have never exercised can begin an exercise program during pregnancy	176 (16.3)	700 (64.7)	95 (8.8)	88 (8.1)	23 (2.1)
Improves a woman's labor and delivery	214 (19.8)	793 (73.3)	32 (3.0)	38 (3.5)	5 (0.4)
Improves the health of the baby	215 (19.9)	792 (73.2)	44 (4.1)	26 (2.4)	5 (0.4)
Feel more energetic	216 (20.0)	747 (69.0)	36 (3.3)	69 (6.4)	14 (1.3)
A pregnant woman can continue to exercise even if she becomes tired	45 (4.2)	180 (16.6)	28 (2.6)	455 (42.0)	374 (34.6)
During pregnancy, regular exercise at least three times per week is better than activity done irregularly or less often	204 (18.8)	716 (66.2)	81 (7.5)	64 (5.9)	17 (1.6)
Pregnancy is a time to rest	210 (19.4)	401 (37.1)	13 (1.2)	317 (29.3)	141 (13.0)

Abbreviations: SA, strongly agree; A, agree; N, neutral; D, disagree; SD, strongly disagree.

Perceived Benefits

Figure 1 presents the perceived benefits of physical activity during pregnancy. A majority of participants maintained that physical activity was beneficial in improving cardiovascular function (86.2%) and reduction in infant weight (61.4%), musculoskeletal discomfort (82.7%), back pain (85.7%), and incidence of muscle cramps and edema in lower limbs (91.3%). In addition, most indicated physical activity in pregnancy improved labor and delivery (96.9%), health of the baby (96.9%) and the mother (98.2%), and mood (90.4%). A majority affirmed that physical activity during pregnancy decreased the risk of gestational diabetes mellitus (92.9%), pregnancy-induced hypertension (92.5%), and complications at birth (97.8%). An overwhelming majority affirmed that physical activity improved self-image (95.7%), sleep patterns (94.2%), and respiratory function (95.8%).

Information Sources

Sources of information and advice received by the participants about physical activity are shown in Figure 2: friends (27.0%), family (45.3%), other women (18.2%), health-care professionals (47.2%), and books, newspapers and magazines (49.1%). The predominant source of information they received about physical activity in pregnancy was from television, the radio, and other media (70.2%).

Discussion

To our knowledge, this is the first study exploring the beliefs, sources of information, and perceived benefits of

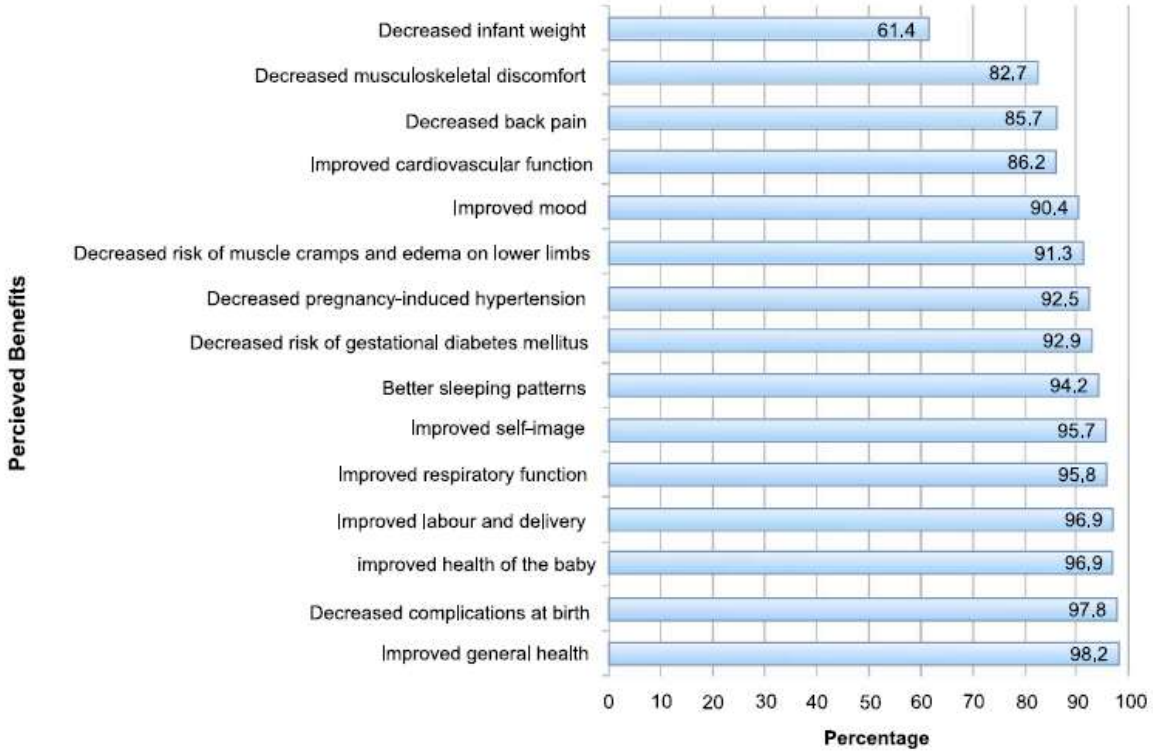


Figure 1 Perceived benefits of physical activity during pregnancy.

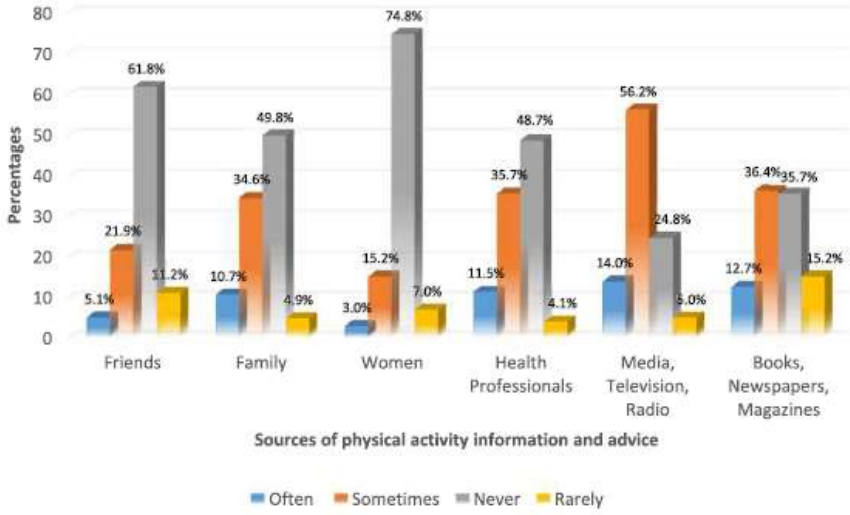


Figure 2 Sources of information on physical activity.

physical activity among pregnant women in a low-income and diverse sample in Eastern Cape, South Africa. Physical activity plays an important role in maternal health; therefore, understanding beliefs, where women get advice, and perceived benefits of physical activity during pregnancy may help in designing educational interventions to encourage, promote, and sustain physical activity among pregnant women. Our study revealed

general positive beliefs about physical activity among the women. Notably, they affirmed the physiological and psychological benefits of being physically active, alongside helping to relieve anxiety or improve mood and consequently correct negative perceptions of prenatal physical activity risk during pregnancy. An overwhelming majority held the positive beliefs that regular exercise during pregnancy was permissible (87.4%), women not previously engaging in exercise could commence exercise during pregnancy (81.0%), and that it improved labor and delivery (93.1%) and the health of the baby (93.1%), and promoted energy (89.0%), and endorsed regular exercise at least three times weekly (85%). These positive beliefs about physical activity align with a previous study in South Africa[32] and others elsewhere, in which pregnant women have expressed the benefits of prenatal physical activity,[28,30,38,39] which serves as an enabling influencer to engage in prenatal activity during pregnancy. If women are informed about the importance of physical activity during pregnancy, this will invariably challenge their traditional beliefs about pregnancy-related risk. Therefore, interventions to improve perceptions of women regarding the benefits of prenatal physical activity are crucial to promote such activity.

In contrast, 56.5% of the women in this study indicated that pregnancy was a time to rest and refrain from physical activity, which contradicts international guidelines on exercise in pregnancy. Thissuggests somewhat of an element of negative belief and ignorance versus positive beliefs, which is difficult to explain. Suffice it to say that the women might have had prior positive beliefs about physical activity, but seemingly did not have adequate knowledge about the benefits of physical activity during pregnancy. Studies have reported women's lack of knowledge about the benefits of physical activity during pregnancy.[40,41] Perhaps the belief that pregnancy is a "rest time" among women in our study could be shaped by social or cultural underpinnings, which is in itself speculative here. Further studies should endeavor to elucidate on social and cultural elements shaping physical activity beliefs with qualitative research.

Nevertheless, as with other studies, pregnant women have expressed the belief that pregnancy is a period to rest. For example, Guelfi et al[29] compared beliefs about exercise during pregnancy between pregnant Chinese and Australian women, and reported that the Chinese women attached more importance to the sedentary behaviors of sleeping and resting/relaxing than exercise and having an active lifestyle. Conversely, the Australian women regarded resting/relaxing to be less important than exercise and having an active lifestyle. Other studies have reported women regarding resting and recuperation during pregnancy a priority.[32,42] Interventions to help disabuse women of the erroneous belief that pregnancy presents a time for resting rather than physical activity practice is needed. A potential strategy to promote awareness about prenatal physical activity is through technology-assisted programs. The MomConnect technology initiative in South Africa is a classic example to use. MomConnect is a program to provide maternal health–related information for pregnant women that can be used to share knowledge of prenatal physical activity benefits to women. Applying technology-assisted (mobile health) programs confers several benefits to the target population, as health information can be delivered at any place and time, is participatory, uses real-life settings, and is accessible to a vast population, regardless of their socioeconomic status or geographic setting.[43,44] In a systematic review, the utilization of mobile phone–based health-behavior interventions in pregnancy correlated with positive beliefs, behaviors, and health outcomes.[45]

Interestingly, our findings revealed that a majority of the women knew the benefits of physical activity during pregnancy. However, knowledge about a health phenomenon does not necessarily translate into positive practice. It remains to be seen whether the knowledge is put to use or not. In this regard, pregnant women need encouragement, guidance, and advice to initiate and maintain a healthier lifestyle behavior. Evidence-based physical activity advice should come from health-care providers, who serve as intermediary between the pregnant woman and her child during pregnancy. Research has shown that maternal advice from health-care providers is more desirable and motivating to women to exercise during pregnancy.[32,46] As in other studies elsewhere, women indicated awareness of the physiological and psychological[28,30,39,47] benefits of physical activity. Even with such awareness, studies have reported low physical activity among women in both developed[48–51] and developing nations,[52–55] with few women meeting the 150-minute/week exercise recommendation. One salient feature of this finding is that knowledge of the benefits of physical activity during pregnancy signals an important message to health-care providers that it is inconsequential directing effort and resources to increasing current levels of education.[56] Instead, it would be appropriate and prudent to apply the theory of planned

behavior,[57] which incorporates other variables, such as barriers, enablers, and social factors, as influencers of intention and subsequent behavior.[57,58] In this context, factoring in the aspects of social support, time efficiency, fun, and enjoyment as interventional efforts is important to ignite desirable behavioral change.[59] Initiating such action may prove more effective in improving pregnant women's participation in physical activity than knowledge or education strategies alone.[56]

Our findings revealed that a majority of the women received information about physical activity in pregnancy from social media, television, and radio (70.2%), and books, newspapers, and magazines (49.1%). Similarly, other studies have reported that apart from health professionals, books, the Internet, and social media form a substantial proportion of pregnancy-related sources of information for women.[60–62] In Mercado et al's[63] study, pregnant women reported receiving prenatal physical activity information mostly from books and the Internet. A majority of the women (65.1%) in the present study indicated receiving no physical activity advice from the midwives responsible for their antenatal care at clinics. This is similar to other studies[30,63–66] and an earlier study in South Africa.[67] Similarly, another study reported that only 19% of South African medical practitioners provided information on physical activity during prenatal visits.[68] Where advice was provided, it was conflicting and misleading, and did not extend beyond telling them "to walk",[69] or the advice is minimal and ineffective.[70] Studies have shown that health-care professionals lack the confidence and knowledge to deliver physical activity advice during routine care.[66] Bearing this in mind, it is unsurprising to discover the disconnect that exists between the evidence for the benefits of physical activity and corresponding behaviors during pregnancy, largely because of a lack of effective information on physical activity from the health-care providers.

Antenatal health-care professionals, primarily midwives, are the key sources of information for pregnant women in South Africa. They have regular contact with pregnant women who routinely visit antenatal health clinics for checkups. It may be possible that the lack of information about physical activity from the midwives would definitely propel the women to resort to seeking information or advice on physical activity from friends, family, magazines, and largely the Internet. There is a potential risk if pregnant women are not receiving evidence-based physical activity advice from health-care professionals, but predominantly from the Internet. Online information cannot necessarily be trusted and can be misleading. Some studies have shown that Internet-based physical activity advice often lacked accuracy and was in most instances misleading.[71–74] This suggests the need for training of midwives and other health professionals to deliver evidence-based physical activity advice during pregnancy. Such training should start at the undergraduate level, and continue after graduation with professional practice training. With training, time, and resource allocation to physical activity as part of maternal healthcare, the desired change in physical activity behavior and practice might occur. Physical activity during pregnancy should be viewed as a holistic and integrative approach to maternal care. A synergistic working attitude among health professionals saddled with the responsibility of advising pregnant women is imperative to support physical activity during and beyond pregnancy.

Implications for Practice and Research

The finding that pregnant women perceived physical activity as beneficial to their health and the baby's, received most of their physical activity information through Internet sources, rather than from midwives, who maintain face-to-face contact with women during antenatal health-care sessions, highlights two scenarios. Firstly, there is a need to design interventions that will create prenatal awareness among women, and secondly a needto assess the quality of Internet-based physical activity advice, in order to educate pregnant women accordingly to avoid misinformation. As can be seen from this present study, an overwhelming majority of the women had positive belief and understood the benefits of physical activity, yet considered pregnancy a period of no physical activity, but to rest. A recent study reported that women viewed pregnancy as a time to relax and received encouragement from families and peers to avoid physical activity.[70] This suggests that more interventions are needed to change the physical activity behavior of women during pregnancy. Providing adequate training to midwives and other health professionals on physical activity in pregnancy could be a powerful intervention in promoting the uptake of physical activity among pregnant women, as these health professionals would in turn provide accurate advice and information about physical activity during pregnancy. Counseling has a strong influence in changing women's health beliefs and behaviors.[75,76] The findings of this study underscore the importance of designing interventions to improve

prenatal physical activity in an understudied, low-income, and diverse sample of pregnant women in the Eastern Cape, and further highlight the need for future study involving pregnant women seeking antenatal health care in the private health sector.

Limitations

One obvious limitation of the study was the use of a self-reported questionnaire to solicit information from participants, where the possibility of response bias cannot be ruled out. In addition, the study was limited to pregnant women attending public primary-health clinics; therefore, the findings cannot be generalized to women attending private health facilities. Future studies should endeavor to include women attending private health facilities. Notwithstanding, this study provides insight into the beliefs, perceived benefits, and sources of physical activity information during pregnancy among a diverse and large sample of pregnant women in an understudied, low-resource setting. The data might inform interventions on changing perceptions about physical activity and the need to provide health facility–based physical activity advice and counseling for pregnant women during antenatal visits.

Conclusion

Notwithstanding the fact that a majority of the women did not participate in physical activity before or during pregnancy, they had positive perceptions about the advantages of prenatal physical activity for their health and the baby's; however, most regarded pregnancy as a period to relax and rest. The predominant source of prenatal physical activity advice was gleaned from the Internet, which can be potentially misleading or contradictory to evidence-based physical activity practice. Interventions targeted at promoting prenatal physical activity, specifically to address erroneous beliefs about prenatal physical activity, are warranted. Given the scarcity of information on this topic in low-income and diverse samples, our data serve as a baseline for future comparative studies on the matter.

Ethicals

The study was conducted according to the Declaration of Helsinki. Informed consent was obtained from participants before data collection. The purpose, nature, and procedures of the study were explained to the participants before they signed the informed-consent form to participate in the study. The Health Research Ethics Committee of the University of Fort Hare approved the study (#2019=06=009=OkaforUB).

Acknowledgment

This work is supported by Govan Mbeki Research and Development Center, University of Fort Hare, South Africa.

Author Contributions

All authors made a significant contribution to the work reported, whether in conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas, took part in drafting, revising, or critically reviewing the article, gave final approval to the version to be published, agreed on the journal to which the article has been submitted, and agree to be accountable for all aspects of the work.

Funding

None.

Disclosure

The authors declare no conflicts of interest for this work.

References

1. da Silva SG, Ricardo LI, Evenson KR, Hallal PC. Leisure time physical activity in pregnancy and maternal-child health: a systematic review and meta-analysis of randomized controlled trials and cohort studies. *Sports Med*. 2017;47(2):295–317.
2. Whitaker KM, Wilcox S, Liu J, Blair SN, Pate RR. Pregnant women's perceptions of weight gain, physical activity, and nutrition using Theory of Planned Behavior constructs. *J Behav Med*. 2016;39(1):41–54.
3. Dipietro L, Evenson KR, Bloodgood B, et al. Benefits of physical activity during pregnancy and postpartum: an umbrella review. *Med Sci Sports Exerc*. 2019;51(6):1292–1302.
4. Ruchat SM, Mottola MF, Skow RJ, et al. Effectiveness of exercise interventions in the prevention of excessive gestational weight gain and postpartum weight retention: a systematic review and meta-analysis. *Br J Sports Med*. 2018;52(21):1347–1356. doi:10.1136/bjsports-2018-099399
5. Harrison AL, Shields N, Taylor NF, Frawley HC. Exercise improves glycaemic control in women diagnosed with gestational diabetes mellitus: a systematic review. *J Physiother*. 2016;62(4):188–196. doi:10.1016/j.jphys.2016.08.003
6. Aune D, Schlesinger S, Henriksen T, et al. Physical activity and the risk of preterm birth: a systematic review and meta-analysis of epidemiological studies. *BJOG Int J Obstet Gynaecol*. 2017;124(12):1816–1826. doi:10.1111/1471-0528.14672
7. Thompson EL, Vamos CA, Daley EM. Physical activity during pregnancy and the role of theory in promoting positive behavior change: a systematic review. *J Sport Health Sci*. 2017;6(2):198–206. doi:10.1016/j.jshs.2015.08.001
8. Catov JM, Parker CB, Gibbs BB, et al. Patterns of leisure-time physical activity across pregnancy and adverse pregnancy outcomes. *Int J Behav Nutr Phys Act*. 2018;15:68–78. doi:10.1186/s12966-018-0701-5

9. Puchalski S. Physical activity: utilizing guidelines to promote health among pregnant women. *J Preg Reprod*. 2017;1(2):1–3. doi:10.15761/JPR.1000107
10. Davenport MH, Ruchat SM, Poitras VJ, et al. Prenatal exercise for the prevention of gestational diabetes mellitus and hypertensive disorders of pregnancy: a systematic review and meta-analysis. *Br J Sports Med*. 2018;52(21):1367–1375. doi:10.1136/bjsports-2018-099355
11. Vamos CA, Flory S, Sun H, et al. Do physical activity patterns across the life course impact birth outcomes? *Matern Child Health J*. 2015;19(8):1775–1782. doi:10.1007/s10995-015-1691-4
12. Davenport MH, Meah VL, Ruchat S, et al. Impact of prenatal exercise on neonatal and childhood outcomes: a systematic review and meta-analysis. *Br J Sports Med*. 2018b;52(21):1386–1396. doi:10.1136/bjsports-2018-099836
13. Davenport MH, McCurdy AP, Mottola MF, et al. Impact of prenatal exercise on both prenatal and postnatal anxiety and depressive symptoms: a systematic review and meta-analysis. *Br J Sports Med*. 2018a;52(21):1376–1385. doi:10.1136/bjsports-2018-099697
14. Davenport MH, Marchand AA, Mottola MF, et al. Exercise for the prevention and treatment of low back, pelvic girdle and lumbopelvic pain during pregnancy: a systematic review and meta-analysis. *Br J Sports Med*. 2019;53(2):90–98. doi:10.1136/bjsports-2018-099400
15. Takami M, Tsuchida A, Takamori A, Aoki S, Ito M. Effects of physical activity during pregnancy on preterm delivery and mode of delivery: the Japan Environment and Children's Study, birth cohort study. *PLoS One*. 2018;13(10):e02066160. doi:10.1371/journal.pone.0206160
16. Rajabi A, Maharlouei N, Rezaianzadeh A, et al. Physical activities (exercises or choreses) during pregnancy and mode of delivery in nulliparous women: a prospective cohort study. *Taiwan J Obstet Gynecol*. 2018;57(10):18–22. doi:10.1016/j.tjog.2017.12.003
17. American College of Obstetricians and Gynaecologists. Physical activity and exercise during pregnancy and the postpartum period. Committee opinion No. 804. *Obstet Gynecol*. 2017;126:e135–e142.
18. Baker JH, Rothenberger SD, Kline CE, Okun ML. Exercise during early pregnancy is associated with greater sleep continuity. *Behav Sleep Med*. 2018;16(5):482–493. doi:10.1080/15402002.2016.1228649
19. Barakat R, Pelaez M, Lopez C, Montejo R, Coteron J. Exercise during pregnancy reduces the rate of caesarean and instrumental deliveries: results of a randomized controlled trial. *J Matern Fetal Neonat Med*. 2012;25(11):2372–2376. doi:10.3109/14767058.2012.696165
20. Cid M, González M. Potential benefits of physical activity during pregnancy for the reduction of gestational diabetes prevalence and oxidative stress. *Early Hum Dev*. 2016;94:57–62. doi:10.1016/j.earlhumdev.2016.01.007
21. Vargas-terrones M, Barakat R, Santacruz B, et al. Physical exercise programme during pregnancy decreases perinatal depression risk: a randomised controlled trial. *Br J Sports Med*. 2018;53(6):348–353. doi:10.1136/bjsports-2017-098926
22. Szegda K, Bertone-Johnson ER, Pekow P, et al. Physical activity and depressive symptoms during pregnancy among Latina women: a prospective cohort study. *BMC Preg Childbirth*. 2018;18:252–263. doi:10.1186/s12884-018-1839-5
23. Padmapriya N, Shen L, Soh SE, et al. Physical activity and sedentary behavior patterns before and during pregnancy in a multi-ethnic sample of Asian women in Singapore. *Matern Child Health J*. 2015;19(11):2523–2535. doi:10.1007/s10995-015-1773-3
24. Patrícia V, De Sousa S, Cury A, Eufrásio LS. The influence of gestational trimester, physical activity practice and weight gain on the low back and pelvic pain intensity in low risk pregnant women. *J Back Musculoskelet Rehabil*. 2019;32(5):671–676. doi:10.3233/BMR-171006
25. Nguyen PTH, Binns CW, Nguyen CL, et al. Physical activity during pregnancy is associated with improved breastfeeding outcomes: a prospective cohort study. *Int J Environ Res Public Health*. 2019;16(10):1740. doi:10.3390/ijerph16101740
26. American College of Obstetricians and Gynaecologists. Physical activity and exercise during pregnancy and the postpartum period. Committee opinion No. 804. *Obstet Gynecol*. 2020;135:e178–e188. doi:10.1097/AOG.0000000000003772
27. Tinius RA, Cahill AG, Cade WT. Origins in the womb: potential role of the physical therapist in modulating the deleterious effects of obesity on maternal and offspring health through movement promotion and prescription during pregnancy. *Phys Ther*. 2017;97(1):114–123. doi:10.2522/ptj.20150678
28. Tinius R, Nagpal TS, Edens K, et al. Exploring beliefs about exercise among pregnant women in rural communities. *J Midwifery Womens Health*. 2020;65(4):538–545. doi:10.1111/jmwh.13080
29. Guelfi KJ, Wang C, Dimmock JA, et al. A comparison of beliefs about exercise during pregnancy between Chinese and Australian pregnant women. *BMC Preg Childbirth*. 2015;15:345. doi:10.1186/s12884-015-0734-6
30. Findley A, Smith DM, Hesketh K, Keyworth C. Exploring women's experiences and decision making about physical activity during pregnancy and following birth: a qualitative study. *BMC Preg Childbirth*. 2020;20:54. doi:10.1186/s12884-019-2707-7
31. Mbada CE, Adebayo OE, Adeyemi AB, et al. Knowledge and attitude of Nigerian pregnant women towards antenatal exercise: a cross sectional survey. *Obstet Gynecol*. 2014;1:8. doi:10.1155/2014/260539
32. Watson ED, Norris SA, Draper CE, et al. "Just because you're pregnant, doesn't mean you're sick!" A qualitative study of beliefs regarding physical activity in black South African women. *BMC Preg Childbirth*. 2016;16:174. doi:10.1186/s12884-016-0963-3
33. Eastern Cape Socio Economic Consultative Council. Buffalo city metro municipality socio economic review and outlook. 2020. Available online: https://www.ecsecc.org/documentrepository/informationcentre/buffalo-city-metro-municipality_44557.pdf. Accessed September 14, 2020.
34. Sarmah HK, Hazarika BB, Choudhury G. An investigation on effect of bais on determination of sample size on the basis of data related to the students of schools of Guwahati. *Int J Appl Math Stat Sci*. 2013;2:33–48.
35. Evenson KR, Bradley CB. Beliefs about exercise and physical activity among pregnant women. *Patient Educ Couns*. 2010;79(1):124–129. doi:10.1016/j.pec.2009.07.028
36. Da Costa D, Ireland K. Perceived benefits and barriers to leisure-time physical activity during pregnancy in previously inactive and active women. *Women Health*. 2013;53(2):185–202. doi:10.1080/03630242.2012.758219
37. Hurst C, Flannery C, Byrne M, et al. Investigating the perceived benefits, barriers and beliefs towards physical activity in pregnancy among women with gestational diabetes mellitus. *Ir Med J*. 2017;110(7):617.
38. Leiferman J, Swibas T, Koiness K, et al. My baby, my move: examination of perceived barriers and motivating factors related to antenatal physical activity. *J Midwifery Women's Health*. 2011;56(1):33–40. doi:10.1111/j.1542-2011.2010.00004.x
39. Battle CL, Scott BLD, Fritzson AE, et al. Acceptability and perceived benefits of exercise among pregnant and postpartum women seeking psychiatric care. *Women's Health Rep*. 2020;1(1):212–217. doi:10.1089/whr.2020.0039
40. Hoodbhoy Z, Qureshi RN, Iqbal R, Muhabat Q.Household chores as the main source of physical activity: perspectives of pregnant Pakistani women. *J Pak Med Assoc*. 2018;68(4):565–569.
41. Marquez DX, Bustamante EE, Bock BC, et al. Perspectives of Latina and non-Latina white women on barriers and facilitators to exercise in pregnancy. *Women Health*. 2009;49(6):505–521. doi:10.1080/03630240903427114
42. Pathirathna ML, Sekijima K, Sadakata M, et al. Effects of physical activity during pregnancy on neonatal birth weight. *Sci Rep*. 2019;9(1):6000. doi:10.1038/s41598-019-42473-7
43. Henriksson P, Sandborg J, Blomberg M, et al. A smartphone app to promote healthy weight gain, diet, and physical activity during pregnancy (HealthyMoms): protocol for a randomized controlled trial. *JMIR Res Protoc*. 2019;8(3):e13011. doi:10.2196/13011

44. O'Brien OA, McCarthy M, Gibney ER, McAuliffe FM. Technology supported dietary and lifestyle interventions in healthy pregnant women: a systematic review. *Eur J Clin Nutr*. 2014;68(7):760–766. doi:10.1038/ejcn.2014.59
45. Hussain T, Smith P, Yee LM. Mobile phone-based behavioral interventions in pregnancy to promote maternal and fetal health in high-income countries: systematic review. *JMIR mHealth uHealth*. 2020;8(5):e15111. doi:10.2196/15111
46. Krans EE, Gearhart JG, Dubbert PM, et al. Pregnant women's beliefs and influences regarding exercise during pregnancy. *J Miss State Med Assoc*. 2005;46(3):67–73.
47. Al-Youbi GM, Elsaid T. Knowledge, attitude, and practices on exercise among pregnant females attending Al-Wazarat Health Center, Riyadh, Saudi Arabia. *J Fam Med Prim Care*. 2020;9:3905–3915. doi:10.4103/jfmpc.jfmpc_276_20
48. Hayes L, Mcparlin C, Kinnunen T, et al. Change in level of physical activity during pregnancy in obese women: findings from the UPBEAT pilot trial. *BMC Preg Childbirth*. 2015;15:52. doi:10.1186/s12884-015-0479-2
49. Schmidt T, Heilmann T, Savelsberg L, et al. Physical exercise during pregnancy—how active are pregnant women in Germany and how well informed? *Geburtshilfe Frauenheilkd*. 2017;77(5):508–515. doi:10.1055/s-0043-107785
50. Bauer C, Graf C, Platschek AM, et al. Reasons, motivational factors, and perceived personal barriers to engagement in physical activity during pregnancy vary within the BMI classes: the prenatal prevention project Germany. *J Phys Act Health*. 2018;15(3):204–211. doi:10.1123/jpah.2016-0563
51. Di Fabio DR, Blomme CK, Smith KM, et al. Adherence to physical activity guidelines in mid-pregnancy does not reduce sedentary time: an observational study. *Int J Behav Nutr Phys Act*. 2015;12:27. doi:10.1186/s12966-015-0191-7
52. Lawan A, Awotidebe AW, Oyeyemi AL, et al. Relationship between physical activity and health related quality of life among pregnant women. *Afr J Reprod Health*. 2018;22(3):80–89. doi:10.29063/ajrh2018/v22i3.9
53. Watson ED, van Poppel MNM, Jones RA, et al. Are South African mothers moving? Patterns and correlates of physical activity and sedentary behavior in pregnant black South African women. *J Phys Act Health*. 2017;14(5):329–335. doi:10.1123/jpah.2016-0388
54. Todorovic J, Terzic-Supic Z, Bjegovic-Mikanovic V, et al. Factors associated with the leisure-time physical activity (LTPA) during the first trimester of the pregnancy: the cross-sectional study among pregnant women in Serbia. *Int J Environ Res Public Health*. 2020;17(4):1366. doi:10.3390/ijerph17041366
55. Hailemariam TT, Gebregiorgis YS, Gebremeskel BF, et al. Physical activity and associated factors among pregnant women in Ethiopia: facility-based cross-sectional study. *BMC Pregnancy Childbirth*. 2020;20:92. doi:10.1186/s12884-020-2777-6
56. Harrison AL, Taylor NF, Shields N, et al. Attitudes, barriers and enablers to physical activity in pregnant women: a systematic review. *J Physiother*. 2018;64(1):24–32. doi:10.1016/j.jphys.2017.11.012
57. Ajzen I. The theory of planned behavior. *Organ Behav Hum Decis Process*. 1991;50(2):179–211. doi:10.1016/0749-5978(91)90020-T
58. Armitage CJ, Conner M. Efficacy of the theory of planned behavior: a meta-analytic review. *Br J Soc Psychol*. 2001;40:471–499. doi:10.1348/014466601164939
59. Bozionelos G, Bennett P. The theory of planned behavior as predictor of exercise: the moderating influence of beliefs and personality variables. *J Health Psychol*. 1999;4(4):517–529. doi:10.1348/014466601164939
60. Walker RE, Choi TST, Quong S, et al. "It's not easy" - A qualitative study of lifestyle change during pregnancy. *Women Birth*. 2020;33(4):e363–e370. doi:10.1016/j.wombi.2019.09.003
61. Willcox JC, Campbell KJ, McCarthy EA, et al. Gestational weight gain information: seeking and sources among pregnant women. *BMC Preg Childbirth*. 2015;15:164. doi:10.1186/s12884-015-0600-6
62. Dalhaug EM, Haakstad LAH. What the health? Information sources and maternal lifestyle behaviors. *Interact J Med Res*. 2019;8(3):e10355. doi:10.2196/10355
63. Mercado A, Marquez B, Abrams B, et al. Where do women get advice about weight, eating, and physical activity during pregnancy? *J Womens Health*. 2017;26(9):951–956. doi:10.1089/jwh.2016.6078
64. Flannery C, McHugh S, Anaba AE, et al. Enablers and barriers to physical activity in overweight and obese pregnant women: an analysis informed by the theoretical domains framework and COM-B model. *BMC Pregnancy Childbirth*. 2018;18(1):178. doi:10.1186/s12884-018-1816-z
65. Hayman M, Reaburn P, Alley S, et al. What exercise advice are women receiving from their healthcare practitioners during pregnancy? *Women Birth*. 2020;33(4):e357–e362. doi:10.1016/j.wombi.2019.07.302
66. De Vivo M, Mills H. "They turn to you first for everything": insights into midwives' perspectives of providing physical activity advice and guidance to pregnant women. *BMC Preg Childbirth*. 2019;19:462. doi:10.1186/s12884-019-2607-x
67. Muzigaba M, Kolbe-Alexander TL, Wong F. The perceived role and influencers of physical activity among pregnant women from low socioeconomic status communities in South Africa. *J Phy Act Health*. 2014;11(7):1276. doi:10.1123/jpah
68. Watson ED, Oddie B, Constantinou D. Exercise during pregnancy: knowledge and beliefs of medical practitioners in South Africa: a survey study. *BMC Preg Childbirth*. 2015;15:245. doi:10.1186/s12884-015-0690-1
69. Ferrari RM, Siega-Riz AM, Evenson KR, et al. A qualitative study of women's perceptions of provider advice about diet and physical activity during pregnancy. *Patient Educ Couns*. 2013;91(3):372–377. doi:10.1016/j.pec.2013.01.011
70. Grenier LN, Atkinson SA, Mottola MF, et al. Be healthy in pregnancy: exploring factors that impact pregnant women's nutrition and exercise behaviors. *Matern Child Nutr*. 2020:e13068. doi:10.1111/mcn.13068
71. Narasimhulu DM, Karakash S, Weedon J, et al. Patterns of internet use by pregnant women, and reliability of pregnancy-related searches. *Matern Child Health J*. 2016;20(12):2502–2509. doi:10.1007/s10995-016-2075-0
72. Huberty J, Dinkel D, Beets MW, et al. Describing the use of the internet for health, physical activity, and nutrition information in pregnant women. *Matern Child Health J*. 2013;17(8):1363–1372. doi:10.1007/s10995-012-1160-2
73. Gao L, Larsson M, Lou S. Internet use by Chinese women seeking pregnancy-related information. *Midwifery*. 2013;29:730–735. doi:10.1016/j.midw.2012.07.003
74. Sayakhot P, Carolan-Olah M. Internet use by pregnant women seeking pregnancy-related information: a systematic review. *BMC Pregnancy Childbirth*. 2016;16:65. doi:10.1186/s12884-016-0856-5
75. Coll CVN, Domingues MR, Gonçalves H, et al. Perceived barriers to leisure-time physical activity during pregnancy: a literature review of quantitative and qualitative evidence. *J Sci Med Sport*. 2017;20(1):17–25. doi:10.1016/j.jsams.2016.06.007
76. Girard AW, Olude O. Nutrition education and counselling provided during pregnancy: effects on maternal, neonatal and child health outcomes. *Paediatr Perinat Epidemiol*. 2012;26(Suppl. 1):191–204. doi:10.1111/j.1365-3016.2012.01278.x

CHAPTER SIX

APPLYING THE ECOLOGICAL MODEL TO UNDERSTAND PREGNANT WOMEN'S PERSPECTIVES ON THE MODIFIABLE CONSTRAINTS TO PHYSICAL ACTIVITY DURING PREGNANCY: A QUALITATIVE RESEARCH STUDY

6.1 INTRODUCTION

The article presented in this chapter responded to specific objective three, and using the ecological model explored the modifiable barriers to prenatal physical activity among women in the Eastern Cape Province. There is dearth of information about the modifiable factors affecting prenatal physical activity in this setting. An understanding of the contextual modifiable restraining factors affecting prenatal physical activity may provide insights on interventions to promote physical activity during pregnancy among women in the region.

6.2 PUBLICATIONS DETAILS

Title:	Applying the Ecological Model to understand pregnant women's perspectives on the modifiable constraints to physical activity during pregnancy: A qualitative research study
Authors:	UB Okafor, DT Goon
Ethics:	University of Fort Hare Health Research Ethics Committee approved the study protocol (Ref#2019 = 06 = 009 = OkaforUB)
Journal:	Medicine
Journal details:	Peer-reviewed (blinded) Journal approved and listed on the Department of Higher Education and Training (DHET)
Status:	Published
	Okafor UB, Goon DT. Applying the Ecological Model to understand pregnant women's perspectives on the modifiable constraints to physical activity during pregnancy: A qualitative research study. *Medicine*, 2020, 99 (49), (e23431). http://dx.doi.org/10.1097/MD.0000000000023431
Impact factor	1.889

6.3 PUBLICATION RECORD

The article was submitted to the journal on the 07 August 2020, and it was accepted on 19 September 2020 and published on 26 October 2020.

Quality Improvement Study

Medicine

OPEN

Applying the Ecological Model to understand pregnant women's perspectives on the modifiable constraints to physical activity during pregnancy

A qualitative research study

Uchenna Benedine Okafor, MCur[a,*], Daniel Ter Goon, D Tech[b]

Abstract

The benefits of physical activity (PA) during pregnancy are widely reported; however, PA practice is seemingly not a valued habit among pregnant women attending public antenatal health centres in the Eastern Cape of South Africa. Guided by the ecological model, we sought to explore modifiable barriers to PA among pregnant women.

Semi-structured interviews involved a purposive sample of 15 pregnant women. Interview questions were guided by the ecological model constructs at intrapersonal, interpersonal, and environmental level. Thematic analysis was applied to summarise the modifiable barriers to PA during pregnancy.

Three main themes emerged, based on the modifiable barriers to PA during pregnancy that belong to the varying Ecological Model constructs. On the intrapersonal level, 5 themes emerged, namely, time-constraint beliefs, feeling of tiredness, low energy, lack of motivation, and a lack of knowledge on benefits and types of PA. Two themes emerged for the interpersonal level, lack of PA advice and lack of information on PA recommendations and guidelines. Another theme defined the environmental level lacking resources. Most themes related to individual factors, which prevent PA-promoting behaviour.

Overall, intrapersonal factors relating to tiredness and exhaustion, lack of time beliefs, work and household commitments, and lack of motivation were key modifiable barriers to PA by the women. The findings provide insights into possible interventional strategies to optimise PA during pregnancy among women in this setting. Appropriate knowledge, education and advice on the benefits, types, and intensity of PA in pregnancy are needed.

Abbreviations: MET = metabolic equivalent, PA = physical activity, WHO = World Health Organization.

Keywords: ecological model, modifiable physical activity barriers, pregnant women, South Africa

Editor: Massimo Tusconi.

This work is based on the research supported wholly by the National Research Foundation of South Africa. To Eastern Cape Department of Heath for granting us permission to conduct the study in the selected health facilities and Health Professionals in Buffalo City Metro Municipality district for their willingness to participate in the study.

UBO received a Doctoral Research Grant from National Research Foundation of South Africa.

The authors have no conflicts of interest to disclose.

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

[a] Department of Nursing Science, [b] Department of Public Health, University of Fort Hare, East London, South Africa.

[*] Correspondence: Uchenna Benedine Okafor, University of Fort Hare, East London, Eastern Cape South Africa (e-mail: ucheysonic@gmail.com).

How to cite this article: Okafor UB, Goon DT. Applying the Ecological Model to understand pregnant women's perspectives on the modifiable constraints to physical activity during pregnancy: a qualitative research study. Medicine 2020;99:49(e23431).

Received: 7 August 2020 / Received in final form: 19 September 2020 / Accepted: 26 October 2020

http://dx.doi.org/10.1097/MD.0000000000023431

1. Introduction

The unique and vulnerable nature of pregnancy,[1,2] confers changes in lifestyle behaviours of a pregnant woman, including physical activity (PA), which can affect her health and that of the fetus.[1,3–5] Against this backdrop, the World Health Organization (WHO) has characterised maternity health as a global health priority.[6] Now, there is a paradigm shift beyond just aiming to reduce the direct causes of maternal morbidity, but the focus has been to address the modifiable health risk factors, which include PA.[7] The World Health Organisation[6] defines "physical activity as any bodily movement produced by skeletal muscles that requires energy expenditure", and health promotion as "the process of enabling people to increase control over and to improve their health". Physical inactivity has been recognised as the fourth leading risk factor for non-communicable diseases, and a global burden.[8] Considering the escalating rate of non-communicable diseases, some of which are linked to physical inactivity, the WHO launched a global action plan to tackle physical inactivity by a relative 10% by 2025, and 15% by 2030.[8–10] Notwithstanding the physical, psychological and social health benefits of PA to the general population, and the pregnant woman, few pregnant women (15%) meet the current PA recommended guideline of 150 min of moderate intensity PA per week, or the metabolic equivalent (METs) of 600 MET minutes per week (MET mins/wk).[11]

The reasons for the non-participation, inactiveness and decline in PA during pregnancy varies from one geographical setting to another, and are shaped by context-specific factors. Previous studies have found non-modifiable determinants of PA such as older, married,[12,13] low socioeconomic,[13] non-formal education and women working at home[12,14] as less likely to be active during pregnancy. However, these non-modifiable factors are unchangeable through application of intervention. Both quantitative and qualitative studies on modifiable correlates of PA during pregnancy have reported interwoven and contrasting findings. Studies have reported time constraints,[15–17] childcare responsibilities,[15] work and family responsibilities,[15,16,18–21] and lack of resources.[16,22] Psychosocial barriers cited include lack of support,[23,24] motivation,[16,19,23] and little or no advice from their healthcare providers.[15,25–27] In addition, body image,[23] and lack of confidence [28,29] are reported as psychosocial limiting factors affecting PA during pregnancy. Physical factors include musculoskeletal pain,[15,21,28,29] nausea,[21,30] fatigue,[15,16,19,21,23] and concern for the baby.[16,21,29] Apparently, the above-mentioned constraints characterise the constructs of the Ecological Model, which posits PA as an interplay of intrapersonal (for example, self-efficacy), interpersonal/social (for example, social support) and physical environment (for example, access to facilities) factors.[31] However, unlike in the general population where this model has gained wide applicability in understanding the multiplicity of the factors influencing PA, such models have been rarely used [21] by researchers to investigate the correlates of modifiable barriers to PA among pregnant women.

As part of the measures to provide safe maternity care and improve neonatal outcome, one of the essential antenatal care services often neglected is the provision and advice on regular PA. However, as reiterated by the American College of Obstetricians and Gynaecologists,[32] PA has become a fundamental aspect of women's lives and constitutes part of antenatal care as well; and therefore, for safe maternal and neonatal outcomes, routine antenatal exercise is recommended.[32] Interestingly, there is a clarion call by the WHO for surveillance and monitoring of disease risk factors, and, PA is included.[33] However, unlike other populations, in the literature, research on pregnancy PA is not widely available pregnant women are an under-researched population.

Moreover, in South Africa, there is a dearth of information concerning the modifiable restraining factors affecting PA participation during pregnancy. Understanding the modifiable barriers to PA during pregnancy is crucial as one of the components of the provision of quality antenatal and obstetric healthcare services to pregnant women, a special population sometimes neglected in the health-behaviour literature, nonetheless PA is fundamentally important for the future postpartum health of both mother and child.[34,35] To facilitate future improvements in pregnancy PA, an understanding of the context-specific factors affecting PA participation during pregnancy is required. Compared to qualitative researches, quantitative approaches have largely dominated PA research. Although quantitative and qualitative approaches do share complementary characteristics, the qualitative research primarily focuses on gaining understanding and insights into a particular phenomenon, which in this case is the "barriers" to PA participation during pregnancy, and perhaps what to do to improve PA uptake among pregnant women. Such a task requires better insights into the reasons restraining pregnant women from PA practice. Viewed in these contexts highlighted above, using a qualitative approach, this study explored the perspectives of pregnant women concerning the underlying modifiable barriers to PA participation during pregnancy. This kind of information is lacking in the Eastern Cape Province of South Africa. We hypothesised that barriers to PA during pregnancy among pregnant women in this setting would characterise the constructs of the ecological model. Such information may be useful when planning context-specific future PA interventions to optimise pregnancy PA.

2. Materials and methods

2.1. Study Design

A qualitative descriptive approach was deemed relevant because it enables understanding of that which determines behaviour in the context of PA participation during pregnancy. As indicated by Connolly et al[36] qualitative methodology is particularly relevant to gain a deeper understanding of the complex factors affecting PA during pregnancy as they pertain to specific subgroups with cultural predispositions.

2.2. Participants selection

Participants were purposively selected pregnant women attending antenatal health clinics in Buffalo City Municipality in the Eastern Cape Province, South Africa. The age of the participants ranged from 18 to 36 years. Pregnant women who met the inclusion criteria (Table 1) were included in the study.

2.3. Data collection procedures

Semi-structured individual interviews were conducted with 15 pregnant women. The interview guide was contextualised and based on the ecological model constructs (at intrapersonal, interpersonal, and environmental levels). The interview guide questions focused on the modifiable barriers to PA during pregnancy. Participants' interviews continued until saturation (when no new emerging facts or themes became evident). Interviews were conducted at the health clinics in a quiet room provided by the health facility manager, and interviews lasted between 45 to 60 minutes each. Permission was obtained from the pregnant women to audio-record the interviews and the recordings. The interview guide was not provided to the participants; nevertheless, participants were provided the chance

Table 1

Participant inclusion and exclusion criteria.

Included	Excluded
Pregnant women	<18 years of age
Attending antenatal care at the study sites (Primary health clinics)	Pregnancy complications (hypertension)
Single pregnancy	Persistent excessive shortness of breath
All level of trimester	Severe chest pain
	Regular and painful uterine contractions
	Vaginal bleeding
	Disabilities or pre-existing health conditions preventing the effect of PA
	Unable to speak English

to freely express their views on the barriers affecting prenatal activity, beyond the items in the interview guide.

2.4. Trustworthiness

Trustworthiness was maintained by applying the concepts of credibility, transferability, dependability and conformability as applicable in qualitative research. Bracketing was achieved by putting aside the researcher own views regarding barriers to PA participation during pregnancy. There was prolonged engagement with the participants during data collection, as the interviews lasted for at least 45 minutes. The participants were given in-depth explanations about the study to enable them to answer the questions appropriately. Regarding member checking, the researchers asked each participant to review the researchers' interpretation of the interview data – this was done to ascertain if it were a true reflection of their views. The data-collection instrument used yielded consistent results (dependability). An external, professional, independent co-coder helped to validate the data as applied in qualitative research.

2.5. Data Analysis

The researchers transcribed the audio-recorded interviews verbatim, and thereafter they repeatedly read all transcribed interviews and field notes.[37] The thematic content analysis method as described by Creswell,[37] based on the 3 levels defining the constructs of the ecological model, was applied for data analysis. Participants' names were concealed for the reason of anonymity. Interview transcripts were carefully reviewed for accuracy. Texts that appeared to describe modifiable PA barriers were outlined. Codes were created, based on the 3 levels of the ecological model, where possible. List of all the topics were drawn up and similar topics were grouped together and clustering identified. The most descriptive wording for the topics was identified and categorised. Subcategories within the 3 levels of the ecological model were defined. The modifiable barriers belonging to each category were categorised separately. Data was grouped as themes and sub-themes, identified by both authors and an independent coder. The authors reached a consensus regarding the data analysis and presentation of the findings.

2.6. Ethics Statement

The Human Research Ethics Committee of the University of Fort Hare (Ref# 2019=06=009=OkaforUB) granted ethical approval for the study. In addition, the Eastern Cape Provincial Department of Health Ethics Research Committee approved the study protocol and gave permission for the researchers to conduct the study in the selected health clinics. The nature and aim of the study were explained to the participants who provided written informed consent prior to participation and data collection.

3. Results

Of the 15 pregnant women interviewed, the mean age was 29.4 years (SD=3.2 years). Most of the participants were peri-urban (n=11), black (n=10), unmarried (n=11), had secondary education (n=10), unemployed (n=13), nulliparous (n=8), and had vaginal delivery (n=11). Most participants reported no antepartum haemorrhage (n=14), chronic illness (n=13), non-smokers (n=12), do not drink alcohol (n=10), and were in their second trimester of pregnancy (n=7) (Table 2). Analysis of the interviews showed 3 main themes highlighting the modifiable barriers to PA within the context of the framework of the ecological model (Table 3). Participants' identities were concealed; instead, a number was assigned to represent extracts and quotes of individual participants. For example, (P3) represents a quote from Participant 3, and so forth.

Table 2

Characteristics of the participants (n=15).

Variables	n
Mean age=29.4 yr	
Residential area	
Peri-urban	11
Urban	4
Race	
Black	10
Coloured	5
Marital status	
Married	4
Never married	11
Educational level	
Primary	1
Secondary	10
Tertiary	4
Employment status	
Unemployed	13
Employed	2
Parity	
Nulliparous	8
Primiparous	5
Multiparous	2
Delivery mode	
Vaginal	11
Caesarian section	4
Antepartum haemorrhage	
Yes	1
No	14
Chronic illness	
Yes	2
No	13
Smoking status	
Yes	3
No	12
Alcohol use	
Yes	5
No	10
Pregnancy status	
1st trimester	4
2nd trimester	7
3rd trimester	4

3.1. Time-related barriers

Three main themes emerged, based on the modifiable barriers to PA during pregnancy, that belong to the varying Ecological Model constructs. Five themes belong to the intrapersonal level (time constraints' belief, feeling of tiredness and low energy, lack of motivation, and safety concerns, and lack of knowledge). Two themes were classified under the interpersonal construct (lack of PA advice and lack of information on PA recommendations and guidelines). Environmentally, a lack of resources was the only theme identified. Most of the themes related to the individual level.

Table 3
Modifiable barriers to physical activity.

Level	Theme	Sub-themes
Intrapersonal	Belief in time-related barriers	Belief that there is not enough time to participate in physical activity Work, school and household commitments impede physical activity Feeling of tiredness and exhaustion obstruct engagement in physical activity Lack of energy to engage in physical activity
	Lack of motivation	Feeling of needing to get enough rest most of the time and rather watch television Having no interest in physical activity
	Lack of knowledge	Lack of knowledge on the benefits and types of physical activity recommended during pregnancy
Interpersonal	Lack of information and advice from support groups	Lack of advice on physical activity recommendations and guidelines Lack of information about physical activity and exercise
Environmental	Lack of resources	No money to register at gym nor for transport to gym

On an intrapersonal level, most women could not exercise or participate in PA during pregnancy because they believed they lacked time. After coming back from school, they felt tired and had no time to do any PA. They expressed themselves in the following way:

> "I agree with sister about tiredness. I also feel tired after I come back from school. I also did not know the benefits of exercise during pregnancy." (P2).

> "I do not exercise regularly because of a lack of time, and sometimes I travel and cannot make time to exercise or do any physical activity." (P3).

> "I do not have the time to exercise because my class starts at 08:00 and ends at 14: 00 every day. I get so tired all the time. I do not have enough energy to do anything; not even to study these days. I sit most of the time and watch television." (P7).

Women indicated on the intrapersonal level that work and household responsibilities were barriers to their participation in PA. For example, upon returning home from work, the women expressed that they felt exhausted and would want to rest:

> "I feel very heavy. I am working in the shop, and after work, I do feel tired. What I do, is to eat, watch television for a while, and go to bed. I sleep a lot." (P4).

> "I attend to so many clients at my work place (post office) every day. Therefore, after work, I am tired. I need to just rest and sleep." (P1).

> "Selling at the shop is a demanding job. It makes you feel tired. I do no longer have the energy to engage in any physical activity." (P8).

Household chores also prevent them from performing exercise or physical activity. They expressed this in the following way:

> "I look after my sister's child the whole day. There is no extra time to do any other activity." (P2).

> "I am always cooking food or preparing food for my family. There is time left to do any physical activity." (P9).

> "During weekends, I do some washing (clothes) and clean the home. I am occupied by these activities and therefore have no time to do something else like exercise or physical activity. I take laundry and cleaning the house as my physical activities." (P15).

Most of the women expressed the feeling of tiredness as the main reason for their non-participation in PA on an intrapersonal level. They gave the following reasons:

> "I am always feeling too tired to do any physical activity. What I do mostly is to sit and watch television." (P6).

> "I sleep often because I feel tired always." (P1).

> "I do not have the energy to do any exercise or physical activity. I do feel very tired and like sleeping and watching television." (P13).

> "I feel tired the whole day. Where do I have the energy to do exercise or physical activity?" (P7).

3.2. Lack of motivation for PA

Perhaps, since most of the women did not received advice from midwives or other health provider about the benefits of PA, at an intrapersonal level, they felt demotivated to engage in PA. However, some women indicated being encouraged by their relatives to participate in PA, at least walking. One participant mentioned a cultural reason as a demotivating factor:

> "I think the PA during pregnancy is good and beneficial although I do not do exercise. Sister, there is something I didn't tell you before: back at home, especially we Africans, I was told that it is not good to exercise during pregnancy so as to avoid hurting oneself as well as the baby." (P11).

> "There is nothing motivating me to exercise. The only thing I do is to lie down and sleep. I like my sleep. Shame!" (P13).

3.3. Lack of information and advice from support groups

On an interpersonal level, most of the participants expressed being uninformed about PA. They indicated receiving no

information about the need or importance of PA for their health and the baby. Therefore, most of the women did not engage in any PA during pregnancy. They narrated:

"The little information I have about exercise and physical activity is from my friend. I also see and hear about it from the television because I watch it a lot." (P10).

"I don't know the type of exercise that is good for me, and how to do the exercise. I think that a pregnant woman should not involve herself in any exercise because, for me, what if she gets hurt and ends up hurting her baby?" (P7).

"I do know that a pregnant woman should be moving around, but I don't know any type of exercise, except walking. I sometimes take a walk to the shop to buy a few groceries." (P2).

"I also don't know the benefits of exercise during pregnancy." (P14).

Again, on an interpersonal level, most of the women did not received any advice from the midwives concerning PA, which limited their participation in PA during pregnancy. They shared their experiences as follows:

"The midwives don't tell us about exercise and physical activity when we attend the clinics. I then assume that it is not safe." (P15).

"In the clinic, midwives don't tell much about physical activity and exercise during pregnancy and how long one should engage in it; neither do they mention the type exercise that is good for us." (P3).

"Well, personally, I don't receive advice concerning exercise from the midwives in the clinic; however, I think is because they don't really know about it. You only teach what you know." (P2).

"I remember asking sister about aerobics exercise during pregnancy, but she did not know about it, and even the types of exercise suitable for a pregnant woman and the intensity level." (P1).

"I assume that the midwives attending to us at the clinics don't talk in detail about exercise and physical activity to us because they don't know much about it. Rather, we often receive advice on the need to stop smoking and decrease alcohol intake during pregnancy. We are always advised to eat well and get enough rest." (P6).

"Midwives don't ever say much about exercise, except to tell us to take a walk always. The midwife would say walking is good for our health." (P4).

The participants did not receive any information about PA. As such, at an interpersonal level, they were not aware of the kind or type of PA to embrace during pregnancy. This kind of information ought to come from the midwives, where they attend antenatal; however, the midwives rarely provide information about the benefits and types of PA. Rather, some of the women received information about PA from their fellow women, families and friends. They women narrated:

"This is my second pregnancy, and the midwives have never told me about exercise and physical activity. I do not know that engaging in physical activity or exercise is important." (P4).

"This group have made me realise how important physical activity is, during pregnancy. However, I think that our healthcare people should do more. They should be able to engage with pregnant women in details about the importance of physical activity and the said recommendations." (P11).

"Apart from other women or family friends, I have never received any information about physical activity." (P8).

"The nurse midwives don't talk about exercise and physical activity to us at the clinics. Sometimes the midwives would tell some of us to walk around the clinics. They do not explain to us why it is important for us to engage in exercise and physical activity. I expect they should tell us in detail what type of physical activity to do, how often and for what purpose." (P5).

"The little information I have about exercise or physical activity during pregnancy is from my friend. She told me exercising during pregnancy is good for my health and the baby." (P3).

"My mother-in law would tell me to do little exercise around the house, at least by walking around. She said exercise allows good circulation of blood in the body and aids a quick delivery." (P2).

"My aunt would sometimes ask me to get up from the lounge and take a walk, so that I will feel better." (P9).

3.4. Non-availability of resources

On the environmental level of the ecological model, the women highlighted a lack of financial resources to register in a gym or to pay for transport to the gym as the reason for not participating in PA. They stated:

"I want to exercise, but I cannot afford the price to register in the gym. It is costly." (P5).

"I am staying far away from the gym, and I do not have money to pay for the gym fee and at the same time to transport myself there." (P4).

4. Discussion

To our knowledge, this is the first study, drawing on the Ecological Model [31] to explore the perspectives of pregnant

women concerning the underlying modifiable barriers to PA participation during pregnancy in the Eastern Cape Province in South Africa. The Ecological Model hinges on 3 constructs to explain behavioural change (intrapersonal, interpersonal and physical environmental factors).[21] An understanding of these constructs in the context of modifiable barriers to PA participation during pregnancy in this setting may help to inform interventions policies that are contextually relevant to improve PA during pregnancy. The modifiable barriers to PA are varied and inconsistent among studies in different geographical settings. Women in our study highlight several barriers that impede their ability to engage in PA.

In this present study, pregnant women believing that they lacked time and felt tired were the most commonly reported barriers to PA during pregnancy. Most of the women expressed they felt tired and had no time to do any PA. Our study results agree with previous findings that a lack of time was a barrier to pregnant women where PA belonged to the intrapersonal level of the ecological model.[15–17,21,38] Pregnant women associated their perceived lack of time with school, work and household responsibilities. Interventions to improve time management skills of pregnant women are crucial to discourage women from the excuse of a 'lack of time' for PA. Such interventions would be most feasible if initiated and executed by the health providers, and in this case, the midwives, who attend to women during antenatal care in the primary healthcare clinics. Women may be more willing to take advice from their healthcare providers concerning issues affecting their maternal health; therefore, the nurses/midwifery and obstetrics ought to incorporate, in their antenatal healthcare package, time management skills focusing on encouraging PA participation during pregnancy. Healthcare providers should play a fundamental role to preach the gospel of PA benefits during pregnancy to the women, which should take precedence over the excuse of 'lack of time'. Women should be counselled to realise the importance of PA for maternal and fetal health, and as such, to create time to initiate, participate and maintain PA during and beyond pregnancy.

Another lifestyle behaviour identified by the women relates to work and household commitments, which affect their participation in PA. Most of the women indicated being exhausted after returning from work, and would rather prefer bed-rest a severe form of sedentary behaviour. The feeling of exhaustion could be explained in the light of the physiological changes that women experience during pregnancy.[39–41] These changes are beyond a woman's control, but perceived as a normal feature of pregnancy;[39] therefore, they should not be seen as a deterrent to PA participation. In a similar vein, worldwide, prenatal exercise guidelines recommend women without contraindication should participate in regular PA throughout pregnancy.[1,32,42,43] Our finding resonates with other studies which report work and family responsibilities as barriers to PA during pregnancy.[15,16,18–21] In view of the above findings, antenatal PA interventions should extend to pregnant women in the work place. Relatedly, policymakers designing maternity leave policies should ensure compulsory leave for pregnant women to participate in health programmes involving activity interventions, as this may help improve and promote their health and well-being during pregnancy, and even in the postpartum period. These initiatives are worthwhile efforts to promote self-efficacy of pregnant women in PA participation.

The women in this study reported tiredness and a lack of energy as constraining factors for PA. The women also link these factors to work, school and household commitments. The finding is consistent with other previous studies,[15,16,19,20,38] in which pregnant women also did not engage in PA because of their perceived feeling of tiredness and their low energy levels. Therefore, it is important for healthcare providers to emphasise the role PA plays in reducing fatigue symptoms.[38] Viewed within the public health context, our findings have implications for understanding and promoting PA during pregnancy. The framing of public health messages about PA during pregnancy should emphasise engagement in PA as having 'fun' and 'feeling better'. This suggests the need to design PA interventions that go beyond serving a therapeutic purpose, but to be pleasurable and transformative in nature as well so as to change some narratives or ideologies around pregnancy.

A number of women who participated in this study expressed their lack of knowledge and motivation regarding PA. Within the context of a "lack of knowledge" frame, they mentioned a lack of advice on PA recommendations by midwives as a constraining reason for non-involvement in PA during pregnancy. Previous studies have reported similar findings indicating a lack of advice from health providers concerning PA.[21,44] A study involving pregnant women from low socioeconomic status communities in Cape Town, South Africa, revealed that women did not receive PA advice and information from the healthcare providers at the clinics.[45] The onus should fall on health providers, as promotors of PA among pregnant women, to provide advice and counselling on current PA recommendations and guidelines. In contrast to our finding, the study of Santo et al.[27] found the overwhelming majority of women in a quantitative study had received PA advice from health providers. Health providers constitute an important fulcrum in maternal healthcare. Therefore, antenatal care providers should recommend appropriate advice on PA to pregnant women; it should be contextually relevant to an individual's psychosocial environment.[27] Similarly, women need support and motivation to engage in PA during pregnancy. In this study, women reported receiving no advice from midwives on the benefits of PA, and only their relatives encouraged their participation in PA, at least walking. These sentiments raised by the women in this study resonate with the reports from other studies concerning the lack of motivation by pregnant women to engage in PA.[16,19,23,24] The complex nature of the factors influencing the behaviour to initiate and engage in PA suggests inter-collaborative support of the partner, friends, and mother's groups, working synergistically with different organisations such as hospitals, community health centers, and local gyms in promoting PA in the community. Such a collaborative path would create the desirable PA awareness on where the women could find information, how to exercise, and the resources available to them.

Pregnant women in this study highlighted the lack of information on PA during pregnancy. Clearly, the women received little or no information on what types of PA they could participate in during pregnancy and whether it is safe or not. Faced with this dilemma, most of the women did not engage in PA during pregnancy. Health providers dealing with pregnant women are key in disseminating reliable and accurate scientific information on PA during pregnancy. However, as alluded to by women in this study, the midwives had rarely provided information on the types and benefits of PA during antenatal visits. Rather, some women had received such information from fellow women, family members and friends. Pregnant women, in this study and other similar studies, have reported receiving little

or no advice from their healthcare providers on PA,[15,25–27,46] so this has been viewed as an interpersonal barrier affecting their active PA lifestyle. Providing evidence-based scientific information on PA during pregnancy is a modifiable barrier; therefore, measures to provide PA advice and counselling to pregnant women are needed. This might create awareness on the benefits of PA, and thus, encourage or motivate women to maintain an active lifestyle behaviour while pregnant. Posters and pamphlets can be used to raise awareness during antenatal visits.

In this present study, the women mentioned they lacked financial resources to register at a gym or to transport themselves to the gym as a hindrance to PA. Similar to other studies, pregnant women with limited income perceived gyms to be generally very expensive, and thus a barrier to PA among pregnant women,[16,22,47] but, interestingly, neither weather nor unsafe spaces were referenced by women. On the contrary, we found the lack of finance to register at a gym or to transport to the gym as a modifiable constraining factor expressed by the women for adopting inactive behaviour during pregnancy. We speculate that the excuses given by the women are unclear: "I want to exercise, but I can't afford the price to register at the gym," and " I do not have money to pay for the gym fee and at the same time to transport myself there". Some of the pregnant women in the present study practiced walking or household activities as a form of PA, so questions around the gyms' locations being far away or having a high cost appear inconsequential to the women. At most, if not moderate-vigorous intensity exercise, pregnant women could undertake walking, which is a simple, safe, and accessible form of PA that requires no expense. Walking, including stationary cycling, aerobic exercise, dancing, resistance exercises (such as using weights or elastic bands), stretching exercises, water aerobics are examples of exercise extensively studied and proven to be safe and beneficial during pregnancy.[48] Therefore, women should be advised to engage in walking for relaxation and fun. However, moderate-vigorous intensity exercise confers more health benefits than mild intensity exercise.[49,50] Pregnancy period offers a window opportunity for behaviour modification and adoption of a healthy lifestyle because of increased motivation and frequent access to medical supervision.[51] Pregnant women are more likely to engage in PA, if encouraged by health providers to do so.[25] Nonetheless, PA counselling of pregnant women should focus on individual needs, taking into account the psychosocial contexts to achieve the desirable optimal health benefits.

4.1. Limitations

Few pregnant women were interviewed in this study; thus, it limits the generalisability of the findings to other pregnant women in the region or entire South Africa. Nevertheless, the focus was to provide insights into the modifiable factors of pregnant women PA, and not to generalise the results. In addition, it is possible to expect variation in barriers as the pregnancy advances, however, our study did not focus specifically on a particular trimester to gauge the change related to each trimester. Trimester-specific barriers could inform interventions and guide antenatal health care PA advice at specific pregnancy time points. The strength of our study lies in the fact that the ecological model was applied as a theoretical framework to guide the study and data analysis.[31]

4.2. Implications

Applying the ecological model, our study unveiled the modifiable barriers to PA in pregnant women attending antenatal healthcare. The findings pointed to understanding what interventions were relevant to address their needs to motivate and support pregnant women to engage in PA during pregnancy. Modifying the modifiable barriers to PA during pregnancy would encourage pregnant women to participate in PA, and this strategy could confer health benefits to the mother and the baby.

5. Conclusion

The findings highlight the barriers to PA participation during pregnancy, which through a change of behaviour and attitude, and assistance, are correctable. Summarily, intrapersonal barriers relating to tiredness and exhaustion, lack of time, work and household commitments, and lack of motivation were key constraining, but modifiable factors to PA by the women. Proper advice and information about the benefits, types of PA and intensity during pregnancy may motivate pregnant women to recognise the importance of PA. Armed with this knowledge, the pregnant women could create time to engage in PA, notwithstanding their work and household commitments, which have room for adjustments. Women without financial resources will also realise there are a variety of physical activities that can be performed without necessarily patronising a gym. Interventions that effectively support pregnant women to engage in PA have the potential to improve the women own and the lifelong health of their children. Therefore, support from the healthcare providers, family and friends would be valuable to motivate and ignite a change of attitude and practice towards PA by pregnant women. Viewed in this context, any antenatal intervention strategy should target these salient, but modifiable barriers to physical activity.

Author contributions

Conceptualization: Uchenna Benedine Okafor, Daniel Ter Goon.
Investigation: Uchenna Benedine Okafor.
Supervision: Daniel Ter Goon.
Writing – original draft: Uchenna Benedine Okafor.
Writing – review & editing: Daniel Ter Goon.

References

[1] Mottola M, Davenport M, Ruchat S, et al. Canadian guideline for physical activity throughout pregnancy. Br J Sports Med 2019;40:1549–59.
[2] Ojukwu CP, Anekwu EM, Okemuo AJ, et al. Antenatal exercise practices: associated factors and correlation with antenatal quality of life. J Appl Life Sci Int 2018;18:1–9.
[3] Lawan A, Awotidebe AW, Oyeyemi AL, et al. Relationship between physical activity and health related quality of life among pregnant women. Afr J Reprod Health 2018;22:80–9.
[4] Davenport MH, McCurdy AP, Mottola MF, et al. Impact of prenatal exercise on both prenatal and postnatal anxiety and depressive symptoms: a systematic review and meta-analysis. Br J Sports Med 2018;52:376–85.
[5] Davenport MH, Ruchat SM, Poitras VJ, et al. Prenatal exercise for the prevention of gestational diabetes mellitus and hypertensive disorders of pregnancy: a systematic review and meta-analysis. Br J Sports Med 2018;52:1367–75.
[6] World Health Organization. Physical Activity. 2017, Available at: http://www.who.int/topics/physical_activity/en/(accessed on 11 July, 2020).

[7] Watson ED, Norris SA, Draper CE, et al. Just because you're pregnant, doesn't mean you're sick!" A qualitative study of beliefs regarding physical activity in black South African women. BMC Preg Childbirth 2016;16:174.
[8] Lee IM, Shiroma EJ, Lobelo F, et al. Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy. Lancet 2012;380:219–29.
[9] Ding D, Lawson KD, Kolbe-Alexander TL, et al. The economic burden of physical inactivity: a global analysis of major non-communicable diseases. Lancet 2016;388:1311–24.
[10] World Health Organization. Global action plan on physical activity 2018-2030: more active people for a healthier world. Geneva, 2018. Licence: CC BY-NC-SA 3.0 IGO.
[11] Mottola MF, Davenport MH, Ruchat SM, et al. Canadian guideline for physical activity throughout pregnancy. Br J Sports Med 2018;52:1339–46.
[12] Hailemariam TT, Gebregiorgis YS, Gebremeskel BF, et al. Physical activity and associated factors among pregnant women in Ethiopia: facility-based cross-sectional study. BMC Preg Childbirth 2020;20:92.
[13] Zhang J, Savitz DA. Exercise during pregnancy among US women. Ann Epidemiol 1996;6:53–9.
[14] Gebregziabher D, Berhe H, Kassa M, et al. Level of physical activity and associated factors during pregnancy among women who gave birth in Public Zonal Hospitals of Tigray. BMC Res Notes 2019;12:454.
[15] Flannery C, McHugh S, Anaba AE, et al. Enablers and barriers to physical activity in overweight and obese pregnant women: an analysis informed by the theoretical domains framework and COM-B model. BMC Preg Childbirth 2018;18:178.
[16] Fathnezhad-Kazemi A, Hajian S. Factors influencing the adoption of health promoting behaviors in overweight pregnant women: a qualitative study. BMC Preg Childbirth 2019;19:43.
[17] Saligheh M, McNamara B, Rooney R. Perceived barriers and enablers of physical activity in postpartum women: a qualitative approach. BMC Pregnancy Childbirth 2016;16:131.
[18] Bauer C, Graf C, Platschek AM, et al. Reasons, motivational factors, and perceived personal barriers to engagement in physical activity during pregnancy vary within the BMI classes: the Prenatal Prevention Project Germany. J Phys Act Health 2018;15:204–11.
[19] White E, Pfeifer K, Holzman C, et al. Motives for and barriers to exercising across trimesters of pregnancy in health club members. Hum Mov 2020;21:21–30.
[20] O'Brien W, Lloyd K, Riot C. Exploring the emotional geography of the leisure time physical activity space with mothers of young children. Leisure Studies 2017;36:220–30.
[21] Connelly M, Brown H, van der Pligt P, et al. Modifiable barriers to leisure-time physical activity during pregnancy: a qualitative study investigating first time mother's views and experiences. BMC Preg Childbirth 2015;15:100.
[22] Alvarado M, Murphy MM, Guell C. Barriers and facilitors to physical activity amongst overweight and obese women in an Afro-Caribbean population: a qualitative study. Int J Behav Nutr Phys Act 2015;12:97.
[23] Chang MW, Nitzke S, Buist D, et al. I am pregnant and want to do better but I can't: Focus groups with low-income overweight and obese pregnant women. Matern Child Health J 2015;19:1060–70.
[24] Harrison AL, Taylor NF, Shields N, et al. Attitudes, barriers and enablers to physical activity in pregnant women: a systematic review. J of Physio 2018;64:24–32.
[25] Hayman M, Reaburn P, Alley S, et al. What exercise advice are women receiving from their healthcare practitioners during pregnancy? Women Birth 2020;33:e357–62.
[26] De Vivo M, Mills H. They turn to you first for everything": insights into midwives' perspectives of providing physical activity advice and guidance to pregnant women. BMC Preg Childbirth 2019;19:462.
[27] Santo EC, Forbes PW, Oken E, et al. Determinants of physical activity frequency and provider advice during pregnancy. BMC Preg Childbirth 2017;17:286.
[28] Marshall ES, Bland H, Melton B. Perceived barriers to physical activity among pregnant women living in a rural community. Public Health Nurs 2013;30:361–9.
[29] Fieril KP, Olsen MF, Glantz A, et al. Experiences of exercise during pregnancy among women who perform regular resistance training: a qualitative study. Phys Ther 2014;94:1135–43.
[30] Leppanen M, Aittasalo M, Raitanen J, et al. Physical activity during pregnancy: Predictors of change, perceived support and barriers among women at increased risk of gestational diabetes. Matern and Child Health J 2014;18:2158–66.
[31] McLeroy KR, Bibeau D, Steckler A, et al. An ecological perspective on health promotion programs. Health Educ Q 1988; 15:351–77.
[32] American College of Obstetricians and GynaecologistsPhysical activity and exercise during pregnancy and the postpartum period. Committee Opinion No. 650. Obstetr. Gynaecol 2015;126: e135–42.
[33] Wu F, Guo Y, Chatterji S, et al. Common risk factors for chronic non-communicable diseases among older adults in China, Ghana, Mexico, India, Russia and South Africa: the study on global aging and adult health. BMC Public Health 2015;15:88.
[34] Heindel JJ, Vandenberg LN. Developmental origins of health and disease: a paradigm for understanding disease cause and prevention. Curr Opin Pediatr 2015;27:248–53.
[35] Baird J, Jacob C, Barker M, et al. Developmental origins of health and disease: a life course approach to the prevention of non-communicable diseases. Healthcare 2017;5:14.
[36] Connolly CP, Conger SA, Montoye AHK, et al. Walking for health during pregnancy: a literature review and considerations for future research. J Sport Health Sci 2019;8:401–11.
[37] Creswell JW. Research design: qualitative, quantitative, and mixed methods approaches. 4th ed.Thousand Oaks: Sage Publication Inc; 2014.
[38] Sytsma TT, Zimmerman KP, Manning JB, et al. Perceived barriers to exercise in the first trimester of pregnancy. J Perinat Educ 2018;27:198–206.
[39] Quinlan JD, Hill DA. Nausea and vomiting in pregnancy. Am Fam Physician 2003;68:121–8.
[40] Richter JE. Gastroesophageal reflux disease during pregnancy. Gastroenterol Clin North Am 2003;32:235–61.
[41] McMurray RG, Mottola MF, Wolfe LA, et al. Recent advances in understanding maternal and foetal responses to exercise. 'Progres recents dans la comprehension des reponses maternelles et foetales a l' exercice. Med Sci Sports Exerc 1993;25:1305–21.
[42] The Royal Australian New Zealand College of Obstetricians and Gynaecologists (RANZCOG). Exercise during pregnancy. 2016. Available online: RANZCOGranzcog.edu.au'statements-guidelinesbstetrics'ex (accessed on 17 June 2020)
[43] US Department of Health and Human Services. 2018 physical activity guidelines Advisory Committee scientific report. Washington, DC, 2018. Available at: https://health.gov/sites/default/files/2019-09/PAG_Advisory_Committee_Report.pdf (accessed on 02 July, 2020).
[44] Evenson KR, Moos MK, Carrier K, et al. Perceived barriers to physical activity among pregnant women. Matern Child Health J 2009;13: 364–75.
[45] Muzigaba M, Kolbe-Alexander TL, Wong F. The perceived role and influencers of physical activity among pregnant women from low socioeconomic status communities in South Africa. J Phy Act Health 2014;11:1276–83.
[46] Duthie EA, Drew EM, Flynn KE. Patient-provider communication about gestational weight gain among nulliparous women: a qualitative study of the views of obstetricians and first-time pregnant women. BMC Preg Childbirth 2013;13:231.
[47] Da Costa D, Ireland K. Perceived benefits and barriers to leisure-time physical activity during pregnancy in previously inactive and active women. Women Health 2013;53:185–202.
[48] Berghella V, Saccone G. Exercise in pregnancy!. Am J Obstet Gynecol 2017;216:335–7.
[49] Barakat R, Perales M, Garatachea N, et al. Exercise during pregnancy. A narrative review asking: what do we know? Br J Sports Med 2015; 49:1377–81.
[50] Harrison AL, Shields N, Taylor NF, et al. Exercise improves glycaemic control in women diagnosed with gestational diabetes mellitus: a systematic review. J Physiother 2016;62:188–96.
[51] Physical Activity and Exercise during Pregnancy and the postpartum periodACOG Committee Opinion No. 804. American College of Obstetrics and Gynaecology. Obstetric Gynaecol 2020;135:e178–88.

CHAPTER SEVEN

UNCOVERING BARRIERS TO PRENATAL PHYSICAL ACTIVITY AND EXERCISE AMONG SOUTH AFRICAN PREGNANT WOMEN: A CROSS-SECTIONAL, MIXED-METHOD ANALYSIS

7.1 INTRODUCTION

The manuscript presented in this chapter responded also to specific objective three, and using the mixed-method analysis assessed the barriers to prenatal physical activity and exercise among South African women in the Eastern Cape Province. Applying a mixed-methods approach provides a unique, deeper insights or understanding of the barriers to prenatal physical activity by integration of both quantitative and qualitative data, than either approach alone.

7.2 PUBLICATIONS DETAILS

Title:	Uncovering barriers to prenatal physical activity and exercise among south African pregnant women: a cross-sectional, mixed-method analysis
Authors:	UB Okafor, DT Goon
Ethics:	University of Fort Hare Health Research Ethics Committee approved the study protocol (Ref#2019 = 06 = 009 = OkaforUB)
Journal:	Frontiers in Public Health
Journal details:	Peer-reviewed (blinded) Journal approved and listed on the Department of Higher Education and Training (DHET)
Status:	Accepted https://www.frontiersin.org/articles/10.3389/fpubh.2022.697386/full
Impact factor	3.709

7.3 PUBLICATION RECORD

The article was submitted to the journal on the 19 April 2021, and it was accepted on 14 March 2022.

Uncovering Barriers to Prenatal Physical Activity and Exercise among South African Pregnant Women: A Cross-Sectional, Mixed-Method Analysis

Uchenna Benedine Okafor[1*] and Daniel Ter Goon[2]

[1]Department of Nursing Science, University of Fort Hare, 50 Church Street, East London, 5201, South Africa. ucheysonic@gmail.com

[2]Department of Public Health, University of Fort Hare, 5 Oxford Street, East London, 5201, South Africa.

* Correspondence: ucheysonic@gmail.com

Background: The barriers to prenatal physical activity and exercise have been widely reported in the literature, highlighting context-specific challenges. However, generally, research on prenatal physical activity and exercise among pregnant women in South Africa is rare; and particularly concerning the barriers to their prenatal physical activity practice. This study assessed the barriers to physical activity participation among pregnant women in the Eastern Cape, South Africa.

Methods: This was a sequential explanatory mixed method, predominantly quantitative study involving 1082 pregnant women. A structured self-administered questionnaire on perceived barriers to physical participation was applied to collect quantitative data; while a subset of 15 pregnant women participated in individual in-depth semi-structured interviews to augment quantitative data. Quantitative and qualitative data were analysed using descriptive statistics and thematic analysis, respectively.

Results: The results of the quantitative analysis presented major barriers: lack of advice on prenatal physical activity and inadequate or conflicting information about prenatal physical activity; tiredness; work commitments; discomfort; lack of time; low energy; non-accessibility to physical activity; lack of financial resources, and safety concerns for the mother and the baby. Qualitatively, the barriers identified relate to four main themes: individual, lack of information, lack of resources, and environmental barriers.

Conclusions: The major barriers cited by the women were tiredness, lack of time, discomfort, and low energy. They also include lack of support, advice and information about prenatal physical activity. The multiple constraining factors responsible for low or non-prenatal

physical activity of pregnant women in this setting highlight the need to tailor interventions to address their individual uniquely perceived barriers.

Keywords: physical activity, exercise, barriers, pregnant women

INTRODUCTION

Worldwide, and in the limited studies in South Africa (1-5), prenatal physical activity and exercise reportedly remain low, despite their benefits for the mother's health and that of the unborn child, and even beyond childbirth. Existing literature indicates context-specific limiting factors–social, economic, and cultural ones affecting women's decisions to initiate, participate and continue physical activity and exercise during pregnancy. In addition, the physiological and anatomical changes during pregnancy could constitute barriers to physical activity (6).

The factors hindering physical activity participation during pregnancy are multi-dimensional and geographically specific. The most commonly and frequently cited barriers to physical activity during pregnancy are tiredness, pregnancy symptoms and discomfort (1,7-9); lack of strength or fatigue (5,7,8), lack of time (1,7,8,10), lack of motivation (5,11,12), lack of social support (13-15), and concern about the safety of physical activity for the baby and the mother (5,11,16-18). In addition, cultural and religious beliefs (19,20), and children, work, and family responsibilities or commitments (15,21-23) are also consistently listed as constraining factors to physical activity during pregnancy. Environmentally, limited accessibility to facilities and resources (24,25), and bad weather conditions (8,15,24) are considered deterrents to physical activity. These barriers have a profound influence in restraining physical activity participation, and research is needed to clarify the issues and indicate solutions.

An understanding of the barriers preventing women from being physically active during pregnancy is important to inform future interventions to improve physical activity levels in pregnancy. However, generally, research on prenatal physical activity and exercise among pregnant women in South Africa is rare; and to the best of the author's knowledge, there are very few studies, if any, applying a mixed-method approach to assess the barriers to physical activity and exercise among pregnant women in the Eastern Cape Province. Applying a mixed-methods approach would provide unique, deeper insights or understanding of the barriers to prenatal physical activity by integration of both quantitative and qualitative data, than either approach alone (26-28). Therefore, the objective of this study was to identify and

explore the underlying factors restraining pregnant women from physical activity and exercise during pregnancy in Buffalo City Municipality, Eastern Cape, South Africa.

MATERIALS AND METHODS

Study Setting, Participant, and Design

The study was conducted among pregnant women in Buffalo City Municipality in Eastern Cape Province, South Africa. Data was collected from July to October 2019. The details describing the study setting has been described elsewhere (29). A health-facility based sequential explanatory mixed method (quantitative and qualitative) approach was used to identify and explore barriers to prenatal physical activity and exercise through a structured questionnaire and in-depth individual interviews. The qualitative research was used to provide in-depth information on barriers to physical activity during pregnancy which might not have being listed in the quantitative questionnaire, thereby also granting the women an opportunity to express their views without limitation.

First, we applied a random table selection technique to select 12 primary health clinics out of the 72 health facilities in Buffalo City Municipality; next, we approached the women attending antenatal appointments and explained the aim and nature of the study to them; after that we conveniently selected those who were willing and eligible to participate in the study. Hence, the study was conducted at the health clinics, convenient sample was deemed appropriate because of cost and easy accessibility of the participants.

Participants were included in the study if 18 years and above, receiving antenatal care in the selected health clinics, single pregnancy, and could read or understand the IsiXhosa, Afrikaans or English languages. We excluded women with disabilities or reasons to cease exercise at the time of recruitment such as “persistent excessive shortness of breath, dizziness or faintness that does not resolve on rest, regular and painful uterine contractions, vaginal bleeding, severe chest pain, and persistent loss of fluid from vagina indicating rupture of the membranes”(30).

The Sarmah et al. (31) formulae was applied to calculate the sample size, which has been reported in a previous publication (32). We recruited 1215 participants in the quantitative study; however, due to eligibility concerns, refusal and missing information on medical records, 1082 were eventually included in the data analysis. Twenty-four pregnant women attending antenatal healthcare appointments in the selected health clinics were purposively

selected to participate in the qualitative interviews, that is, two pregnant women per selected primary health clinic who met the inclusion criteria were selected for interview. However, due to interview data saturation, 15 pregnant women comprised the participated in individual in-depth semi-structured interviews during antenatal visits.

Ethical Considerations

The study protocol was approved by the University of Fort Hare's Health Research Ethics Committee (Ref#2019=06=009=OkaforUB). In addition, permission was obtained from the Eastern Cape Department of Health and from all the selected health clinics before data collection. The nature and aim of the study was explained to the participants. They were assured of voluntary participation and could withdraw from the study at any time, without any prejudice or penalty. Women who accepted to participate in the study provided their written informed consent. The confidentiality, anonymity and rights of the participants were strictly adhered to and respected.

Quantitative Data

Quantitative data were collected in 12 selected health clinics by the primary investigator (BUO) and the research assistants. Interviewer-administered structured closed-ended questionnaire was used to collect quantitative data on socio-demographic (racial affiliation, marital status, religion, employment status, and family support); lifestyle behaviours (smoking and alcohol use); obstetrics or maternal (parity, mode of pregnancy delivery, antepartum haemorrhage); and anthropometric (pregravid body mass index) characteristics of participants. The latter part of the questionnaire solicits participant's information on the perceived barriers to prenatal physical activity and exercise. The items on the perceived barriers to prenatal physical activity and exercise were self-developed based on extensive review of the literature (7,11,13,15,16,21,22,33). We defined barriers as anything hindering one from engaging in physical activity or exercise (34).

Qualitative Data

The interviews were conducted in English and lasted between 45 and 60 minutes in a quiet health facility room to ensure a non-threatening, comfortable and free environment, which encouraged freedom of speech. Participants gave consent to audio-record their interviews, which were transcribed verbatim. The participants expressed their views freely on the barriers to prenatal physical activity. To ensure accuracy and validity, the transcripts were cross-checked with the audio-recorded interviews, and similarly, participants were provided with

the interview transcripts and emergent themes for comment and confirmation regarding the accuracy of the interviews.

Data Analysis

We analysed the quantitative and qualitative datasets separately. Descriptive statistics of mean, frequency and percentages were used to analyse the quantitative data using the Statistical Package for Social Sciences (SPSS) (Version 24.0, IBM SPSS, Chicago, IL, USA); while the in-depth semi-structured interviews were analysed using the thematic content analysis method, following Tesch's procedure for qualitative analysis (35). An independent coder analysed the transcripts and identified emerging themes. Applying the principles of explanatory sequential mixed methods study design (26), both the quantitative and qualitative results were merged and interpreted as a comprehensive summary of the total findings (26). Shown in Figure 1 is the mixed methods design flow chart.

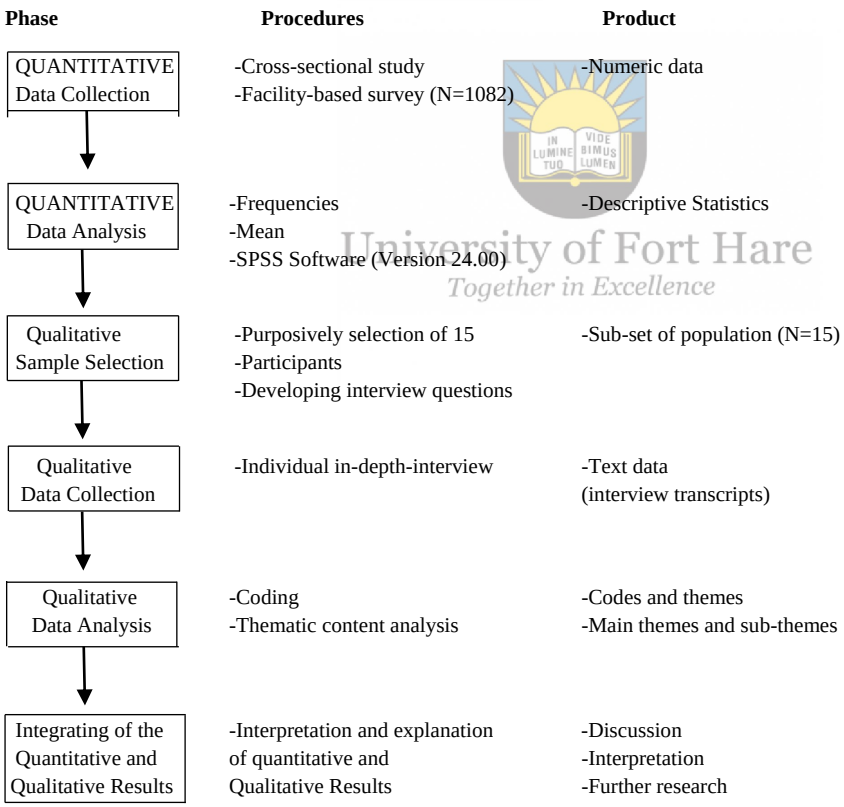


FIGURE 1 Chart flow of the mixed methods of the study

RESULTS

Quantitative

The participants' socio-demographic, obstetrics and lifestyle characteristics are have been described elsewhere (36,37). The mean age of the participants was 27.0 ± 6.2 years. Briefly, most of the participants were of black race (86.4%), had never married (66.3%), and had a secondary education (74.2%). Additionally, 67.7% were unemployed, had not experienced antepartum haemorrhage (93.6%), and were having both a vaginal and Caesarian (49.7%) delivery. The majority of the participants had a normal pregnancy body mass index (18.5-24.9 kg/m^2) (84.8%), nearly two-thirds received no physical activity advice (64.7%), had not participated in pre-pregnancy physical activity (65.1%), and had failed to participate in physical activity during pregnancy (69.6%).

Shown in Table 1 are the barriers to physical activity and exercise. The major barriers to physical activity and exercise cited by the women were inadequate information from healthcare professionals (85.3%), feeling of tiredness (73.3%), lack of advice from healthcare professionals (nurses/midwives) (64.7%), and low energy (64.5%). Other barriers included insufficient and contradictory information (64.8%), non-accessibility to physical activity facilities (63.0%), lack of transport to the gym for exercise (82.3%) and the money to pay for the gym fee (80.1%).

Qualitative

The mean age of participants interviewed was 29.4 ± 3.2 years (n =15). The characteristics of the participants have been described elsewhere (38). Four main themes regarding the barriers to prenatal physical activity were identified (Table 2).

Individual barriers

Tiredness as a physical constraint was the barrier mentioned most by the participations. The participants expressed feeling tired after work and performing household chores and other commitments. They further expressed that they lacked the time to engage in physical activity or exercise. They narrated thus:

"*I am always tired after work.*"

"*I am lazy to exercise.*"

"*I am always tired, sister; I rather sit at home and watch television.*"

The participants further maintained they feel exhausted and have low energy, that is, not enough to engage in physical activity during pregnancy:

"*I usually have low energy to do anything*."

"*I usually feel so heavy, especially now that I am close to my delivery. I feel … carrying heavy load ...I feel exhausted ….to sleep non-stop*."

TABLE 1 Barriers to physical activity and exercise (n=1082)

Barriers	Response distribution			
	SA n (%)	A n (%)	D n (%)	SD n (%)
Feeling of tiredness	194 (17.9)	599 (55.4)	212 (19.6)	77 (7.1)
Low energy	175 (16.2)	523 (48.3)	329 (30.4)	55 (5.1)
Feeling of illness and morning sickness	86 (8.0)	261 (24.1)	635 (58.7)	100 (9.2)
Feel nausea, vomiting and back pain	97 (9.0)	257 (23.7)	622 (57.5)	106 (9.8)
Feeling of discomfort	74 (6.8)	473 (43.7)	417 (38.6)	118 (10.9)
No one to exercise with	64 (5.9)	499 (46.1)	399 (36.9)	120 (11.1)
Advised to avoid exercise	86 (8.0)	255 (23.6)	640 (59.1)	101 (9.3)
Lack of support from family or friends	45 (4.2)	322 (29.8)	616 (56.9)	99 (9.1)
Partner and family dislike my involvement in physical activity	28 (2.6)	172 (15.9)	766 (70.8)	116 (10.7)
Conflicting advice about physical activity and exercise	88 (8.1)	579 (53.5)	308 (28.5)	107 (9.9)
Cultural dislike or disapproval	12 (1.1)	112(10.4)	811 (74.9)	147 (13.6)
Work commitment	83 (7.7)	253 (23.4)	529 (48.9)	217 (20.1)
Childcare and responsibilities	89 (8.2)	275 (25.4)	573 (53.0)	145 (13.4)
Lack of transport to go to the gym	391 (36.1)	500 (46.2)	120 (11.1)	71 (6.6)
Lack of recreational facilities in the area	130(12.0)	457 (42.3)	408 (37.7)	87 (8.0)
Lack of money to pay for gym fee	273 (25.2)	594 (54.9)	145 (13.4)	70 (6.5)
Lack of access to physical activity facilities	204 (19.0)	476 (44.0)	345 (31.7)	57 (5.3)
Environment not safe to exercise	54 (5.0)	351 (32.4)	572 (52.9)	105 (9.7)
Weather conditions	52 (4.8)	380 (35.1)	183(16.9)	467 (43.2)
Lack of advice and support on the benefits of physical activity	129 (11.9)	568 (52.5)	325 (30.0)	60 (5.6)
Insufficient and contradictory information	237 (22.0)	463 (42.8)	272 (25.0)	110 (10.2)
Lack of advice from healthcare professionals	218 (20.2)	482 (44.5)	268 (24.8)	114 (10.5)
Lack of clear advice about the intensity and dose of exercise	322 (29.8)	601 (55.5)	130 (12.0)	29 (2.7)
Large body weight	37 (3.4)	141 (13.0)	739 (68.3)	165 (15.3)

SA = Strongly agree, A = Agree, D = Disagree, SD = Strongly disagree

TABLE 2 Themes and sub-themes reflecting the responses of pregnant women regarding barriers to physical activity during pregnancy

Themes	Sub-themes	Example quotes
Individual or personal barriers	Physical constraints (fatigue, laziness, dizziness, nausea)	*"My mother and mother in-law sometimes asked me to exercise but it is hard for me to exercise because I am always tired after work."* *"So, for me, I am lazy to exercise. I like to stay at home rather than to walk around."* *"Well I think that if the woman feels comfortable to continue physical activity during pregnancy…she can do it. Yhoooo, but me, I can't because I am too lazy to exercise, I just want to sleep."* *"I am always tired, sister. I rather sit at home and watch television"* *"I get too tired to do exercise during pregnancy"* *"I still feel nauseous and vomit non-stop."* *"In the morning or when I take that medication…you dissolve in water (calcium carbonate). After the vomit, I don't want to do anything"* *"I still vomit but not always like before, only certain food (smell) still make me vomit or nauseous."*
	Body exhaustion	*"I usually have low energy to do anything, but I don't vomit and I no longer feel morning sickness."* *"My area is safe to exercise but I don't have energy"* *"I usually feel so heavy especially now that I am close to my delivery. I feel like I am carrying heavy load, so after work, when I came back, I feel tired and want to sleep non-stop."*
	Safety concerns	*"I was not thinking that a pregnant woman should be exercising because for me, what if she gets hurt and ends up hurting her baby?"* *"I thought it's dangerous to the baby, maybe it may cause an abortion or maybe I might bleed or hurt the baby."* *"Sister, there is something I didn't tell you before, back at home especially we Africans, I was told that it is not good to exercise during pregnancy: one must avoid hurting oneself as well the baby."*
	Lack of time	*"Another reason why I don't exercise is a lack of time. My classes start by 08:00 and end by 14: 00 every day, so that's why I get so tired all the time. It's like I don't have enough energy to do anything, not even to study my books these days. And when I am not doing anything - especially during weekends - I sit around, I also watch television."* *"I don't exercise regularly because of the time factor"*
	Work, school, household and childcare responsibilities	*"I am usually tired after work."* *"I also feel tired but I must finish preparing food, doing washing and cleaning. Most times I look after my sister's child the whole day, it is tiring."* *"Well, I don't exercise but I also do a lot of other things, I walk around a lot, and when I get a job, I clean, wash, iron and sometimes cook. I think that is enough for me."* *"I also feel tired after I come back from school. And by weekends, is the only time I rest and do my laundry and cleaning."*
Lack of information barriers	Lack of knowledge on the importance of physical activity during pregnancy	*"No Ma'am, they don't really talk about it, except one time the sister said to me that I should walk a lot now that I am pregnant because it is good. Other than that, no they did not tell us about any benefit and how often or the type of physical activity to do during pregnancy."* *"I was not told about the health benefits of physical activity during pregnancy."* *"I don't have enough information on exercise during pregnancy."* *"I don't know that exercise is recommended during pregnancy."* *"I don't know the type of exercise and the duration of the exercise."* *"I have no idea that a pregnant woman should exercise during pregnancy."*
	Lack of prenatal physical activity advice or counselling from midwives	*"I didn't received any information about physical activity and exercise during pregnancy, not even from the nurses."* *"I have never been told about physical activity during pregnancy by a nurse."* *"Yhoo!! I am not aware of physical activity during pregnancy nor the type of physical activity to do during pregnancy."*
Lack of resources barriers	Insufficient finances	*"I usually find it difficult to exercise, not because I don't want to, but the price to register in the gym is costly. I'm not working."* *"Yhooooo!!! Where I stay is very far from the gym, so it is very inconvenient for me."* *"About gyming, yhooo!!! Gym, noooooo!!! I don't gym, even if I wanted to, I don't have money to register at the gym."*
Environmental barriers	Weather conditions	*"The weather is so cold, even now that I am talking with you, I am feeling cold."* *"I can't exercise in this cold weather."* *"Weather is cold for exercise."* *"In this weather, yhooo!! It's still cold, sister."* *"The weather is so cold. I can't exercise in this cold weather."*
	Safety neighbourhood	*"My area is not safe for someone to go out and exercise."* *"Fear of being attacked by criminals in the street while walking or jogging late evening".*

The women felt concern about the safety of physical activity during pregnancy. They indicated that participating in physical activity would hurt the mother and the baby. They narrated:

"*I .... what if she gets hurt and ends up hurting her baby*?"

"*I thought it's dangerous to the baby, maybe it may cause an abortion or maybe I might bleed or hurt the baby*."

"*I was told it is not good to exercise during pregnancy; one needs to avoid hurting oneself as well the baby*."

Furthermore, the lack of time was a factor restraining the women from prenatal physical activity. The lack of time was related to their household and work commitments. Some of the women highlighted thus:

"*I'm too busy doing other things in the house. I have not time because I don't have someone to help me. Sisi, time, time is my problem*."

"*I don't exercise regularly because of time*."

"*I am usually tired after work*."

"*I also feel tired after I come back from school. And by weekends, is the only time I rest and do my laundry and cleaning*."

Lack of information

The participants mentioned a lack of knowledge of the importance of physical activity during pregnancy as another barrier to their prenatal physical activity practice. They maintained having no or limited knowledge about prenatal physical activity. In addition, the midwives whom they consult during antenatal healthcare sessions, did not provide advice or counselling about physical activity during pregnancy. They highlighted as follows:

"*I don't have enough information on exercise during pregnancy*."

"*I don't know the type of exercise and the duration of the exercise*."

"*I didn't receive any information about physical activity and exercise during pregnancy, not even from the nurses*."

"*Yhoo!! I am not aware of physical activity during pregnancy, nor the type of physical activity to do during pregnancy*."

3.2.3. Lack of resources. The women expressed that they lacked the resources to afford registration at a gym and could not pay for it. They maintained:

"*The price to register at the gym is high. I cannot afford the price. I'm not working*".

"*Yhooooo!!! Where I stay is very far from the gym, so it is very inconvenient for me*."

"*I don't gym; even if I wanted to, I don't have money to register at the gym*."

Environmental barriers

Most of the participants indicated that generally, their areas are not safe to go out for physical activity or exercise. The cold weather do sometimes constitute a barrier to their prenatal physical activity or exercise practice. In addition, the fear of being attacked by some criminal individuals in the street is possible. They narrated thus:

"*My area is not safe for someone to go out and exercise because of fear of being attacked by criminals in the streets, especially if it is late in the evening."*
"It is sometimes very cold in the winter season to go out for walking or jogging in the street."
Sometimes the weather is too cold, as you can feel it now. I can't exercise in this cold weather."

"I feel the weather is too cold to go out for jogging or walking."

DISCUSSION

This is the first study to use a mixed-methods approach to assess the barriers to prenatal physical activity among pregnant women in the Eastern Cape Province, in South Africa. Understanding the reasons restraining pregnant women from being physically active during pregnancy may provide useful information on how to design context-specific interventions to address the factors in order to promote prenatal physical activity in this region. The present study revealed that inadequate information from healthcare professionals about the intensity and dose of exercise, lack of advice from healthcare professionals (nurses/midwives), insufficient and contradictory information about prenatal physical activity, and conflicting advice about physical activity and exercise hinders women from practising prenatal physical activity. We confirmed the above findings in the qualitative findings. The participants repeatedly mentioned that the midwives do not offer advice on prenatal physical activity. Our

results thus align with findings from other qualitative studies which reported women receiving no or minimal and ineffective physical activity counselling (1,18). As maintained by Sytsma et al.(7) effective counselling of pregnant women entails the need to identify and understand the barriers to prenatal physical activity; furthermore, it was found that women who received physical activity advice or counselling from healthcare providers are more likely to practise and maintain their physical activity levels (33,39,40). Notably, health care providers are faced with challenges in providing effective prenatal physical counselling, which include a lack of adequate education/training, limited resources and time to address issues pertaining to prenatal physical activity with the women during antenatal consultations (40-42). Nevertheless, information from healthcare providers is very important to pregnant women seeking answers to questions about their maternal health; therefore, addressing their individuals concerns and needs based on scientific evidence would empower women to take informed decisions or choices regarding their maternal health, and in this regard, prenatal physical activity.

Our findings in the quantitative phase of this study showed that tiredness, exhaustion, discomfort, and low energy are the barriers to their physical activity participation. The findings from qualitative findings mirrored the quantitative results. Tiredness, fatigue, work commitments, lack of time have been widely reported in the literature as barriers to physical activity participation during pregnancy (7,9,13,16-18,22,33). The participants in the current study repeatedly mentioned that tiredness linked to work and household responsibilities, was a predominate barrier to their physical activity participation; exacerbated by lack of time and feelings of exhaustion drastically limiting their exercise or initiation of any physical activity. As quoted, "*I am always tired after work*" and "*I don't exercise regularly because of time*" spoke to this. In addition, the participants echoed having low energy to engage in physical activity during pregnancy. In other qualitative studies of black South African pregnant women, pregnancy-related discomforts and a lack of time were the perceived barriers to physical activity (1,5); other studies echoed similar findings (7,8,10). Although the physiological changes affecting women- especially in early pregnancy such as nausea, morning sickness and vomiting, were rarely reported among women in this present study, both in the quantitative and qualitative data. A previous study have shown that these physical physiological variables affect the level of prenatal physical activity and exercise (7).

Other barriers mentioned by the women in this present study included the non-accessibility to physical activity facilities and lack of recreational facilities. Pregnant women without access to some basic equipment, facilities, or instructor guidance may limit their

participation in physical activity (9,43-45). Provision of access to appropriate and affordable exercise facilities in the community may aid in facilitating the promotion of physical activity during pregnancy (46,47).

Similar to other studies (1,24,48,49), women in this current study reported a lack of financial resources to register and pay for gym exercise as a barrier for prenatal physical practice, a finding, stressed in the qualitative finding. "*The price to register at the gym is high. I cannot afford the price. I'm not working*". Maternal employment is associated with prenatal physical activity practice as women who are unemployed tend to have lower prenatal physical activity (32).

It has been demonstrated that physical activity is safe for both the mother and fetus; it is associated with minimal or rare adverse health complications and is associated with the likelihood of reduced preterm birth, low birth weight, fewer miscarriage and perinatal mortality (33,49-52). The present study demonstrated that pregnant women felt concern about their safety and the baby during physical activity in pregnancy. This resonated more prominently during the qualitative interviews in which women expressed concern that participating in physical activity may harm the baby. For example, "*I ...what if she gets hurt and ends up hurting her baby*?" In studies reporting both quantitative (16,53) and qualitative (11,17,18) findings, women expressed the fear of hurting the baby during physical activity in pregnancy. Our study echoed the findings of Muzigaba et al. (5) whose study indicated most pregnant women were unsure of the safety of exercising during pregnancy and unaware of what type of exercise or physical activity is safely recommended (5). Importantly, in the absence of any contraindications, pregnant women should be encouraged to engage in physical activity; and follow advice regarding prenatal physical activity provided to them regarding the benefits of physical activity in pregnancy (49). This, again, stressed the need for providing prenatal counselling to change the perception and behaviour of women towards physical activity in order to improve their physical activity levels during pregnancy.

The findings of this study revealed participating in outdoor physical activity or exercise, for example, jogging and walking is not safe, and the weather constitute a barrier to physical activity or exercise during pregnancy. One-third of the participants perceived the neighbourhood environment (37.4%) and cold weather (39.9%) as barriers. This was certainly supported during the individual interview conversations. The participants indicated that the fear of being attacked by some criminal individuals in the street was possible. "*It is sometimes very cold in winter season*". Women avoided exercising in the neighbourhood streets and public open spaces because of a perceived fear of personal safety (48,54,55).

Seemingly, the women feel more vulnerable to street crime compared to their male counterparts. The fear of unleashed dogs is also possible. However, these variables were not investigated. The findings underscored the need for safe neighbourhood and public space interventions for prenatal physical activity. Neighbourhood safety may affect the practice of outdoor physical activities, and the utilisation of public physical activity facilities such as parks, sports clubs, fitness centres and gyms (56). According to Uddin et al. (57) improving neighbourhood safety requires a multidisciplinary approach involving the government provision of infrastructure, local policing and the participation of the local community. Notably, this present study was conducted in a semi urban area; therefore, the issue of personal safety as a barrier seems inconsequential. Although weather was not mentioned as a major barrier to physical activity among pregnant women in our study, other studies cited weather condition as a top deterrent to physical activity (9,11,48). Contrastingly, a previous study conducted in the USA, cited weather as a lesser barrier to physical activity (54). The issue of weather is seasonal and varies in different geographical settings. Notwithstanding this connotation, interventions to encourage women to exercise indoors, when the weather conditions are inclement, are desirable. The public physical activity and recreational places should be provided with adequate security and protection from rain and cold; this could help to motivate pregnant women to engage in regular physical activities.

Implications

This study presents several barriers to prenatal physical activity practice among women in this setting. The findings of this present study might be relevant in different contexts: public health, policy health advisors, and health practitioners concerned with prenatal health of the women. Pointedly, the several barriers reported herein, and in the literature, suggest the need for information sharing and education. These findings from both the quantitative and qualitative approaches regarding the barriers to physical activity during pregnancy among pregnant women in this present study present some salient suggestions for developing context-specific interventions to address the barriers reported by the women in this setting. Seemingly, possible interventions in this regard may include providing advocacy on prenatal physical activity and exercise at the health facilities, where women attend antenatal healthcare; this could be extended at the community level to involve a multidisciplinary healthcare team concerned with maternal health; it could also include printed matter and social media. In addition, we advocate for the need to infuse prenatal physical activity into the curriculum of medical and healthcare professions and the training of healthcare providers

on prenatal physical activity prescription, recommendations and guidelines. In turn, the healthcare providers would be better equipped to offer physical activity advice based on scientific evidence during prenatal care. Prenatal care presents a good opportunity to counsel women to achieve an active lifestyle for improved perinatal health outcomes (56). The advocacy dictum 'Exercise is Medicine' should be imbibed by healthcare providers to improve the uptake of physical activity during pregnancy; and interventions should focus on individuals' unique needs to be effective. Furthermore, it should be a priority for city policymakers to create recreational facilities for physical activities that women could engage in outside the home setting.

Limitations

The limitations of the study are worth noting. First, we used a self-reported questionnaire to assess barriers, which may be subject to bias and individual interpretation. Secondly, we investigated an important health behaviour for pregnant women, in a diverse, understudied and predominantly black population; however, the study made use of a sample of women seeking only antenatal healthcare in public health facilities in Buffalo City Municipality in the Eastern Cape Province. Therefore, the findings of this study cannot be generalised to pregnant women attending private health facilities nor to other regions of the Eastern Cape or provinces in South Africa. In addition, we qualitatively explored the barriers to physical activity with a relatively small percentage of the women under study, which further limits generalisation of the results of the study. However, the primary focus of conducting qualitative study is to gain insights on a matter, rather than to generalise the findings.

Future studies in other settings of South Africa are needed to provide a wider context of the constraining factors for prenatal physical activity of women to inform wide-scale governmental and community-based interventions to address the barriers. In addition, longitudinal studies are needed to ascertain the barriers to physical activity pre, during and after pregnancy, as ours was a cross-sectional study. It is also important to determine which prenatal physical activity interventions are most effective over time.

CONCLUSION

The findings of this study highlight a range of constraining factors that hinder pregnant women to engage in prenatal physical activity. Majorly, women reported tiredness, lack of time, exhaustion, discomfort, and low energy. In addition, they mentioned lack of advice,

information and support about prenatal physical activity. These findings calls for a context-specific interventions to address the barriers to prenatal physical activity in this setting.

AUTHOR CONTRIBUTIONS

Conceptualization and drafting of manuscript, UBO and DTG. Data collection, UBO. Review and editing, DTG. Supervision, DTG. All authors read and approved the final manuscript.

CONFLICT OF INTERESTS

The authors declares no conflicts of interest.

ACKNOWLEDGEMENTS

The Govan Mbeki Research and Development Centre, University of Fort Hare. the participants for participating in the study; the Eastern Cape Department of Heath for granting permission to conduct the study in selected health facilities in Buffalo City Metro Municipality District; and the Research Assistants for their assistance in data collection.

FUNDING

The work reported herein was made possible through funding by the South African Medical Research Council through its Division of Research Capacity Development under the Bongani Mayosi National Health Scholars Programme from funding received from the Public Health Enhancement Fund/South African National Department of Health. The content hereof is the sole responsibility of the authors and does not necessarily represent the official views of the SAMRC.

DATA AVAILABILITY STATEMENT

The data available for this study is available on request.

REFERENCES

1. Watson ED, Norris SA, Draper, CE, Jones RA, van Poppel MNM, Micklesfield LK. “Just because you’re pregnant, doesn’t mean you’re sick!” A qualitative study of beliefs regarding physical activity in black South African women. *BMC Preg. Childbirth* (2016) 16:174. doi: 10.1186/s12884-016-0963-3.
2. Watson ED, Van Poppel MNM, Jones RA, Norris SA, Micklesfield LK. Are South African mothers moving? Patterns and correlates of physical activity and sedentary behaviour in pregnant black South African women. *J. Phys. Act. Health* (2017) 14:329-335. doi: 10.1123/jpah.2016-0388.
3. Watson, ED, Brage S, White T, et al. The influence of objectively measured physical activity during pregnancy on maternal and birth outcomes in urban black South African women. *Matern. Child Health J*. (2018) 22:1190-1199. doi: 10.1007/s10995-018-2504-3.

4. Brunette EL, Kotze J, Wood PS, Du Toit PJ, Grant CC. An epidemiological study of physical activity patterns and weight gain in physically active and sedentary pregnant women in Tshwane, South Africa. *Afr. J. Phy. Health Edu. Recreat. Dance* (2012) 18:132–143.
5. Muzigaba M, Kolbe-Alexander TL, Wong F. The perceived role and influencers of physical activity among pregnant women from low socioeconomic status communities in South Africa. *J. Phys. Act. Health* (2014) 11:1276-1283. doi: 10.1123/jpah.2012-0386.
6. Soma-Pillay P, Nelson-Piercy C, Tolppanen H, Mebazaa A. Physiological changes in pregnancy. *Cardiovasc. J. Afr.* (2016) 27:89-94. doi: 10.5830/CVJA-2016-021.
7. Sytsma TT, Zimmerman KP, Manning JB, et al. Perceived barriers to exercise in the first trimester of pregnancy. *J. Perinat. Educ*. (2018) 27:198-206. doi: 10.1891/1058-1243.27.4.198.
8. Whitaker KM, Wilcox S, Liu J, Blair SN, Pate RR. Pregnant women's perceptions of weight gain, physical activity, and nutrition using Theory of Planned Behaviour constructs. *J. Behav. Med*. (2016) 39:41-54. doi: 10.1007/s10865-015-9672-z.
9. Cadmus-Bertram LA, Gorzelitz JS, Dorn DC, Malecki KMC. Understanding the physical activity needs and interests of inactive and active rural women: a cross-sectional study of barriers, opportunities, and intervention preferences. *J. Behav. Med*. (2020) 43:638-647. doi: 10.1007/s10865-019-00070-z.
10. O'Brien W, Lloyd K, Riot C. Exploring the emotional geography of the leisure time physical activity space with mothers of young children. *Leisure Stud*. (2017) 36:220-230, doi: 10.1080/02614367.2016.1203353
11. Koleilat M, Vargas N, Kodjebacheva G. Perceived barriers to physical activity during pregnancy among participants of the special supplemental nutrition program for women, infants and children (WIC) in Southern California. *FASEB J.* (2016) 30: (1 Supplement). doi.org/10.1096/fasebj.30.1_supplement.152.2
12. Babbar S, Chauhan SP. Exercise and yoga during pregnancy: A survey. *J. Matern. Fetal Neonatal Med*. (2015) 28:431-435. doi: 10.3109/14767058.2014.918601.
13. Harrison AL, Taylor F, Nora Shields N, Frawley HC. Attitudes, barriers and enablers to physical activity in pregnant women: A systematic review. *Physiother.* (2018) 64:24-32. doi: 10.1016/j.jphys.2017.11.012.
14. Ekelin M, Langeland Iversen M, Grønbæk Backhausen M, Hegaard HK. Not now but later—A qualitative study of non-exercising pregnant women's views and experiences of exercise. *BMC Preg. Childbirth* (2018) 18:399. doi: 10.1186/s12884-018-2035-3.
15. Leppanen M, Aittasalo M, Raitanen J, Kinnunen TI, Kujala UM, Luoto R. Physical activity during pregnancy: Predictors of change, perceived support and barriers among women at increased risk of gestational diabetes. *Matern. Child Health J.* (2014) 18:2158–2166. doi: 10.1007/s10995-014-1464-5.
16. Haakstad LAH, Vistad I, Sagedal LR, Lohne-Seiler H, Torstveit MK. How does a lifestyle intervention during pregnancy influence perceived barriers to leisure-time physical activity? The Norwegian fit for delivery study, a randomized controlled trial. *BMC Preg. Childbirth*. (2018) 18:127. doi.org/10.1186/s12884-018-1771-8.
17. Vanstone M, Kandasamy S, Giacomini M, DeJean D, McDonald SD. Pregnant women's perceptions of gestational weight gain: A systematic review and meta-synthesis of qualitative research. *Matern. Child Nutr.* (2017) 13:e12374. doi: 10.1111/mcn.12374.
18. Grenier LN, Atkinson SA, Mottola MF, et al. Be Healthy in Pregnancy: Exploring factors that impact pregnant women's nutrition and exercise behaviours. *Matern. Child Nutr*. (2020) e13068. 23:e13068. doi: 10.1111/mcn.13068.

19. Chasan-Taber L. Physical activity and dietary behaviours associated with weight gain and impaired glucose tolerance among pregnant Latinas. *Adv. Nutr.* (2012) 3:108-18. doi: 10.3945/an.111.001214.
20. Ojukwu CP, Anekwu EM, Okemuo AJ, et al. Antenatal exercise practices: Associated factors and correlation with antenatal quality of life. *J. Appl. Life Sci. Int.* (2018) 18: 1-9. doi: 10.9734/JALSI/2018/43947.
21. Flannery C, McHugh S, Anaba AE, et al. Enablers and barriers to physical activity in overweight and obese pregnant women: An analysis informed by the theoretical domains framework and COM-B model. *BMC Preg. Childbirth* (2018) 18:178.doi: 10.1186/s12884-018-1816-z.
22. Bauer C, Graf C, Platschek AM, Struder HK, Ferrari N. Reasons, motivational factors, and perceived personal barriers to engagement in physical activity during pregnancy vary within the BMI classes: The Prenatal Prevention Project Germany. *J. Phys. Act. Health* (2018) 15:204-211. doi: 10.1123/jpah.2016-0563.
23. Sujindra E, Bupathy A, Suganya A, Praveena R. Knowledge, attitude, and practice of exercise during pregnancy among antenatal mothers. *Int. J. Edu. Psychol. Res*. (2018) 1:234–237. doi: 10.4103/2395-2296.158347.
24. Sui Z, Moran LJ, Dodd JM. Physical activity levels during pregnancy and gestational weight gain among women who are overweight or obese. *Health Promot. J. Austr*. (2013) 24:206-13. doi: 10.1071/HE13054
25. Adeniyi AF, Ogwumike OO, Osinike CI. Physical activity and energy expenditure: Findings from the Ibadan pregnant women's survey. *Afr. J. Reprod. Health* (2014) 18:117-126. PMID: 25022148.
26. Creswell JW, Plano Clark VL. *Designing and Conducting Mixed Method Research* Thousand Oaks, CA: Sage. 2nd ed. (2011).
27. Morse JM, Niehaus L. *Mixed Method Design: Principles and Procedures* Walnut Creek, CA: Left Coast Press. (2009).
28. Patton MQ. *Qualitative Research and Evaluation Methods* 3rd ed. Thousand Oaks, CA: Sage; (2002).
29. Okafor UB, Goon DT. Developing a physical activity intervention strategy for pregnant women in Buffalo City Municipality, South Africa: A study protocol. *Int. J. Environ. Res. Public Health* (2020) 17:6694. doi: 10.3390/ijerph171786694.
30. Mottola MF, Davenport MH, Ruchat S, Davies GA, Poitras VJ, Gray CE, et al. 2019 Canadian guideline for physical activity throughout pregnancy. *Br. J. Sport Med*. (2018) 40: 1339-1346.
31. Sarmah HK, Hazarika BB, Choudhury G. An investigation on effect of bias on determination of sample size on the basis of data related to the students of schools of Guwahati. *Int. J. Appl. Math. Stat. Sci*. (2013) 2: 33-48.
32. Okafor UB, Goon DT. Physical activity level during pregnancy in South Africa: A facility based cross-sectional study. *Int. J. Environ. Res. Public Health* (2020)17:7928. doi: 10.3390/ijerph17217928.
33. Coll CV, Domingues MR, Gonçalves H, Bertoldi AD. Perceived barriers to leisure-time physical activity during pregnancy: A literature review of quantitative and qualitative evidence. *J. Sci. Med. Sport* (2017) 20:17-25. doi: 10.1016/j.jsams.2016.06.007.
34. Cramp AG, Bray SR. A prospective examination of exercise and barrier self-efficacy to engage in leisure-time physical activity during pregnancy," *Ann. Behav. Med*. (2009) 37:325-34. doi: 10.1007/s12160-009-9102-y.
35. Creswell JW. Research design: Qualitative, quantitative, and mixed methods approaches. 4th ed.; SAGE Publications: Thousand Oaks, CA, USA, (2014).

36. Okafor UB, Goon DT. Physical activity level during pregnancy in South Africa: A facility-based cross-sectional study. *Int. J. Environ. Res. Public Health* (2020) 117: 7928; doi:10.3390/ijerph17217928
37. Okafor UB, Goon DT. Physical activity in pregnancy: Beliefs, benefits and information-seeking practices of pregnant women in South Africa. *J. Multidisciplinary Healthcare*, (2021):14:787-798. doi: 10.2147/JMDH.S287109.
38. Okafor UB, Goon DT. Applying the Ecological Model to understand pregnant women's perspectives on the modifiable constraints to physical activity during pregnancy: A qualitative research study. *Medicine* (2020):99: e23431). doi.org/10.1097/MD.0000000000023431
39. May LE, Suminski RR, Linklater ER, Jahnke S, Glaros AG. Exercise during pregnancy: The role of obstetric providers. *J. Am. Osteopath. Assoc*. (2013)113:612-619. doi: 10.7556/jaoa.2013.022.
40. Malta MB, Carvalhaes MD, Takito MY, et al. Educational intervention regarding diet and physical activity for pregnant women: changes in knowledge and practices among health professionals. *BMC Preg. Childbirth* (2016) 16:175. doi.org/10.1186/s12884-016-0957-1
41. Lee A, Newton M, Radcliffe J, Belski R. Pregnancy nutrition knowledge and experiences of pregnant women and antenatal care clinicians: A mixed methods approach. *Women and Birth* (2018) 31:269-277. doi: 10.1016/j.wombi.2017.10.010
42. Luca C, Charlton KE, Yeatman H. Nutrition advice during pregnancy: Do women receive it and can health professionals provide it? *Matern. Child Health J*. (2014) 18:2465-2478. doi: 10.1007/s10995-014-1485-0.
43. McParlin C, Robson SC, Muirhead C, Araujo-Soares V. What helps or hinders midwives to implement physical activity guidelines for obese pregnant women? A questionnaire survey using the theoretical domains framework. *Midwifery* (2017) 49:110-116. doi: 10.1016/j.midw.2016.09.015.
44. Connolly CP, Conger SA, Montoye AHK, et al. Walking for health during pregnancy: A literature review and considerations for future research. *J. Sport Health Sci*. (2019) 8:401-411. doi: 10.1016/j.jshs.2018.11.004
45. Kegler MC, Swan DW, Alcantara I, Wrensford L, Glanz K. Environmental influences on physical activity in rural adults: The relative contributions of home, church, and work settings. *J. Phys. Act. Health* (2012) 9:996-1003. doi: 10.1123/jpah.9.7.996.
46. Saligheh M, McNamara B, Rooney R. Perceived barriers and enablers of physical activity in postpartum women: A qualitative approach. *BMC Preg. Childbirth* (2016) 16:131. doi: 10.1186/s12884-016-0908-x.
47. Krans EE, Chang JC. A will without a way: Barriers and facilitators to exercise during pregnancy of low-income, African American women. *Women & Health* (2011) 51:777-794. doi: 10.1080/03630242.2011.633598.
48. Leiferman J, Swibas T, Koiness K, Marshall JA, Dunn AL. My baby, my move: Examination of perceived barriers and motivating factors related to antenatal physical activity. *J. Midwifery Women's Health* (2011) 56:33-40. doi: 10.1111/j.1542-2011.2010.00004.x.
49. American College of Obstetricians and Gynaecologists. Physical activity and exercise during pregnancy and the postpartum period: ACOG Committee Opinion, Number 804. *Obstet. Gynaecol*. (2020) 135:e178-e188. doi: 10.1097/AOG.0000000000003772.
50. Davenport MH, Ruchat SM. Poitras VJ et al. Prenatal exercise for the prevention of gestational diabetes mellitus and hypertensive disorders of pregnancy: A systematic

review and meta-analysis. *Br. J. Sports Med*. (2018) 52:1367-1375. doi: 10.1136/bjsports-2018-099355.
51. Davenport MH, Ruchat SM, Sobierajski F, et al. Impact of prenatal exercise on maternal harms, labour and delivery outcomes: A systematic review and meta-analysis. *Br. J. Sports Med*. (2019) 53:99-107. doi: 10.1136/bjsports-2018-099821.
52. Davenport MH, Kathol AJ, Mottola MF et al. Prenatal exercise is not associated with fetal mortality: A systematic review and meta-analysis. *Br. J. Sports Med*. (2019) 53:108-115. doi: 10.1136/bjsports-2018-099773.
53. Put W, Chua S, Chan L. Physical activity in pregnancy: Attitudes and practices of Hong Kong Chinese women. *Hong Kong J. Gynaecol. Obstetr. Midwifery* (2015) 15: 138–147.
54. Evenson KR, Moos MK, Carrier K, Siega-Riz AM. Perceived barriers to physical activity among pregnant women. *Matern. Child Health J*. (2009) 13:364-75. doi: 10.1007/s10995-008-0359-8.
55. Santos PC, Abreu S, Moreira C, et al. Impact of compliance with different guidelines on physical activity during pregnancy and perceived barriers to leisure physical activity. J. Sports Sci. (2014) 32:1398-408. doi: 10.1080/02640414.2014.893369.
56. Joy EA, Chamblisa H. Integrating exercise is Medicine® into the care of pregnant women. *Curr. Sports Med. Reports* (2013) 2:245-7. doi: 10.1249/JSR.0b013e31829a6f7e.
57. Uddin R, Burton NW, Khan, A. Perceived environmental barriers to physical activity in young adults in Dhaka City, Bangladesh—does gender matter? *Int. Health*, (2018) 10: 40–46, https://doi.org/10.1093/inthealth/ihx057

CHAPTER EIGHT

KNOWLEDGE AND ATTITUDE OF PREGNANT WOMEN TOWARDS PHYSICAL ACTIVITY IN THE EASTERN CAPE, SOUTH AFRICA

8.1 INTRODUCTION

The manuscript presented in this chapter responded to specific objective four, and assessed the knowledge, attitudes and practices of pregnant women regarding prenatal physical in the Eastern Cape.

The knowledge, attitudes and practices of pregnant women about prenatal physical activity is shape by a multiplicity of factors. An understanding of these factors would inform context-specific intervention strategies to address negative behaviors, attitudes and practices to prenatal physical activity, and measures to sustain women's positive attitude or behaviour concerning prenatal physical activity. Therefore, the scarcity of information on this topic in the South African context warrant investigation.

8.2 PUBLICATIONS DETAILS

Title:	Efficacy and Positive Outcome of Physical Activity in Pregnant Women
Authors:	UB Okafor, DT Goon
Ethics:	University of Fort Hare Health Research Ethics Committee approved the study protocol (Ref#2019 = 06 = 009 = OkaforUB)
Journal:	Pakistan Journal of Medical Sciences
Journal details:	Peer-reviewed (blinded) Journal approved and listed on the Department of Higher Education and Training (DHET)
Status:	Accepted UB Okafor, DT Goon. Efficacy and Positive Outcome of Physical Activity in Pregnant Women. *Pakistan Journal of Medical Sciences*, 2022.
Impact factor:	1.088

8.3 PUBLICATION RECORD

The manuscript has been submitted for review on 16 June 2021, and revision made on 26 September 2021, and accepted on 20 October 2021.

Efficacy and Positive outcome of Physical Activity in Pregnant Women

Uchenna Benedine Okafor[1], Daniel Ter Goon[2]

1. Uchenna Benedine Okafor,
   Department of Nursing Science,
   University of Fort Hare, South Africa.
2. Prof. Daniel Ter Goon,
   Department of Public Health,
   University of Fort Hare, East London, South Africa.

Correspondence:
Uchenna Benedine Okafor
Department of Nursing Science,
University of Fort Hare, South Africa
East London, South Africa.
Email: ucheysonic@gmail.com
Cell: +27-71 083 656
* Correspondence: ucheysonic@gmail.com

ABSTRACT

Background: Evidence has shown the innumerable benefits of prenatal physical activity practice; therefore, the knowledge pregnant women have, and efforts to sustain the knowledge and encourage them to engage in prenatal physical activity, are desirable. We assess the knowledge and attitudes concerning prenatal physical activity of pregnant women attending primary health antenatal care clinics in Buffalo City Municipality, Eastern Cape province, South Africa.

***Methods*:** A cross-sectional study of 1082 pregnant were sampled. Socio-demographic and maternal characteristics, and knowledge, attitude and practices towards prenatal activity were obtained.

***Results*:** Overall, 62.4% women had high knowledge regarding prenatal physical activity; and half of the women showed a positive attitude toward it (50.1%). The majority of the participants affirmed prenatal physical activity is safe (88.2%) and beneficial for the baby (79.6%). Whilst participants had knowledge of other types of antenatal exercises, 80.9% of the women had no knowledge of swimming exercise. Negative attitudes towards physical

activity included the feeling of tiredness (67.7%), lack of interest (64.8%), and inadequate information on physical activity (59.5%).

***Conclusions*:** The women had high knowledge of prenatal physical activity, and relatively positive attitudes toward prenatal physical activity. The feeling of tiredness, lack of motivation and inadequate information on physical activity constituted negative attitudes towards physical activity. There is need to provide education and advocacy in the clinical settings; also, interventions to encourage and promote prenatal physical activity in the community and at home are desirable to address the weaknesses identified in this study regarding the women's knowledge and attitudes concerning prenatal physical activity.

KEYWORDS: Physical activity, Self-efficacy, Positive attitude, Pregnant women.

INTRODUCTION

Physical activity or exercise can be viewed as an antidote to the health challenges of populations. However, previously, physical activity participation by women was not a widely acceptable norm, as the society expressed disapproval and reservations about women's involvement in any physical activity; primarily, this was underpinned by cultural and safety concerns. However, the negative perception regarding the safety of prenatal physical activity has improved, or rather, changed: attitudes toward physical activity or exercise in pregnancy have improved significantly. Today, scientific evidence has counteracted the erroneous beliefs of linking prenatal physical activity with maternal adverse health outcomes, such as preterm birth, low birth weight, miscarriage and perinatal mortality.[1-4] In other words, prenatal physical activity practice has minimal or rare adverse health complications,[5] as previously thought.

Participation in physical activity during pregnancy is beneficial to health as widely reported in the literature. Notably, studies have shown that physically active pregnant women are less likely to have a caesarean section and quick postpartum recovery time,[6,7] and chances of harm to the mother and baby are minimal.[8] Women who partake of physical activity also find it reduces fatigue, stress, anxiety, and depression,[9-11] low back pain,[12-14] and self-efficacy, and better body image.[15] Self-efficacy connotes an individual's confidence regarding the ability to engage in a particular behaviour,[16] it predicts health behaviours, and further act as impetus to initiate and maintain physical activity and exercise during pregnancy.[17] Thus, the theory of self-efficacy helps to explain the reasons for physical activity behaviour change, in this context, during pregnancy.[18]

Environmental, physical and cultural factors could shaped the knowledge and attitudes of pregnant women regarding prenatal physical activity. Examining the knowledge and attitudes of pregnant women towards prenatal physical activity or exercise, a topic rarely studied in the context of South Africa, would inform possible intervention strategies. Such intervention strategies could improve women's knowledge of prenatal physical activity; it could possibly address women's negative attitudes and craft measures to sustain their positive attitude or behaviour concerning prenatal physical activity. Prenatal physical activity or exercise is, and should be, part of the antenatal healthcare agenda in both primary and clinical settings. In this context, this present study assesses the knowledge and attitudes of pregnant women towards physical activity and exercise during pregnancy in the Eastern Cape, South Africa.

METHODS

Study design, setting and sampling procedure: This cross-sectional study of 1082 convenient sample of pregnant women was conducted in 12 randomly selected antenatal primary health clinics in Buffalo City Municipality, Eastern Cape province, South Africa. We included pregnant woman over 18 years, receiving antenatal healthcare at the primary healthcare clinics, ability to read and speak the IsiXhosa, Afrikaans or English languages, and experiencing a single pregnancy. We excluded women with disabilities or reasons to stop exercise at the time of the study, based on the American College of Obstetricians and Gynaecologists (ACOG) recommendations,[19] as previously reported in our earlier study.[20]

Measures*:* The demographic questionnaire solicited information on the age, residence, ethnicity, marital status, level of education, employment status, religion, and whether they received family support from family. Furthermore, the behavioural and lifestyle characteristics was determined by asking the participants their current exposure to alcohol during pregnancy and smoking. We also asked the participants whether they had had antepartum haemorrhage in their first trimester, and how they perceived their general health. In addition, the women were asked whether they received physical activity advice from health providers during pregnancy, and had participated in physical activity before and during pregnancy. However, information on parity, pregnancy delivery mode, and pre-pregnancy body mass index were obtained from the antenatal medical records of the participants.

A structured knowledge and attitude questionnaire with pre-coded questions derivable from literature[21,22] was used for data collection. We asked the women whether they had knowledge regarding the benefits, contraindications, and types of exercise during pregnancy.

There were four general statements on the knowledge of physical activity and 10 items defining the contraindications of physical activity in pregnancy. The participants were required to provide a *"yes"*, *"no"* or *"don't know"* response to each of the statement. Likewise, we solicited participant's knowledge regarding the types of physical activity during pregnancy. The questionnaire on attitudes towards prenatal physical activity had 13 items on a 5-point Likert scale ranging from 1 (strongly agree) to 5 (strongly disagree).

Ethics approval: The study protocol received ethical approval from the University of Fort Hare's Human Research Ethics Committee (Ref#2019=06=009=OkaforUB). The study was conducted according to "Declaration of Helsinki" ethical research principles,

Data collection*:* Both demographic and the knowledge and attitude questionnaires were self-administered to pregnant women at the selected health clinics between July to October 2019.

Data analysis*:* The descriptive statistics of mean, frequency and percentages was applied. The participants responses on women's knowledge and attitude toward physical activity during pregnancy were analysed as "strongly agreed" and "agreed" as one variable; likewise, the responses on "disagree" and "strongly disagreed" as a single variable. Each response was assigned a numerical value; and a high score indicated a more positive response. All statistical analyses were carried out using the Statistical Package for Social Sciences (SPSS) (Version 24.0, IBM SPSS, Chicago, IL, USA).

Operational definitions: Participants knowledge on physical exercise during pregnancy was classified as *high* or *low*. High knowledge about physical activity entails whether a participant knew and could answer correctly a statement pertaining to the types, appropriate or relevant antenatal exercises, and contraindications of exercises during pregnancy. Conversely, low knowledge means a participant is not aware and could not provide a correct statement on the types, benefits, and the contraindications of exercise during pregnancy. In addition, the attitude of women relating to prenatal physical activity practice was scored as correct answer = 1 score, incorrect (No) = minus score, unsure= 0 score. Therefore, participants with plus score were considered positive, while 0 or minus score was considered negative.

RESULTS

The participants' mean age was 27.0 years (Standard deviation = 6.2 years). The participants were mostly between the age of 19-34 years (*n* = 812; 75.1%) and living in urban settings (*n*

= 523; 48.3%). They were mostly blacks (*n* = 935; 86.4%), never married (*n* = 717; 66.3%), and with a secondary education (*n* = 803; 74.2%). A majority of the participants were unemployed (*n* = 733; 67.7%) and had the support of their families (*n* = 837; 77.4%). The majority of participants were nulliparous (*n* = 517, 47.8%), had no antepartum haemorrhage (*n* = 1013; 93.6%), and had both vaginal and Caesarian (*n* = 538; 49.7%) delivery. An overwhelming majority of the participants had normal pregravid body mass index (18.5-24.9 kg/m^2) (*n* = 909; 84.8%) and 753 (69.6%) had never participated in physical activity during pregnancy (data not shown).

Knowledge on prenatal physical activity

The knowledge of participants on the contraindications of prenatal physical activity (Table I) indicated that the vast majority of participants had no knowledge of antennal exercise (65.8%), and indicated that physical activity during pregnancy is safe (88.2%) and beneficial for the baby (79.6%). In addition, the majority of the participants exhibited good knowledge by disagreeing with the statement that exercise during pregnancy would result in swelling of lower extremities (56.1%), extreme weight gain or loss (78.7%) and back pain (46.7%). Conversely, the overwhelming majority of the participants affirmed that exercise during pregnancy would result in difficulty in breathing (78.9%), chest pain (84.9%), dizziness (94.8%), uterine contractions (82.9%), incompetent cervix and preterm labour (82.3%), and vaginal bleeding (82.5%).

Table-I: Participants knowledge on benefits and contraindications of exercise during pregnancy

Knowledge aspect	Yes *n* (%)	Don't Know *n* (%)	No *n* (%)
Are you aware of antenatal exercise?	346 (32.0)	24 (2.2)	712 (65.8)
Physical activity in pregnancy is beneficial for the baby	861 (79.6)	139 (12.8)	82 (7.6)
Physical activity in pregnancy is safe	954 (88.2)	102 (9.4)	26 (2.4)
Healthy eating and physical activity are good	1051 (97.1)	25 (2.3)	6 (0.6)
Contraindications			
Swelling of lower extremities	290 (26.8)	185 (17.1)	607 (56.1)
Extreme weight gain or loss	118 (10.9)	113 (10.4)	851 (78.7)
Back pain	439 (40.6)	138 (12.7)	505 (46.7)
Difficulty in breathing	854 (78.9)	83 (7.7)	145 (13.4)
Chest pain	919 (84.9)	55 (5.1)	108 (10.0)
Dizziness	1026 (94.8)	29 (2.7)	27 (2.5)
Uterine contractions	897 (82.9)	90 (8.3)	95 (8.8)
Incompetent cervix and preterm labour	890 (82.3)	92 (8.5)	100 (9.2)
Vaginal bleeding	892 (82.5)	116 (10.7)	74 (6.8)
Diabetes	337 (31.1)	202 (18.7)	543 (50.2)

The participants had knowledge on pelvic floor exercise (49.6%), muscle-strengthening exercise (58.8%), back care exercise (59.3%), relaxation and breathing exercise (68.7%), abdominal exercise (46.6%), and aerobics exercise (46.6%). Conversely, majority of them had no knowledge of swimming exercise (80.9%) as part of antenatal exercise during pregnancy (Fig I).

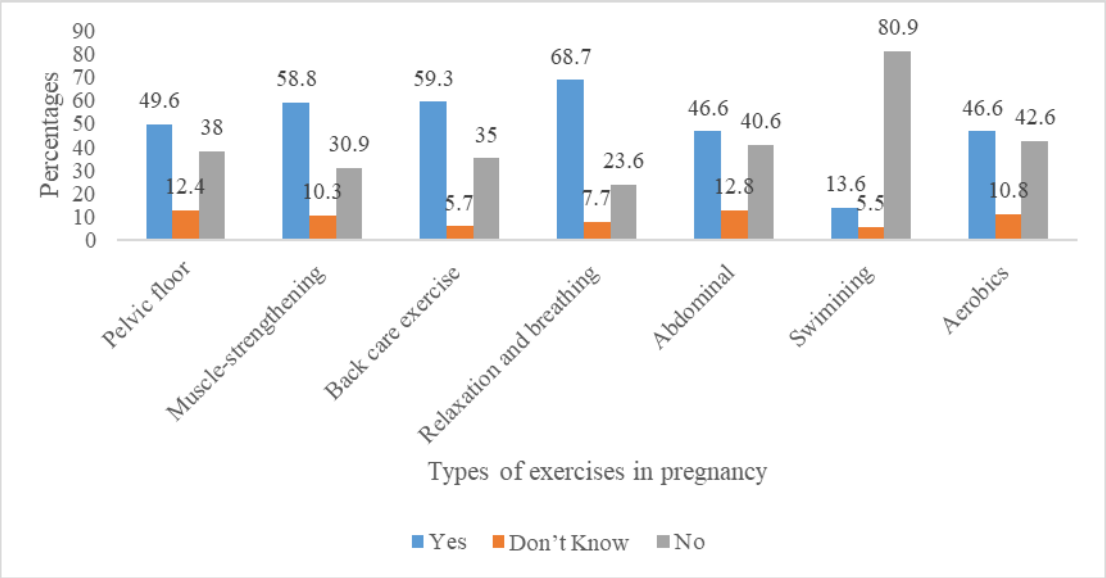


Fig.-I: Participants knowledge regarding different types of exercises during pregnancy

Attitude towards prenatal physical activity

Most of the participants expressed positive attitudes toward physical activity and exercise during pregnancy (Table II). The participants expressed that healthy physical activity during pregnancy is an enjoyable experience (50.9%) and it prepared them for a healthy birth (73.3%). They refuted the statements that engaging in healthy physical activity is a waste of time (77.0%); makes them feel guilty (58.6%), and harms the baby (67.1%). The participants also affirmed that regardless of the busy schedule (49.9%) and care of children (64.6%), they are not afraid of physical activity/exercise (68.0%) during pregnancy. On the other hand, negative attitudes towards physical activity/exercise expressed by the participants included the feeling of tiredness (67.7%), lack of interest in physical activity/exercise (64.8%), inadequate information on physical activity/exercise (59.5%), and difficulty in achieving healthy physical activity/exercise during pregnancy (59.7%).

Table-II: Attitudes towards physical activity and exercise

Attitude	Response distribution				
	SA *n* (%)	A *n* (%)	N *n* (%)	D *n* (%)	SD *n* (%)

I enjoy engaging in healthy physical activity during pregnancy	11(10.3)	439(40.6)	120(11.1)	261(24.1)	150(13.9)
Healthy physical activity makes me fit for birth	135(12.5)	658(60.8)	115(10.6)	94 (8.7)	80 (7.4)
Healthy physical activity in pregnancy is waste of time	10 (0.9)	155(14.3)	84 (7.8)	612(56.6)	221 20.4)
I feel guilty by not doing physical activity during pregnancy	61 (5.6)	327(30.2)	61 (5.6)	439(40.6)	194(18.0)
Physical activity harms the health of the baby	40 (3.7)	242(22.4)	74 (6.8)	544(50.3)	182(16.8)
I feel tired to exercise	146(13.5)	587(54.2)	26 (2.4)	216(20.0)	107 (9.9)
I do not feel like exercising	108(10.0)	593(54.8)	16 (1.5)	257(23.7)	108(10.0)
I have busy schedule	113(10.4)	413(38.2)	27(2.5)	307(28.4)	222(20.5)
I have children to care for	91 (8.4)	261(24.1)	31 (2.9)	445(41.1)	254(23.5)
I am afraid of exercise	57 (5.3)	249(23.0)	4(3.7)	521(48.1)	215(19.9)
I do not have sufficient information on exercise	126(11.6)	518(47.9)	13(1.2)	303(28.0)	122(11.3)
I dislike physical activity during pregnancy	93 (8.6)	495(45.8)	16(1.5)	350(32.3)	128(11.8)
It is difficult to achieve healthy physical activity	84 (7.8)	562(51.9)	29(2.7)	289(26.7)	118(10.9)

Note: SA, strongly agree; A, agree; N, neutral; D, disagree; SD, strongly disagree

Overall knowledge and attitudes regarding physical activity among pregnant mothers (Fig. II) showed that the majority (62.4%) had high knowledge regarding prenatal physical activity. Similarly, half of the women showed a positive attitude toward prenatal physical activity (50.1%).

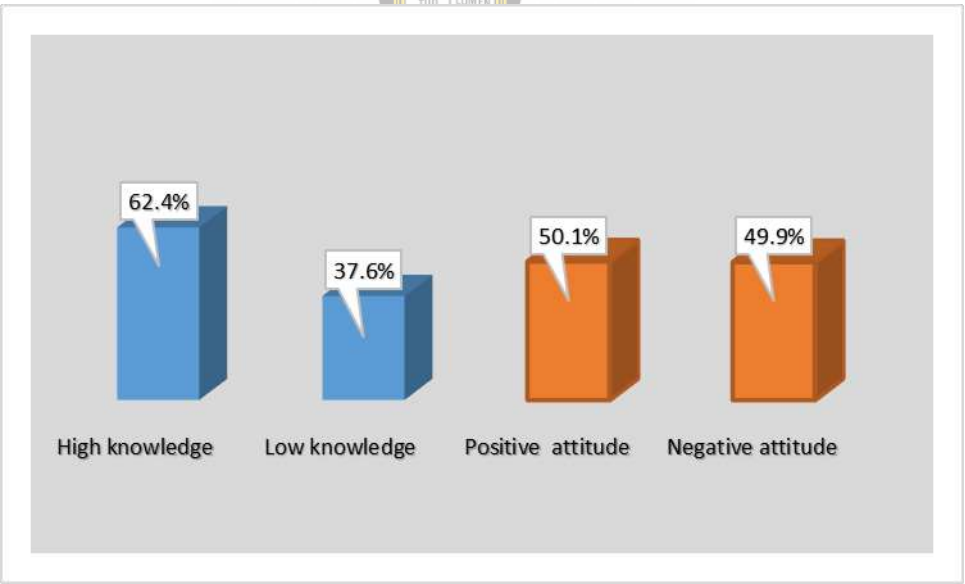


Fig.-II: Frequency distribution of knowledge and attitude levels.

DISCUSSION

To our knowledge, this is the first study exploring knowledge and attitudes towards physical activity and exercise among pregnant women in the Eastern Cape Province in South Africa. Exploring the factors that influence the decision of pregnant women to initiate and participate in physical activity or exercise during pregnancy have the potential of identifying

the areas of weakness, and based on this, may help to design interventional strategies to improve maternal healthcare of women in the context of physical activity health outcomes. Overall, the finding of this current study revealed that the majority of the women (62.4%) had a high knowledge regarding physical activity. The women were aware of the safety and benefits of physical activity for the mother and baby, all of which have some support in the literature.[1-5] Notably, the ACOG[5] has categorically stated "in the absence of obstetric or medical complications or contraindications, physical activity in pregnancy is safe and desirable, and pregnant women should be encouraged to continue or to initiate safe physical activities". Our study's findings support those of studies conducted among pregnant women in Kenya,[23] Nigeria,[24] and Saudi Arabia,[25] which shows women's awareness regarding the benefits accruable from participation in prenatal physical activity. However, knowledge does not automatically translate into practice. Other studies have reported that, although women recognise the importance of prenatal physical activity, they rarely translate the knowledge into practice by participating in physical activity.[26,27] Therefore, efforts to improve women's knowledge is advocated as this would affect change in their attitudes and practices regarding prenatal physical activity.

Our findings show that women have mixed knowledge about the contraindications of exercise during pregnancy. While others refute that exercise does not result in swelling of lower extremities, extreme weight gain or loss, and back pain, the majority of the women hold an opposite view that exercising during pregnancy would result in difficulty in breathing, chest pain, dizziness, uterine contractions, incompetent cervix and preterm labour, and vaginal bleeding. In the study of Mbada et al.[21] the majority of the Nigerian women under study indicated that exercise in pregnancy results in lesser risk of back pain (75.9%), prevention of excess weight gain (69.1%), and increased ability to cope with labour and delivery (69.6%).

Consistent with other studies, women in this present study had knowledge on the types of antenatal exercises, such as muscle-strengthening, back care, relaxation and breathing, abdominal, and aerobics exercises. Our finding confirmed similar findings about pregnant women studied in Nigeria,[21] and Pakistan.[28]

Concerning the types of antenatal exercises and consistent with other studies,[21,22] the majority of the participants had no knowledge of swimming exercise (80.9%) as part of antenatal exercise during pregnancy. However, walking, stationary cycling, aerobic exercises, dancing, resistance exercises (for example, using weights, elastic bands), stretching exercises, hydrotherapy, and water aerobics are, reportedly, safe exercises to engage in during

pregnancy.[5] The women in this present study are mostly from low-socio economic backgrounds, and may lack the resources to own or construct a swimming pool, possibly lack the skills to swim, and on another caveat, their knowledge of swimming may be limited and shaped by cultural beliefs and the concept of hydrophobia.[21] However, these variables were not assessed; therefore, one cannot ascertain their influence on the lack of knowledge on swimming as an antenatal exercise.

The present study showed half of the women having expressed positive attitudes towards physical activity during pregnancy. This is similar to previous studies conducted among Nigerian,[21,24] Pakistani,[28] Australian,[29] Indonesian,[30] and Sri Lankan[31]pregnant women, which reported positive attitudes toward antenatal exercise. Nowadays, the negative perception regarding the safety of prenatal physical activity has relatively improved, based on scientific evidence demonstrating manifold advantages of prenatal physical activity. Clearly, there is no evidence linking prenatal physical activity with maternal adverse outcomes,[1-4] which hitherto seemed to be safety issues. Contrastingly, some pregnant women in our present study indicated negative (49.9%) attitudes towards physical activity, which was linked to tiredness, lack of interest, and inadequate information on physical activity. Our study echoes similar findings affecting the attitude of women to engage in prenatal physical activity.[22,26,28,32] These modifiable barriers expressed by the women in our study highlight the need to tailor context-specific interventions to address their concerns. Attitude regulates one's predisposition toward behaviour,[33] and in this case, toward prenatal physical activity; therefore, information on women's positive attitudes and knowledge on prenatal physical activity suggest interventions should target educational messages on the benefits and importance of engaging in prenatal physical activity to improve maternal health outcomes.

Limitations of the study: We included only pregnant women attending public primary health clinics in Buffalo City Municipality in the Eastern Cape Province, South Africa; therefore, the findings of the study cannot be generalised to other pregnant women attending private health facilities nor to the entire group of women in the province or South Africa. Notably, the definition of low knowledge in this present study is subject to varying perspectives of an individual, depending also on one's level of accessibility to their various means, communication and experience. Notwithstanding these limitations, using a large sample of pregnant women, our study provides a unique insight into the efficacy and positive outcome of prenatal physical activity among women in an understudied, poorly resourced region.

CONCLUSION

Most pregnant women are generally knowledgeable about prenatal physical activity; and while half of them expressed positive attitudes towards physical activity during pregnancy; they, however, identify lack of time, tiredness, lack of interest, and inadequate information, which are modifiable barriers, as being negative attitudes toward participation in physical activity. This finding points to the need to prioritise efforts in providing prenatal physical activity counselling as one of the important components of antenatal healthcare in the primary healthcare programme.

Conflicts of interest: The authors declare no conflicts of interest.

Grant Support & Financial Disclosures: UBO received scholarship from the Bongani Mayosi National Health Scholars Programme (BM-NHSP) under the auspices of the South African Medical Research Council (SAMRC). The Supervisory-linked bursary from the Govan Mbeki Research and Development Centre, University of Fort Hare is appreciated.

REFERENCES

1. Davenport MH, Ruchat SM, Sobierajski F, Poitras VJ, Gray CE, Yoo C, et al. Impact of prenatal exercise on maternal harms, labour and delivery outcomes: A systematic review and meta-analysis. Br J Sports Med. 2019;53(2):99–107. doi: 10.1136/bjsports-2018-099821.
2. Davenport MH, Ruchat SM, Poitras VJ, Jaramillo Garcia A, Gray CE, Barrowman N, et al. Prenatal exercise for the prevention of gestational diabetes mellitus and hypertensive disorders of pregnancy: A systematic review and meta-analysis. Br J Sports Med. 2018;52(21):1367–1375. doi: 10.1136/bjsports-2018-099355.
3. Davenport MH, Kathol AJ, Mottola MF, Skow RJ, Meah VL, Poitras VJ, et al. Prenatal exercise is not associated with fetal mortality: A systematic review and meta-analysis. Br J Sports Med. 2019;52(2):108–115. doi: 10.1136/bjsports-2018-099773.
4. Coll CV, Domingues MR, Gonçalves H, Bertoldi AD. Perceived barriers to leisure-time physical activity during pregnancy: A literature review of quantitative and qualitative evidence. J Sci Med Sport 2017;20(1):17–25. doi: 10.1016/j.jsams.2016.06.007.
5. American College of Obstetricians and Gynaecologists. Physical activity and exercise during pregnancy and the postpartum period: ACOG Committee Opinion, Number 804. Obstet Gynaecol. 2020;135(4):e178–e188. doi: 10.1097/AOG.0000000000003772.
6. Takami M, Tsuchida A, Takamori A, Aoki S, Ito M. Effects of physical activity during pregnancy on preterm delivery and mode of delivery: The Japan Environment and Children's Study, birth cohort study. PLoS ONE 2018;13(10):e02066160. doi: 10.1371/journal.pone.0206160.
7. Rajabi A, Maharlouei N, Rezaianzadeh A, Lankarani KB, Esmaeilzadeh F, Gholami A, et al. Physical activities (exercises or choreses) during pregnancy and mode of delivery in nulliparous women: a prospective cohort study. Taiwan J Obstet Gynecol. 2018;57(1):18–22. doi: 10.1016/j.tjog.2017.12.003.

8. Whitaker KM, Wilcox S, Liu J, Blair SN, Pate RR. Pregnant women's perceptions of weight gain, physical activity, and nutrition using Theory of Planned Behaviour constructs. J Behav Med. 2016;39(1):41–54. doi: 10.1007/s10865-015-9672-z
9. Vargas-terrones M, Barakat R, Santacruz B, Fernandez-Buhigas, I. Physical exercise programme during pregnancy decreases perinatal depression risk: a randomised controlled trial. Br J Sports Med. 2018;53(6):348–353. doi: 10.1136/bjsports-2017-098926
10. Szegda K, Bertone-Johnson ER, Pekow P, Powers S, Markenson G, Dole N, et al. Physical activity and depressive symptoms during pregnancy among Latina women: A prospective cohort study. BMC Preg Childbirth 2018;18(1):252–263. doi: 10.1186/s12884-018-1839-5.
11. Padmapriya N, Shen L, Soh SE, Shen Z, Kwek K, Godfrey KM, et al. Physical activity and sedentary behaviour patterns before and during pregnancy in a multi-ethnic sample of Asian women in Singapore. Matern Child Health J. 2015;9(11):2523–2535. doi: 10.1007/s10995-015-1773-3.
12. Patrícia V, De Sousa S, Cury A, Eufrásio LS. The influence of gestational trimester, physical activity practice and weight gain on the low back and pelvic pain intensity in low risk pregnant women. J Back Musculoskeletal Rehabil. 2019;32(5):671–676. doi: 10.3233/BMR-171006
13. Thompson EL, Vamos CA, Daley EM. Physical activity during pregnancy and the role of theory in promoting positive behaviour change: a systematic review. J Sport Health Sci. 2017;6(2):198–206. doi: 10.1016/j.jshs.2015.08.001.
14. Puchalski S. Physical activity: Utilizing guidelines to promote health among pregnant women. J Preg Reprod. 2017;1(2):1–3. doi: 10.15761/JPR.1000107
15. DiNallo JM. Examining the moderating influence of motherhood status on the determinants of exercise motivation and behaviour in pregnancy. The Pennsylvania State University; 2011. https://etda.libraries.psu.edu/catalog/12628
16. Bandura A. A social cognitive theory of action. J.P. Forgas, M.J. Innes (Eds.), Recent advances in social psychology: An international perspective, Elsevier, North Holland (1989), pp. 127-138. https://www.uky.edu/~eushe2/Bandura/Bandura1989AP.pdf
17. Gaston A, Cramp A, Prapavessis H. Enhancing self-efficacy and exercise readiness in pregnant women. Psychol Sport Exerc.2012;13:550-7 doi:10.1016/j.psychsport.2012.03.001.
18. Schunk DH, Pajares F. Self-Efficacy Beliefs. In: McGaw PPB, ed. International Encyclopedia of Education. 3rd ed. Oxford: Elsevier; 2010:668-672. doi:10.1016/B978-0-08- 044894-7.00620-5.
19. Mottola MF, Davenport MH, Ruchat S, Davies GA, Poitras VJ, Gray CE, et al. 2019 Canadian guideline for physical activity throughout pregnancy. Br J Sport Med. 2018;52(21):1339–1346. doi: 10.1136/bjsports-2018-100056.
20. Okafor UB, Goon DT. Physical activity level during pregnancy in South Africa: A facility-based cross-sectional study. Int J Environ Res Public Health 2020;17(21):7928. doi: 10.3390/ijerph17217928.
21. Mbada CE, Adebayo OE, Adeyemi AB, Arije OO, Dada OO, Akinwande OA, et al. Knowledge and attitude of Nigerian pregnant women towards antenatal exercise: A cross sectional survey. Obstet Gynecol. 2014; Apr 14;2014:260539. doi: 10.1155/2014/260539.
22. Sujindra E, Bupathy A, Suganya A, Praveena R. Knowledge, attitude, and practice of exercise during pregnancy among antenatal mothers. Int J Educ Psychol Res. 2015;1:234–237. doi: 10.4103/2395-2296.158347

23. Sabiri E, Olutende OM, Wabuyabo IK, Vurigwa E. Knowledge of prenatal exercise among expectant women from selected health facilities, Kakamega County, Kenya. J Phy Act Res. 2018;3(1):55–59. doi: 10.12691/jpar-3-1-9
24. Maruf FA, Chianakwana C, Hanif S. Perception, knowledge, and attitude toward physical activity behavior: Implications for participation among pregnant women. J Women's Health Phy Therapy 2017;41(3):145–153. doi: 10.1007/s40292-017-0235-y
25. Al-Youbi GM, Elsaid T. Knowledge, attitude, and practices on exercise among pregnant females attending Al-Wazarat Health Center, Riyadh, Saudi Arabia. J Fam Med Prim Care 2020;9(8):3905–3915. doi: 10.4103/jfmpc.jfmpc_276_20.
26. Ribeiro CP, Milanez H. Knowledge, attitude and practice of women in Campinas, São Paulo, Brazil with respect to physical exercise in pregnancy: a descriptive study. Reprod Health 2011;8:31. doi: 10.1186/1742-4755-8-31.
27. Alkaabi MS, Alsenaidi LK, Mirghani H. Women's knowledge and attitude towards pregnancy in a high-income developing country. J Perinatal Med. 2015;43(3):445–448. doi: 10.1515/jpm-2013-0296.
28. Hasan M, Zahid S, Hafeez S, Hashmi Z, Mannan H, Hassan D. Knowledge and attitude of Pakistani women towards antenatal exercise: A cross-sectional survey across Lahore. J Pak Med Assoc. 2019;69(12):1900–1902. doi: 10.5455/JPMA.294813.
29. Guelfi KJ, Wang C, Dimmock JA, Jackson B, Newnham JP, Yang H. A comparison of beliefs about exercise during pregnancy between Chinese and Australian pregnant women. BMC Preg Childbirth 2015;15:345. doi: 10.1186/s12884-015-0734-6.
30. Amalia L, Lisna AF, Putri ST, Sumartini S, Mega N. The contribution of pregnant women characteristics to pregnancy exercise perception. Adv Health Sci Res. 2019;21:4th International Conference on Sport Science, Health, and Physical Education (ICSSHPE 2019). doi.org/10.2991/ahsr.k.200214.045
31. Wijesiriwardana WS, Gunawardena NS. Knowledge, attitudes and practices regarding antenatal exercises among pregnant mothers attending De Soyza Maternity Hospital Colombo. Sri Lanka J Obstet Gynaecol. 2016;37(4):65–71. doi: http://doi.org/10.4038/sljog.v37i4.7773
32. Alaglan AA, Almousa RF, Alomirini AA, Alabdularazaq ES, Alkheder RS, Alzaben KA, et al. Saudi women's physical activity habits during pregnancy. Women's Health 2020;16:1-6. doi: 10.1177/1745506520952045.
33. Harrison AL, Taylor NF, Nora Shields N, Frawley HC. Attitudes, barriers and enablers to physical activity in pregnant women: A systematic review. Physiother 2018;64(1):24–32. doi: 10.1016/j.jphys.2017.11.012.

Author`s Contribution:

UBO conceptualized the study, collected data and wrote the manuscript.

DTG read, interpreted the data, and critically reviewed the manuscript.

All authors contributed to the writing of the manuscript, read and approved the final version of the manuscript.

CHAPTER NINE

PROVIDING PHYSICAL ACTIVITY EDUCATION AND COUNSELLING DURING PREGNANCY: A QUALITATIVE STUDY OF MIDWIVES' PERSPECTIVES

9.1 INTRODUCTION

The article presented in this chapter responded to specific objective five, and explored a cohort of midwives' perspectives on providing prenatal physical activity education and counselling during pregnancy in the Eastern Cape Province. Providing information about the advantages of prenatal physical activity and the existing prenatal physical activity guidelines to women are important to inform good understanding and decision-making. However, whether midwives provide prenatal physical activity education and in the South African context, particularly in the Eastern Cape Province, is speculative, as no information exist on the phenomenon.

9.2 PUBLICATIONS DETAILS

Title:	Providing physical activity education and counselling during pregnancy: a qualitative study of midwives' perspectives
Authors:	UB Okafor, DT Goon
Ethics:	University of Fort Hare Health Research Ethics Committee approved the study protocol (Ref#2019 = 06 = 009 = OkaforUB)
Journal:	Nigerian Journal of Clinical Practice
Journal details:	Peer-reviewed (blinded) Journal approved and listed on the Department of Higher Education and Training (DHET)
Status:	Published
	Okafor UB, Goon DT. Providing Physical Activity Advice during Pregnancy: A Qualitative Study of Nurses' Perspectives. *Nigeria Journal of Clinical Practice*, 2021, 24:718-28. DOI:10.4103/njcp.njcp_486_20.
Impact factor	0.968

9.3 PUBLICATION RECORD

The article was submitted to the journal on the 05 August 2020, revised on 08 August 2020, accepted on 01 March 2021, and published on 20 May 2021.

Original Article

Providing Physical Activity Education and Counseling During Pregnancy: A Qualitative Study of Midwives' Perspectives

UB Okafor, DT Goon[1]

Departments of Nursing Science, and [1]Public Health, University of Fort Hare, East London, South Africa

ABSTRACT

Background: Midwives have a strategic role to inform, educate, and encourage pregnant women to maintain an active lifestyle during pregnancy. **Aim:** This study explored a cohort of midwives' perspectives on providing prenatal physical activity education and counseling during pregnancy. **Subjects and Methods:** Seventeen midwives participated in semistructured interviews which were audio-recorded and transcribed verbatim. A thematic analysis approach was applied to the transcribed qualitative data. **Results:** Midwives rarely provide physical activity education and counseling to pregnant women, citing lack of knowledge on which physical activity to recommend, and the duration and intensity of the physical activity as reasons. Walking is the only physical activity recommended during antenatal sessions. Barriers to providing physical activity education and counseling include shortage of midwives, busy work responsibilities, nonavailability of exercise equipment, and nonprioritization of antenatal physical activity. The midwives also cited overwhelming work responsibilities resulting in extreme fatigue rendering them hardly able to counsel the women. They advocated for the introduction of exercise classes in antenatal health care and the training of midwives on exercises to improve the uptake of midwives' knowledge regarding prenatal exercise and their engagement with pregnant women during antenatal consultations. **Conclusions:** The midwives lacked knowledge of physical activity during pregnancy and rarely provided such education and counseling. They advocated the need for training and workshops on maternal physical activity. Our findings suggest that physical activity should be integrated into the midwifery/nursing curriculum to empower midwives and other health providers to offer evidence-based physical activity education and counseling to women during antenatal health care as part of the primary health-care service.

Keywords: *Knowledge, midwives, physical activity, practices, pregnancy*

Received: 05-Aug-2020;
Revision: 08-Aug-2020;
Accepted: 01-Mar-2021;
Published: 20-May-2021

Introduction

Participation in physical activity, and as recommended by various bodies and organizations throughout the lifetime, provides one with many physical and mental health benefits. Several studies have reported the benefits of physical activity participation during pregnancy. These include a lowered prevalence of excessive maternal weight gain,[1-4] reduced risk of gestational diabetes mellitus,[3,5,6] and pre-eclampsia.[7-11] Other benefits include an increased probability of a normal delivery,[12] reduced length of labor, lowered risk of delivery complications,[13] and reduced risk of low birth weight.[14,15] Additionally, it was found that physical activity during pregnancy improved sleep,[16,17] reduced fatigue, stress, anxiety, and depression,[7,18] reduced lower back pain,[9,10] and improved overall well-being of the mother.[19] The evidence indicating that physical

Address for correspondence: Dr. UB Okafor, Department of Nursing Science, University of Fort Hare, East London, South Africa.
E-mail: ucheysonic@gmail.com

Access this article online

Quick Response Code:

Website: www.njcponline.com

DOI: 10.4103/njcp.njcp_486_20

How to cite this article: Okafor UB, Goon DT. Providing physical activity education and counseling during pregnancy: A qualitative study of midwives' perspectives. Niger J Clin Pract 2021;24:718-28.

activity participation during pregnancy improves maternal health of the mother and child suggests the need for physical activity and exercise advice to women to ensure their optimal participation in regular physical activity and exercise throughout the gestational period and postpartum phase.

Designing interventions to encourage, promote, and increase physical activity levels and to decrease time spent in sedentary activities are key public health goals,[20] given the benefits of physical activity during pregnancy. Viewed from this perspective, exploring whether health-care providers possess the relevant scientific knowledge on physical activity to give to pregnant women, and what attitude and practices they exhibit toward physical activity during pregnancy, are important to inform educational interventions to improve levels of physical activity during pregnancy. Routinely, physicians and midwives do offer counseling to women to reduce or refrain from tobacco use, avoid alcohol, and improve their dietary intake to ensure healthy growth and development of the unborn baby. Similarly, as gatekeepers of health care, health providers, they ought to incorporate physical activity advice into both the prenatal and antenatal care of pregnant women. In contrast, pregnant women rarely receive counseling from health-care providers on the need for regular physical activity during pregnancy, as reported among South African[21] and Australian[22] women, and among community midwives in antenatal clinics in England.[23] Often, women received incomplete information or guidance,[21,22,24-27] and confusing or overwhelming advice[22,27] from health-care providers on physical activity during pregnancy. Health-care providers' action, inaction, and ignorance on physical activity counseling during antenatal sessions would definitely influence a pregnant woman's decision concerning physical activity participation during pregnancy and beyond gestation period. Previous studies have shown that counseling women on physical activity during routine antenatal care is effective in sustaining physical activity levels among pregnant women.[28,29]

In South Africa, pregnant women are mostly at high risk of being inactive and sedentary[30]; and data from the South Africa National Health and Nutrition Examination Survey indicate that 46% of the national population are physically inactive.[30] It is likely that pregnant women in South Africa have limited access and knowledge on pregnancy and health outcomes during physical activity participation; they might also be ignorant of wholesome physical activity recommendations. The beneficial effects of physical activity on pregnancy outcomes motivate the need to encourage and provide proper, safe, and sustainable guidelines on physical activity during pregnancy. Providing information about the advantages of physical activity during pregnancy and the existing physical activity guidelines to women are important to inform good understanding and decision-making. Therefore, health-care providers are important sources of support, information, and advice about physical activity during pregnancy.[31,32] They have a crucial role, which includes clarifying the benefits, emphasizing the importance of physical activity during pregnancy,[7] and translating the scientific evidence supporting exercise during pregnancy into the clinical setting and the community. However, health-care providers offer pregnant women with little advice on physical activity during pregnancy. This gap was identified in a South African study, but it focused exclusively on medical practitioners,[33] who operate on a different health-care model.

Although the South African Nursing Council (under the provisions of the Nursing Act, 2005) enjoin midwives and nurses to "instruct antenatal exercises" for pregnant women during antenatal sessions,[34] there is hardly any information on the promotion of physical activity by midwives as health-care providers working in primary health-care facilities to guide prenatal physical activity intervention. Therefore, the aim of the study was to explore the midwives' perspectives regarding prenatal physical activity education and counseling in the Eastern Cape.

Subjects and Methods

Study design, setting, and participants

A qualitative descriptive approach was applied, using semistructured face-to-face interviews with 17 purposively selected midwives. The midwives were offering antenatal health-care services to pregnant women attending 12 antenatal health clinics in Buffalo City Municipality in the Eastern Cape Province, South Africa. The inclusion criteria were practicing as community midwives for more than a year and being able to communicate in English.

Data collection procedure

Participants were each provided with an informed consent form and those who consented to participate were requested to return their signed consent forms and completed demographic questionnaires to the principal investigator (UBO). They were subsequently contacted by phone concerning convenient date, time, and venue for the interviews.

The interview guide consisted of open-ended questions assessing the knowledge, attitude, and practices of midwives about physical activity during antenatal

health-care consultation with pregnant women. The interview guide was pretested in a pilot interview with a practicing community midwife to ensure its content validity. Following a pilot interview and discussion with the second author (DTG), minor revisions were made on the semistructured interview schedule.

In South Africa, midwives are largely responsible for the antenatal care of women at the clinics. The interviews were all conducted by the first author, individually and face-to-face until data saturation (no new emerging facts or information) was reached. This resonates with the Malterud *et al*.[35] model of power size estimation in qualitative studies. Their model stipulates that few participants would be required in a study whose aim is narrow; furthermore, the participants would likely possess more information that is relevant to the phenomenon under investigation. Typically, purposive sampling in qualitative studies aims to target knowledgeable participants who can provide the relevant information to a particular subject of study. Qualitative sample sizes are large enough to allow the unfolding of a "new and richly textured understanding" of the phenomenon under study and if there is no repetition of information during the interviews, then data saturation can be reached with the total number of participants interviewed.[36]

The interviews took place between August and October 2019 with each interview lasting between 35 and 45 min. Interviews were conducted in English language at the health facility (participants' place of work) in a quiet designated place allocated to the first author by the health facility manager. All interviews were audio-recorded with the permission of the participants, and the recordings were transcribed verbatim afterward by the first author (UBO). The interview guide was not made available to the participants but was used to assist the primary researcher during the interviews. Notwithstanding, the participants were given the opportunity to freely express their views or opinions on the focus of the matter, beyond the items in the interview guide.

Data analysis

Data were analyzed using the content analysis method according to the steps described by Tesch.[37] The interviews were read through to get a sense of the whole. Then, one document was drawn up with the most interesting, the shortest, and that which summed up what was being said on each topic. A list of all the topics and similar topics, and their clustering was compiled. The topics were coded, abbreviated, and the codes written next to the appropriate segments of the text. The most descriptive wording for the topics was identified and then turned into thematic categories. The abbreviation for each category from the formulated topics was coded. The coded primary analysis was conducted and the data material belonging to each category arranged accordingly. The data were grouped as the main theme, other themes, and subthemes, identified by both authors and the independent coder. Finally, all the authors reached consensus regarding analysis and presentation of the findings.

Trustworthiness

Trustworthiness was maintained by applying the principles of credibility, transferability, dependability, and conformability.[38] In order to ascertain the validity and reliability of the data, member checking and audit trial were performed, and the transcribed data were cross-checked with the audio-recorded interviews for accuracy on several occasions. In addition, some of the participants were shown the interviews' transcripts and emergent themes for comments and confirmation. All the participants endorsed the transcripts and themes.

Ethics

The study was approved by the Human Research Ethics Committee of the University of Fort Hare (Ref# 2019=06=009=Okafor, UB). The aim and nature of the study was explained to the participants. Informed consent was obtained from participants prior to the interview. Permission was also obtained from the Eastern Cape provincial Department of Health. Participants were informed that their participation in the study was voluntary and they could withdraw at any time, without prejudice. Participants were assured of their anonymity, right to privacy, and confidentiality.

Results

The age range of the participants ranged from 27 to 50 years and the mean age was 39.4 ± 18.3 years. The midwives had professional experience ranging from 3 to 20 years. Most of the participants were female midwives (n = 17). The analysis of the transcripts identified three themes regarding knowledge, attitude, and practices of the midwives toward physical activity participation during pregnancy. Table 1 provides an overview of the themes and subthemes on midwives' knowledge, attitudes, and practices regarding physical activity during pregnancy.

Theme 1: Nature of physical activity education and counseling provided by midwives

The midwives reported on the general nature of education and counseling they provide to the pregnant women as part of the antenatal care services. These services cover healthy sexual lifestyle, smoking, alcohol

Table 1: Themes and subthemes reflecting midwives' perspectives about physical activity during pregnancy

Themes	Subthemes	Codes examples
Nature of physical activity education and counseling provided by midwives	Lifestyle behavior assessment and advice to pregnant women	Assess pregnant women and give advice; provide health education; life style change; diagnosis of pregnancy-related illness; danger signs of pregnancy, provide referral for further investigation, if possible; take blood sample for laboratory test; perform HIV testing after counseling; use of condom for protection during coitus, especially those living with HIV/AIDS and other immune deficiency illnesses
	Importance and benefits of engaging in passive physical activities and household chores	Encourage walking exercise; encourage … to do relaxation and breathing exercise … help during delivery; normally advice not to lift a very heavy object or do something very hard like excessive running; jogging, or stand up for a very long time without moving; walking is good
	Lack of emphasis on antenatal exercises at clinics	Physical activity is not a priority; don't talk about exercise in details during antenatal care; exercise a rare topic during antenatal care; don't know anything about physical activity during pregnancy; sometimes, just tell them to walk around the clinics; many times we believe that a pregnant woman should rest instead of exercising; honestly, no pamphlets or posters in the clinics displaying physical activity information; don't conduct talk about the importance of physical activity during pregnancy
Knowledge of midwives related to antenatal physical activity	Benefits of antenatal exercises	Support exercise during pregnancy; exercise promote the wellbeing of the pregnant mother and her baby; reduces lower back pain; improves better sleeping pattern; help with women with pregnancy-induced hypertension; lower blood sugar
	Lack of versus existing knowledge related to the types, safe, and intensity of antenatal exercises	Well, the older nurses … tell us about antenatal classes in their times; antenatal classes not happening now in our clinics; don't have antenatal exercise facilities; recommend walking exercise; don't know running or swimming or gym is safe; don't know about the about exercise; types, duration, and intensity; don't provide individualized exercise program; not knowledgeable about exercise for pregnant women
	Contraindications to exercise during pregnancy	Refrain from exercise if not feeling well; if dizzy, have severe headache; I really don't know about contradictions to exercise
Barriers to physical activity advice	Lack of resources (shortage of workforce and lack of equipment)	Busy and always having shortage of staff; usually brief and fast when with a client; no time and enough space to talk to all at the same time; no pamphlets or posters in the clinics; no space to engage in any kind of exercise demonstration
	Tiredness and body exhaustion	Few of us working; feel tired and exhausted attending to many women; little or no time for talking about physical activity
	Lack of knowledge on physical activity practice guidelines on the care of pregnant women	Unaware of any physical activity guideline; there is no guideline on physical activity during pregnancy at the clinic
	Lack of referral and physical activity practice guidelines on the care of pregnant women	Nonavailability of prenatal physical activity guidelines; doubt other facilities practice antenatal classes; don't refer anyone for exercise to other facilities; don't know anything about physical activity guidelines
Improvement plan related to antenatal exercises	Improvement on antenatal exercises classes	Antenatal exercise classes should be back in the local clinics; should form part of interactive sessions; need to get women motivated
	Training of midwives on antenatal exercises	Department of Health to organize training for the nurses and other health-care professionals; pregnancy and exercise workshops; training will teach the women the right thing about exercise
	Provision of information sources on prenatal physical activity	Provide posters and pamphlets in clinics; MomConnect … is a very good platform to circulate information

consumption, importance of healthy diet, breastfeeding, personal and proper hygiene, and rest. They also offer prenatal physical activity counseling on the importance, benefits, and passive or lack of emphasis on antenatal exercise at the clinics. Three key issues (or subthemes) dominate this perception.

Subtheme 1.1: Lifestyle behavior assessment and advice to pregnant women

Lifestyle behavior assessment and advice to pregnant women are the key roles of midwives working in antenatal health facilities. However, the findings revealed that midwives rarely discussed physical activity with the pregnant women during their antenatal visits. The midwives admitted providing education and counseling to the pregnant women around refraining from smoking and alcohol, and maintaining good nutrition during pregnancy; however, physical activity was downplayed. Likewise, there were no pamphlets or posters displayed containing physical activity information at the clinics. The participants indicated as follows:

Things we usually focus on include danger signs, breastfeeding, personal and proper hygiene; what a

woman should do when she feels that something is wrong with her and her baby, and not exercise. (#10)

The only thing we usually do here in the clinic is to talk about lifestyle changes during pregnancy. We tell the women not to smoke or take alcohol. We also tell them about the dangers of smoking and drinking alcohol during pregnancy. We also talk about health nutrition during pregnancy. We tell them to take more vegies and fruits, to plan good nutrition per day and to refrain from caffeine. (#6)

Subtheme 1.2: Importance and benefits of engaging in passive physical activities and household chores

The midwives were ignorant about types of physical activity recommended for pregnant women. As such, walking is the only physical activity known to most of them for the pregnant women. Notably, they doubted whether jogging, swimming, and going to the gym are safe for a pregnant woman and her baby. One participant stated:

Well, so many times I do tell them to walk, especially women in their third trimester because they are near to delivery. This is the only exercise I know. Jogging, swimming, or even going to gym are things I don't usually touch on because I don't know whether they are safe or not. (#13)

Many times, we believe that a pregnant woman should rest instead of exercising. (#2)

I advise women not to lift a very heavy object or do something very hard like running and jogging too much or standing up for a very long time without moving. This is particularly important for those who are working at tills in shops. I usually tell them that the type of exercise good for them is walking. Walking is a good exercise during pregnancy. I encourage walking. (#5)

The midwives did not recommend an individualized exercise program for the pregnant women to follow. One participant mentioned:

Such a thing doesn't exist. The truth is that I don't even talk about exercise with pregnant women. I'm also not knowledgeable about exercise for pregnant women. (#2)

One of the participants also emphasized that she encouraged the pregnant women from engaging in relaxation and breathing exercises, as these are assistive during delivery.

I encourage women to do relaxation and breathing exercises because they may help them during delivery, when they are pushing. (#16)

Subtheme 1.3: Lack of emphasis on antenatal exercises at clinics

Although the midwives recognized physical activity as a component of prenatal care for primary health care, they hardly provided such advice to the women attending primary health clinics because of their lack of knowledge on the matter, the recommended duration, and intensity of the exercise. They indicated:

Exercise and physical activity are not topics that we usually touch on during the antenatal session with clients. And honestly, there are no pamphlets or posters anywhere in the clinic with such information. (#9)

I can't remember asking any pregnant woman about her exercise history. (#3)

Well, to be candid, exercise is not a topic that we usually touch on; however, I usually say to them that if you are doing exercise, then you should continue. Nevertheless, exercise is not our focus during antenatal consultations. (#4)

Hmmn! Not really, maybe occasionally would a client ask me about exercise during pregnancy. Exercise is a rare topic talked about during antenatal. (#1)

Theme 2: Knowledge of midwives related to antenatal physical activity

The midwives expressed awareness of antenatal exercises and the benefits accruable from participation in some forms of physical activity during pregnancy. However, they were ignorant about the contraindications to exercise during pregnancy. Three themes emerged from midwives' knowledge on prenatal physical activity.

Subtheme 2.1: Benefits of antenatal exercises

In their counseling sessions, some of the midwives indicated they did encourage women to engage in moderate exercise or light physical activity because it prevents pregnancy-induced diseases (hypertension, diabetes) and reduces musculoskeletal discomforts. The participants maintained:

I think many people believe that exercise during pregnancy may increase the risk of low birth weight. I think as a health care provider, I really don't think so; rather, exercise promotes the wellbeing of the pregnant mother and her baby. (#8)

I think exercise during pregnancy helps to reduce back pain, cramps and helps one to sleep better. I also think that it helps women who have pregnancy-induced hypertension and lower blood sugar during pregnancy. I, therefore, think that exercise during pregnancy is beneficial. (#16)

The midwives maintained that women without pregnancy complications should engage in moderate-intensity physical activity. They, however, indicated that most pregnant women do not exercise,

citing tiredness as a reason. The participants gave the following reasons:

Well, in my opinion, I think pregnant women should try to exercise no matter how little because it will make a lot of difference throughout their pregnancy. I think exercise is good, even if it is just for 10 minutes. And pregnant women who have been exercising prior to being pregnant, I think should continue with their exercise for as long as their body can take it. At least exercise done at moderate intensity is good. (#12)

The women don't exercise. They give many excuses. Even if you ask them to take just a walk around the clinic, they will tell you they are too tired to walk. I think it is important to bring back antenatal classes in clinics. (#14)

Subtheme 2.2: Lack of versus existing knowledge related to the types, safety, and intensity of antenatal exercises

The midwives expressed not being knowledgeable about exercise prescription during pregnancy. They cited lack of existing knowledge related to the benefits, importance, types, safety, and intensity of antenatal physical activity or exercises. They narrated thus:

I don't have any knowledge about the type of exercise a pregnant woman should engage in, and how to teach them. I do tell them to walk. If I say running, to what extent will I recommend this? Those who go to gym and do aerobics, swim and other types of exercise, to what extent will I recommend they participate? I don't know which one is good for her and the baby. (#9)

The clinics as primary health-care facilities are the first entry into health-care service. It therefore means it is supposed to inform the women on what to expect throughout their pregnancy. However, the truth is that we do not know about the exercise, the type to be recommended, the duration and intensity to be done, despite the fact that advising pregnant women during pregnancy is a component of prenatal care. (#17)

You know we learn every day. I must say that I have learnt a lot since you came here and educated us about the importance of physical activity during pregnancy. I notice how you have been educating the pregnant women about the importance of exercise during pregnancy. I must confess it exposed us. This is something we don't do for clients in the clinics. (#1)

Subtheme 2.3: Contraindications to exercises during pregnancy

Midwives expressed ignorance about the contraindications to prenatal physical activity. They highlighted that pregnant women should stop exercises if they are not feeling well, dizzy, and have a severe headache. They maintained:

I don't have any idea about the contraindications to exercise during pregnancy. (#12)

I know that a pregnant woman should stop exercising if she is has a headache and dizziness. (#15)

I won't encourage a pregnant woman to do physical activity if she is feeling unwell. (#3)

Theme 3: Barriers to physical activity advice

Despite the importance of prenatal physical activity, the midwives highlighted several perceived constraints to providing prenatal physical activity education and counseling. Four subthemes exemplify these barriers [Table 1].

Subtheme 3.1: Lack of resources (shortage of workforce and lack of equipment)

A shortage of midwives was one of the reasons highlighted by the participants as a hindrance to the provision of antenatal exercise classes for pregnant women attending antenatal health facilities. The midwives lamented that health clinics are always busy, and with too many work responsibilities, providing advice on antenatal exercise is rarely a priority to them. The participants indicated:

Here in the clinic, you find out that the number of midwives *is small, so we end up seeing too many patients per person. It becomes impossible to talk in depth about what you are supposed to be talking to the patients.* (#10)

We don't conduct talks about the importance of physical activity during pregnancy, since there is no time because we have to attend to a lot of clients in a day, and secondly, we don't have space to engage in any kind of demonstration. (#4)

Likewise, the midwives mentioned the nonavailability of exercise facilities/equipment in public health clinics for pregnant women as a constraint. Consequently, their ability to conduct exercise sessions with the women, and even refer them elsewhere, is limited. One participant reiterated:

Information sessions on exercise or physical activity are not part of our antennal agenda. Even if they are, where are the facilities or equipment to teach them practically? We don't even know how to conduct any exercise or physical activity for them. It was not part of our learning curriculum, so most of us have no idea about it. (#13)

Subtheme 3.2: Tiredness and body exhaustion

The overwhelming work responsibilities alluded to by the midwives make them exhausted and tired to a

level where they could hardly provide counseling to the women concerning physical activity during pregnancy. One of them lamented:

We feel tired and exhausted after attending to so many clients. Take note, we are few here, attending to many women. It is not easy. (#2)

Subtheme 3.3: Lack of knowledge on physical activity practice guidelines on the care of pregnant women

The midwives expressed a lack of knowledge on physical activity practice guidelines on the care of pregnant women, resulting in non-provision of antennal exercise classes. All the midwives had no knowledge about any existing recommendations or guidelines for exercise during pregnancy:

Yhooo! I'm not aware of such guidelines as you mentioned. In fact, I have no idea about this nor do we have any guideline on physical activity during pregnancy in the clinic. This is my first time of hearing about the American College of Obstetricians and Gynaecologists Guidelines. (#16)

Subtheme 3.4: Lack of referral and physical activity practice guidelines on the care of pregnant women

Midwives expressed the absence of any existing physical activity guideline for pregnant women. They maintained:

Well, other senior midwives do tell us there used to be antenatal classes, where all the pregnant women after teaching, would do different types of exercise; but we don't have such in the clinic here. I also doubt other clinics have antenatal classes, and for this reason, we don't refer anyone for exercise to other health clinics or facilities. (#9)

Theme 4: Improvement plan related to antenatal exercises

Midwives were desirous of improvements in the manner in which antenatal exercise is handled, given the value of prenatal physical activity on the maternal health of the mother and the baby. They advocated for various improvement plans to promote antenatal physical activity uptake. Three subthemes highlight the potential interventions [Table 1].

Subtheme 4.1: Improvement plan on antenatal exercise classes

Recognizing the importance of physical activity during pregnancy, the midwives advocated the reintegration of antennal physical activity exercises class into the antennal health care as part of the primary health-care program for pregnant women. One participant stated:

Personally, we think that antenatal classes should be back in the local clinics. With antenatal classes, we will be able to teach, and demonstrate the need for exercise during pregnancy to our women. (#3)

Bringing back antenatal exercises classes will be good and beneficial. (#7)

Subtheme 4.2: Training of nurses on antenatal exercises

The midwives advocated training and workshops on the types and benefits of physical activity desirable for pregnant women at each stage of the trimesters. In addition, they highlighted the need to provide alternative ways of creating health awareness and physical activity during pregnancy. They narrated thus:

I think the department of health should organise training for midwives so that they can teach pregnant women about physical activity during pregnancy ... the recommendations about physical activity and its importance to health promotion. With training,... teach the women the right thing about exercise. (#7)

I would go for a pregnancy and exercise workshop because this will help me learn about exercise, and the types a pregnant woman should engage in. I will also be able to answer some questions pregnant women asked me about exercise. (#6)

Subtheme 4.3: Provision of information sources on prenatal physical activity

Regarding the sources of information about prenatal physical activity, the midwives advocated the provision of posters and pamphlets at all health facilities. They also stressed the need for the utilization of information technology to teach physical activity to pregnant women, such as sharing prenatal exercises on "MomConnect," a technological device to provide health information for pregnant women. It was thought that it might improve the uptake.

... if posters and pamphlets are available in clinics and hospitals in the antenatal units, this will create a lot of awareness on the importance of exercise during pregnancy. (#14)

To me, the MomConnect is a very good way to circulate information on exercise to pregnant women. Personally, I am not MomConnected, but I helped the women who have cell phones to connect on the MomConnect for them to receive health-related messages. (#17)

Discussion

To our knowledge, this is the first study which explored midwives' perspectives on providing prenatal physical activity education and counseling during pregnancy to pregnant women in the Eastern Cape, South Africa.

The findings revealed that midwives rarely educate and counsel pregnant women about physical activity during their antenatal visits. Even when the information is provided, it is inadequate or lacking in scientific content, because they have no scientific knowledge and training on physical activity recommendations during pregnancy. The midwives mainly provide education and counseling to the women on the need to refrain from smoking and alcohol intake during pregnancy; they are also encouraged to maintain good nutrition. Several reasons could be plausible in explaining why midwives do not provide physical activity/exercise advice to women during antenatal health care. The current nursing curriculum does not incorporate physical activity or exercise; as such, the nursing students receive no information on physical activity promotion during nursing school or clinical training. In addition, the current antenatal health care in the primary health-care system places little emphasis on lifestyle counseling. Notably, this scenario culminates in the women and midwives becoming doubtful about the safety of physical activity during pregnancy. There is a need to incorporate physical activity guidelines in the antennal care.

Midwives working in the primary health-care settings, like in this case, have a strategic role to play in changing the attitudes and practices of the women toward physical activity during and after pregnancy. A study conducted among midwives in the United Kingdom found inaccurate or misleading information among midwives concerning physical activity recommendations during pregnancy, notwithstanding the fact that the majority of them could confidently answer questions on physical activity during pregnancy.[23] Other studies conducted in South Africa,[33] Saudi Arabia,[39] and the United Kingdom[40,41] reported similar findings, showing health-care providers' ignorance about physical activity/exercise guidelines. Decisive decision-making is imperative to address the barriers to prenatal physical activity counseling in the South African context. Nursing schools, particularly in South Africa, should include in their curriculum, information on the benefits of physical activity during pregnancy, and the integration of counseling into antenatal health care. Previous studies have shown that pregnant women who received physical activity counseling from their health providers during prenatal visits achieved higher physical activity levels compared to those who were not counseled.[42,43] As such, the onus is on the midwives and other health providers to provide proper, safe, and sustainable guidelines on physical activity during pregnancy. Health-care providers should offer prenatal physical activity counseling to encourage women to initiate and practice physical activity.[31,32,40]

Our finding indicated that the shortage of midwives impedes the provision of antenatal exercise classes for pregnant women attending antenatal health facilities. As midwives work under busy schedules and have many official responsibilities, they rarely treat antenatal physical activity as a priority. A cursory observation of the nature of the antenatal health clinics in the region indicates midwives having limited time to see each client, in view of the dire shortage of this category of health-care provider. Similarly, there are no antenatal exercise facilities/equipment for pregnant women in the clinics visited. These institutional bottlenecks, directly or indirectly, have a negative impact on maternal health promotion, especially physical activity counseling. Our findings reinforce those of earlier studies affirming insufficient time, resources, and education as the main impediments to health-care providers offering physical activity advice to pregnant women,[44-46] as well as more recent studies.[39,40] The results of this study further suggest the need to design physical activity guidelines for clinical assessment of pregnant women attending primary health-care clinics. Additionally, to promote the uptake of physical activity counseling associated with the shortage of health providers, there is need to strengthen the primary health-care clinics workforce and infrastructure.

Furthermore, notwithstanding the lack of knowledge on physical activity and the antenatal facility constraints in providing pregnant women with physical activity advice, the midwives in this study recognized the importance of physical activity in improving maternal health outcomes. They expressed willingness to provide effective physical activity education and counseling to pregnant women, if empowered through training and workshops on the benefits, types of exercise desirable for pregnant women at each stage of their trimester, risks and precautions for those with complicated midwifery conditions. Several studies have echoed the disconnect between the lack of undergraduate training on physical activity and the challenge of health-care providers in providing the requisite knowledge and skills on physical activity promotion in the clinical, primary, and community health practice.[40,47-49] Midwives require training in order to provide better antenatal care. A previous study has reported an improvement in the knowledge and practices of health professionals concerning physical activity during pregnancy after an educational intervention.[39,50] Training of midwives on physical activity during pregnancy could play a significant role in promoting physically active lifestyle among pregnant women. To be effective, such training should be diffused in the midwifery/nursing curriculum.

Other feasible opportunities identified by the midwives in changing pregnant women's physical activity behavior include creating health awareness on exercise and physical activity during pregnancy. In this regard, the midwives proposed that necessary health information should be displayed at antenatal health facilities. Previous studies in South Africa have stressed the utilization of instructional resources, such as posters, brochures, and DVDs to promote healthy behaviors in antenatal clinics.[21,51] In addition, the midwives emphasized the utilization of information technology to teach physical activity to pregnant women. Specifically, they recommended the use of the "MomConnect," which might improve physical activity uptake among expectant mothers. In the South African context, the "MomConnect" is a phone-based technological maternal initiative health program of the South African National Department of Health used to support maternal health and child health services. It is free to the user, and health promotion messages are available in all of the 11 official South African languages. The midwives also call for the reintegration of antenatal exercise classes in antenatal health care as part of the primary health-care service for pregnant women. These suggestions and issues raised by midwives are important in changing the face of physical activity in the scope of antenatal health-care practice in the setting.

Limitations of the study

A limitation of this study was that few midwives were interviewed, which from the qualitative point of view limits our generalizability of the findings to other public health clinics. In addition, the exclusion of other midwives working in private health facilities limits our understanding of the perspectives of midwives on physical activity during pregnancy by the vast majority of the South African population. However, we are convinced that the interviewed midwives provided frank and reliable responses. As can be seen, apart from admitting their limited knowledge on physical activity during pregnancy, the respondents' reference to other health clinics in the region also indicated the nonavailability of antenatal physical exercise classes. We believe that this study might trigger discussions among health-care professionals on what they ought to be doing regarding physical activity education, counseling, and debate on the introduction of physical activity in antenatal health care to positively promote physical activity behavior of women during pregnancy. Overall, a quantitative study research design may further provide valuable information on the constraints of providing prenatal physical activity counseling by midwives and as well as other health-care providers in the setting.

Conclusion

Our finding indicated that midwives lack knowledge of physical activity during pregnancy. Presumably, it was not offered to them during midwifery/nursing education and training, and they, therefore, are not currently equipped to provide evidence-based exercise recommendations to pregnant women. In addition, midwives may be constrained to offer such service because physical activity is not part of the antenatal health care, amidst other system and facility-related problems. There is a need to include physical activity in the midwifery/nursing curriculum and to integrate it into the antenatal health-care agenda. Tomorrow's midwives should be adequately trained to discuss, educate, counsel, and engage in the topic of physical activity with pregnant women during antenatal visits.

Acknowledgments

This work is based on the research supported by the National Research Foundation of South Africa. The Govan Mbeki Research and Development Centre, University of Fort Hare. Eastern Cape Department of Heath for granting the permission to conduct the study in the selected health facilities and Health Professionals in Buffalo City Metro Municipality district for their willful participation in the study.

Author's contribution: UBO conceived and wrote the first draft. interviews, UBO; writing—first draft preparation, UBO; writing—review and editing, DTG; supervision, DTG. All authors read and approved the final manuscript.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Sanabria-Martínez G, García-Hermoso A, Poyatos-León R, Álvarez-Bueno C, Sánchez-López M, Martínez-Vizcaíno V. Effectiveness of physical activity interventions on preventing gestational diabetes mellitus and excessive maternal weight gain: A meta-analysis. Br J Obstet Gynaecol 2015;122:1167–74.
2. Muktabhant B, Lawrie TA, Lumbiganon P, Laopaiboon M. Diet or exercise, or both, for preventing excessive weight gain in pregnancy. Cochrane Database Sys Rev 2015;6:CD007145.
3. da Silva SG, Ricardo LI, Evenson KR, Hallal PC. Leisure time physical activity in pregnancy and maternal-child health: A systematic review and meta-analysis of randomized controlled trials and cohort studies. Sports Med 2016;47:1–23.
4. Whitaker KM, Baruth M, Schlaff RA, Talbot H, Connolly CP, Liu J, *et al*. Provider advice on physical activity and nutrition in twin pregnancies: A cross-sectional electronic survey. BMC Pregnancy Childbirth 2019;19:418.
5. Harrison AL, Shields N, Taylor NF, Frawley HC. Exercise improves glycaemic control in women diagnosed with

gestational diabetes mellitus: A systematic review. J Physiother 2016;62:188–96.
6. Russo LM, Nobles C, Ertel KA, Chasan-Taber L, Whitcomb BW. Physical activity interventions in pregnancy and risk of gestational diabetes mellitus: A systematic review and meta-analysis. Obstet Gynaecol 2015;125:576-82.
7. Thompson EL, Vamos CA, Daley EM. Physical activity during pregnancy and the role of theory in promoting positive behaviour change: A systematic review. J. Sport Health Sci 2017;6:198–206.
8. Catov JM, Parker CB, Gibbs BB, Bann CM, Carper B, Silver RM, *et al*. Patterns of leisure-time physical activity across pregnancy and adverse pregnancy outcomes. Int J Behav Nutr Phys Act 2018;15:68–78.
9. Harrison AL, Taylor NF, Nora Shields N, Frawley HC. Attitudes, barriers and enablers to physical activity in pregnant women: A systematic review. J Physiother 2018;64:24–32.
10. Puchalski S. Physical activity: Utilizing guidelines to promote health among pregnant women. J Pregnancy Reprod 2017;1:1-3.
11. Davenport MH, Ruchat SM, Poitras VJ, Garcia AJ, Gray CE, Barrowman N, *et al*. Prenatal exercise for the prevention of gestational diabetes mellitus and hypertensive disorders of pregnancy: A systematic review and meta-analysis. Br J Sports Med 2018;52:1367–75.
12. Poyatos-León R, García-Hermoso A, Sanabria-Martínez G, Álvarez-Bueno C, Sánchez-López M, Martínez-Vizcaíno V. Effects of exercise during pregnancy on mode of delivery: A meta-analysis. Acta Obstet Gynecol Scand 2015;94:1039–47.
13. Barakat R, Pelaez M, Lopez C, Montejo R, Coteron J. Exercise during pregnancy reduces the rate of caesarean and instrumental deliveries: Results of a randomized controlled trial. J. Matern Fetal Neonatal Med 2012;25:2372–6.
14. Davenport MH, McCurdy AP, Mottola MF, Skow RJ, Meah VL, Poitras VJ, *et al*. Impact of prenatal exercise on both prenatal and postnatal anxiety and depressive symptoms: A systematic review and meta-analysis. Br J Sports Med 2018;52:376–85.
15. American College of Obstetricians and Gynaecologists. Physical activity and exercise during pregnancy and the postpartum period. Committee Opinion No. 650. Obstet Gynaecol 2015;126:e135–42.
16. American College of Obstetricians and Gynaecologists. Physical activity and exercise during pregnancy and the postpartum period. Committee Opinion No. 804. Obstet Gynaecol 2017;126:e135–42.
17. Baker JH, Rothenberger SD, Kline CE, Okun ML. Exercise during early pregnancy is associated with greater sleep continuity. Behav Sleep Med 2018;16:482–93.
18. Vargas-terrones M, Barakat R, Santacruz B, Fernandez-buhigas I, Mottola MF. Physical exercise programme during pregnancy decreases perinatal depression risk: A randomised controlled trial. Br J Sports Med 2018;53:348–53.
19. Barakat R, Pelaez M, Montejo R, Luaces M, Zakynthinaki M. Exercise during pregnancy improves maternal health perception: A randomised controlled trial. Am J Obstet Gynecol 2011;204:e401–7.
20. Sallis JF, Owen N, Fotheringham MJ. Behavioural epidemiology: A systematic framework to classify phases of research on health promotion and disease prevention. Ann Behav Med 2000;22:294–8.
21. Watson ED, Norris SA, Draper CE, Jones RA, van Poppel MN, Micklesfield LK. "Just because you're pregnant, doesn't mean you're sick!" A qualitative study of beliefs regarding physical activity in black South African women. BMC Pregnancy Childbirth 2016;16:174.
22. Hayman M, Reaburn P, Alley S, Cannon S, Short C. What exercise advice are women receiving from their healthcare practitioners during pregnancy? Women Birth 2020;e357-62.
23. Hopkinson Y, Hill DM, Fellows L, Fryer S. Midwives understanding of physical activity guidelines during pregnancy. Midwifery 2018;59:23-6.
24. De Vivo M, Mills H. "They turn to you first for everything": Insights into midwives' perspectives of providing physical activity advice and guidance to pregnant women. BMC Pregnancy Childbirth 2019;19:462.
25. Lindqvist M, Persson M, Mogren I. Longing for individual recognition-Pregnant women's experiences of midwives' counselling on physical activity during pregnancy. Sex Reprod Healthc 2018;15:46–53.
26. Findley A, Smith DM, Hesketh K, Keyworth C. Exploring women's experiences and decision making about physical activity during pregnancy and following birth: A qualitative study. BMC Pregnancy Childbirth 2020;20:54.
27. Ferrari RM, Siega-Riz AM, Evenson KR, Moos MK, Carrier KS. A qualitative study of women's perceptions of provider advice about diet and physical activity during pregnancy. Patient Educ Couns 2013;91:372–7.
28. May LE, Suminski RR, Linklater ER, Jahnke S, Glaros AG. Exercise during pregnancy: The role of obstetric providers. J Am Osteopath Assoc 2013;113:612–9.
29. Aittasalo M, Pasanen M, Fogelholm M, Kinnunen TI, Ojala K, Luoto R. Physical activity counselling in maternity and child health care-A controlled trial. BMC Womens Health 2008;8:1–14.
30. Watson ED, Van Poppel MNM, Jones RA, Norris SA, Micklesfield LK. Are South African mothers moving? Patterns and correlates of physical activity and sedentary behaviour in pregnant black South African women. J Phys Act Health 2017;14:329-35.
31. Goodrich K, Cregger M, Wilcox S, Liu J. A qualitative study of factors affecting pregnancy weight gain in African American women. Matern Child Health J 2013;17:432–40.
32. Sui Z, Turnbull D, Dodd J. Overweight and obese women's perceptions about making healthy change during pregnancy: A mixed method study. Matern Child Health J 2013;17:1879–87.
33. Watson ED, Oddie B, Constantinou D. Exercise during pregnancy: Knowledge and beliefs of medical practitioners in South Africa: A survey study. BMC Pregnancy Childbirth 2015;15:245.
34. South African Nursing Council. 2004 – 2021 South African Nursing Council (Under the provisions of the Nursing Act, 2005). Available from: https://www.sanc.co.za/regulat/reg-cmi.htm. [Last accessed on 2021 Feb 01].
35. Malterud K, Siersma VD, Guassora AD. Sample size in qualitative interview studies: Guided by information power. Qual Health Res 2016;26:1753–60.
36. Vasileiou K, Barnett J, Thorpe S, Young T. Characterising and justifying sample size sufficiency in interview-based studies: Systematic analysis of qualitative health research over a 15-year period. BMC Med Res Methodol 2018;18:148.
37. Creswell JW. Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. 4th ed.. Thousand Oaks: Sage Publication Inc.; 2014.
38. Guba EG, Lincoln YS. Competing paradigms in qualitative research. Handbook Qualitative Res 1994;2:163-94.
39. Alahmed Z, Lobelo F. Correlates of physical activity counselling provided by physicians: A cross-sectional study in Eastern Province, Saudi Arabia. PLoS One 2019;14:e0220396.

40. Kime N, Pringle A, Zwolinsky S, Vishnubala D. How prepared are healthcare professionals for delivering physical activity guidance to those with diabetes? A formative evaluation. BMC Health Serv Res 2020;20:8.
41. Din NU, Moore GF, Murphy S, Wilkinson C, Williams NH. Health professionals' perspectives on exercise referral and physical activity promotion in primary care: Findings from a process evaluation of the National Exercise Referral Scheme in Wales. Health Educ J 2015;74:743-57.
42. Sinclair MB, Liddle D, Hill A, Stockdale D, Stockdale M. Motivating pregnant women to eat healthily and engage in physical activity for weight management: An exploration of routine midwife instruction. Evid Based Midwifery 2013;11:120–7.
43. Aittasalo M, Raitanen J, Kinnunen TI, Ojala K, Kolu P, Luoto R. Is intensive counselling in maternity care feasible and effective in promoting physical activity among women at risk for gestational diabetes? Secondary analysis of a cluster randomized NELLI study in Finland. Int J Behav Nutri Phys Act 2012;9:104.
44. Hebert ET, Caughy MO, Shuval K. Primary care providers' perceptions of physical activity counselling in a clinical setting: A systematic review. Br J Sports Med 2012;46:625–31.
45. Aljaberi AS. Assessment of physical activity (counselling) at primary health care centres in Aseer Region, Saudi Arabia. Med J Cairo Uni 2014;82:207–13.
46. Lindqvist M, Mogren I, Eurenius E, Edvardsson K, Persson M. "An on-going individual adjustment": A qualitative study of midwives' experiences counselling pregnant women on physical activity in Sweden. BMC Pregnancy Childbirth 2014;14:343.
47. Cuthill JA, Shaw M. Questionnaire survey assessing the leisure-time physical activity of hospital doctors and awareness of UK physical activity recommendations. BMJ Open Sport Exerc Med 2019;5:e000534.
48. Lion A, Vuillemin A, Thornton JS, Theisen D, Stranges S, Ward M. Physical activity promotion in primary care: A utopian quest? Health Promot Int 2018;1:10.
49. Radenkovic D, Aswani R, Ahmad I, Kreindler J, Robinson R. Lifestyle medicine and physical activity knowledge of final year UK medical students. BMJ Open Sport Exerc Med 2019;5:e000518.
50. Malta MB, Carvalhaes MD, Takito MY, Tonete VLP, Barros AJD, Garcia de Lima Parada CM, *et al*. Educational intervention regarding diet and physical activity for pregnant women: Changes in knowledge and practices among health professionals. BMC Pregnancy Childbirth 2016;16:175.
51. Muzigaba M, Kolbe-Alexander TL, Wong F. The perceived role and influencers of physical activity among pregnant women from low socioeconomic status communities in South Africa. J Phys Act Health 2014;11:1276-83.

CHAPTER TEN

DEVELOPMENT AND VALIDATION OF PRENATAL PHYSICAL ACTIVITY INTERVENTION STRATEGY FOR WOMEN IN BUFFALO CITY MUNICIPALITY, SOUTH AFRICA

10.1 INTRODUCTION

The article pertains to the development and validation of the physical activity strategies to promote physical activity practices in pregnant women based on the empirical findings from phase one, which is the last objective of the study. Research, across studies, including South Africa has indicated that women rarely participate in physical activity during pregnancy, notwithstanding its importance thereof. Informed by the lack of any study on development of strategies to promote prenatal physical activity in the South African context, the manuscript presented herein seeks to fill this gap. Context-specific intervention strategies are needed to encourage and promote prenatal physical activity of women to improve their maternal health outcomes. This is particularly important in the context of the Eastern Cape where information on prenatal activity is lacking.

10.2 PUBLICATIONS DETAILS

Title:	Development and Validation of Prenatal Physical Activity Intervention Strategy for Women in Buffalo City Municipality, South Africa
Authors:	UB Okafor, DT Goon
Ethics:	University of Fort Hare Health Research Ethics Committee approved the study protocol (Ref#2019 = 06 = 009 = OkaforUB)
Journal:	Healthcare
Journal details:	Peer-reviewed (blinded) Journal approved and listed on the Department of Higher Education and Training (DHET)
Status:	Published
	Okafor UB, Goon DT. Development and Validation of Prenatal Physical Activity Intervention Strategy for Women in Buffalo City Municipality, South Africa. *Healthcare*, 2021, 9(11):71445. https://doi.org/10.3390/healthcare9111445.
Impact factor:	2.645

10.3 PUBLICATION RECORD

The article was submitted to the journal on the 24 August 2021, revised on 12 October 2021, accepted on 23 October 2021.

healthcare

MDPI

Article

Development and Validation of Prenatal Physical Activity Intervention Strategy for Women in Buffalo City Municipality, South Africa

Uchenna Benedine Okafor [1,*] and Daniel Ter Goon [2]

[1] Department of Nursing Science, University of Fort Hare, East London 5201, South Africa
[2] Department of Public Health, University of Fort Hare, East London 5201, South Africa; dgoon@ufh.ac.za
* Correspondence: ucheysonic@gmail.com

Abstract: Women rarely participate in physical activity during pregnancy, despite scientific evidence emphasising its importance. This study sought to develop an intervention strategy to promote prenatal physical activity in Buffalo City Municipality, Eastern Cape Province, South Africa. A multi-stage approach was utilised. The Strength, Weakness, Opportunity and Threat (SWOT) approach was applied to the interfaced empirical findings on prenatal physical activity in the setting. Subsequently, the Build, Overcome, Explore and Minimise model was then used to develop strategies based on the SWOT findings. A checklist was administered to key stakeholders to validate the developed strategies. Key strategies to promote prenatal physical activity include the application of the Mom-Connect (a technological device already in use in South Africa to promote maternal health-related information for pregnant women) in collaboration with cellphone and network companies; the South African government to integrate prenatal physical activity and exercise training in the medical and health curricula to empower the healthcare providers with relevant knowledge and skills to support pregnant women in prenatal physical activity counselling; provision of increased workforce and the infrastructure necessary in antenatal sessions and antenatal physical exercise classes and counselling; the government, in partnership with various stakeholders, to provide periodical prenatal physical activity campaigns based in local, community town halls and clinics to address the lack of awareness, misrepresentations and concerns regarding the safety and benefits of physical activity during pregnancy. The effective implementation of this developed prenatal physical activity by policymakers and health professionals may help in the promotion of physical activity practices in the context of women in the setting.

Keywords: physical activity; strategies; pregnant women; SWOT analysis; BOEM plan; PESTEL analysis

Citation: Okafor, U.B.; Goon, D.T. Development and Validation of Prenatal Physical Activity Intervention Strategy for Women in Buffalo City Municipality, South Africa. *Healthcare* **2021**, *9*, 1445. https://doi.org/10.3390/healthcare9111445

Academic Editors: Eric Sobolewski and José Carmelo Adsuar Sala

Received: 24 August 2021
Accepted: 23 October 2021
Published: 26 October 2021

1. Introduction

Contrary to previously held negative beliefs, prenatal physical activity is associated with numerous health benefits, including physical, psychological and social advantages of physical activity during pregnancy, which are widely reported in the literature [1–7]. Nonetheless, while scientific evidence emphasises these benefits, most pregnant women do not participate. Furthermore, there is a considerable decline worldwide in physical activity among this special population [8–13]. In contrast to this trend, health professionals are advising women to partake in regular physical activity both during and after pregnancy, unless there are relevant medical or obstetrical complications [14]. Consequently, researchers have conducted various studies across countries and regions in an attempt to understand why pregnant women reduce or never take part in physical activity [8–12,15–22]. Unfortunately, most of these studies conducted are in developed countries, and there is very little information available within an African context [23]. Moreover, within the specific context of South Africa, the literature does not contain any research into the development of prenatal strategies that promote physical activity practices in pregnant women. In order

to address this lack, our empirical findings on different aspects of prenatal physical activity in pregnant women, and midwives' views of related counselling [24–27] informed and supported the need to develop and validate intervention strategies to promote physical activity and exercise during pregnancy in Buffalo City Municipality, Eastern Cape Province, South Africa.

Presumably, pregnancy serves as an opportune period to encourage a healthy lifestyle in individuals, since pregnant women are seemingly receptive to health messages [28]; therefore, a strategy to promote physical activity in pregnancy may prove useful to health professionals responsible for the antenatal healthcare of women. Strategy, as a term, refers to 'what one may use to reach goals' [29]. Strategically, a SWOT and/or Political, Economic Growth, Socio-Cultural, Technological, Laws and Environmental (PESTLE) analysis investigates both internal and external factors influencing pregnant women's participation in physical activity. A SWOT analysis assesses the Strengths (S) and Weaknesses (W) as internal capabilities of an organisation/institution in contrast to Opportunities (O) and Threats (T) caused by the external environment [29–31]. This type of strategy entails the careful weighing of internal factors that enable the successful achievement of aims, which are termed 'strengths' or 'weaknesses' [29–31]. On the other hand, external factors are variables outside the reach of control, which constitute 'threats' or 'opportunities' related to the set goal [29–31]. In this particular SWOT analysis, since health providers assume the role of the strategic planner, 'strengths' or 'weaknesses' are identified as those factors relating to the provision of prenatal physical activity advice and health providers' capability to deliver such advice. Subsequently, 'opportunities' or 'threats' are those factors of prenatal physical activity that mostly relate to pregnant women, such as behaviour, motivation or ability to engage in prenatal physical activity. In addition, the PESTLE model's analytical tool is useful in identifying and analysing the fundamental drivers of change that operate in the external environment, which is useful in research reports [32]. The Build, Overcome, Explore and Minimize (BOEM) strategic model leverages on building strengths, overcoming weaknesses, exploring opportunities and minimizing threats, and in this case, factoring in the components of the BOEM to enhance prenatal physical uptake. The BOEM framework indicates the need to develop strategies that overcome mistrust, financial and human resources deficit, barriers to access and utilise physical activity facilities by pregnant women, while also eliminating stereotypical myths and beliefs, and minimising misuse of resources and ensure collaborative efforts by various stakeholders in promoting prenatal physical activity. Therefore, these strategic tools were used to comprehensively explore the various factors that define the facilitators of, or barriers to prenatal physical activity. Gaining insight into these environments would help minimise threats to prenatal physical activity while, at the same time, maximising opportunities for prenatal physical activity participation. In this article, we present the development and validation of the physical activity intervention strategy to encourage and promote prenatal physical activity and exercise within the context of the Eastern Cape by applying the SWOT, PESTLE and BOEM strategy models as part of the development and validation of a physical activity intervention strategy.

This study will, potentially, add to the body of knowledge on maternal health and further guide physical activity interventions that seek to address the needs of pregnant women in South Africa.

2. Methods

A multi-stage approach was utilized, with Phase I focussing on the empirical findings on facilitators of or barriers to prenatal physical participation in Buffalo City Municipality, Eastern Cape Province, which then lays the groundwork for the development of a prenatal physical activity strategy [24–27]. Therefore, the results of the studies above have provided us with guidance into developing an effective prenatal physical activity strategy that promotes the practice of prenatal physical activity. A study protocol was previously

published on the development and validation of physical activity intervention strategy for pregnant women in Buffalo City Municipality, South Africa [33].

The SWOT, PESTLE and BOEM models underpin the development of the proposed intervention for the promotion of prenatal physical activity in Buffalo City Municipality, Eastern Cape Province. SWOT analysis is applicable to many health-related issues, including strategies for future healthcare [34]. Figure 1 presents the SWOT, PESTLE and BOEM strategies used to develop prenatal physical activity strategies.

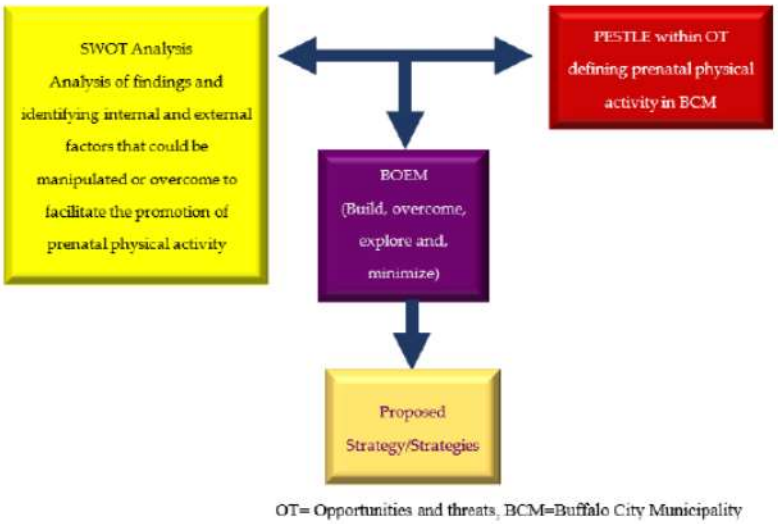


Figure 1. SWOT, PESTLE and BOEM strategies.

As previously pointed out, the SWOT analysis strategy assesses a situation to determine the 'strengths', 'weaknesses' that internally characterise a system, which needs to be addressed, respectively, while 'opportunities' and 'threats' are viewed as external factors that may be used or avoided [35]. For the sake of this study, the SWOT tool was used to evaluate and manage the internal and external factors affecting the uptake of prenatal physical activity and the provision of prenatal physical services at primary healthcare clinics in Buffalo City Municipality. Similarly, the PESTLE analytical tool analyses a particular situation to identify actions that may cause failure. In addition, the researchers utilised the BOEM approach to develop a prenatal physical activity strategy by building on the identified strengths, overcoming the weakness, exploring the opportunities and minimising the threats to physical activity [36]. In order to identify the relevant strengths and weaknesses of prenatal physical activity participation in the setting, the researchers conducted various interviews with experts, and consulted published and/or unpublished data from the Department of Health. An external assessment (or analysis) was used to identify the opportunities and threats [35]. Table 1 presents the action plan indicating the BOEM developing strategies based on SWOT analysis.

Table 1. The BOEM strategy from the SWOT analysis of prenatal physical activity among women in the Eastern Cape.

	Strengths	Weaknesses
INTERNAL	• Effective allocation of antenatal resources • Availability of medical and health sciences departments to offer prenatal physical activity courses locally • Free antenatal healthcare provision • All available health centres provide antenatal healthcare services • Government and research bodies, such as the National Research Foundation of South Africa and the South Africa Medical Research Council, support of research and development activities related to maternal health	• Insufficient number of healthcare providers (midwives) to provide antenatal healthcare services, including prenatal physical activity advice or exercise classes • Training on and knowledge about prenatal physical activity is sorely lacking • Financial support for prenatal physical activity is lacking • Prenatal physical activity advice, counselling or information is often unavailable • Prenatal physical activity class or sessions are not provided for • Patients are not referred for prenatal physical activity • Prenatal physical activity is not a prioritised component of the antenatal primary healthcare service • Prenatal physical activity guidelines do not exist • There is no training course for midwives on prenatal physical activity • No individualised prenatal physical activity counselling to pregnant women
EXTERNAL	Threats • Inadequate material to provide prenatal physical activity services • No political funding of prenatal physical training for midwives and organisation of prenatal physical activity community campaigns • Human and material resources are scarce, which constrains the provision of prenatal physical activity services • Unemployment in women result in the following: ○ There is no money to pay for gym exercise ○ There is no money to pay transport costs to and from the gym ○ There is no money to hire or employ a house helper ○ There are changes in household responsibilities • Poor support (family, friends and peers) of pregnant women in terms of prenatal physical activity • Women rarely participate in physical activity during pregnancy • Women hold negative beliefs about the safety of physical activity and exercise during pregnancy • Women are uneducated • Women are underprivileged • Women have a high unemployment rate • The main source of women's income is social grants • Social media is absent and cannot be used to promote prenatal physical activity • Technological resources for communication are lacking • Weather conditions are unsafe or unfriendly • Women have misconceptions about prenatal physical activity • Neighbourhoods are unsafe for outdoor physical activity • Recreational and outdoor physical activity is lacking • COVID-19 pandemic challenges	Opportunities • Government has a desire to provide primary health care services more accessible to people • Mom-Connect technology is available to provide maternal health information • Other stakeholders (non-governmental organisations (NGOs), faith-based organisations, community) are partnering with government concerning women's maternal health

Table 1. *Cont.*

Strengths	Weaknesses
Legal • There is a lack of policy and guidelines on prenatal physical activity for possible interventions	Legal • Strengthen maternal basic health education • Initiate prenatal physical activity or exercise training courses and workshops to address lack of knowledge of healthcare professionals, particularly among midwives who have limited knowledge and information on prenatal physical activity and exercise

2.1. Validation of the Developed Intervention Strategy

Phase I and II of the study preceded the validation of the developed intervention strategy. Validation seeks to ascertain the empirical credibility of a scientific model of a particular discipline [37], and there are several ways of validating empirical knowledge. One alternative approach is to note and share a thought or opinion pertaining to what a phenomenon is and operates, without conducting formal research to test the views [37]. We analysed the empirical findings synergistically with SWOT and PESTLE analytical strategic frameworks in order to identify pointers that would aid the validation of the developed strategy deemed feasible, effective and sustainable to address the gaps identified during the research.

A purposive sample of seven professional academic experts with extensive knowledge and proven academic and scholarly background on prenatal physical activity and maternal health were selected to participate in the validation process. They include gynaecologists, obstetricians, midwives/professional nurses and exercise physiologists. The findings from Phase I, the SWOT and PESTLE analyses, as well as the BOEM model and the subsequently developed strategies were presented to the professional academic experts. They were requested to provide critical comments on the developed strategy in the context of needs of the pregnant women, determine the feasibility of the strategy in promoting prenatal activity in women in the locality. Therefore, the feedback from the experts help to modify the strategy, which was then presented to the key stakeholders for validation.

2.2. Key Stakeholder Consultation

Key stakeholders that were consulted were mainly maternity health team managers, such as physician, obstetrician, midwife, paediatric nurse and primary healthcare nurse. In each of the 12 selected antenatal health clinics, two midwives and pregnant women were purposively chosen to participate in the validation process. In all, 54 participants participated. The managers of these particular healthcare facilities were also included since they are the agents who would implement or supervise the application of these developed strategies in their respective healthcare facilities. Moreover, it is important to also include pregnant women since patient engagement may provide insights into possible contextual interventions strategies that are relevant to addressing the individual needs of pregnant women in order to promote their physical activity. Furthermore, a checklist of the developed strategies was utilised to solicit the opinion of and information from the above-mentioned stakeholders.

The empirical findings of the study (Phase I) and the developed strategies based on the SWOT/PESTLE analysis were presented to the relevant participants to discuss, deliberate on and provide their comments and opinions regarding its feasibility, accessibility and sustainability. The stakeholders' views were analysed and then used to perfect the accepted strategy for the promotion and implementation of prenatal physical activity within the context of Buffalo City Municipality the Eastern Cape.

2.3. Data Analysis

A checklist was created to determine the possible strategies to facilitate physical activity promotion based on the PESTLE/SWOT analytical matrix; the comments and opinions on the checklist from the experts and stakeholders were analysed using frequency and percentage counts, and where applicable, a content thematic analysis was applied. The unit of analysis was the different constructs in the PESTLE/SWOT framework. Firstly, the comments from the experts were analysed. Secondly, two strategies that proved irrelevant were removed, while three were merged. Then, the stakeholders' comments and views were analysed and integrated into the developed strategy.

3. Results

There were very few comments and critique received in terms of the stakeholder's analysis of the prenatal physical activity strategy to promote physical activity and exercise

during pregnancy (Table 2); these comments and suggestions were incorporated into the strategy, accordingly. Table 3 presents stakeholders' validation of the physical activity intervention strategies for the promotion of prenatal physical activity in Buffalo City Municipality. Of all the strategies endorsed by the health managers and midwives, the most highly endorsed strategy was the application of scientific and technological innovations to provide basic information of the benefits of prenatal physical activity to pregnant women with the use of the Mom-Connect device. This device is already used in South Africa and promotes maternal health-related information for pregnant women. Relatedly, stakeholders also highly recommended collaborative partnerships with the various cellphone and network companies operating in South Africa. These partners include companies such as Vodacom, MTN, Cell C and 8ta, which would assist in dissemination information to regarding the benefits of prenatal physical activity. In addition, the pregnant participants who were sampled in the validation process shared similar opinions. They were all excited about a partnership between the government and the networks to facilitate the communication of information on prenatal physical activity. Relatedly, the use of cellphone networks was supported since many people own and use cellphones.

These pregnant women vehemently supported the incorporation of antenatal physical activity and exercise classes into routine antenatal healthcare services. They indicated that 'this will build in them, the spirit of team play and encourage us to embrace physical activity during pregnancy'. Furthermore, the midwives highly praised the feasibility of the interventional strategy, which includes the provision of periodic prenatal physical activity, exercise training and workshops for healthcare professionals in order to mitigate their lack of knowledge on prenatal physical activity recommendations and guidelines.

Table 2. Experts analyses and comments on the developed prenatal physical activity strategy.

Developed Strategy Item	Comment/Critique/No Comment
Intervention strategy 1: Building on strengths	
Training of gynaecologists/obstetrics/midwives/nurses to provide prenatal physical activity during antenatal sessions, and other categories of health providers, such as physiotherapists, exercise physiologists, biokineticists (practice exclusively in South Africa and Nambia), responsible for women's' healthcare in order to offer prenatal physical activity counselling during antenatal or consultation sessions.	This is good but beyond their scope of practice. They can only provide physical activity counselling. Commendable. Necessary since physical exercise in pregnancy helps burn calories and assist in minimising excessive weight gain. This would be feasible and to be included in documentation.
Increased focus of health/medical education on the morbidity of excess weight gain and physical inactivity during pregnancy.	Agree. Too general. Good, but can be merge with prenatal physical counselling.
Provision of prenatal physical activity campaigns in the community, involving ward-based outreach teams, NGOs and faith-based organisations. To empower and motivate women, well-known, influential female public figures should be involved as guest speakers at outreach events to create awareness on physical activity participation during pregnancy.	Very practical. Feasible.
The inclusion of physical activity counselling by trained professionals and antenatal exercise classes as one of the components of antenatal healthcare.	Yes. I agree.
Intervention strategy 2: Overcoming of weaknesses	
Application of scientific and technological innovations to provide basic information about the benefits of prenatal physical activity. For example, the use of Mom-Connect, a technological device already in use in South Africa to promote maternal health-related information for pregnant women.	Yes. I agree. No comments. Very important. Mom-Connect was developed many years ago but is still not widely enough utilised. My suggestion would be to focus on one or two interventions, which seem to be more achievable since the platform is already in place and funded, though it would be necessary to conduct some monitoring and evaluation to determine whether this strategy is effective. I fully agree that the technological platform of Mom-Connect would be the best manner in which to communicate basic information.

Table 2. *Cont.*

Developed Strategy Item	Comment/Critique/No Comment
Actively involve support groups (partners, family and friends) in prenatal care so that others who influence the mothers are empowered to ask questions, understand risks and have the same goals regarding the benefits of prenatal physical activity for maternal health of both the mother and the baby.	Yes. I agree. No comments. This is relevant and important. This is feasible.
Midwives to conduct exercise classes of suitable duration and intensity that are consistent with the recommended guidelines for pregnant women to maintain health.	Not feasible
Intervention strategy 3: Exploring opportunities	
Negotiate with corporate organisations or companies to include in their products slogans promotional information on prenatal physical activity. For example, refrigerator magnets, grocery plastic bags, sanitary pads, cosmetics, baby products, billboards along the road and public. Radio stations and television broadcasting should also be included.	Yes. I agree. Very practical and can be rolled out with ease. This is possible.
Collaborate with cellphone and network companies, such as Vodacom, MTN, Cell C and 8ta, and have them assist in the dissemination of information related to the benefits of prenatal physical activity. Furthermore, they can include such information on their airtime slips and set up automatic voice messages, either when dialling or receiving calls, to create awareness of the importance of recommended physical activity during pregnancy.	I agree. This is very helpful. This is an excellent strategy and all members of communities that can share the information use it.
Conduct continued research in the field of effective interventions that promote physical activity during pregnancy.	I agree. Very necessary. There must be scientific evidence of all interventions.
Provide healthcare providers with relevant physical activity education and counselling strategies that are culturally appropriate, sensitive and effective.	Yes. I agree. Correct.
Create and provide an opportunity for pregnant women and other support groups (family members, spouses/partners) to attend monthly group meetings that focus on physical activity. Make those meetings attractive by providing treats, snacks or games.	Helpful. Doable. Feasible, but it needs to be in close proximity to where antenatal care is received.
Intervention strategy 4: Mitigation of threats	
Document the misconceptions and clarifications about the safety concerns of prenatal physical activity. Make this document accessible to women at the clinics in the form of a small pamphlet or booklet.	Yes. I agree. No comments. This will provide a readily accessible information resource for the mothers. Feasible strategy. This will be good and make it accessible in formats that can be taken home such as a small pamphlet or booklet.
Implement individual face-to-face or group interviews emphasising the risks of a sedentary lifestyle and physical activity and provide information on the minimal physical activity required for pregnant women, as well as the importance of nutrition during and after pregnancy during routine consultations.	Difficult to implement. Not feasible considering lack of human resources.
Provide general health education training to home-based carers and community health workers in terms of the importance and benefits of prenatal physical activity, so that they are equipped to create more awareness within their respective communities about the need to participate in physical activity and exercise during pregnancy.	Yes. I agree. No comments. Very beneficial. This will be an excellent strategy to continue spreading awareness.

Table 2. *Cont.*

Developed Strategy Item	Comment/Critique/No Comment
Periodic professional training of midwives, and keeping them updated on the latest prenatal physical activity and exercise prescriptions, contraindications, recommendations and guidelines; furthermore, as part of the nursing education training curriculum, policy-makers should further add to the maternal guidelines that address prenatal physical activity information and practice.	Yes. I agree. No comments. Training of healthcare providers is important.
The government should recruit more midwives at primary healthcare centres to assist in the antenatal sessions, this would include them providing antenatal physical exercise classes.	This will aid successful intervention if this is possible at the government level. This would be excellent.
Form a multi-disciplinary antenatal physical exercise team comprised exercise physiologists and biokineticists who can demonstrate antenatal exercises to women during their antenatal clinic visits.	Would be very helpful. This would be good, but they are not always involved in all health care facilities or available.
As a long-term strategy, build and procure antenatal physical exercise facilities and equipment to encourage and promote prenatal physical activity.	Would rather recommend physical activity that can be conducted with minimal equipment to encourage all women to continue exercising at home and not only during the antenatal clinic. Excellent intervention.

Table 3. Developed physical activity intervention strategy.

Intervention Strategy 1: Building on Strengths	Responsibility
Provide knowledge to gynaecologists, obstetricians, midwives and nurses on prenatal physical activity counselling during antenatal sessions.	Eastern Cape Department of Health
Provide relevant prenatal campaigns within communities and involve ward-based outreach teams, NGOs and faith-based organisations. Utilise influential well-known female public figures as guest speakers at outreach events to create awareness of the benefits of physical activity participation during pregnancy and empower communities.	Eastern Cape Department of Health, in collaboration with the Primary Health Care Nurses/Midwives
Include physical activity counselling by trained professionals and antenatal exercise classes as one of the components of antenatal healthcare.	Primary Health Care Nurses/Midwives
Intervention strategy 2: Overcoming of weaknesses	
Utilise scientific and technological innovations to provide basic information on the benefits of prenatal physical activity. For example, the use of Mom-Connect, a technological device already available in South Africa, to promote maternal health-related information to pregnant women.	Eastern Cape Department of Health in collaboration with the Primary Health Care Nurses/Midwives
Actively involve support groups (partners, family and friends) in prenatal care so they are empowered to ask questions, understand risks and have the same goals regarding the benefits of prenatal physical activity for the maternal health of both the mother and the baby.	Primary Health Care Nurses/Midwives
Midwives should conduct exercise classes with duration and intensity consistent with the recommended guidelines for pregnant women to maintain health.	The Primary Health Care Nurses/Midwives
Intervention strategy 3: Exploring opportunities	
Negotiate with corporate organisations or companies to include in their products slogans promotional information on prenatal physical activity. For example, refrigerator magnets, grocery plastic bags, sanitary pads, cosmetics, baby products, billboards along the road and public. Additionally, radio stations and television broadcasting.	Eastern Cape Department of Health in collaboration with the Primary Health Care Nurses/Midwives
Collaborate with cellphone and network companies, for example, Vodacom, MTN, Cell C and 8ta, to assist in information dissemination regarding the benefits of prenatal physical activity. They can write information on prenatal physical activity on their airtime slips, provide automatic voice message either when dialling or receiving calls to create awareness on recommended physical activity during pregnancy.	Eastern Cape Department of Health in collaboration with the Primary Health Care Nurses/Midwives

Table 3. *Cont.*

Intervention Strategy 1: Building on Strengths	Responsibility
Conduct continued and ongoing research into effective interventions that promote physical activity during pregnancy.	Research institutions, organisations and government-initiated and sponsored researches
Educate prenatal healthcare providers on physical activity education and counselling strategies that are culturally appropriate, sensitive and effective.	Primary Health Care Nurses/Midwives
Create and provide an opportunity for pregnant women and other support groups to attend monthly group meetings on physical activity.	Primary Health Care Nurses/Midwives
Intervention strategy 4: Mitigation of threats	
Documenting the misconceptions and clarifications about the safety concerns of prenatal physical activity and making the document accessible to women at the clinics in form of a small pamphlet or booklet.	The Primary Health Care Nurses/Midwives
Providing general health education training to the home-based carers and community health workers on the importance and benefits of prenatal physical activity, so that they would, in turn, create such awareness to the community about the need to participate in physical activity and exercise during pregnancy.	The Primary Health Care Nurses/Midwives
Periodic training and update of midwives on prenatal physical activity and exercise prescriptions, contraindications, recommendations and guidelines.	Eastern Cape Department of Health
Policymakers to add to the maternal guidelines prenatal physical activity information and practice as part of the nursing education training curriculum.	Eastern Cape Department of Health/Primary Healthcare antenatal managers
The government to recruit more midwives at the primary healthcare centres to assist in antenatal sessions, which will include providing antenatal physical exercise classes.	Eastern Cape Department of Health
As a long-term strategy, build and procure antenatal physical exercise facilities and equipment to encourage and promote prenatal physical activity.	Eastern Cape Department of Health

4. Discussion

Physical activity is one of the key elements in promoting maternal health during the prenatal and postpartum period; therefore, interventions strategies to drive this agenda are needed to encourage women to maintain an active lifestyle during and after pregnancy. However, prenatal physical activity and exercise have not been widely studied within the context of South Africa. To address this lack, a prenatal physical activity intervention strategy has been developed specifically for South Africa and is on the first empirical findings [24–27]. This timely move provides a unique contribution to, and lays the groundwork for, future prenatal physical activity intervention strategies, not only in the Eastern Cape Province but throughout South Africa as a whole.

The most notable intervention strategy to promote physical activity in pregnant women in this setting is the application of scientific and technological innovations to provide basic information on the benefits of prenatal physical activity to pregnant women by utilising the Mom-Connect device to provide maternal health-related information to pregnant women. As previously stated, the study's stakeholders highly sanctioned a collaborative partnership with the various cellphone and network companies in South Africa, namely Vodacom, MTN, Cell C and 8ta, who assist in disseminating information regarding the benefits of prenatal physical activity. They further asserted that printing relevant information on airtime slips, and automatic voice messaging, provided when dialling or receiving calls, to create awareness on recommended physical activity during pregnancy. In order to reap the benefits of participation in prenatal physical activity entails the designing and implementation of corresponding interventions strategies that seek to address the needs of women during pregnancy. Accordingly, community health programmes tailored to suit pregnant women should include activities that would help in promoting awareness about physical activity during pregnancy [38]. However, the

empirical findings showed that pregnant women in South Africa rarely, if ever, received physical activity counselling since prenatal healthcare providers themselves had little or no knowledge of prenatal physical activity, nor did they possess the skills by which to impart such information [25]. This lack on the part of healthcare providers is one of the main barriers to prenatal physical activity counselling [39–41]. Consequently, the government and other non-governmental bodies have a tremendous role to play in augmenting the efforts of the healthcare providers in this direction. In light of this, as sanctioned by the stakeholders in this present study, the existing Mom-Connect is deemed a good platform by which to incorporate prenatal physical activity messages encouraging and promoting physical activity among women in South Africa during and after pregnancy. This phone-based, technological device was developed by the South African National Department of Health to promote maternal and child health. Midwives emphasised the use of information technology, in this case, the Mom-Connect, to disseminate information about prenatal physical activity to pregnant women [27]. This is particularly concerning in this era of the COVID-19 pandemic. Even before the COVID-19 pandemic, the pregnancy stage presents unique challenges to being sufficiently active, and the COVID-19 pandemic has ushered in more difficulties in terms of limiting social contact and other opportunities for physical activity [42]. These prevailing circumstances suggest the need to explore the available technological applications and devices mentioned above to promote and influence women to be physically active during pregnancy. Notably, other studies have shown that including other strategies such as regular telephone reminders or meetings with the intervention deliverer, as well as encouraging regular physical activity at home, would help participants maintain healthy behaviours [43,44].

Another relevant strategy is that the government and policymakers integrate or infuse prenatal physical activity and exercise training into the medical and health curricula of existing higher institutions of learning concerned with the teaching of maternal health in the Eastern Cape Province since the research has found empirical proof that indicates prenatal healthcare providers lack the knowledge and skills, resulting in the inability to offer prenatal physical activity. Educational intervention is a key to change behaviour. A previous educational interventional study showed improvement in the professionals' knowledge regarding leisure-time walking and women who were cared for by the intervention group were more likely to receive guidance regarding leisure-time walking [45]. A recent study combining education about physical activity with a training session on facilitating behaviour change emphasised the importance of educating health professionals on prenatal physical activity based on the findings from a needs assessment that demonstrates health professionals had limited knowledge about physical activity during pregnancy [46], which is likely attributed to limited availability of undergraduate and continued professional training of healthcare professions on prenatal physical activity [47]. Thus, incorporating prenatal physical activity into the medical and nursing training schools would empower the healthcare providers with the knowledge and requisite skills they need to assist pregnant women in terms of prenatal physical activity prescription and advice. Therefore, there is a 'call to action' for policy makers to integrate physical activity and exercise prescription as part of the curricula training of medical students [48,49], and across all health professions saddle with the responsibility of antenatal care [50], such as midwives [28,51] and exercise physiologists [52].

Another strategy that received overwhelming support from the stakeholders is that the government recruit more midwives to assist in antenatal sessions and antenatal physical exercise classes and counselling. However, the feasibility of this particular strategy hinges on addressing the current shortage of midwives by employing more of them to mitigate the challenge of busy schedules and many responsibilities of the antenatal health clinics. The dire shortage of this category of a healthcare provider is one of the reasons that prenatal physical activity is seldom a priority in primary health clinics in Buffalo City Municipality since midwives have to perform several other functions [27]. The limited human resources affect their ability to discuss physical activity with pregnant women and is compounded

by the lack of antenatal exercise facilities/equipment for these women at the clinics. These institutional bottlenecks, directly or indirectly, have a negative impact on maternal health promotion, especially physical activity counselling [27]. Therefore, to promote the uptake of physical activity counselling associated with the shortage of health providers, there is a need to strengthen the primary healthcare clinics' workforce and infrastructures.

Notwithstanding, another practical strategy endorsed by the stakeholders is the documentation of misconceptions and subsequent clarification of the safety concerns of prenatal physical activity. In addition, the document should be accessible to all women at the clinics in form of a small pamphlet or booklet. Various studies have found physical activity counselling through one-on-one sessions [44,53–55], and providing prenatal physical activity counselling and advice on the recommended physical exercise for pregnant women using information booklets, leaflets, and/or websites [53,55–57] are feasible interventions options that promote prenatal physical activity. Previous studies in South Africa have emphasised the utilisation of instructional resources, such as posters, brochures and Digital Video Discs (DVDs), as part of an intervention strategy to promote physical activity in antenatal clinics [58,59]. In a recent study, pregnant women advocated the inclusion of exercise brochures and videos [60,61], which tend to suggest that pregnant women are aware of what they require to be physically active; therefore, context-specific interventions to accommodate their needs or concerns on physical activity during pregnancy are essential. The ultimate goal of any strategy is to effect a change in behaviour and attitude to prenatal physical activity; therefore, incorporating behaviour change techniques into interventions may be helpful in improving physical activity levels during pregnancy [62]. In this regard, providing prenatal physical education and counselling would help educate women concerning the importance of prenatal physical activity practice, and is seemingly most effective through one-on-one approach [62]. A recent systematic review has identified individual interviews, group interviews, access to information through brochures or multimedia supports and use of smartphone applications for personal training and general information as interventions to promote physical activity during pregnancy [60]. The review further indicated that individual interventions are commonly used, and are reinforced by reminders during routine consultations, or through emails or informative brochures [60]. It has been shown that an individualised intervention incorporating two telephonic reminders increased physical activity participation in overweight and obese pregnant women [63].

In addition, we reason that if periodic prenatal physical activity campaigns are presented in local community town halls and clinics by the government in synergy with the other stakeholders such as NGO's and faith-based organisations, this would aid and address the lack of awareness, misrepresentations and concerns around the safety and benefits of physical activity during pregnancy. Koleliat et al. [61] support designing a community-based intervention in which pregnant women can interact and share their challenges and concerns.

4.1. Implications

We envisaged that the barriers to prenatal physical activity among women in this particular setting would be addressed through this present, developed and validated physical activity strategy to facilitate and promote the practice of prenatal physical activity for better maternal health outcomes. This strategy captures several different prenatal physical activity perspectives within the context of Buffalo City Municipality in the Eastern Cape Province, South Africa. If implemented, it would aid context-specific interventions that could address the needs of pregnant women; furthermore, it would assist in motivating them, to engage in physical activity during pregnancy, and would support them in this endeavour. Therefore, the implementation of the developed prenatal physical activity strategy could improve physical activity practice of women.

4.2. Strengths

This context-specific prenatal physical activity strategy would potentially provide insight and direction on how to address the impediments to physical activity during pregnancy identified in this studied region, and how to promote physical activity in pregnant women. In addition, the developed physical activity strategy was based on a prospective evaluation of physical activity in an under-researched, poor and resource-constrained setting; therefore, it sets the pace for future studies investigating on physical activity interventions strategies aimed at promoting prenatal physical activity in this particular geographical area of South Africa, and even outside of it.

5. Conclusions

The application of scientific and technological innovations to provide basic information on prenatal physical activity by utilising the Mom-Connect, a technological device already available in South Africa, to promote maternal health-related information for pregnant women is a feasible, effective and sustainable strategy to promote prenatal physical activity within the BCM setting. This strategy can work effectively in synergy and collaboration with the various cellphone and network companies operating in South Africa, such as Vodacom, MTN, Cell C and 8ta, in order to assist the spread of information related to the benefits of prenatal physical activity. In addition, offering professional development courses for health professionals involved in maternity care in the Eastern Cape Province would empower healthcare providers with the necessary basic knowledge and requisite skills required to assist pregnant women with effective prenatal physical activity advice or counselling. The recruitment of more midwives (by the government) to assist in antenatal sessions and antenatal physical exercise classes and counselling is another strategy that received overwhelming support from the stakeholders. However, to address the shortage of health providers, as its impact on prenatal physical activity counselling, there is a need to strengthen primary healthcare clinics' workforce and infrastructures. In addition, if the government, in collaboration with other stakeholders, provides periodic prenatal physical activity campaigns, the lack of awareness, misrepresentations and concerns regarding the safety and benefits of physical activity during pregnancy could be effectively addressed. The above-mentioned prenatal physical activity strategies provide direction for policy-makers and health professionals in the promotion of prenatal physical activity practices of women and, if implemented, may further improve their maternal health outcomes within the Buffalo City Municipality setting.

Author Contributions: U.B.O. designed the study, collected data and drafted the manuscript. D.T.G. supervised data collection, analysed the data, critically review and edited the paper. All authors contributed to the interpretation of the results and to the discussion and approved the final version of the paper. All authors have read and agreed to the published version of the manuscript.

Funding: The work reported herein was made possible through funding by the South African Medical Research Council through its Division of Research Capacity Development under the Bongani Mayosi National Health Scholars Programme from funding received from the Public Health Enhancement Fund/South African National Department of Health. The content hereof is the sole responsibility of the authors and does not necessarily represent the official views of the SAMRC.

Institutional Review Board Statement: The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Human Research Ethics Committee of the University Fort Hare (Ref#2019=06=009=OkaforUB).

Informed Consent Statement: Informed consents were obtained from the participants.

Data Availability Statement: Data available on request.

Acknowledgments: South African Medical Research Council through its Division of Research Capacity Development under the Bongani Mayosi National Health Scholars Programme from funding received from the Public Health Enhancement Fund/South African National Department of Health, and the Supervisory-link bursary received from the Govan Mbeki Research and Development,

University of Fort Hare are both appreciated. We acknowledge the Eastern Cape Department of Health for granting permission to conduct the study in the selected health facilities in Buffalo City Municipality District.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Yan, W.; Wang, X.; Kuang, H.; Chen, Y.; Baktash, M.B.; Eskenazi, B.; Ye, L.; Fang, K.; Xia, Y. Physical activity and blood pressure during pregnancy: Mediation by anxiety symptoms. *J. Affect. Disord.* **2020**, *264*, 376–382. [CrossRef] [PubMed]
2. Collings, P.J.; Farrar, D.; Gibson, J.; West, J.; Barber, S.E.; Wright, J. Associations of pregnancy physical activity with maternal cardiometabolic health, neonatal delivery outcomes and body composition in a Biethnic Cohort of 7305 Mother–Child Pairs: The Born in Bradford Study. *Sports Med.* **2020**, *50*, 615–628. [CrossRef]
3. Galliano, L.M.; Del Vecchio, A.H.M.; Silvani, J.; Façanha, C.; Del Vecchio, F.B. Physical activity level in women with gestational diabetes mellitus: Lifestyle INtervention for diabetes prevention after pregnancy (LINDA-Brasil) study. *J. Diabet.* **2019**, *11*, 457–465. [CrossRef]
4. Dipietro, L.; Evenson, K.R.; Bloodgood, B.; Sprow, K.; Troiano, R.P.; Piercy, K.L.; Vaux-Bjerke, A.; Powell, K.E. Benefits of Physical Activity during Pregnancy and Postpartum: An Umbrella Review. *Med. Sci. Sports Exerc.* **2019**, *51*, 1292–1302. [CrossRef]
5. Ruchat, S.M.; Mottola, M.F.; Skow, R.J.; Skow, R.J.; Nagpal, T.S.; Meah, V.L.; James, M.; Riske, L.; Sobierajski, F.; Kathol, A.J.; et al. Effectiveness of exercise interventions in the prevention of excessive gestational weight gain and postpartum weight retention: A systematic review and meta-analysis. *Br. J. Sports Med.* **2018**, *52*, 1347–1356. [CrossRef]
6. Patricia, V.; De Sousa, S.; Cury, A.; Eufrásio, L.S. The influence of gestational trimester, physical activity practice and weight gain on the low back and pelvic pain intensity in low risk pregnant women. *J. Back Musculoskel. Rehabil.* **2019**, *32*, 671–676.
7. Mottola, M.F.; Davenport, M.H.; Ruchat, S.; Davies, G.A.; Poitras, V.J.; Gray, C.E.; Jaramillo Garcia, A.; Barrowman, N.; Adamo, K.B.; Duggan, M.; et al. 2019 Canadian guideline for physical activity throughout pregnancy. *Br. J. Sport Med.* **2018**, *40*, 1339–1346. [CrossRef]
8. Bauer, C.; Graf, C.; Platschek, A.M.; Struder, H.K.; Ferrari, N. Reasons, motivational factors, and perceived personal barriers to engagement in physical activity during pregnancy vary within the BMI classes: The Prenatal Prevention Project Germany. *J. Phys. Act. Health* **2018**, *15*, 204–211. [CrossRef] [PubMed]
9. Schmidt, T.; Heilmann, T.; Savelsberg, L.; Maass, N.; Weisser, B.; Eckmann-Scholz, C. Physical exercise during pregnancy—How active are pregnant women in Germany and how well informed? *Geburtshilfe Frauenheilkd* **2017**, *77*, 508–515. [CrossRef]
10. Hailemariam, T.T.; Gebregiorgis, Y.S.; Gebremeskel, B.F.; Haile, T.G.; Spitznagle, T.M. Physical activity and associated factors among pregnant women in Ethiopia: Facility-based cross-sectional study. *BMC Pregnancy Childbirth* **2020**, *20*, 92. [CrossRef]
11. Todorovic, J.; Terzic-Supic, Z.; Bjegovic-Mikanovic, V.; Piperac, P.; Dugalic, S.; Gojnic-Dugalic, M. Factors associated with the leisure-time physical activity (LTPA) during the first trimester of the pregnancy: The cross-sectional study among pregnant women in Serbia. *Int. J. Environ. Res. Public Health* **2020**, *17*, 1366. [CrossRef] [PubMed]
12. Watson, E.D.; Van Poppel, M.N.M.; Jones, R.A.; Norris, S.A.; Micklesfield, L.K. Are South African mothers moving? Patterns and correlates of physical activity and sedentary behaviour in pregnant black South African women. *J. Phys. Act. Health* **2017**, *14*, 329–335. [CrossRef] [PubMed]
13. Lawan, A.; Awotidebe, A.W.; Oyeyemi, A.L.; Rufa, A.A.; Oyeyemi, A.Y. Relationship between physical activity and health related quality of life among pregnant women. *Afr. J. Reprod. Health* **2018**, *22*, 80–89. [PubMed]
14. Bull, F.C.; Al-Ansari, S.S.; Biddle, S.; Borodulin, K.; Buman, M.P.; Cardon, G.; Carty, C.; Chaput, J.P.; Chastin, S.; Chou, R.; et al. World Health Organization 2020 guidelines on physical activity and sedentary behaviour. *Br. J. Sports Med.* **2020**, *54*, 1451–1462. [CrossRef] [PubMed]
15. Catov, J.M.; Parker, C.B.; Gibbs, B.B.; Bann, C.M.; Carper, B.; Silver, R.M.; Simhan, H.N.; Parry, S.; Chung, J.H.; Haas, D.M.; et al. Patterns of leisure-time physical activity across pregnancy and adverse pregnancy outcomes. *Int. J. Behav. Nutr. Phys. Act.* **2018**, *15*, 68–78. [CrossRef] [PubMed]
16. Alaglan, A.A.; Almousa, R.F.; Alomirini, A.A.; Alabdularazaq, E.S.; Alkheder, R.S.; Alzaben, K.A.; Alonayzan, G.A.; Saquib, J. Saudi women's physical activity habits during pregnancy. *Women's Health* **2020**, *16*, 1745506520952045. [CrossRef]
17. Sytsma, T.T.; Zimmerman, K.P.; Manning, J.B.; Jenkins, S.M.; Nelson, N.C.; Clark, M.M.; Boldt, K.; Borowski, K.S. Perceived Barriers to Exercise in the First Trimester of Pregnancy. *J. Perinat. Educ.* **2018**, *27*, 198–206. [CrossRef] [PubMed]
18. Mendinueta, A.; Esnal, H.; Arrieta, H.; Arrue, M.; Urbieta, N.; Ubillos, I.; Whitworth, K.W.; Delclòs-Alió, X.; Vich, G.; Ibarluzea, J. What accounts for physical activity during pregnancy? Astudy on the sociodemographic predictors of self-reported and objectively assessed physical activity during the 1st and 2nd trimesters of pregnancy. *Int. J. Environ. Res. Public Health* **2020**, *17*, 2517. [CrossRef]
19. Zhang, Y.; Dong, S.; Zuo, J.; Hu, X.; Zhang, H.; Zhao, Y. Physical activity level of urban pregnant women in Tianjin, China: A cross-sectional study. *PLoS ONE* **2014**, *9*, e109624. [CrossRef]
20. Alvarado, M.; Murphy, M.M.; Guell, C. Barriers and facilitors to physical activity amongst overweight and obese women in an Afro-Caribbean population: A qualitative study. *Int. J. Behav. Nutr. Phys. Act.* **2015**, *12*, 97. [CrossRef]

21. Grenier, L.N.; Atkinson, S.A.; Mottola, M.F.; Wahoush, O.; Thabane, L.; Xie, F.; Vickers-Manzin, J.; Moore, C.; Hutton, E.K.; Murray-Davis, B. Be healthy in pregnancy: Exploring factors that impact pregnant women's nutrition and exercise behaviors. *Matern. Child. Nutr.* **2021**, *17*, e13068. [CrossRef] [PubMed]
22. Tinius, R.; Nagpal, T.S.; Edens, K.; Duchette, C.; Blankenship, M. Exploring beliefs about exercise among pregnant women in rural communities. *J. Midwifery Womens Health* **2020**, *65*, 538–545. [CrossRef] [PubMed]
23. Okafor, U.B.; Goon, D.T. Physical activity and exercise during pregnancy in Africa: A review of the literature. *BMC Pregnancy Childbirth* **2020**, *20*, 732. [CrossRef]
24. Okafor, U.B.; Goon, D.T. Physical activity level during pregnancy in South Africa: A facility-based cross-sectional study. *Int. J. Environ. Res. Public Health* **2020**, *17*, 7928. [CrossRef]
25. Okafor, U.B.; Goon, D.T. Applying the Ecological Model to understand pregnant women's perspectives on the modifiable constraints to physical activity during pregnancy: A qualitative research study. *Medicine* **2020**, *99*, e23431. [CrossRef]
26. Okafor, U.B.; Goon, D.T. Physical activity in pregnancy: Beliefs, benefits and information-seeking practices of pregnant women in South Africa. *J. Multidiscip. Healthc.* **2021**, *14*, 787–798. [CrossRef]
27. Okafor, U.B.; Goon, D.T. Providing physical activity education and counselling during pregnancy: A qualitative study of midwives' perspectives. *Nig. J. Clin. Pract.* **2021**, *24*, 718–728.
28. Lindqvist, M.; Persson, M.; Mogren, I. Longing for individual recognition-Pregnant women's experiences of midwives' counselling on physical activity during pregnancy. *Sex. Reprod Healthc.* **2018**, *15*, 46–53. [CrossRef]
29. Von Kodolistsch, Y.; Bernhardt, A.M.; Robinson, P.N.; Kolbel, T.; Reichenspurner, H.; Debus, S.; Detter, C. Analysis of Strengths, Weaknesses, Opportunities, and Threats as a Tool for Translating Evidence into Individualized Medical Strategies (I-SWOT). *Aorta* **2015**, *3*, 98–107. [CrossRef]
30. Giusti, A.; Maggini, M.; Colaceci, S. The burden of chronic diseases across Europe: What policies and programs to address diabetes? A SWOT analysis. *Health Res. Policy Syst.* **2020**, *18*, 12. [CrossRef] [PubMed]
31. Gretzky, W. Strategic planning and SWOT analysis. In *Essentials of Strategic Planning in Healthcare*; Gretzky, W., Ed.; Health Administration Press: Chicago, IL, USA, 2010; pp. 91–97.
32. Chan, H.Y.L.; Lee, D.T.F.; Woo, J. Diagnosing gaps in the development of palliative and end-of-life care: A qualitative exploratory study. *Int. J. Environ. Res. Public Health* **2020**, *17*, 151. [CrossRef]
33. Okafor, U.B.; Goon, D.T. Developing a physical activity intervention strategy for pregnant women in Buffalo City Municipality, South Africa: A study protocol. *Int. J. Environ. Res. Public Health* **2020**, *17*, 6694. [CrossRef]
34. Aslan, I.; Çınar, O.; Özen, Ü. Developing strategies for the future of healthcare in Turkey by benchmarking and SWOT analysis. *Procedia Soc. Behav. Sci.* **2014**, *150*, 230–240. [CrossRef]
35. Gurel, E.; Tat, M. SWOT Analysis: A theoretical review. *J. Int. Soc. Res.* **2017**, *10*, 994–1006. [CrossRef]
36. Nunu, W.J.; Makhado, L.; Mabunda, J.T.; Lebese, R.T. Strategies to facilitate safe sexual practices in adolescents through integrated health systems in selected districts of Zimbabwe: A mixed method study protocol. *Reprod. Health* **2020**, *17*, 1–16. [CrossRef]
37. Peggy, J.; Chinn, M.K.; Kramer, M.K. *Integrated Theory Knowledge Development*, 5th ed.; Mosby: London, UK, 2011.
38. Chan, C.W.H.; Au Yeung, E.; Law, B.M.H. Effectiveness of physical activity interventions on pregnancy-related outcomes among pregnant women: A systematic review. *Int. J. Environ. Res. Public Health* **2019**, *16*, 1840. [CrossRef]
39. Leiferman, J.; Gutilla, M.; Paulson, J.; Pivarnik, J. Antenatal physical activity counselling among healthcare providers. *Open J. Obstet. Gynecol.* **2012**, *2*, 346–355. [CrossRef]
40. De Vivo, M.; Mills, H. "They turn to you first for everything": Insights into midwives' perspectives of providing physical activity advice and guidance to pregnant women. *BMC Pregnancy Childbirth* **2019**, *19*, 462. [CrossRef]
41. McParlin, C.; Bell, R.; Robson, S.C.; Muirhead, C.R.; Araújo-Soares, V. What helps or hinders midwives to implement physical activity guidelines for obese pregnant women? A questionnaire survey using the Theoretical Domains Framework. *Midwifery* **2017**, *49*, 110–116. [CrossRef] [PubMed]
42. Atkinson, L.; De Vivo, M.; Hayes, L.; Hesketh, K.R.; Mills, H.; Newham, J.J.; Olander, E.K.; Smith, D.M. Encouraging physical activity during and after pregnancy in the COVID-19 era, and beyond. *Int. J. Environ. Res. Public Health* **2020**, *17*, 7304. [CrossRef]
43. Aşcı, O.; Rathfisch, G. Effect of lifestyle interventions of pregnant women on their dietary habits, lifestyle behaviors, and weight gain: A randomized controlled trial. *J. Health Popul. Nutr.* **2016**, *35*, 7. [CrossRef]
44. Miquelutti, M.A.; Cecatti, J.G.; Makuch, M.Y. Evaluation of a birth preparation program on lumbopelvic pain, urinary incontinence, anxiety and exercise: A randomized controlled trial. *BMC Pregnancy Childbirth* **2013**, *13*, 154. [CrossRef] [PubMed]
45. Malta, M.B.; Carvalhaes, M.D.; Takito, M.Y.; Tonete, V.L.P.; Barros, A.J.D.; Parada, M.G.; D'Auino Benicio, M.H. Educational intervention regarding diet and physical activity for pregnant women: Changes in knowledge and practices among health professionals. *BMC Preg. Childbirth* **2016**, *16*, 175. [CrossRef]
46. Dieberger, A.M.; van Poppel, M.N.M.; Watson, E.D. Baby Steps: Using intervention mapping to develop a sustainable perinatal physical activity healthcare intervention. *Int. J. Environ. Res. Public Health* **2021**, *18*, 5869. [CrossRef] [PubMed]
47. Weiler, R.; Chew, S.; Coombs, N.; Hamer, M.; Stamatakis, E. Physical activity education in the undergraduate curricula of all UK medical schools. Are tomorrow's doctors equipped to follow clinical guidelines? *Br. J. Sports Med.* **2012**, *46*, 1024–1026. [CrossRef]
48. Joy, E.; Mottola, M.; Chambliss, H. Integrating exercise is medicine into care of pregnant women. *Curr Sports Med. Rep.* **2013**, *12*, 245–247. [CrossRef]
49. Philips, E.M. A call to arms (and legs): Exercise prescription for medical students. *PM&R* **2012**, *4*, 914–918.

50. Hayman, M.; Reaburn, P.; Alley, S.; Cannon, S.; Short, C. What exercise advice are women receiving from their healthcare practitioners during pregnancy? *Women Birth* **2020**, *33*, e357–e362. [CrossRef]
51. Hopkinson, Y.; Hill, D.M.; Fellows, L.; Fryer, S. Midwives understanding of physical activity guidelines during pregnancy. *Midwifery* **2018**, *59*, 23–26. [CrossRef] [PubMed]
52. Thornton, J.; Fremont, P.; Khan, K.; Poirier, P.; Fowles, J.; Wells, G. Physical activity prescription: A critical opportunity to address a modifiable risk factor for the prevention and management of chronic disease: A position statement by the Canadian Academy of Sport and Exercise Medicine. *Br. J. Sports Med.* **2016**, *50*, 1109–1114. [CrossRef] [PubMed]
53. Ozdemir, S.; Bebis, H.; Ortabag, T.; Acikel, C. Evaluation of the efficacy of an exercise program for pregnant women with low back and pelvic pain: A prospective randomized controlled trial. *J. Adv. Nurs.* **2015**, *71*, 1926–1939. [CrossRef]
54. Ronnberg, A.K.; Ostlund, I.; Fadl, H.; Gottvall, T.; Nilsson, K. Intervention during pregnancy to reduce excessive gestational weight gain—A randomised controlled trial. *BJOG* **2015**, *122*, 537–544. [CrossRef]
55. Sagedal, L.R.; Øverby, N.C.; Bere, E.; Torstveit, M.K.; Lohne-Seiler, H.; Småstuen, M.; Hillesund, E.R.; Henriksen, T.; Vistad, I. Lifestyle intervention to limit gestational weight gain: The Norwegian Fit for Delivery randomised controlled trial. *BJOG* **2017**, *124*, 97–109. [CrossRef]
56. Stafne, S.N.; Salvesen, K.A.; Romundstad, P.R.; Stuge, B.; Mørkved, S. Does regular exercise during pregnancy influence lumbopelvic pain? A randomized controlled trial. *Acta Obstet. Gynecol. Scand.* **2012**, *91*, 552–559. [CrossRef] [PubMed]
57. Eggen, M.H.; Stuge, B.; Mowinckel, P.; Jensen, K.S.; Hagen, K.B. Can supervised group exercises including ergonomic advice reduce the prevalence and severity of low back pain and pelvic girdle pain in pregnancy? A randomized controlled trial. *Phys. Ther.* **2012**, *92*, 781–790. [CrossRef] [PubMed]
58. Muzigaba, M.; Kolbe-Alexander, T.L.; Wong, F. The perceived role and influencers of physical activity among pregnant women from low socioeconomic status communities in South Africa. *J. Phys. Act. Health* **2014**, *11*, 1276–1283. [CrossRef]
59. Watson, E.D.; Norris, S.A.; Draper, C.E.; Jones, R.A.; van Poppel, M.N.M.; Micklesfield, L.K. "Just because you're pregnant, doesn't mean you're sick!" A qualitative study of beliefs regarding physical activity in black South African women. *BMC Preg. Childbirth* **2016**, *16*, 174. [CrossRef] [PubMed]
60. James, P.; Morgant, R.; Merviel, P.; Saraux, A.; Giroux-Metgese, M.A.; Guillodo, Y.; Dupré, P.F.; Muller, M. How to promote physical activity during pregnancy: A systematic review. *J. Gynecol. Obstetr. Hum. Reprod.* **2020**, *49*, 101864. [CrossRef]
61. Koleilat, M.; Vargas, N.; vanTwist, V.; Kodjebacheva, G.D. Perceived barriers to and suggested interventions for physical activity during pregnancy among participants of the special supplemental nutrition program for women, infants, and children (WIC) in Southern California. *BMC Pregn. Childbirth* **2021**, *21*, 69. [CrossRef]
62. Currie, S.; Sinclair, M.; Murphy, M.H.; Madden, E.; Dunwoody, L.; Liddle, D. Reducing the decline in physical activity during pregnancy: A systematic review of behavior change interventions. *PLoS ONE* **2013**, *8*, e66385. [CrossRef]
63. Dodd, J.M.; Cramp, C.; Sui, Z.; Yelland, L.N.; Deussen, A.R.; Grivell, R.M.; Moran, L.J.; Crowther, C.A.; Turnbull, D.; McPhee, A.J.; et al. The effects of antenatal dietary and lifestyle advice for women who are overweight or obese on maternal diet and physical activity: The LIMIT randomised trial. *BMC Med.* **2014**, *12*, 161. [CrossRef] [PubMed]

CHAPTER 11

SYNTHESIS AND CONCLUSIONS

11.1 INTRODUCTION

This chapter summarises the findings of this particular study and makes recommendations in the form of developed strategies based on the results. While the conclusions of Chapters Four to Nine represent how the research objectives of the study were collectively met, this particular chapter provides an overall synthesis and explains the collective contribution of the findings in each of the manuscripts about prenatal physical activity practice. Furthermore, it outlines the developed prenatal physical activity strategies that could be implemented to promote physical activity within the context of the Buffalo City Municipality, Eastern Cape, South Africa. The study's particular limitations and strengths are presented; and, lastly, the implications for future research within the field of maternal health in South Africa are described.

11.2 RESEARCH CONTEXT

While the various advantages of participation in prenatal physical activity and exercise are widely reported in the literature (Collings *et al*., 2020; Galliano *et al*., 2019; Dipietro *et al*., 2019; Mottola *et al*., 2018; Yan *et al*., 2020; Broberg *et al*., 2017; Davenport et al., 2018) low levels of prenatal physical activity are still being reported (Mottola *et al*., 2018), Lindqvist *et al*., 2016; Todorovic *et al*., 2020; Catov *et al*., 2018; Meander *et al*., 2021; Lawan *et al*., 2018; Padmapriya *et al*,. 2016; Yan *et al*., 2020; Owe *et al*., 2009; Hailemarian *et al*., 2020; Antosiak-Cyrak & Demuth, 2019) with several reasons given for this phenomenon in different regions or settings across the world. However, most of the studies on prenatal physical activity are conducted in the Western countries with only a few studies being done within the South African context (Watson *et al*., 2016; Watson *et al*., 2017; Watson *et al*., 2018; Brunnete *et al*., 2012; Muzigaba, Kolbe-Alexander & Wong, 2014; Maputle *et al*., 2014). Furthermore, none of these were conceptualised to develop intervention strategies aimed at promoting physical activity and exercise among pregnant women in Africa.

Therefore, an evaluation was warranted into the various associated aspects, namely the level, patterns, and associated factors of prenatal physical activity; beliefs, knowledge, attitudes, perceived benefits, and sources of information women received during pregnancy in the context of the Eastern Cape province. Subsequently, and based on the information derived

from the empirical findings, a physical activity intervention strategy was developed and validated to promote prenatal physical activity in the above-mentioned setting. The findings of this study may, potentially, add to the body of knowledge of maternal health and further guide physical activity interventions tailored to pregnant women in the Eastern Cape Province, and possibly, by extension, South Africa. The study was guided by the following research questions:

11.3 RESEARCH QUESTIONS

i. What are the levels, patterns and associated factors of prenatal physical activity and exercise of women in the Buffalo City Municipality in the Eastern Cape Province?

ii. What are the beliefs, perceived benefits, and available sources of information on prenatal physical activity and exercise of the women in the above-mentioned context?

iii. What are the barriers of prenatal physical activity and exercise of women in the Buffalo City Municipality in the Eastern Cape Province?

iv. What knowledge of, practice, and attitudes towards prenatal physical activity and exercise do these particular women have?

v. What attitudes, knowledge and practices do midwives have of prenatal physical activity education and counselling in the Eastern Cape Province?

vi. What context-specific intervention strategy would be relevant to enhance the understanding and promotion of prenatal physical activity and exercise, and to mitigate the barriers associated with prenatal physical activity and exercise participation among women in the Buffalo City Municipality in the Eastern Cape Province?

The empirical findings from both the quantitative and qualitative approaches, as presented in the form of manuscripts in Chapters Four to Ten underpinned the development of a prenatal physical activity strategy to promote physical activity participation during pregnancy in Buffalo City Municipality in the Eastern Cape Province.

Chapter Two presented the literature review which highlighted the physical activity levels and associated factors, beliefs, sources of information, perceived benefits, barriers, knowledge, attitudes, and practices of pregnant women concerning physical activity and exercise. It also described healthcare providers' perspectives of prenatal physical activity advice and counselling of pregnant women and prenatal physical activity intervention strategies to promote this. Furthermore, the review provided a plethora of research evidence on the benefits of physical activity during pregnancy.

However, as stated in the chapter, most of the published work on prenatal physical activity are based on studies conducted in high-income countries. However, there are only a few studies carried out in Africa on different aspects of prenatal physical activity, more specifically, South Africa. None of the studies reviewed developed a prenatal physical activity strategy to promote physical activity practice in South Africa. To support this claim, a published review article is included as supplementary File 1 in this thesis. In addition, due to the paucity of research evidence on prenatal physical activity counselling by healthcare providers, a scoping review was undertaken and the published manuscript is included as supplementary File 2. Chapter Three described the methodology used in this study; while Chapters Four to Ten highlighted the findings of the study in the form of manuscripts.

11.4 SUMMARY OF MAIN FINDINGS

11.4.1 Article One

The first objective of this study was to assess the levels, patterns and associated factors of prenatal physical activity and exercise among women in the Eastern Cape Province.

The findings of this study showed low levels of physical activity during pregnancy among the women, and further established that the most preferred form of activity was light intensity and household activities. Additionally, the significant predictors of prenatal physical activity among the women were age, residential area, lower educational levels, unemployment, nulliparity, and trimester timing of exercise. It is therefore imperative that efforts to increase the activity levels of pregnant women in this setting should include education and advocacy on the importance of prenatal physical activity.

11.4.2 Article Two

The second objective of the research was to assess the beliefs, perceived benefits and sources of information on prenatal physical activity and exercise in the Eastern Cape Province.

The findings demonstrated that the majority of pregnant women perceived prenatal physical as beneficial to both their health and that of their babies. However, they also held contradictory belief that pregnancy is a time to rest. In addition, their predominant sources of information about prenatal physical activity were the media, television, the radio and Internet-based websites. Given that pregnant women would perceive the information provided by the healthcare providers as most reliable and may be willing to adhere to it; providing adequate training to healthcare providers on prenatal physical activity is a crucial strategy to present accurate and reliable information on prenatal physical activity to pregnant women.

11.4.3 Article Three

The third objective of the study was to explore the modifiable constraining factors to prenatal physical activity and exercise participation in the Eastern Cape Province. The ecological model was applied to gain insight into the women's perspectives in this regard.

On an intrapersonal level, the findings from this particular study highlighted major modifiable barriers to the practice of prenatal physical activity as tiredness, lack of time, work and household responsibilities, and a lack of motivation. Participants further mentioned the lack of physical activity advice and information on the recommendations and guidelines as barriers to their physical activity participation on an interpersonal level. Lastly, the lack of financial resources to register at a gymnasium or transportation to the gymnasium for physical exercise, although not a cognate reason limiting physical activity participation because exercise can be performed outdoors, was mentioned by the women. The above-mentioned findings suggest a need to design context-specific intervention strategies to address these modifiable barriers.

11.4.4 Manuscript Four

The third objective of the study further uncover the barriers to prenatal physical activity and exercise among South African pregnant women by applying the a mixed-methods approach to gain a deeper understanding of the factors influencing physical activity participation.

The study revealed inadequate information from healthcare professionals about the intensity and dose of exercise, lack of advice from healthcare professionals (nurses/midwives), insufficient and contradictory information about prenatal physical activity, and conflicting advice about physical activity and exercise hinders women from practising prenatal physical activity. These were confirmed in the qualitative findings. The participants repeatedly mentioned that the midwives do not offer advice on prenatal physical activity. These findings from both the quantitative and qualitative approaches regarding the barriers to physical activity during pregnancy among pregnant women in this present study present some salient suggestions for developing context-specific interventions to address the barriers reported by the women in this setting.

11.4.5 Manuscript Five

The fourth objective of the study aimed to assess the knowledge, attitudes, and practices of pregnant women regarding prenatal physical in the Eastern Cape Province.

The study revealed that the majority of the pregnant women were knowledgeable about physical activity. They were aware of the safety and benefits of physical activity for both mother and baby. Moreover, the women were aware of different types of antenatal exercises such as muscle-strengthening, back care, relaxation and breathing, abdominal, and aerobics exercises. Nonetheless, their knowledge was not translated into practice since only a few actually engaged in prenatal physical activity.

The findings further revealed that the women displayed somewhat contradictory knowledge of the contraindications of exercise during pregnancy. Notably, while some refuted that exercise results in swelling of lower extremities, extreme weight gain or loss, and back pain, the majority maintained a contrary opinion that prenatal exercise could result in breathing difficulties, chest pain, dizziness, uterine contractions, and incompetent cervix, preterm labour, and vaginal bleeding. In addition, half of the women expressed a positive attitude to prenatal physical activity; they also indicated that tiredness, lack of interest, and inadequate information on physical activity are factors that reinforced their negative attitudes towards it.

11.4.6 Article Six

The fifth objective of the study explored the perspectives of the midwives concerning prenatal physical activity education and counselling within the Eastern Cape Province.

The findings of this study showed that the midwives rarely educated and counselled pregnant women about physical activity during their scheduled antenatal visits. Furthermore, even when information is provided, it is inadequate or lacking in scientific content since they had no scientific knowledge and training on physical activity recommendations during pregnancy. The finding of this chapter further indicated that the shortage of midwives impedes the provision of antenatal exercise classes for women attending antenatal health facilities. Since midwives work according to busy schedules and have many official responsibilities, they rarely treat the antenatal physical activity as a priority.

In light of their lack of knowledge pertaining to prenatal physical activity coupled with facility-related constraints, midwives did recognise the importance of physical activity in improving maternal health outcomes.

Interestingly, the midwives expressed willingness to provide effective physical activity education and counselling to pregnant women, if effectively empowered through training and workshops about the benefits and types of exercise desirable at each stage of pregnancy as well as the relevant risks and precautions for women with complicated midwifery conditions. Subsequently, the midwives proposed that the necessary health information should be displayed at antenatal health facilities, and information technology should be utilised to promote prenatal physical activity. Specifically, they recommended the use of the Mom-Connect application, which is a technological device designed by the National Department of Health to disseminate relevant information about maternal and child health. The Mom-Connect technological model can be used beneficially to promote and improve physical activity participation among expectant mothers in South Africa.

11.4.7 Article Seven

The sixth objective of the study examined the development and validation of prenatal physical intervention strategy for women in the Buffalo City Municipality, Eastern Cape Province.

This study emphasised several strategies to address the barriers to physical activity participation among women within this particular setting. Notably, using scientific and technological innovations to provide basic information on prenatal physical activity to pregnant women by means of Mom-Connect is a veritable platform able to incorporate

prenatal physical activity messages during and after pregnancy. This particular approach can work effectively, in collaborative partnership with the various mobile phone and network companies in South Africa to assist with distributing fact-based information. This suggests that creating an awareness of the recommended prenatal physical activity by the printing of relevant information on airtime vouchers, and using automatic voice messaging may also prove effective. In addition, the Department of Health, South African Nursing Council and policymakers should integrate prenatal physical activity prescription and counselling into the curricula of the tertiary institutions that train maternal health workers in the Eastern Cape Province. This policy action would help to empower healthcare providers and improve their skills in terms of prenatal physical activity prescription and counselling in both clinical and community settings.

Furthermore, the government should recruit a greater number of midwives to assist with physical activity instruction and counselling by means of antenatal sessions, physical exercise classes to address the current staff shortage to eliminate the present reality of midwives being overwhelmed by multiple responsibilities at antenatal health clinics. In this regard, strengthening the primary healthcare clinics' workforce and infrastructures is paramount to achieving the desired objective. Other strategies include the documentation and subsequent clarification of misconceptions related to the safety concerns often associated with prenatal physical activity. These documents should be accessible to all women at the clinics in the form of pamphlets or booklets. Lastly, periodic prenatal physical activity campaigns, presented in both the local community town halls and clinics, should be offered by the government and other stakeholders to successfully address the current lack of awareness, and eliminate misrepresentations and falsehoods around the safety of prenatal physical activity in the Eastern Cape Province.

Table 11.1 presents a summary of the above-mention research objectives, manuscripts, and chapters as laid out in the thesis, along with their main findings and contributions ensuring the achievement of the overall aim of this study.

Table 11.1: Summary of research objectives, findings, and implications of the study

Research objective	Manuscript	Key findings	Implications of the study
To assess the level, types and intensity, and correlates of physical activity among pregnant women.	Chapter Four Physical activity level during pregnancy in South Africa: A facility-based cross-sectional study.	The findings of the study indicated low levels of prenatal physical activity among the South African cohort. The majority of participants did not meet the recommended 150 min of moderate-intensity activity per week. In addition, the most preferred form of activity were light-intensity and household activities. Significant predictors included factors such as age, residential area, lower educational level, unemployment, nulliparity, and trimester timing of exercise.	Intervention strategies are required on how to promote the uptake of physical activity among women in need; this requires providing education and advocacy.
To examine the beliefs, perceived benefits, and sources of information on prenatal physical activity.	Chapter Five Physical activity in pregnancy: Beliefs, benefits, information-seeking practices of pregnant women in South Africa.	This paper demonstrated that the majority of pregnant women held positive beliefs about physical activity during pregnancy. Furthermore, they maintained that physical activity was safe for the mother and foetus, improved labour and delivery, promoted energy, and should be discontinued when tired. In addition, most women held negative convictions that prenatal physical activity increased body temperature and that pregnancy was a time to rest and refrain from physical activity. Moreover, the common sources of information were listed as the television, radio, and other media. Most participants were aware of the benefits of prenatal physical activity for both mother and baby.	The government and healthcare providers have the responsibility of educating pregnant women about the benefits of prenatal physical activity and provide them with reliable information on the related recommendations and guidelines.
To explore the modifiable barriers to prenatal physical activity participation.	Chapter Six Applying the Ecological Model to understand pregnant women's perspectives on the modifiable constraints to physical activity during pregnancy: A qualitative research study.	By applying the afore-mentioned model, this study highlighted the modifiable barriers to prenatal physical activity among pregnant women attending antenatal healthcare. Overall, the intrapersonal factors identified by participants as major modifiable barriers to prenatal physical activity included the following: tiredness, a lack of time, work and household responsibilities.	The modifiable barriers to prenatal physical activity identified by participating women provided insights into the context-specific intervention strategies which may prove useful to address the barriers. In this regard, healthcare providers and the government have a tremendous role to play in this direction.

To assess the barriers to prenatal physical activity and exercise among pregnant women	Chapter Seven Uncovering barriers to prenatal physical activity and exercise among South African Pregnant women: a cross-sectional, mixed-method analysis	The mixed-method analysis revealed major barriers: lack of advice on prenatal physical activity and inadequate or conflicting information about prenatal physical activity; tiredness; work commitments; discomfort; lack of time; low energy; non-accessibility to physical activity; lack of financial resources, and safety concerns for the mother and the baby. Qualitatively, the barriers identified relate to four main themes: individual, lack of information, lack of resources, and environmental barriers.	The barriers to prenatal physical activity suggest the need for providing advocacy on prenatal physical activity and exercise at the health facilities, the community level to involve a multidisciplinary healthcare team concerned with maternal health, print materials and social media.
To assess the knowledge, attitudes, and practices of pregnant women about prenatal physical activity and exercise.	Chapter Eight Knowledge and attitude of pregnant women towards physical activity in the Eastern Cape Province, South Africa.	The findings of the study revealed that the majority of women had a high level of knowledge regarding prenatal physical activity. They were aware of the safety and benefits of physical activity for mother and baby. However, they possessed contradictory knowledge of the contraindications of prenatal exercise. While some refute that exercise does results in swelling of lower extremities, extreme weight gain or loss, and back pain, the majority held the opposite view, namely that exercising during pregnancy could result in difficulty in breathing, chest pain, dizziness, uterine contractions, an incompetent cervix and preterm labour, and vaginal bleeding. Additionally, the women had knowledge of the types of antenatal exercises, such as muscle-strengthening, back care, relaxation and breathing, abdominal, and aerobics exercises. Although the present study indicated that half of the women expressed positive attitudes to prenatal physical activity; yet, the feeling of tiredness, lack of motivation, and inadequate information on physical activity during pregnancy affected their attitude to prenatal physical activity.	Creating an awareness of and promoting positive attitudes to prenatal physical activity among the relevant demographic entails prioritising efforts to provide prenatal physical activity counselling as a necessary component of antenatal healthcare in clinical settings. Healthcare providers may not be knowledgeable enough to provide physical activity advice to their clients; therefore, this study include a call for the inclusion of prenatal physical activity in the medical/health curriculum.
To explore midwives' perspectives regarding the	Chapter Nine	This study indicated that midwives rarely educate and counsel pregnant women about prenatal physical activity	The knowledge of midwives in providing prenatal physical activity education and

provision of prenatal physical activity education and counselling in the Eastern Cape Province.	Providing physical activity education and counselling during pregnancy: A qualitative study of midwives' perspectives.	during related clinical visits. The study further revealed that even when the information is provided, it is often inadequate or lacking in scientific content since they, as providers, lack the scientific knowledge of and training on prenatal physical activity recommendations. In addition, the barriers to providing prenatal physical activity education and counselling include a shortage of relevant staff, busy work schedules, multiple job responsibilities, and the non-availability of exercise equipment. They expressed a willingness to provide effective physical activity education and counselling to pregnant women, if empowered through training and workshops related to the benefits, types of trimester-specific exercise desirable, as well as the risks and precautions for women with complicated midwifery conditions. The midwives, however, recommended the use of the Mom-Connect, which might improve physical activity uptake among expectant mothers.	counselling needs to be supported as it seems not to be at par with the international physical activity recommendations and guidelines. Providing the midwives with adequate training on the skills required to offer prenatal physical activity education and counselling will enable improvement in the physical activity of pregnant women.
To develop and validate the physical activity intervention strategy in order to promote prenatal physical activity and exercise practice of women.	Chapter Ten Development and validation of a prenatal physical activity intervention strategy for women in the Buffalo City Municipality, South Africa	In this study, several strategies were developed and endorsed by the stakeholders. However, the most highly endorsed strategy was the application of scientific and technological innovations to provide basic information on the benefits of prenatal physical activity to pregnant women using the Mom-Connect, an existing application developed to promote maternal health-related information among pregnant women in South Africa. Relatedly, stakeholders highly recommended the establishment of collaborative partnerships with the various cell-phone and network companies operating in South Africa to assist in the dissemination of relevant information. Another strategy is for the South African government to encourage and integrate prenatal physical activity and exercise training into the medical and health curricula to equip healthcare providers with the necessary and relevant	The developed strategy will enable the promotion of physical activity during pregnancy within the context of the Eastern Cape Province if effectively implemented; in turn, it may improve maternal health outcomes of women in this province.

		knowledge of and skills to support pregnant women in terms of prescribing prenatal physical activity prescription and providing counselling. In addition, this requires an increased workforce and the necessary infrastructure for antenatal sessions, antenatal physical exercise classes, and related counselling. As such, the government, in partnership with various stakeholders, should provide periodic prenatal physical activity campaigns in local, community town halls and clinics to address the lack of awareness, misrepresentations, and other concerns about the safety and benefits of prenatal physical activity. Pregnant women supported the above strategy, and they vehemently supported the incorporation of antenatal physical activity and exercise classes into routine antenatal healthcare services. Furthermore, midwives highly sanctioned the provision of periodic prenatal physical activity, exercise training, and workshops for healthcare professionals to mitigate their lack of knowledge on prenatal physical activity recommendations and guidelines.	

11.5 IMPLICATIONS OF THE STUDY

11.5.1 Policy and Practice

The findings of this study suggest the need for policy advocacy of prenatal physical activity to create much needed awareness and promote physical activity participation during pregnancy. It is therefore necessary that healthcare providers prioritise physical activity advice and counselling to pregnant women during their antenatal sessions. They should consider prenatal physical activity as a prescription, and not an option (Okafor & Goon, 2020c). Similarly, the government should employ more adequately trained healthcare providers, more specifically, midwives and provide programmes or pamphlets, posters and DVDs containing information and instructions on this subject. In addition, there is need to mandate medical and health programmes to include inter-professional contents as they relate to the exercise science and to train healthcare providers before employing more trained healthcare providers. These initiatives would help to promote it and encourage women to change their attitudes during this period of their lives since they are more likely to accept health advice from their healthcare provider concerning maternal health; furthermore, they are more likely to practice physical activity if their health providers encourage the behaviour (Hayman *et al*., 2020).

Consequently, there is a need for the government and policymakers to organise periodic workshops on prenatal physical activity, involving a multidisciplinary team of exercise physiologists, physiotherapists, gynaecologists and obstetricians, to provide talks on the importance of prenatal physically activity and the types that are beneficial to both mother and baby. In addition, the Mom-Connect technological device, designed for providing maternal information to women in the South African context, is another option to advocate for prenatal physical activity. Furthermore, it is crucial that ward-based outreach teams are used, whose primary focus will be to promote and create an awareness of various health issues within the various communities, as they would provide advocacy to the women on the importance of physical activity on maternal health. Prenatal physical activity should also be included as part of community health advocacy/awareness campaigns to sensitise the community to the importance of prenatal physical activity for the health of the mother and baby.

In addition, the absence of physical activity guidelines for pregnant women suggests the need to design and include such parameters as part of the clinical assessment of pregnant women

attending primary healthcare clinics within the relevant setting. If information about prenatal physical activity are distributed throughout the spheres of clinical and community settings, as part of an antenatal healthcare agenda, this approach will help to prioritise prenatal physical activity as a therapeutic and preventative measure for maternal health promotion.

Lastly, since the developed physical activity strategy was based on a prospective evaluation of physical activity in an under-researched, poor, and resource-constrained setting; it may set the pace for future studies investigating physical activity interventions strategies and promoting prenatal physical activity in this particular geographical area of South Africa, or even further afield.

11.5.2 Training

The findings from this study revealed that midwives lack the knowledge and skills to provide adequate prenatal physical activity advice and training; and most pregnant women received information on physical activity from social media, which can be misleading. Therefore, the training of midwives and other health professionals to provide evidence-based physical activity advice and counselling during pregnancy is necessary to provide better antenatal care pertaining to prenatal physical activity. Relatedly, prenatal physical activity should be included in the midwifery/nursing curriculum. In addition, the international certification available for personal trainer with ACSM will help guide knowledge, skills and abilities in medical education of the prenatal healthcare providers. Previous studies have shown an improvement in the knowledge and prenatal physical participation of health professionals after an educational intervention (Malta *et al*., 2016; Alahmed & Lobelo, 2019). This, therefore, calls for the inclusion of prenatal physical activity in the training and curriculum of medical and health professionals concerned with maternal healthcare.

11.5.3 Research

Based on this study's findings, intervention studies are warranted to evaluate methods to assist women to engage in prenatal physical activity and exercise. Given the multi-dimensionality of the factors influencing such activity and exercise practices, there is an urgent need for further context-research studies to verify the specific, structural issues that act as facilitators and barriers of prenatal physical activity and exercise participation which may affect maternal health outcomes for both mother and baby.

Furthermore, the qualitative component of the study was based on a small sample. As such, additional research should endeavour to incorporate a larger sample of participants from more regions/provinces of the country for a more representative study. In addition, participatory action research of pregnant women and their partners/family members would help develop educational programmes and support pertaining to prenatal physical activity and exercise by taking into account the culturally sensitive context of the geographical setting being researched on, which is the Buffalo City Municipality in the Eastern Cape Province.

Notably, pregnant women in this present study hold the belief that pregnancy is a time to rest; therefore, further studies are encouraged to unpack the social and cultural paradigms underpinning the physical activity beliefs with a qualitative research approach, as this will provide insights into the myths or norms affecting physical activity involvement during pregnancy in this region. In addition, research on the promotion of prenatal physical activity and exercise involving collaborative efforts of the government, community, organisations/institutions and individuals is needed.

It is incontestable that different life-changing events may influence an individual's participation in physical activity; and pregnancy, a unique phase in a woman's life, is such an event associated with a decline in physical activity (Abbasi *et al*., 2015, Walasik *et al*., 2020). Viewed from this context, there is a need to conduct longitudinal, as well as more qualitative studies among pregnant women in this setting to gain more insight into the manner in which pregnancy affects their physical activity participation, and, whether they return to physical activity postpartum as well as how their activity patterns may have been altered post-delivery. Inevitably, women have unique experiences in any of the gestational or trimester stage of pregnancy. Therefore, there is a need for future studies to develop trimester-specific interventions that require an understanding of how pregnancy experience influences lifestyle physical activity and change behaviour through its various trimesters (Garland *et al*., 2019) since the present study did not focus on any particular trimester in particular.

As the finding of this study revealed, the midwives advocated the use of the Mom-Connect to promote the dissemination of information pertaining to prenatal physical activity. The above-mentioned application is a phone-based maternal health programme established by the South African National Department of Health to support maternal and child health services. However, although it contains numerous health messages, there is currently no content related to prenatal physical activity and exercise. Therefore, further research is required to

develop feasible and related content in terms of prenatal physical activity on this application to successfully promote healthy prenatal behaviour among pregnant women in South African. Future research is needed to develop the resources that are necessary in assisting health care providers to counsel pregnant women regarding the importance of prenatal physical activity as a healthy lifestyle.

In terms of physical activity measurement, future studies should also endeavour to incorporate both self-report and objective measures of physical activity to obtain a more accurate estimate of total activity. It is important that future research investigates the association of physical activity with maternal, obstetric, cardio-metabolic health, and neonatal adiposity outcomes. While it is important to note that an ideal prenatal physical activity intervention strategy probably does not exist, an optimal intervention would implement a combination of different types of interventions, depending on the contextual issues affecting maternal physical activity. Therefore, further research to explore contextually relevant intervention strategies that encourage pregnant prenatal physical activity and exercise within the specific setting of the Buffalo City Municipality is encouraged.

Finally, researchers should be encouraged to conduct similar studies of this nature in other regions of South Africa to further promote prenatal physical activity since this would improve maternal healthcare for pregnant women.

11.6 LIMITATIONS OF THE STUDY

Since the limitations of the study have been reported in detail in each manuscript, they will not be repeated in this section. Nevertheless, some of the limitations of the study pertaining to the design of the study and measurement tool are worth noting.

Firstly, as a cross-sectional design was used in this study, a cause-effect relationship cannot be established between the various factors affecting prenatal physical activity involvement among the cohort of participants within the context of the Eastern Cape Province. As such, the findings of the study might be affected by a selection bias because participants were recruited from pregnant women attending public antenatal health clinics in the Buffalo City Municipality. Since participation was voluntary, the study may not be representative of the entire population of pregnant women in the Eastern Cape Province.

Secondly, the self-administration of the Pregnancy Physical Activity Questionnaire as a subjective tool, might have introduced bias in participants' responses regarding their physical activity participation, which may have influenced the observed results. Furthermore, since the questionnaire was not validated locally against objective methods, an undisputed conclusion cannot be made regarding its psychometric properties in the context of South Africa. Similarly, the self-designed questionnaire used to assess the beliefs, perceived benefits, and sources of physical activity information, as well as the knowledge/attitudes and barriers to prenatal physical activity participation, cannot be completely devoid of response bias. However, this study did present with certain strengths.

11.7 KNOWLEDGE CONTRIBUTION

While prenatal physical activity and exercise have been widely researched in different perspectives or contexts in developed countries, information in the South African context is scarce and limited to only two provinces. Thus, the present study contributes new, important, and clear insights into prenatal physical activity participation among women in the Buffalo City Municipality of the Eastern Cape Province. Furthermore, the study contributes to the pool of literature on decreasing prenatal physical activity as a major public health issue, also emphasising the dynamics and complexity of factors impeding prenatal physical activity practice and highlights the need to improve the levels thereof among South African women. Moreover, the present findings support the notion that prenatal physical activity advice and counselling by healthcare providers are key to the successful promotion of physical activity during pregnancy. This study adds to the literature which reports a lack of prenatal physical activity advice and counselling by healthcare providers, and, in particular, midwives attending to pregnant women in antenatal clinics in the Eastern Cape Province.

As previously established, a neglected component of the improvement of maternal health is that of physical activity, which is reportedly low among pregnant women across most countries, including South Africa. Consequently, intervention strategies to promote prenatal physical activity are crucial to encourage and improve this particular practice. As far as it is known, this is probably the first prenatal physical activity intervention strategy developed in South Africa and is based on the empirical findings presented in this study. Thus, this provides a unique contribution to and lays the groundwork for future prenatal physical activity intervention programmes within the South African context. The developed strategies, if effectively implemented, may effectively address the needs of pregnant women and

motivate them to embrace physical activity participation. Similarly, the developed strategies provide insight into and direction on how to address the constraining factors affecting prenatal physical activity counselling by healthcare providers. The strategies may potentially improve the clinical and public uptake of prenatal physical activity and exercise within a setting, which, to date, has not recognised antenatal physical activity as a priority for antenatal care in clinical setting.

11.8 STRENGTHS OF THE STUDY

As far as could be established, this is the first study to assess the levels and the associated factors of prenatal physical activity, the beliefs, benefits, sources of information, barriers, and knowledge and attitudes of pregnant women of physical activity and exercise participation in the Buffalo City Municipality, Eastern Cape Province. The study focused on healthy pregnant women instead of obese or diabetic women. Hence, healthy women constitute the majority of expectant mothers; therefore, from a public health standpoint, they are an important group to target with interventions (Merkx *et al*., 2017). In addition, no previous study has explored midwives' perspectives of prenatal physical activity education and counselling in this setting. This is probably the first study to develop a context-specific prenatal physical activity intervention strategy to encourage women to practically implement this activity in the Eastern Cape Province. Therefore, the findings of this study provide considerable insight into the prenatal physical activity level of women in this region, the barriers to their prenatal physical activity, and the experiences of midwives regarding physical activity education and counselling. Therefore, this study has also created an opportunity for critical reflection on and implementation of the developed strategies to promote prenatal physical activity in the antenatal healthcare agenda. Furthermore, the present findings have created room for discussion and further research among health care providers, governmental and non-governmental organisations, as well as individuals with interest in physical activity and maternal health outcomes.

11.9 DEVELOPED PRENATAL PHYSICAL ACTIVITY STRATEGIES FOR IMPLEMENTATION

Since the outcome measure of this study was to develop a prenatal physical activity strategy to promote physical activity and exercise specifically within the Buffalo City Municipality, the strategies endorsed by the various stakeholders after the expert critique are summarised below, as presented in Chapter Nine (Table 3) to serve as recommendations. The strategies

are targeted at the Eastern Cape Department of Health, primary healthcare clinic managers, primary health care nurses and midwives, and research institutions or organisations for its implementation. These strategies are as follows:

i. Train and equip gynaecologists, obstetricians, midwives, and nurses with the necessary skills to provide prenatal physical activity during antenatal sessions.

ii. Conduct prenatal physical activity campaigns within communities and involve ward-based outreach teams, non-governmental, and faith-based organisations.

iii. Utilise well-known influential women and celebrities as guest speakers at outreach events to create awareness of the importance of prenatal physical activity participation.

iv. Utilise scientific and technological innovations to provide basic information to women of the benefits of prenatal physical activity. For example, use the Mom-Connect application, which is already available in South Africa, to promote maternal health-related information.

v. Negotiate with corporate organisations or companies to include in their products slogans promoting information on prenatal physical activity. For example, refrigerator magnets, grocery plastic bags, sanitary pads, cosmetics, baby products, billboards, and public spaces, as well as advertising through print and electronic media.

vi. Collaborate with local mobile phone companies such as Vodacom, MTN, Cell C and 8ta, to assist in information dissemination regarding the benefits of prenatal physical activity. Accordingly, information on prenatal physical activity could be written on the airtime vouchers and creating automatic voice messages when dialling or receiving calls, so as to promote the importance of physical activity during pregnancy.

vii. Conduct research into effective interventions that promote physical activity during pregnancy.

viii. Educate prenatal healthcare providers about physical activity education and counselling strategies that are culturally appropriate, sensitive, and effective.

ix. Create and provide an opportunity for pregnant women and support groups (partners, family, and friends) to attend monthly group meetings about prenatal physical activity.

x. Document the misconceptions and present clarifications pertaining to the safety concerns of prenatal physical activity and make the document accessible to women at clinics in the form of pamphlets or booklets.

xi. Provide general health education and training to home-based carers and community health workers on the importance and benefits of prenatal physical activity.

xii. Provide periodic training and update the skills of midwives on prenatal physical activity and exercise prescriptions, contraindications, recommendations, and guidelines.

xiii. Infuse prenatal physical activity information and practice as part of the nursing education training.

xiv. Recruit more midwives at primary healthcare centres to assist in antenatal sessions, and antenatal physical exercise classes.

xv. Lastly, as a long-term strategy, build and procure antenatal physical exercise facilities and equipment to encourage and promote prenatal physical activity in the context of the geographical setting researched on.

11.10 CONCLUSIONS

The conclusions from this study are summarised based on each research objective as follows:

Firstly, there were low levels of physical activity participation among pregnant women in the Buffalo City Municipality in the Eastern Cape Province, South Africa. The most predominant activity performed by the women were light-intensity and household activities. Age, residential area, lower educational level, unemployment, nulliparity and trimester timing of exercise were significant predictors of prenatal physical activity among the women. The above findings suggest that education and advocacy campaigns are needed to motivate women to engage in physical activity during pregnancy.

Secondly, the findings demonstrate that the majority of pregnant women affirmed the physical, physiologic and psychological benefits of being physically active, alongside helping to relieve their anxiety or mood state. They, however, held a contradictory belief about prenatal physical activity by indicating that pregnancy is a time to rest. They perceived

prenatal physical activity as beneficial to them and their babies. The predominant sources of information on prenatal physical activity were television, radio, and other media, which may be potentially misleading or contradictory to evidence-based physical activity practice. Thus, there is a need for interventions to change the physical activity behaviour of women during pregnancy.

Thirdly, applying the Ecological Model to the understanding of the underlying modifiable barriers to prenatal physical activity showed that at an intrapersonal level, the feeling of tiredness, lack of time, work and household responsibilities, and lack of motivation were major modifiable barriers to prenatal physical activity by the women. Pregnant women rarely received information on prenatal physical activity during pregnancy; rather, some women only received such information from family members and friends. In this regard, context-specific intervention strategies to address these modifiable barriers are warranted. For example, the benefits of physical activity could also be discussed in faith-based organizations and schools in Africa when younger learners are adopting lifelong habits with the assistance of specialized health or physical education teachers.

Fourthly, the present study reveals that women reported tiredness, lack of time, exhaustion, discomfort, and low energy as constraining factors to prenatal physical activity. Additionally, they mentioned a lack of advice, information and support about prenatal physical activity from the prenatal care providers. There is a need for healthcare providers to endorse the benefits or the importance of prenatal physical activity for pregnant women during consultation sessions.

In addition, the findings indicate that the majority of the women possess a high level of knowledge regarding prenatal physical activity. They were aware of the safety and benefits of physical activity for both mother and baby. However, they presented with mixed, contradictory knowledge about the contraindications of prenatal exercise. The factors affecting their attitude to prenatal physical activity included tiredness, lack of motivation, and inadequate information. The study further shows that half of the participating women had positive attitudes towards physical activity during pregnancy.

Furthermore, the midwives lacked knowledge, and rarely provided prenatal physical activity education and counselling to women during antenatal visits. The shortage of staff, busy schedules and other priorities impeded the midwives' provision of antenatal exercise classes

for pregnant women attending antenatal clinics. Again, the midwives recognised the importance of physical activity in improving maternal health outcomes. They also expressed willingness to provide effective physical activity education and counselling to pregnant women, provided they are given adequate training and workshops about the benefits, and stage-specific types of exercise desirable for pregnant women, and the risks and precautions for women with complicated midwifery conditions. Notably, they recommended the use of the Mom-Connect, which might improve physical activity uptake among expectant mothers**.**

Lastly, intervention strategies promoting physical activity during pregnancy in this setting include the application of scientific and technological innovations to provide basic information on the associated benefits of such activity. This can be done by utilising the Mom-Connect device to provide maternal health-related information to pregnant women. The stakeholders also endorsed the strategy of collaborating with the various cell-phone and network companies in South Africa to assist in disseminating information regarding the benefits of prenatal physical activity. Another suggested strategy is to incorporate prenatal physical activity and exercise training into the medical and health curricula of existing higher institutions of learning in the Eastern Cape Province since the research has found empirical proof that prenatal healthcare providers lack the required knowledge and skills, which results in an inability to offer prenatal physical activity advice or counselling to expectant mothers. Therefore, prenatal physical activity should be incorporated into the medical and nursing training schools to empower healthcare providers with the knowledge and requisite skills they need to assist pregnant women. Additionally, the need for the South African government to recruit more midwives to assist in antenatal sessions and, equally, have time to provide antenatal physical exercise classes and counselling, is a feasible strategy endorsed by the stakeholders. However, there is need to mandate medical and health programmes to include inter-professional contents as they relate to the exercise science and to train healthcare providers before employing more trained healthcare providers. Another practical strategy the participants endorsed is the documentation of misconceptions and provision of subsequent clarification pertaining to the safety concerns of prenatal physical activity. This can be achievable by providing accessible documents and materials such as pamphlets or booklets, and DVDs to women during antenatal visits to clinics. In addition, safe and recommendable scientific websites, as well as safe and scientific social media pages providing information on prenatal physical activity should be included as resources for promoting prenatal physical activity and exercise.

Consolidated References

Abbasi, M. & van den Akker O. (2015). A systematic review of changes in women's physical activity before and during pregnancy and the postnatal period. *Journal of Reproductive and Infant Psychology*, 33(4):325–328.

Abdullah, W. & Najib, B. (2019). Knowledge and attitude of pregnant women towards antenatal exercise in Erbil City. *Erbil Journal of Nursing and Midwifery*, 2(2):108–115.

Acosta-Manzano, P., Leopold-Posch, B., Simmons, D., Devlieger, R., Galjaard, S., Corcoy, R., Adelantado, J. M., Dunne, F., Harreiter, J., Kautzky-Willer, A., Damm, P., Mathiesen, E. R., Jensen, D.M., Andersen, L.L., Tanvig, M., Lapolla, A., Dalfra, M. G., Bertolotto, A., Wender-Ozegowska, E., Zawiejska, A., Hill, D. J., Snoek, F. J., Jelsma, J.G.M, G Desoye, G. & van Poppel, M. (2021). The unexplored role of sedentary time and physical activity in glucose and lipid metabolism-related placental mRNAs in pregnant women who are obese: the DALI lifestyle randomised controlled trial. BJOG: *An International Journal of Obstetrics & Gynaecology*, 24. https://doi.org/10.1111/1471-0528.16945.

Active Pregnancy Foundation (2020). Preliminary Findings from the 'Pregnancy and Physical Activity during the COVID-19 Pandemic' Survey; Unpublished; Active Pregnancy Foundation: Kingston upon Thames, UK.

Adeniyi, A.F., Ogwumike, O.O. & Osinike, C.I. (2014). Physical activity and energy expenditure: Findings from the Ibadan pregnant women's survey. *African Journal of Reproductive Health*, 18(2):117–126.

Ajzen, I. (1985). The theory of planned behaviour from P.A.M. Lange, A.W. Kruglanski & E.T. Higgins (2010) (Eds.). *Handbook of theories of social psychology*. London, UK: Sage.

Ajzen, I. (1991). The theory of planned behaviour. *Organizational Behaviour and Human Decision Processes*, 50 (2):179–211.

Ajzen, I. (2011). The theory of planned behaviour: Reactions and reflections. *Health Psychology*, 26(9):1113–1127.

Alaglan, A.A., Almousa, R.F., Alomirini, A.A., Alabdularazaq, E.S., Alkheder, R.S., Alzaben, K.A., Alonayzan, G.A. & Saquib, J. (2020). Saudi women's physical activity habits during pregnancy. *Women's Health (London)*, 16:1–6.

Alahmed, Z. & Lobelo, F. (2019). Correlates of physical activity counselling provided by physicians: A cross-sectional study in Eastern Province, Saudi Arabia. *PLOS One*, 14(7):e0220396.

Alimoradi, Z., Taghizadeh, Z., Rezaypour, A. & Mehran A. (2013). Evaluation of midwives' communication skills. *African Journal of Midwifery Women's Health*, 7: 19–24.

American College of Obstetricians and Gynaecologists (2020). Physical activity and exercise during pregnancy and the postpartum period. Committee Opinion No. 804. *Obstetrics Gynecology*, 135(4):e178–e188.

American College of Obstetricians and Gynaecologists (ACOG). (2014). Health disparities in rural women. Committee Opinion No. 586: *Obstetrics & Gynaecology*, 123(2 Pt 1):384–388.

American College of Obstetricians and Gynaecologists. (2015). Physical activity and exercise during pregnancy and the postpartum period. ACOG Committee Opinion No. 650. *Obstetrics Gynecology*, 126:e135–e142.

American College of Obstetrics and Gynecologists (2013). ACOG committee opinion no. 559: Cesarean delivery on maternal request. *Obstetrics & Gynecology*, 121(4):904–907.

Amezcua-Prieto, C., Olmedo-Requena, R., Jiménez-Mejías, E., Mozas-Moreno, J., Lardelli-Claret, P. & Jiménez-Moleón, J.J. (2013). Factors associated with changes in leisure time physical activity during early pregnancy. *International Journal of Gynecology & Obstetrics*, 121(2):127–131.

Ana, Y., Lewis, M.G., van Schayck, O.C.P. & Babu, G.R. (2021). Is physical activity in pregnancy associated with prenatal and postnatal depressive symptoms? Results from MAASTHI cohort study in South India. *Journal of Psychosomatic Research*, 144:1–7.

Anjana, R.M., Sudha, V., Lakshmipriya, N., Anitha, C., Unnikrishnan, R, Bhavadharini, B., Mahalakshmi, M.M., Maheswari, K., Kayal, A., Ram, U., Ranjani, H., Ninov, L., Deepa, M., Pradeepa, R., Pastakia, S.D., Malanda, B., Belton, A. & Mohan, V. (2016). Physical activity patterns and gestational diabetes outcomes - The wings project. *Diabetes Research and Clinical Practice*, 116:253–262.

Antosiak-Cyrak, K.Z. & Demuth, A. (2019). A study of physical activity levels of pregnant women using the Polish version of Pregnancy Physical Activity Questionnaire (PPAQ-Pl). *Ginekologia Polska*, 90(5):250–255.

Arrish, J., Yeatman, H. & Williamson, M. (2016). Australian midwives and provision of nutrition education during pregnancy: a cross sectional survey of nutrition knowledge, attitudes, and confidence. *Women Birth*, 29: 455–464.

Arrish, J., Yeatman, H. & Williamson, M. (2016). Midwives' role in providing nutrition advice during pregnancy: meeting the challenges? A qualitative study. *Nursing Research and Practice*, 7698510.

Arrish, J., Yeatman, H. & Williamson, M. (2017). Self-reported nutrition education received by Australian midwives before and after registration. *Journal of Pregnancy*, 5289592.

Arrish, J., Yeatman, H. & Williamson. M. (2016). Nutrition education in Australian Midwifery Programmes: a mixed-methods study. *Journal of Biomedical Education*, 9680430.

Artal, R. (2015). The role of exercise in reducing the risks of gestational diabetes mellitus in obese women. *Best Practice & Research: Clinical Obstetrics & Gynaecology*, 29(1):123–132.

Aslan, I., Çınar, O. & Özen, Ü. (2014). Developing strategies for the future of healthcare in Turkey by benchmarking and SWOT analysis. *Procedia - Social and Behavioral Sciences*, 150: 230–240.

Atkinson, L., De Vivo, M., Hayes, L., Hesketh, K. R., Mills, H., Newham, J. J., Olander, E. K. & Smith, D.M. (2020). Encouraging Physical Activity during and after Pregnancy in the COVID-19 Era, and beyond. *International journal of environmental research and public health, 17*(19), 7304.

Aune, D., Schlesinger, S., Henriksen, T., Saugstad, O. & Tonstad, S. (2017). Physical activity and the risk of preterm birth: A systematic review and meta-analysis of epidemiological studies. *BJOG: An International Journal of Obstetrics & Gynaecology*, 124(12):1816–1826.

Australian Institute of Health and Welfare (2019). Physical activity during pregnancy 2011–12. Canberra. Available from: https://nla.gov.au/nla.obj-1397450062/view. (Assessed 20 March, 2021).

Babbar, S. & Chauhan, S.P. (2015). Exercise and yoga during pregnancy: A survey. *Journal of Maternal-Fetal and Neonatal Medicine*, 28(4):431–435.

Bacchi, E., Bonin, C., Zanolin, M.E., Zambotti, F., Livornese, D., Donà, S., Tosi, F., Baldisser, G., Ihnatava, T., Di Sarra, D., Bonora, E. & Moghetti, P. (2016). Physical activity patterns in normal-weight and overweight/obese pregnant women. *PloS One*, 11(11):e0166254.

Badon, S., Wartko, P., Qiu, C., Sorensen, T., Williams, M. & Enquobahrie, D. (2016). Leisure-time physical activity and gestational diabetes mellitus in the Omega study. *Medicine & Science in Sports & Exercise*, 48(6):1044–1052.

Baena-García, L., Acosta-Manzano, P., Ocón-Hernández, O., Borges-Cosic, M., Romero-Gallardo, L., Marín-Jiménez N. & Aparicio V.A. (2021). Objectively measured sedentary time and physical activity levels in Spanish pregnant women. Factors affecting the compliance with physical activity guidelines. *Women Health*, 61(1):27–37.

Baena-García, L., Ocón-Hernández, O., Acosta-Manzano, P., Coll-Risco, I., Borges-Cosic, M., Romero-Gallardo, L., de la Flor-Alemany, M. & Aparicio, V.A. (2019). Association of sedentary time and physical activity during pregnancy with maternal and neonatal birth outcomes. The GESTAFIT Project. *Scandinavian Journal of Medicine & Science in Sports*, 29(3):407–414.

Bahri Khomami, M., Walker, R., Kilpatrick, M., de Jersey, S., Skouteris, H. & Moran, L.J. (2021). The role of midwives and obstetrical nurses in the promotion of healthy lifestyle during pregnancy. *Therapeutic Advances in Reproductive Health*, 15:1–12.

Baidal, J.A.W., Locks, L.M., Cheng, E.R., Blake-Lamb, T.L., Perkins, M.E. & Taveras, E.M. (2016). Risk factors for childhood obesity in the first 1,000 days: A systematic review. *American Journal of Preventive Medicine*, 50(6):761–779.

Bailey, C., Skouteris, H., Harrison, C. L., Boyle, J., Bartlett, R., Hill, B., Thangaratinam, S., Teede, H. & Ademi, Z. (2020). Cost effectiveness of antenatal lifestyle interventions for preventing gestational diabetes and hypertensive disease in pregnancy. *PharmacoEconomics - Open*, 4(3):499–510.

Baker, J.H., Rothenberger, S.D., Kline, C.E. & Okun, M.L. (2018). Exercise during Early Pregnancy is Associated with Greater Sleep Continuity. *Behavioural Sleep Medicine*, 16(5):482–493.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York, NY: Freeman.

Barakat, R., Pelaez, M., Lopez, C., Montejo, R. & Coteron, J. (2012). Exercise during pregnancy reduces the rate of caesarean and instrumental deliveries: Results of a randomized controlled trial. *Journal of Maternal-Fetal and Neonatal Medicine*, 25(11):2372–2376.

Barakat, R., Perales, M., Garatachea, N., Ruiz, J.R. & Lucia, A. (2015). Exercise during pregnancy. A narrative review asking: What do we know? *British Journal of Sports Medicine*, 49(21):1377–1381.

Basu, A., Kennedy, L., Tocque, K. & Jones, S. (2014). Eating for 1, Healthy and Active for 2; feasibility of delivering novel, compact training for midwives to build knowledge and confidence in giving nutrition, physical activity and weight management advice during pregnancy. *BMC Pregnancy Childbirth*, 14:218.

Bauer, C., Graf, C., Platschek, A.M., Strüder, H.K. & Ferrari, N. (2018). Reasons, motivational factors, and perceived personal barriers to engagement in physical activity during pregnancy vary within the BMI classes: The prenatal prevention project Germany. *Journal of Physical Activity and Health*, 15(3):204–211.

Bauer, P.W., Broman, C.L. & Pivarnik J.M. (2010). Exercise and pregnancy knowledge among healthcare providers. *Journal of Women's Health (Larchmt)*, 19(2):335–341.

Beetham, K.S., Giles, C., Noetel, M., Clifton, V., Jones, J.C. & Naughton, G. (2019). The effects of vigorous intensity exercise in the third trimester of pregnancy: A systematic review and meta-analysis. *BMC Pregnancy and Childbirth*, 19(1):281.

Bird, A.L., Grant, C.C., Bandara, D.K., Mohal, J., Atatoa-Carr, P.E., Wise, M.R., Inskip, H., Miyahara, M. & Morton, S.M. (2017). Maternal health in pregnancy and associations with adverse birth outcomes: evidence from growing up in New Zealand. *Australian and New Zealand Journal of Obstetrics and Gynaecology*, 57(1):16–24.

Bisson, M., Alméras, N., Dufresne, S.S., Robitaille, J., Rhéaume, C., Bujold, E., Frenette, J., Tremblay, A. & Marc, I. (2015). A 12-week exercise program for pregnant women with obesity to improve physical activity levels: An open randomised preliminary study. *PLoS One*, 10(9):e0137742.

Blankenship, M.M., Link, K.A., Henry, S.J. & Tinius, R.A. (2020). Patient and provider communication regarding exercise during pregnancy in a rural setting. *International Journal of Exercise Science*, 13(3):1228–1241.

Bø, K., Artal, R., Barakat, R., Brown, W.J., Davies, G.A.L., Dooley, M., Evenson, K.R., Haakstad, L.A.H., Kayser, B., Kinnunen, T.I., Larsen, K., Mottola, M.F., Nygaard, I., van Poppel, M., Stuge, B. & Khan, K.M. (2018). Exercise and pregnancy in recreational and elite athletes: 2016/2017 evidence summary from the IOC expert group meeting, Lausanne. Part 5. Recommendations for health professionals and active women. *British Journal of Sports Medicine*, 52**:**1080–1085.

Bondarianzadeh, D., Yeatman, H. & CondonPaoloni, D. (2007). Listeria education in pregnancy: lost opportunity for health professionals. *Australian and New Zealand Journal of Public Health*, 31:468–474.

Bonnevie, E., Bart, C., May, J., Carey T., Knell, S.B., Wartella, E. & Smyser, J. (2021) Glowing and Growing: A digital media campaign to increase access to pregnancy-related health information for black women during the COVID-19 pandemic. Available at SSRN: https://ssrn.com/abstract=3826759.

Broberg, L., Backhausen, M., Damm, P., Bech, P., Tabor, A. & Hegaard, H.K. (2017). Effect of supervised exercise in groups on psychological well-being among pregnant women at risk of depression (the EWE Study): Study protocol for a randomized controlled trial. *Trials*, 18(1): 210.

Broberg, L.A.S., Ersbøll, M.G., Backhausen, P., Damm, A.T. & Hegaard, H.K (2015). Compliance with national recommendations for exercise during early pregnancy in a Danish cohort. *BMC Pregnancy and Childbirth*, 15:137.

Brunette, E.L., Kotze, J., Wood, P.S., Du Toit, P.J. & Grant, C.C. (2012). An epidemiological study of physical activity patterns and weight gain in physically active and sedentary pregnant women in Tshwane, South Africa. *African Journal for Physical, Health Education, Recreation and Dance*, 18 (Suppl. S1):132–143.

Bull, F.C., Al-Ansari, S.S., Biddle, S., Borodulin, K., Buman, M.P., Cardon, G., Carty, C., Chaput, J.P., Chastin, S., Chou, R., Dempsey, P.C., DiPietro, L., Ekelund, U., Firth, J., Friedenreich, C.M., Garcia, L., Gichu, M., Jago, R., Katzmarzyk, P.T., Lambert, E., Leitzmann, M., Milton, K., Ortega, F.B., Ranasinghe, C., Stamatakis, E., Tiedemann, A., Troiano, R.P., van der Ploeg, H.P., Wari, V. & Willumsen, J.F. (2020). World Health Organization 2020 guidelines on physical activity and sedentary behaviour. *British Journal of Sports Medicine*, 54(24):1451–1462.

Camargo, S.F., Camargo, J.D., Schwade, D., Silva, R.M., Cornetta, M.D.C.M., Cobucci, R.N. & Costa E.C. (2021). Movement behavior during pregnancy and adverse maternal-fetal outcomes in women with gestational diabetes: A pilot case-control study. *International Journal of Environmental Research and Public Health*, 18(3):1114.

Cannon, S., Lastella, M., Vinzze, L., Vandelanotte, C. & Hayman, M. (2020). A review of pregnancy information on nutrition, physical activity and sleep websites. *Women and Birth*, 33(1): 35–40.

Carvalho, K., Kheyfets, A., Lawrence, B., Moky, A., Harris, L., Abouhala, S., & Amutah-Onukagha, N. (2021). Examining the role of psychosocial influences on black maternal health during the COVID-19 pandemic. *Maternal and Child Health Journal*, 1-6.

Caspersen, C., Powell, K. & Christenson, G. (1985). Physical activity, exercise, and physical fitness: Definitions and distinctions of health-related research. *Public Health Reports*, 100(2):126–131.

Cassidy C.A. (1997). Facilitating behaviour change. Use of the trans theoretical model in the occupational health setting. *AAOHN journal: official journal of the American Association of Occupational Health Nurses*, 45(5), 239–246.

Catov, J.M., Parker, C.B., Gibbs, B.B., Bann, C.M., Carper, B., Silver, R.M., Simhan, H.N., Parry, S., Chung, J.H., Haas, D.M., Wapner, R.J., Saade, G.R., Mercer, B.M., Bairey-Merz, C.N., Greenland, P., Ehrenthal, D.B., Barnes, S.E., Shanks, A.L., Reddy, U.M., Grobman, W.A. & NICHD NuMoM2b and NHLBI NuMoM2b Heart Health Study Network (2018). Patterns of leisure-time physical activity across pregnancy and adverse pregnancy outcomes. *The International Journal of Behavioral Nutrition and Physical Activity*, *15* (1):68.

Chan, C.W.H., Au Yeung, E. & Law, B.M.H. (2019). Effectiveness of physical activity interventions on pregnancy-related outcomes among pregnant women: A systematic review. *International Journal of Environmental Research and Public Health*, 16(10):1840.

Chandonnet, N., Saey, D., Almeras, N. & Marc, I. (2012). French pregnancy physical activity questionnaire compared with an accelerometer cut point to classify physical activity among pregnant obese women. *PLoS One*, 7(6):e38818.

Chasan-Taber, L. (2012). Physical activity and dietary behaviours associated with weight gain and impaired glucose tolerance among pregnant Latinas. *Advances in Nutrition*, 3(1):108–118.

Chasan-Taber, L.; Schmidt, M.D.; Roberts, D.E.; Hosmer, D.; Markenson, G. & Freedson, P.S. (2004). Development and validation of a Pregnancy Physical Activity Questionnaire. *Medicine & Science in Sports & Exercise*, 36(10):1750–1760.

Chen, K.Y., Janz, K.F., Zhu, W. & Brychta, R.J. (2012). Redefining the roles of sensors in objective physical activity monitoring. *Medicine & Science in Sports & Exercise*, 44 (Suppl. 1):S13–S23.

Clapp, J. & Kiess, W. (1998). Cord blood leptin reflects foetal fat mass. *Journal of the Society for Gynecologic Investigation*, 5(6):300–303.

Clayton, D.A. & Griffith, C.J. (2008). Efficacy of an extended theory of planned behaviour model for predicting caterers' hand hygiene practices. *International Journal of Environmental Research and Public Health*, 18(2):83–98.

Coll, C.V., Domingues, M.R., Gonçalves, H. & Bertoldi, A.D. (2017). Perceived barriers to leisure-time physical activity during pregnancy: A literature review of quantitative and qualitative evidence. *Journal of Science and Medicine in Sport*, 20(1):17–25.

Coll, C.V.N., Domingues, M.R., Hallal, P.C., da Silva, I.C.M., Bassani, D.G., Matijasevich, A. Barros, A., Santos, I.S. & Bertoldi, A.D. (2017). Changes in leisure-time physical activity among Brazilian pregnant women: Comparison between two birth cohort studies (2004–2015). *BMC Public Health*, 17:119.

Collings, P.J., Farrar, D., Gibson, J., West, J. & Barber, S.E. Wright, J. (2020). Associations of pregnancy physical activity with maternal cardiometabolic health, neonatal delivery outcomes and body composition in a biethnic cohort of 7305 mother–child pairs: The born in Bradford study. *Sport Medicine*, 50(3):615–628.

Conn, V., Hafdahl, A. & Mehr, D. (2011). Interventions to increase physical activity among healthy adults: Meta-analysis of outcomes. *American Journal of Public Health*, 101(4), 751–758.

Connelly, L.M. (2016). Trustworthiness in Qualitative Research. *Medsurg Nursing: Official Journal of the Academy of Medical-Surgical Nurses*, 25(6):435–436.

Connelly, M., Brown, H., van der Pligt, P. & Teychenne, M. (2015). Modifiable barriers to leisure-time physical activity during pregnancy: A qualitative study investigating first time mother's views and experiences. *BMC Pregnancy and Childbirth*, 15:100.

Conner, M. & Armitage, C.J. (1998). Extending the theory of planned behaviour: A review and avenues for future research. *Journal of Applied Social Psychology*, 28(15):1429–1464.

Connolly, C.P., Conger, S.A., Montoye, A.H.K., Marshall, M.R., Schlaff, R.A., Badon, S.E. & Pivarnik, J.M. (2018). Walking for health during pregnancy: A literature review and considerations for future research. *Journal of Sport and Health Science*, 8:401–411.

Creswell, J.W. & Plano Clark, V.L. (2011). *Designing and conducting mixed methods research*. 2nd ed., SAGE Publications: Thousand Oaks, CA, USA.

Currie, S., Sinclair, M., Murphy, M.H., Madden, E., Dunwoody, L. & Liddle, D. (2013). Reducing the decline in physical activity during pregnancy: A systematic review of behaviour change interventions. *PLoS One*, 8(6):e66385.

da Silva, S.G., Evenson, K.R., da Silva, I.C.M., Mendes, M.A., Domingues, M.R., da Silveira, M.F., Wehrmeister, F.C., Ekelund, U. & Hallal, P.C. (2018). Correlates of accelerometer-assessed physical activity in pregnancy—The 2015 Pelotas (Brazil) birth cohort study.

Da Silva, S.G., Ricardo, L.I., Evenson, K.R. & Hallal, P.C. (2017). Leisure-time physical activity in pregnancy and maternal-child health: A systematic review and meta-analysis of randomized controlled trials and cohort studies. *Sports Medicine*, 47(2): 295–317.

Dacey, M.L., Kennedy, M.A., Polak, R. & Phillips, E.M. (2014). Physical activity counselling in medical school education: A systematic review. *Medical Education Online*, 19:24325.

Dalhaug, E.M. & Haakstad, L. A.H. (2019). What the health? Information sources and maternal lifestyle behaviors. *Interactive Journal of Medical Research*, 8(3):e10355.

Daniel, J.A., Nwaogu, E.I. & Ezeugwu, C.C. (2015). Effects of antenatal exercise on length of gestation among women attending antenatal clinic of the Federal Medical Centre Owerri, Southeast Nigeria. *International Journal of Health and Rehabilitation Sciences*, 4(4):212–216.

Davenport, M.H., Marchand, A.A., Mottola, M.F., Poitras, V.J., Gray, C.E., Jaramillo Garcia, A., Barrowman, N., Sobierajski, F., James, M., Meah, V.L., Skow, R.J., Riske, L., Nuspl, M., Nagpal, T.S., Courbalay, A., Slater, L.G., Adamo, K.B., Davies, G.A., Barakat, R. & Ruchat, S.M. (2019). Exercise for the prevention and treatment of low back, pelvic girdle and lumbopelvic pain during pregnancy: A systematic review and meta-analysis. *British Journal of Sports Medicine*, 53(2):90–98.

Davenport, M.H., McCurdy, A.P., Mottola, M.F, Skow, R.J., Meah, V.L., Poitras, V.J., Jaramillo Garcia, A., Gray, C.E., Barrowman, N, Riske, L., Sobierajski, F., James, M., Nagpal, T., Marchand, A.A., Nuspl, M., Slater, L.G., Barakat, R., Adamo, K.B., Davies, G.A. & Ruchat, S. (2018b). Impact of prenatal exercise on both prenatal and postnatal anxiety and depressive symptoms: A systematic review and meta-analysis. *British Journal of Sports Medicine*, 52(21):1376–1385.

Davenport, M.H., Meah, V.L., Ruchat, S.M., Davies, G.A., Skow, R.J., Barrowman, N., Adamo, K.B., Poitras, V.J., Gray, C.E., Jaramillo Garcia, A., Sobierajski, F., Riske, L., James, M., Kathol, A.J., Nuspl, M., Marchand, A.A., Nagpal, T.S., Slater, L.G., Weeks, A., Barakat, R. & Mottola, M.F. (2018a). Impact of prenatal exercise on neonatal and childhood outcomes: A systematic review and meta-analysis. *British Journal of Sports Medicine*, 52(21):1386–1396.

Davenport, M.H., Ruchat, S.M., Poitras, V.J., Jaramillo Garcia, A., Gray, C.E., Barrowman, N., Skow, R.J., Meah, V.L., Riske, L., Sobierajski, F., James, M., Kathol, A.J., Nuspl, M., Marchand, A.A., Nagpal, T.S., Slater, L.G., Weeks, A., Adamo, K.B., Davies, G.A., Barakat, R. & Mottola, M.F. (2018). Prenatal exercise for the prevention of gestational diabetes mellitus and hypertensive disorders of pregnancy: A systematic review and meta-analysis. *British Journal of Sports Medicine*, 52(21):1367–1375.

Davenport, M.H., Ruchat, S.M., Sobierajski, F., Poitras, V.J., Gray, C.E., Yoo, C., Skow, R.J., Jaramillo Garcia, A., Barrowman, N., Meah, V.L., Nagpal, T.S., Riske, L., James, M., Nuspl, M., Weeks, A., Marchand, A.A., Slater, L.G., Adamo, K.B., Davies, G.A., Barakat, R. & Mottola, M.F. (2019). Impact of prenatal exercise on maternal harms, labour and delivery outcomes: A systematic review and meta-analysis. *British Journal of Sports Medicine*, 53(2):99–107.

David, J.S. (2016). *Cultural beliefs and prenatal exercise*. 13th ed. Church Hill Living Stone London Elsevier Ltd.

Davis, R., Campbell, R., Hildon, Z., Hobbs, L. & Michie, S. (2014) Theories of behaviour and behaviour change across the social and behavioural sciences: A scoping review. *Health Psychology Review*, 9(3):1–22.

de Jersey, S.J., Tyler, J., Guthrie, T. & New, K. (2018). Supporting healthy weight gain and management in pregnancy: Does a mandatory training education session improve knowledge and confidence of midwives? *Midwifery*, 65:1–7.

De Vivo, M. & Mills, H. (2019). 'They turn to you first for everything": Insights into midwives' perspectives of providing physical activity advice and guidance to pregnant women. *BMC Pregnancy Childbirth*, 19(1):462.

De Vivo, M., Hulbert, S., Mills, H. & Uphill, M. (2016). Examining exercise intention and behaviour during pregnancy using the theory of planned behaviour: A meta-analysis. *Journal of Reproductive and in Psychology*, 34(2):122–138.

Deci, E.L. & Ryan, R.M. (2000). The what and why of goal pursuits: Human needs and the self-determination of behaviour. *Psychological Inquiry*, 11(54):227–268.

Department of Health & Social Care (2019). UK Chief Medical Officer's physical activity guidelines, Available online: https://assestts.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/832868/ukchief-medical-officersphysical-activity-guidelines.pdf. (Accessed 17 October 2020).

Ding, D., Lawson, K.D., Kolbe-Alexander, T.L. Finkelstein, E.A., Katzmarzyk, P.T., van Mechelen, W., Pratt, M. & Lancet Physical Activity Series 2 Executive Committee (2016). The economic burden of physical inactivity: A global analysis of major non-communicable diseases. *Lancet*, 388(10051):1311–1324.

Dipietro, L., Evenson, K.R., Bloodgood, B., Sprow, K., Troiano, R.P., Piercy, K.L., Vaux-Bjerke, A., Powell, K.E. & 2018 PHYSICAL ACTIVITY GUIDELINES ADVISORY COMMITTEE. (2019). Benefits of physical activity during pregnancy and postpartum: An umbrella review. *Medicine & Science in Sports & Exercise*, 51(6):1292–1302.

Dishani, M.R., Johnson, A.R., Joseph, M., James, M., Lakra, P. & Ramesh, N. (2020). How physically active are women in the third trimester of pregnancy? A cross-sectional study of physical activity in pregnancy and its outcomes among women delivering at a rural maternity hospital in South India. *Indian Journal of Health Sciences and Biomedical Research*, 13(3):221–225.

Dodd, J. M., Cramp, C., Sui, Z., Yelland, L. N., Deussen, A. R., Grivell, R. M., Moran, L. J., Crowther, C. A., Turnbull, D., McPhee, A. J., Wittert, G., Owens, J. A., Robinson, J. S. & LIMIT Randomised Trial Group (2014). The effects of antenatal dietary and lifestyle advice for women who are overweight or obese on maternal diet and physical activity: the LIMIT randomised trial. *BMC Medicine*, 12:161.

Domingues, M., Santos, I., Matijasevich, A., Horta, B.L., Hallal, P.C. & Coll, C. (2016). Changes in leisure-time physical activity from the pre-pregnancy to the postpartum period: 2004 Pelotas (Brazil) Birth Cohort Study. *Journal of Physical Activity and Health*, 13(4):361–365.

Du, M.C., Ouyang, Y.Q., Nie, X.F., Huang, Y. & Redding, S.R. (2019). Effects of physical exercise during pregnancy on maternal and infant outcomes in overweight and obese pregnant women: A meta-analysis. *Birth*, 46(2):211–221.

Duke, E.U., Ekpoanwan, E., Ella, E., Ndukaku, N.C. & Agba, M. (2020). Perception of prenatal exercise and its perceived outcome among pregnant women attending antenatal clinic at the university of Calabar teaching hospital. *Global Journal of Health Science*, 12(8):157-165.

Eastern Cape Socio Economic Consultative Council (2017). Buffalo City Metro Municipality socio economic review and outlook. Available online: https://www.ecsecc.org/documentrepository/informationcentre/buffalo-citymetro-municipality_44557.pdf. (Assessed November, 2020).

Ekelin, M., Langeland Iversen, M., Grønbæk Backhausen, M. & Hegaard, H.K. (2018). Not now but later—A qualitative study of non-exercising pregnant women's views and experiences of exercise. *BMC Pregnancy Childbirth*, 18:399.

EL-Rafie, M.M., Khafagy, G.M. & Gamal, M.G. (2016). Effect of aerobic exercise during pregnancy on antenatal depression. *International Journal of Women's Health*, 8:53–57.

El-Shamy, F.F. & EL-Fatal, E.A. (2017). Effect of antenatal pelvic floor muscle exercise on mode of delivery: a randomised control trial. *Integrative Medicine International*, 4(3-4):187–197.

Evenson, K.R. & Bradley, C.B. (2010). Beliefs about exercise and physical activity among pregnant women. *Patient Education and Counselling*, 79(1):124-9.

Evenson, K.R., Mottola, M.F. & Artal, R. (2019). Review of recent physical activity guidelines during pregnancy to facilitate advice by health care providers. *Obstetrical & Gynecological Survey*, 74(8):481–489.

Fairley, L., Dundas, R. & Leyland, A.H. (2011). The influence of both individual and area based socioeconomic statuson temporal trends in caesarean sections in Scotland 1980–2000. *BMC Public Health*, 11:330.

Fazzi, C., Saunders, D.H., Linton, K., Norman, J.E. & Reynolds, R.M. (2017). Sedentary behaviours during pregnancy: A systematic review. *International Journal of Behavioral Nutrition and Physical Activity*, 14(32): 1–13.

Ferrari, N., Bae-Gartz, I., Bauer, C., Janoschek, R., Koxholt, I., Mahabir, E., Appel, S., Alejandre Alcazar, M.A., Grossmann, N., Vohlen, C., Brockmeier, K., Dötsch, J., Hucklenbruch-Rother, E. & Graf, C. (2018). Exercise during pregnancy and its impact on mothers and offspring in humans and mice. *Journal of Developmental Origins of Health and Disease*, 9(1):63–76.

Ferraro, Z.M., Gaudet, L. & Adamo, K.B. (2012). The potential impact of physical activity during pregnancy on maternal and neonatal outcomes. *Obstetrical & Gynaecological Survey*, 67(2):99–110.

Findley, A., Smith, D.M., Hesketh, K. & Keyworth, C. (2020). Exploring women's experiences and decision making about physical activity during pregnancy and following birth: A qualitative study. *BMC Pregnancy & Childbirth*, 20:54.

Flannery, C., Fredrix, M., Olander, E.K., McAuliffe, F.M., Byrne, M. & Kearney, P.M. (2019). Effectiveness of physical activity interventions for overweight and obesity during pregnancy: A systematic review of the content of behaviour change interventions. *International Journal of Behavioural Nutrition and Physical Activity*, 16(97):1–20.

Flannery, C., McHugh, S., Anaba, A.E., Clifford, E., O'Riordan, M., Kenny, L.C., McAuliffe, F.M., Kearney, P.M. & Byrne, M. (2018). Enablers and barriers to physical activity in overweight and obese pregnant women: an analysis informed by the theoretical domains framework and COM-B model. *BMC Pregnancy Childbirth*, 18(1):178.

Galliano, L.M., Del Vecchio, A.H.M., Silvani, J., Façanha, C. & Del Vecchio, F.B. (2019). Physical activity level in women with gestational diabetes mellitus: Lifestyle intervention for diabetes prevention after pregnancy (LINDA-Brasil) study. *Journal of Diabetes*, 11(6):457–465.

Gao, L., Larsson, M. & Lou, S. (2013). Internet use by Chinese women seeking pregnancy-related information. *Midwifery*, 29(7):730–735.

Garland, M. (2017). Physical activity during pregnancy: A prescription for improved perinatal outcomes. *The Journal for Nurse Practitioners*, 13(1):54–58.

Garland, M., Wilbur, J., Semanik, P. & Fogg, L. (2019). Correlates of physical activity during pregnancy: A systematic review with implications for evidence-based practice. *Worldviews on Evidence-Based Nursing*, 16(4):310–318.

Gaston, A. & Cramp, A. (2011). Exercise during pregnancy: A review of patterns and determinants. *Journal of Science and Medicine in Sport*, 14(4):299–305.

Gaston, A. & Vamos, C.A. (2013). Leisure-time physical activity patterns and correlates among pregnant women in Ontario, Canada. *Maternal and Child Health Journal*, 17(3):477–484.

Gebregziabher, D., Berhe, H., Kassa, M. & Berhanie, E. (2019). Level of physical activity and associated factors during pregnancy among women who gave birth in public zonal hospitals of Tigray. *BMC Research Notes*, 12(1):454.

Gehan, A.A., Khadiga, S.A., Amir, G.A. & Eman, A. (2015). Efficacy of antenatal exercises on maternal and neonatal outcomes in elderly primigravida. *Kasr Al-Ainy Medical Journal*, 21:109–114.

Ghiasi, A. (2021). Health information needs, sources of information, and barriers to accessing health information among pregnant women: a systematic review of research. *The Journal of Maternal-Fetal & Neonatal Medicine*, 34(8):1320–1330.

Glanz, K., Rimer, B.K. & Viswanath, K. (2008). Models of individual health behaviour. In: *Health Behavior and Health Education: Theory, Research, and Practice*. 4th ed. San Fransisco, CA: Wiley & Sons.

Global Burden of Disease (2017). Risk Factor Collaborators. Global, regional, and comparative risk assessment of 84 behavioral, environmental and occupational, and metabolic or clusters of risks for 195 countries and territories, 1990-2017: A systematic analysis for the global burden of diseases study. *The Lancet,* 392(10159):1923–1994.

Grenier, L.N., Atkinson, S.A., Mottola, M.F., Wahoush, O., Thabane, L., Xie, F., Vickers-Manzin, J., Moore, C., Hutton, E.K. & Murray-Davis, B. (2021). Be healthy in pregnancy: Exploring factors that impact pregnant women's nutrition and exercise behaviors. *Maternal & Child Nutrition*, 17(1):e13068.

Grimes, H.A., Forster, D.A. & Newton, M.S. (2014). Sources of information used by women during pregnancy to meet their information needs. *Midwifery*, 30(1):e26–e33.

Gronwald, T. & Budde, H. (2019). Commentary: Physical exercise as personalized medicine for dementia prevention? *Frontiers of Physiology*, 10:726.

Grove, S.K. Burns, N. & Gray, J.R. (2013). *The practice of nursing research: Appraisal, synthesis and generation of evidence.* 7th ed. Philadelphia: Elsevier Saunders.

Guba, E.G. & Lincoln, Y.S. (1994). Competing paradigms in qualitative research. In N. K. Denzin, & Y. S. Lincoln, *Handbook of qualitative research* (pp. 105-117). Thousand Oaks: Sage Publications Inc.

Guelfi, K.J., Wang, C., Dimmock, J.A., Jackson, B., Newnham, J.P. & Yang, H. (2015). A comparison of beliefs about exercise during pregnancy between Chinese and Australian pregnant women. *BMC Pregnancy Childbirth*, 15:345.

Guérin, E., Ferraro, Z.M., Adamo, K.B. & Prud'homme, D. (2018). The need to objectively measure physical activity during pregnancy: Considerations for clinical research and public health impact. *Maternal and Child Health Journal*, 22(5):637–641.

Gurel, E. & Tat, M. (2017). SWOT Analysis: A theoretical review. *The Journal of International Social Research*, 10(51): 994–1006.

Haakstad, L.A.H., Mjønerud, J.M.F. & Dalhaug, E.M. (2020) MAMMA MIA! Norwegian Midwives' practices and views about gestational weight gain, physical activity, and nutrition. *Frontiers in Psychology*, 11:1463.

Haakstad, L.A.H., Vistad, I., Sagedal, L.R., Lohne-Seiler, H. & Torstveit, M.K. (2018). How does a lifestyle intervention during pregnancy influence perceived barriers to leisure-time physical activity? The Norwegian fit for delivery study, a randomized controlled trial. *BMC Pregnancy Childbirth*, 18:127.

Hailemariam, T.T., Gebregiorgis, Y.S., Gebremeskel, B.F., Haile, T.G. & Spitznagle, T.M. (2020). Physical activity and associated factors among pregnant women in Ethiopia: Facility-based cross-sectional study. *BMC Pregnancy Childbirth*, 20(1):92.

Halse, R.E., Wallman, K.E., Dimmock, J.A., Newnham, J.P. & Guelfi, K.J. (2015). Home-based exercise improves fitness and exercise attitude and intention in women with GDM. *Medicine & Science in Sports & Exercise*, 47(8):1698–1704.

Hamer, M., Kivimäki, M., Gale, C.R. & Batty, G.D. (2020). Lifestyle risk factors, inflammatory mechanisms, and COVID-19 hospitalization: A community-based cohort study of 387,109 adults in UK. *Brain, Behavior, and Immunity*, 87:184–187.

Han, S., Middleton, P. & Crowther, C.A. (2012). Exercise for pregnant women for preventing gestational diabetes mellitus. *Cochrane Database Systematic Review*, 11(7):CD009021.

Harrison, A.L., Taylor, N.F., Shields, N. & Frawley, H.C. (2018). Attitudes, barriers and enablers to physical activity in pregnant women: A systematic review. *Journal of Physiotherapy*, 64(1):24–32.

Harrison, C.L., Brown, W.J., Hayman, M., Moran, L.J. & Redman, L.M. (2016). The role of physical activity in preconception, pregnancy and postpartum health. *Seminars in Reproductive Medicine*, 34(2), e28–e37.

Hawkins, M., Youngdeok, K., Gabriel, K.P., Rockette-Wagner, B.J. & Chasan-Taber, L. (2017). Sedentary behaviour patterns in non-pregnant and pregnant women. *Preventative Medicine Reports*, 6:97–103.

Hayman, M., Reaburn, P., Alley, S., Cannon, S. & Short C. (2020). What exercise advice are women receiving from their healthcare practitioners during pregnancy? *Women and Birth*, 33(4):e357–e362.

Herold, F., Müller, P., Gronwald, T. & Müller, N.G. (2019). Dose-response matters!—A perspective on the exercise prescription in exercise-cognition research. *Frontier in Psychology*, 10:2338.

Herold, F., Törpel, A., Schega, L. & Müller, N.G. (2019). Functional and/or structural brain changes in response to resistance exercises and resistance training lead to cognitive improvements—A systematic review. *European Review of Aging and Physical Activity*, 16(10):1–33.

Heslehurst, N., Russell, S., McCormack, S., Sedgewick, G., Bell, R. & Rankin, J. (2013). Midwives perspectives of their training and education requirements in maternal obesity: a qualitative study. *Midwifery*, 29(7):736–744.

Hill, B., McPhie, S. & Moran, L.J. (2017). Lifestyle intervention to prevent obesity during pregnancy: implications and recommendations for research and implementation. *Midwifery*, 49:13–18.

Hjorth, M.F., Kloster, S., Girma, T., Faurholt-Jepsen, D., Andersen, G., Kæstel, P., Brage, S. & Friis, H. (2012). Level and intensity of objectively assessed physical activity among pregnant women from urban Ethiopia. *BMC Pregnancy Childbirth*, 12:154.

Hoffmann, J., Günther, J., Geyer, K., Stecher, L., Rauh, K., Kunath, J., Meyer, D., Sitzberger, C., Spies, M., Rosenfeld, E., Kick, L., Oberhoffer, R. & Hauner, H. (2019). Effects of a lifestyle intervention in routine care on prenatal physical activity - Findings from the cluster-randomised GeliS trial. *BMC Pregnancy and Childbirth*, 19(1):414.

Hopkinson, Y., Hill, D.M., Fellows, L. & Fryer, S. (2018). Midwives understanding of physical activity guidelines during pregnancy. *Midwifery*, 59:23–26.

Huang, L., Fan, L. & Ding P. (2017). Maternal exercise during pregnancy reduces the risk of preterm birth through the mediating role of placenta. *Journal of Maternal-Fetal and Neonatal Medicine*, 32(1): 109–116.

Huberty J, Dinkel D, Beets, M.W. & Coleman, J. (2013). Describing the use of the internet for health, physical activity, and nutrition information in pregnant women. *Maternal and Child Health Journal*, 17(8):1363–72.

Huberty, J.L., Buman, M.P., Leiferman, J.A., Bushar, J. & Adams, M.A. (2016). Trajectories of objectively-measured physical activity and sedentary time over the course of pregnancy in women self-identified as inactive. *Preventive Medicine Reports*, 3:353–360.

Hurst C, Flannery C, Byrne M, Kearney, P.M., Dunne, F., O'Riordan, M. & Walsh, J.C. (2017). Investigating the perceived benefits, barriers and beliefs towards physical activity in pregnancy among women with gestational diabetes mellitus. *Irish Medical Journal*, 110(7):617.

Issakainen, M., Schwab, U. & Lamminpää, R. (2020).Qualitative study on public health nurses' experience and assessment of nutritional and physical activity counselling of women with gestational diabetes. *European Journal of Midwifery*, 4:37.

James, P., Morgant, R., Merviel, P., Saraux, A., Giroux-Metgese, M.A., Guillodo, Y., Dupré, P.F. & Muller, M. (2020). How to promote physical activity during pregnancy: A systematic review. *Journal of Gynecology Obstetrics and Human Reproduction*, 49(9):101864.

Janakiraman, B., Gebreyesus, T., Yihunie, M. & Genet, M.G. (2021). Knowledge, attitude, and practice of antenatal exercises among pregnant women in Ethiopia: A cross-sectional study. *PLoS One*, 16(2):e0247533.

Jayakody K, Gunadasa S. & Hosker C. (2014). Exercise for anxiety disorders: systematic review. *British Journal of Sports Medicine*, 48(3):187–196.

Kamali, S., Ahmadian, L., Khajouei, R. & Bahaadinbeigy, K. (2018). Health information needs of pregnant women: Information sources, motives and barriers. *Health Information & Libraries Journal*, 35(1):24–37.

Kaur, M. (2016). Application of mixed method approach in public health research. *Indian Journal of Community Medicine: official publication of Indian Association of Preventive & Social Medicine*, 41(2):93–97.

Kessler, J.L. & Phillippi, J.C. (2015). Incorporating a primary care practicum in midwifery education. *Journal of Midwifery & Women's Health*, 60:258–262.

Kime, N., Pringle, A., Zwolinsky, S. & Vishnubala, D. (2020). How prepared are healthcare professionals for delivering physical activity guidance to those with diabetes? A formative evaluation. *BMC Health Services Research*, 20:8.

Koleilat, M., Vargas, N. & Kodjebacheva G. (2016). Perceived barriers to physical activity during pregnancy among participants of the special supplemental nutrition program for women, infants and children (WIC) in Southern California. *The FASEB Journal*, 30(S1): 152.2–152.2.

Koleilat, M., Vargas, N., vanTwist, V. & Kodjebacheva G.D. (2021). Perceived barriers to and suggested interventions for physical activity during pregnancy among participants of the special supplemental nutrition program for women, infants, and children (WIC) in Southern California. *BMC Pregnancy Childbirth*, 21(1):69.

Kołomańska, D., Zarawski, M. & Mazur-Bialy, A. (2019). Physical activity and depressive disorders in pregnant women-a systematic review. *Medicina (Kaunas)*, 55(5):212.

Kothe, E., Bailey, C., Weiner, C., Nagle, C., Nowson, C., Hill, B., McPhie, S., Savaglio, M. & Skouteris, H. (2019). An investigation of Australian midwifery curricula for obesity management and health behaviour change training. Nurse education in practice, 36, 54–57.

Krzepota, J., Sadowska, D. & Biernat, E. (2018). Relationships between physical activity and quality of life in pregnant women in the second and third trimester. *International Journal of Environmental Research and Public Health*, 15(12):2745.

Kvam, S., Kleppe, C.L., Nordhus, I.H. & Hovland, A. (2016). Exercise as a treatment for depression: A meta-analysis. *Journal of Affective Disorders*, 15(202):67–86.

Lardon, E., St-Laurent, A., Babineau, V., Descarreaux, M. & Ruchat, S.M. (2018). Lumbopelvic pain, anxiety, physical activity and mode of conception: A prospective cohort study of pregnant women. *BMJ Open*, 8(11):e022508.

Lawan, A., Awotidebe, A.W., Oyeyemi, A.L., Rufa A.A. & Oyeyemi, A.Y. (2018). Relationship between physical activity and health related quality of life among pregnant women. *African Journal of Reproductive Health*, 22(3):80-89.

Lee, A., Newton, M., Radcliffe, J. & Belski, R. (2018). Pregnancy nutrition knowledge and experiences of pregnant women and antenatal care clinicians: A mixed methods approach. *Women and Birth*, 31(4):269–277.

Lee, C.F., Chiang, I.C., Hwang, F.M., Chi, L.K. & Lin, H.M. (2016). Using the theory of planned behaviour to predict pregnant women's intention to engage in regular exercise. *Midwifery*, 42:80–86.

Lee, C.F., Hwang, F.M., Lin, H.M., Chi, L.K. & Chien, L.Y. (2016). The physical activity patterns of pregnant Taiwanese women. *Journal of Nursing Research*, 24(4):291–299.

Lee, Y.M., Park, N.H. & Kim, Y.H. (2006). Process of change, decisional balance, self-efficacy and depression across the stages of change for exercise among middle aged women in Korea. *Taehan Kanho Hakhoe chi*, 36(4), 587–595.

Leppanen, M., Aittasalo, M., Raitanen. J., Kinnunen, T.I., Kujala, U.M. & Luoto, R. (2014). Physical activity during pregnancy: Predictors of change, perceived support and barriers among women at increased risk of gestational diabetes. *Maternal and Child Health Journal*, 18(9):2158–2166.

Liguori, G., Feito, Y., Fountaine, C., Roy, B. & American College of Sports Medicine (2022). *ACSM's Guidelines for Exercise Testing and Prescription* (11th ed.). Philadelphia: Wolter Kluwer.

Lindqvist, M., Lindkvist, M., Eurenius, E., Persson, M. & Mogren. I. (2017). Change of lifestyle habits – motivation and ability reported by pregnant women in Northern Sweden. *Sexual & Reproductive HealthCare*, 13:83–90.

Lindqvist, M., Lindqvist, M., Eurenius, E., Persson, M., Ivarsson, A. & Mogren, I. (2016). Leisure time physical activity among pregnant women and its associations with maternal characteristics and pregnancy outcomes. *Sexual & Reproductive HealthCare Journal*, 9:14–20.

Lindqvist, M., Mogren, I., Eurenius, E., Edvardsson, K. & Persson, M. (2014). "An on-going individual adjustment": a qualitative study of midwives' experiences counselling pregnant women on physical activity in Sweden. BMC pregnancy and childbirth, 14, 343.

Lindqvist, M., Persson, M. & Mogren, I. (2018). Longing for individual recognition - pregnant women's experiences of midwives' counselling on physical activity during pregnancy. *Sexual & Reproductive HealthCare*, 15:46–53.

Liu, K.T., Kueh, Y.C., Arifin, W.N., Kim, Y. & Kuan, G. (2018). Application of transtheoretical model on behavioral changes, and amount of physical activity among university's students. *Frontiers in psychology*, *9*, 2402.

Liu, Y. & Luo, B.R. (2016). Factors affecting maternal physical activities: An analysis based on the structural equation modelling. *Journal of Southern Medical University*, 36:1514–1520.

Lucas, C., Starling, P., McMahon, A. & Charlton, K. (2016). Erring on the side of caution: pregnant women's perceptions of consuming fish in a risk averse society. *Journal of Human Nutrition and Dietetics*, 29(4):418–426.

Lynch, K.E., Landsbaugh. J.R., Whitcomb, B.W., Pekow, P., Markenson, G., Chasan-Taber & L. (2012). Physical activity of pregnant Hispanic women. *American Journal of Preventive Medicine*, 43(4):434–439.

Magro-Malosso, E.R, Saccone, G., Di Tommaso., M. Roman, A. & Berghella, V. (2017). Exercise during pregnancy and risk of gestational hypertensive disorders: A systematic review and meta-analysis. *Acta Obstetricia et Gynecologica Scandinavica*, 96:921– 931.

Makinde, O., Adeyemo, F. & Ogundele, B. (2014). Perception of pregnant mothers attending antenatal clinic on usefulness of prenatal exercise in Osogbo, Osun state, Nigeria. *Journal of Health Science*, 8(2):229–239.

Malta, M.B., Carvalhaes, M.D., Takito, M.Y., Tonete, V.L.P., Aluísio, J.D., Barros, A.J.D., de Lima Parada, C.M.G. & D'Aquino Benício, M.H. (2016). Educational intervention regarding diet and physical activity for pregnant women: Changes in knowledge and practices among health professionals. *BMC Pregnancy Childbirth*, 16: 175.

Maputle, M.S., Lebese, R.T. & Khoza, L.B. (2014). Perceptions of women regarding physical activity during pregnancy and post-natal period at rural village in Vhembe district of Limpopo Province, South Africa. *African Journal for Physical, Health Education, Recreation and Dance*, (Supplement 1:1):51–63.

Marcus, B.H., Selby, V.C., Niaura, R.S. & Rossi, J.S. (1992). Self-efficacy and the stages of exercise behaviour change. *Research Quarterly for Exercise and Sport*, 63 (1):60–6.

Mbada, C.E., Adebayo, O.E., Adeyemi, A.B., Arije, O.O., Dada, O.O., Akinwande, O.A., Awotidebe, T.O. & Alonge, I.A. (2014). Knowledge and attitude of Nigerian pregnant women towards antenatal exercise: A cross sectional survey. *Obstetrics and Gynaecology*, 1(8): 260539.

Mbada, C.E., Orji, O.E., Iyiola, A.M., Adeyemi, A.B., Afolabi, E.K., Petronilla, O.C., Adeyemi, A. B., Akinwande, O A. & Makinde, M.O. (2019). Relationship between physical activity and fatigue among Nigerian pregnant women. *Women Health Bulletin*, 6(1):e61339.

McLellan, J. M., O'Carroll, R. E., Cheyne, H. & Dombrowski, S. U. (2019). Investigating midwives' barriers and facilitators to multiple health promotion practice behaviours: a qualitative study using the theoretical domains framework. *Implementation science*, 14(1), 64.

McLeroy, K.R., Bibeau, D., Steckler, A. & Glanz, K. (1988). An ecological perspective on health promotion programs. *Health Education Quarterly*, 15(4):351–377.

McParlin, C., Bell, R., Robson, S.C., Muirhead, C.R. & Araújo-Soares, V. (2017). What helps or hinders midwives to implement physical activity guidelines for obese pregnant women? A questionnaire survey using the Theoretical Domains Framework. *Midwifery*, 49:110–116.

Meander, L., Lindqvist, M., Mogren, I. Sandlund, J., West C.E. & Domellöf, M. (2021). Physical activity and sedentary time during pregnancy and associations with maternal and foetal health outcomes: An epidemiological study. *BMC Pregnancy Childbirth*, 21:166.

Mendinueta, A., Esnal, H., Arrieta, H., Arrue, M., Urbieta, N., Ubillos, I., Whitworth, K. W., Delclòs-Alió, X., Vich, G. & Ibarluzea, J. (2020). What accounts for physical activity during pregnancy? A study on the sociodemographic predictors of self-reported and objectively assessed physical activity during the 1st and 2nd trimesters of pregnancy. *International Journal of Environmental Research and Public Health*, *17*(7): 2517.

Mercado, A., Marquez, B., Barbara Abrams, B., Phipps, M.G., Rena R.W. & Phelan, S. (2017). Where do women get advice about weight, eating, and physical activity during pregnancy? *Journal of Women's Health*, 26(9):951–956.

Merkx, A., Ausems, M., Budé, L., de Vries, R. & Nieuwenhuijze, M.J. (2017). Factors affecting perceived change in physical activity in pregnancy. *Midwifery*, 51:16–23.

Mizgier, M., Mruczyk, K., Jarząbek-Bielecka, G. & Jeszka, J. (2018). The impact of physical activity during pregnancy on maternal weight and obstetric outcomes. *Ginekologia Polska*, 89(2):80–88.

Mottola, M.F., Davenport, M.H., Ruchat, S.M., Davies, G.A., Poitras, V.J., Gray, C.E., Jaramillo Garcia, A., Barrowman, N., Adamo, K.B., Duggan, M., Barakat, R., Chilibeck, P., Fleming, K., Forte, M., Korolnek, J., Nagpal, T., Slater, L.G., Stirling, D. & Zehr, L. (2019). 2019 Canadian guideline for physical activity throughout pregnancy. *Journal of Obstetrics and Gynaecology Canada*, 40 (11):1449–1559.

Mottola, M.F., Davenport, M.H., Ruchat, S.M., Davies, G.A., Poitras, V.J., Gray, C.E., Garcia, A.J., Barrowman, N., Adamo, K.B., Duggan, M., Barakat, R., Chilibeck, P., Fleming, K., Forte, M., Korolnek, J., Nagpal, T., Slater, L.G., Stirling, D. & Zehr, L. (2018). 2019 Canadian guideline for physical activity throughout pregnancy. *British Journal of Sports Medicine*, 52(21):1339–1346.

Mottola, M.F., Davenport, M.H., Ruchat, S.M., Davies, G.A., Poitras, V., Gray, C., Jaramillo Garcia, A., Barrowman, N., Adamo, K.B., Duggan, M., Barakat, R., Chilibeck, P., Fleming, K., Forte, M., Korolnek, J., Nagpal, T., Slater, L., Stirling, D. & Zehr, L. (2018). No. 367-2019 Canadian Guideline for Physical Activity throughout Pregnancy. *Journal of Obstetrics and Gynaecology Canada*, 40:1528–1537.

Muzigaba, M., Kolbe-Alexander, T.L. & Wong, F. (2014). The perceived role and influencers of physical activity among pregnant women from low socioeconomic status communities in South Africa. *Journal of Physical Activity and Health*, 11(7):1276–1283.

Nakamura, A., van der Waerden, J., Melchior, M., Bolze, C., El-Khoury, F. & Pryor, L. (2019). Physical activity during pregnancy and postpartum depression: Systematic review and meta-analysis. *Journal of Affective Disorders*, 246:29–41.

Narasimhulu, D.M., Karakash S, Weedon J. & Minkoff, H. (2016). Patterns of internet use by pregnant women, and reliability of pregnancy-related searches. *Maternal and Child Health Journal*, 20(12):2502–2509.

Nascimento, S.L., Surita, F.G., Godoy, A.C., Kasawara, K.T. & Morais, S.S. (2015). Physical activity patterns and factors related to exercise during pregnancy: A cross sectional study. *PLoS One*, 10(7):1–14.

Nguyen, C.L., Pham, N.M., Lee, A.H., Nguyen, P.T.H., Chu, T.K., Ha, A.V.V. (2018). Physical activity during pregnancy is associated with a lower prevalence of gestational diabetes mellitus in Vietnam. *Acta Diabetologica*, 55(9):955–962.

Nguyen, P.T.H., Binns, C.W., Nguyen, C.L., van Ha, A.V., Chu, K.T., Duong, D.V., Do, D.V. & Lee, A.H. (2019). Physical activity during pregnancy is associated with improved breastfeeding outcomes: a prospective cohort study. *International Journal of Environmental Research and Public Health*, 16(10):1740.

Nielsen, E.N., Andersen, P.K., Hegaard, H.K. & Juhl, M. (2017). Mode of delivery according to leisure time physical activity before and during pregnancy: A multicenter cohort study of low-risk women. *Journal of Pregnancy*, 6209605: 1–8.

Nunu,W.J., Makhado, L., Mabunda, J.T. & Lebese, R.T. (2020). Strategies to facilitate safe sexual practices in adolescents through integrated health systems in selected districts of Zimbabwe: A mixed method study protocol. *Reproductive Health,* 17: 20.

Ogbo, F.A., Eastwood, J., Hendry, A., Jakandin, B., Agho, K.E., Barnett, B. & Page, A. (2018). Determinants of antenatal depression and postnatal depression in Australia. *BMC Psychiatry*, 18(1):49.

Ojukwu, C.P., Anekwu, E.M., Okemuo, A.J., Nwabueze, J.O., John, D.O., Ezugwu, U.A. & Uchenwoke, C.I. (2018). Antenatal exercise practices: Associated factors and correlation with antenatal quality of life. *Journal of Applied Life Sciences International*, 18(4):1–9.

Okafor, U.B. & Goon, D.T. (2020a). Developing a physical activity intervention strategy for pregnant women in Buffalo City Municipality, South Africa: Study protocol. *International Journal of Environmental Research and Public Health,* 17:6694.

Okafor, U.B. & Goon, D.T. (2020b). Physical activity and exercise during pregnancy in Africa: a review of the literature. *BMC Pregnancy and Childbirth*, 20:732.

Okafor, U.B. & Goon, D.T. (2020c). Physical activity level during pregnancy in South Africa: A facility based cross-sectional study. *International Journal of Environmental Research and Public Health*, 17*:*7928.

Okafor, U.B. & Goon, D.T. (2021). Physical activity advice and counselling by healthcare providers: A scoping review. *Healthcare*, 9:609.

Othman, S.M.E., Steen, M. & Fleet, J.A. (2021). A sequential explanatory mixed methods study design: An example of how to integrate data in a midwifery research project. *Journal of Nursing Education and Practice*, 11(2):75-90.

Owe, K.M., Nystad, W. & Bø, K. (2009). Correlates of regular exercise during pregnancy: the Norwegian mother and child cohort study. *Scandinavian Journal of Medicine & Science in Sports*, 19(5):637–45.

Owe, K.M., Nystad, W., Stigum, H., Vangen, S. & Bø, K. (2016). Exercise during pregnancy and risk of cesarean delivery in nulliparous women: A large population-based cohort study. *American Journal of Obstetrics and Gynaecology*, 215(6):791.E1–971. E13.

Padmapriya, N., Bernard, J.Y., Liang, S., Loy, S.L., Shen, Z., Kwek, K., Godfrey, K.M., Gluckman, P.D. & Chong, S.M. (2016). Association of physical activity and sedentary behaviour with depression and anxiety symptoms during pregnancy in a multi-ethnic cohort of Asian women. *Archives of Women's Mental Health*, 19(6):1119–1128.

Padmapriya, N., Shen, L., Soh, S., Shen, Z., Kwek, K., Godfrey, K., Gluckman, P.D., Chong, Y.S., Saw, S.M. & Müller-Riemenschneider, F. (2015). Physical activity and sedentary behavior patterns before and during pregnancy in a multi-ethnic sample of Asian women in Singapore. *Maternal and Child Health Journal*, 19(11):2523–2535.

Pastorino, S., Bishop, T., Crozier, S.R., Granström, C., Kordas, K., Küpers, L.K., O'Brien, E.C., Polanska, K., Sauder, K.A., Zafarmand, M.H., Wilson, R.C., Agyemang, C., Burton, P.R., Cooper, C., Corpeleijn, E., Dabelea, D., Hanke, W., Inskip, H.M., McAuliffe, F.M., Olsen, S.F., Vrijkotte, T.G., Brage, S., Kennedy, A., O'Gorman, D., Scherer, P., Wijndaele, K., Wareham, N.J., Desoye, G. & Ong, K.K. (2019). Associations between maternal physical activity in early and late pregnancy and offspring birth size: Remote federated individual level meta-analysis from eight cohort studies. *BJOG: An International Journal of Obstetrics & Gynaecology*, 126(4):459–470.

Pathirathna, M.L., Sekijima, K., Sadakata, M., Fujiwara, N., Muramatsu, Y. & Wimalasiri, K.M.S. (2019). Effects of physical activity during pregnancy on neonatal birth weight. *Scientific Reports*, 9(1):6000.

Patrícia, V., De Sousa, S., Cury, A. & Eufrásio, L.S. (2019). The influence of gestational trimester, physical activity practice and weight gain on the low back and pelvic pain intensity in low risk pregnant women. *Journal of Back and Musculoskeletal Rehabilitation*. 32(5):671–676.

Peggy, J., Chinn, M.K. & Kramer, M.K. (2011). *Integrated theory knowledge development*. 5th ed. Mosby: London, UK.

Perales, M. & Artal, R.L.A. (2017). Exercise during pregnancy. *Journal of American Medical Association*, 317(11):1113–1114.

Phelan, S. (2010). Pregnancy: A "teachable moment" for weight control and obesity prevention. *American Journal of Obstetrics and Gynecology*, 202(2):e1–e8.

Physical Activity Guidelines Advisory Committee (2018). *2018 Physical Activity Guidelines Advisory Committee Scientific Report.* U.S. Department of Health and Human Services; Washington, DC, USA.

Pirzadeh, A., Mostafavi, F., Ghofranipour, F., & Feizi, A. (2015). Applying Trans-theoretical Model to Promote Physical Activities among Women. *Iranian Journal of Psychiatry and Behavioural Sciences*, *9*(4), e1580.

Polit, D.F. & Beck, C.T. (2014). *Essentials of nursing research: Appraising evidence for nursing practice*. 8th ed. New York: Library of Congress Cataloguing-in-Publication Data.

Poston, L., Briley, A.L., Barr, S., Bell, R., Croker, H., Coxon, K., Essex, H.N., Hunt, C., Hayes, L., Howard, L.M., Khazaezadeh, N., Kinnunen, T., Nelson, S.M., Oteng-Ntim, E., Robson, S.C., Sattar, N., Seed, P.T., Wardle, J., Sanders, T.A. & Sandall, J. (2013). Developing a complex intervention for diet and activity behaviour change in obese pregnant women (the UPBEAT trial); assessment of behavioural change and process evaluation in a pilot randomised controlled trial. *BMC Pregnancy and Childbirth*, 13:148.

Poston, L., Caleyachetty, R., Cnattingius, S., Corvalán, C., Uauy, R., Herring, S. & Gillman, M.W. (2016). Preconceptional and maternal obesity: Epidemiology and health consequences. *The Lancet Diabetes and Endocrinology*, 4(12):1025–1036.

Poyatos-León, R., Sanabria-Martínez, G., García-Prieto, J.C., Álvarez-Bueno, C., Pozuelo-Carrascosa, D.P., Cavero-Redondo, I., García-Hermoso, A., Gómez-Cantarino, S., Garrido-Miguel, M. & Martínez-Vizcaíno, V. (2016). A follow-up study to assess the determinants and consequences of physical activity in pregnant women of Cuenca, Spain. *BMC Public Health*, 16:437.

Prochaska, J.O., Johnson, S.S. & Lee, P. (2009). The transtheoretical model of behaviour change. In S. Schumaker, E. Schorn, J. Ockenes, & K. Richert (Eds.), *The handbook of health behaviour change* (3rd ed., pp. 59–83). New York, NY: Springer.

Raguema, N., Benletaifa, D., Mahjoub, T. & Lavoie J.L. (2020). Increased physical activity is correlated with improved pregnancy outcomes in women with preeclampsia: A retrospective study. *Pregnancy Hypertension*, 21:118–123.

Rajabi, A., Maharlouei, N., Rezaianzadeh,A., Lankarani, K.B., Esmaeilzadeh, F., Gholami, A. & Mansori, K. (2018). Physical activities (exercises or choreses) during pregnancy and mode of delivery in nulliparous women: A prospective cohort study. *Taiwanese Journal of Obstetrics and Gynecology*, 57(10):18–22.

Richardsen, K.R., Falk, R.S., Jenum, A.K., Mørkrid, K., Martinsen, E.W., Ommundsen, Y. & Berntsen, S.B. (2016). Predicting who fails to meet the physical activity guideline in pregnancy: A prospective study of objectively recorded physical activity in a population-based multi-ethnic cohort. *BMC Pregnancy Childbirth*, 16:1–11.

Roland, C.B., Knudsen, S.P., Alomairah, S.A., Andersen, A.D., Bendix, J., Clausen, T.D., Molsted, S., Jensen, A.K., Teilmann, G., Jespersen, A.P., Larsen, J.E., Hall, G.V., Andersen, E., Barrès, R., Mortensen, O.H., Maindal, H.T., Tarnow, L., Løkkegaard, E. & Stallknecht, B. (2021). Structured supervised exercise training or motivational counselling during pregnancy on physical activity level and health of mother and offspring: FitMum study protocol. *British Medical Journal Open*, 11(3):e043671.

Román-Gálvez, M.R., Amezcua-Prieto, C., Salcedo-Bellido, I., Olmedo-Requena, R., Martínez-Galiano, J.M., Khan, K.S. & Bueno-Cavanillas, A. (2021). Physical activity before and during pregnancy: A cohort study. *International Journal of Gynecology & Obstetrics*, 152(3):374–381.

Ruchat, S.M., Mottola, M.F., Skow, R.J., Nagpal, T.S., Meah, V.L., James, M., Riske, L., Sobierajski, F., Kathol, A.J., Marchand, A.A., Nuspl, M., Weeks, A., Gray, C.E., Poitras, V.J., Jaramillo Garcia, A., Barrowman, N., Slater, L.G., Adamo, K.B., Davies, G.A., Barakat, R. & Davenport, M.H. (2018). Effectiveness of exercise interventions in the prevention of excessive gestational weight gain and postpartum weight retention: A systematic review and meta-analysis. *British Journal of Sports Medicine*, 52(21):1347–1356.

Russell, E. (2013). Exercise is Medicine. *Canadian Medical Association Journal*, 185(11): E526.

Santos, P.C., Abreu, S., Moreira, C., Lopes, D., Santos, R., Alves, O., Silva, P. & Jorge Mota, N.M. (2014). Impact of compliance with different guidelines on physical activity during pregnancy and perceived barriers to leisure physical activity. *Journal of Sports Sciences*, 32(14):1398–1408.

Santos, P.C., Abreu, S., Moreira, C., Santos, R., Ferreira, M, Alves O, Moreira, P. & Mota, J. (2016). Physical activity patterns during pregnancy in a sample of Portuguese women: A longitudinal prospective study. *Iranian Red Crescent Medical Journal*, 18(3):e22455.

Sarmah, H.K., Hazarika, B.B. & Choudhury, G. (2013). An investigation on effect of bais on determination of sample size on the basis of data related to the students of schools of Guwahati. *International Journal of Statistics and Applied Mathematics*, 2(1):33–48.

Sayakhot, P. & Carolan-Olah, M. (2016). Internet use by pregnant women seeking pregnancy-related information: a systematic review. *BMC Pregnancy Childbirth*, 16:65.

Schafer, M.A., Alvis, M., Morris, C., Garrard, T., Hughes, A., Hunt, L., Koester, M., Yocum, I.C. & Tinius, R. (2019). Evidence-based educational brochures influenced beliefs and improved knowledge regarding the benefits of exercise during pregnancy: 3109: Board# 155 May 31 2:00 PM-3:30 PM. *Medicine & Science in Sports & Exercise*, 51(6):859.

Schmidt, T., Heilmann, T., Savelsberg, L., Maass, N., Weisser, B. & Eckmann-Scholz, C. (2017). Physical exercise during pregnancy - How active are pregnant women in Germany and how well informed? *Geburtshilfe und Frauenheilkunde*, 77(5):508–515.

Seneviratne, S.N., McCowan, L.M., Cutfield, W.S., Derraik, J.G. & Hofman, P.L. (2015). Exercise in pregnancies complicated by obesity: Achieving benefits and overcoming barriers. *American Journal of Obstetrics and Gynecology*, 212(4):442–449.

Shady, N.W., Sallam, H.F., Ali, S.S. & Abbas, A.M. (2017). The effect of regular daily walking on adverse pregnancy outcomes among overweight primigravidas: a prospective cohort study. *Proceedings in Obstetrics & Gynaecology*, 7(3):2–9.

Shiri, R., Coggon, D. & Falah-Hassani, K. (2018). Exercise for the prevention of low back pain: Systematic review and meta-analysis of controlled trials. *American Journal of Epidemiology*, 187(5):1093–1101.

Silva-Jose, C., Diaz-Blanco, Á., Barakat, R., Coterón, J. & Refoyo, I. (2021). Physical activity during pregnancy is associated with a lower number of perineal tears. *Translational Sports Medicine*, 4:38–45.

Sinikovic, D.S., Yeatman, H.R., Cameron, D. & Meyer, B.J. (2009) Women's awareness of the importance of long-chain omega-3 polyunsaturated fatty acid consumption during pregnancy: knowledge of risks, benefits and information accessibility. *Public health nutrition*, 12(4):562–569.

Sport England (2020). COVID-19 Briefing: Exploring attitudes and behaviours in England during the COVID-19 Pandemic; Sport England: London, UK.

Stefani, L., Mascherini, G. & Galanti, G. (2017). Indications to promote physical activity during pregnancy. *Journal of Functional Morphology and Kinesiology*, 2(3):31.

St-Laurenta, A., Lardon, É., Babineau, V. & Ruchat, S.M. (2019). Reproductive history, maternal anxiety and past physical activity practice predict physical activity levels throughout pregnancy. *Preventive Medicine Reports*, 16:100992.

Straughen, J.K., Sealy-Jefferson, S., Bazydlo, M., Helmkamp, L. & Misra, D.P. (2018). Physical activity and risk of preterm birth in a cohort of African American women. Women's health issues: *Official Publication of the Jacobs Institute of Women's Health*, 28(6):488–494.

Sui, Z. & Dodd, J.M. (2013). Exercise in obese pregnant women: Positive impacts and current perceptions. *International Journal of Women's Health*, 5:389-98.

Sui, Z., Turnbull, D. & Dodd, J. (2013). Overweight and obese women's perceptions about making healthy change during pregnancy: A mixed method study. *Maternal and Child Health Journal*, 17(10):1879–1887.

Sujindra, E., Bupathy, A., Suganya, A. & Praveena. R. (2018). Knowledge, attitude, and practice of exercise during pregnancy among antenatal mothers. *International Journal of Educational Psychological Researches*, 1(3): 234–237.

Swift, J.A., Langley-Evans, S.C., Pearce, J., Jethwa, P.H., Taylor, M.A., Avery, A., Ellis, S., McMullen, S. & Elliott-Sale, K.J. (2017). Antenatal weight management: diet, physical activity, and gestational weight gain in early pregnancy. *Midwifery*, 49:40–46.

Syed, H., Slayman, T. & Thoma, K.D. (2021). ACOG Committee Opinion No. 804: Physical activity and exercise during pregnancy and the postpartum period. *Obstetrics & Gynecology*, 137(2):375-376.

Sytsma, T.T., Zimmerman, K.P., Manning, J.B., Jenkins, S.M., Nelson, N.C., Clark, M.M., Boldt, K. & Borowski, K.S. (2018). Perceived barriers to exercise in the first trimester of pregnancy. *The Journal of Perinatal Education*, 27(4):198–206.

Szegda, K., Bertone-Johnson, E.R., Pekow, P., Powers, S., Markenson, G., Dole, N. & Chasan-Taber, L. (2018). Physical activity and depressive symptoms during pregnancy among Latina women: A prospective cohort study. *BMC Pregnancy and Childbirth*, 18(1):252–263.

Takami, M., Tsuchida, A., Takamori, A., Aoki, S. & Ito, M. (2018). Effects of physical activity during pregnancy on preterm delivery and mode of delivery: The Japan Environment and Children's Study, birth cohort study. *PLoS One*, 13(10):e02066160.

Tan, L., Zou, J., Zhang, Y., Yang, Q. & Shi, H. (2020). A longitudinal study of physical activity to improve sleep quality during pregnancy. *Nature and Science of Sleep*, 12:431–442.

Tariq, S. & Woodman, J. (2013). Using mixed methods in health research. *Journal of the Royal Society of Medicine Short Reports*, 4(6):1–8.

Taylor, B., Cross-Sudworth, F., Goodwin, L., Kenyon, S. & MacArthur, C. (2019). Midwives' perspectives of continuity based working in the UK: A cross-sectional survey. *Midwifery*, 75, 127–137.

The Royal Australian New Zealand College of Obstetricians and Gynaecologists (RANZCOG) (2016). Exercise during pregnancy. Available online: RANZCOGranzcog.edu.au›statements-guidelinesbstetrics›ex. Accessed 17 October, 2020.

Thompson, E.L., Vamos, C.A. & Daley, E.M. (2017). Physical activity during pregnancy and the role of theory in promoting positive behaviour change: A systematic review. *Journal of Sport and Health Science*, 6(2):198–206.

Thorell, E. & Kristiansson, P. (2012). Pregnancy related back pain, is it related to aerobic fitness? A longitudinal cohort study. *BMC Pregnancy Childbirth*, 12:30.

Timmermans, Y., van de Kant, K., Krumeich, J., Zimmermann, L., Dompeling, E., Kramer, B. W., Maassen, L., Spaanderman, M. & Vreugdenhil, A. (2020). Socio-ecological determinants of lifestyle behavior of women with overweight or obesity before, during and after pregnancy: qualitative interview analysis in the Netherlands. *BMC pregnancy and childbirth*, 20(1), 105.

Tinius, R., Duchette, C., Beasley, S., Blankenship, M. & Schoenberg, N. (2021). Obstetric patients and healthcare providers perspectives to inform mobile app design for physical activity and weight control during pregnancy and postpartum in a rural setting. *International Journal of Women's Health*, 13:405.

Tinius, R.A., Cahill, A.G. & Cade, W.T. (2017). Origins in the womb: Potential role of the physical therapist in modulating the deleterious effects of obesity on maternal and offspring health through movement promotion and prescription during pregnancy. *Physical Therapy*, 97(1):114-123.

Todorovic, J., Terzic-Supic, Z., Bjegovic-Mikanovic, V., Piperac, P., Dugalic, S. & Gojnic-Dugalic, M. (2020). Factors associated with the leisure-time physical activity (LTPA) during

the first trimester of the pregnancy: The cross-sectional study among pregnant women in Serbia. *International Journal of Environment Research & Public Health*, 17(4):1366.

Trego, L.L. & Wilson, C. (2021). A Social Ecological Model for Military Women's Health. *Women's Health Issues*, 31(Supplement 1): S11-S21.

U.S. Department of Health and Human Services. (2018). Physical activity guidelines for Americans. U.S. Department of Health and Human Services: Washington, DC, USA.

Van Mulken, M.R.H., McAllister, M. & Lowe, J.B. (2016). The stigmatisation of pregnancy: Societal influences on pregnant women's physical activity behaviour. *Culture, Health & Sexuality*, 18(6):921–935.

Vanstone, M., Kandasamy, S., Giacomini, M., DeJean, D. & McDonald, S.D. (2017). Pregnant women's perceptions of gestational weight gain: A systematic review and meta-synthesis of qualitative research. *Maternal and Child Nutrition*, 13(4):1–18.

Vargas-terrones, M., Barakat, R., Santacruz, B., Fernandez-Buhigas, I. & Mottola, M.F. (2019). Physical exercise programme during pregnancy decreases perinatal depression risk: A randomised controlled trial. *British Journal of Sports Medicine*, 53(6):348–353.

Vézina-Im, L.A., Nicklas, T.A. & Baranowski, T. (2018). Intergenerational effects of health issues among women of childbearing age: A review of the recent literature. *Current Nutrition Reports*, 7(4): 274–285.

Von Kodolistsch, Y., Bernhardt, A.M., Robinson, P.N., Kolbel, T., Reichenspurner, H., Debus, S. & Detter, C. (2015). Analysis of strengths, weaknesses, opportunities, and threats as a tool for translating evidence into individualized medical strategies (I-SWOT). *Aorta*, 3(3):98–107.

Wahedi, M. (2016). Should midwives consider associated psychological factors when caring for women who are obese? *British Journal of Midwifery*, 24(10):724–735.

Walasik, I., Kwiatkowska, K., Kosińska Kaczyńska, K. & Szymusik, I. (2020). Physical activity patterns among 9000 Pregnant Women in Poland: A cross-sectional study. *International Journal of Environmental Research and Public Health*, 17(5):1771.

Walker, R.E., Choi, T.S.T., Quong, S., Hodges, R., Truby, H. & Kumar, A. (2020). "It's not easy" - A qualitative study of lifestyle change during pregnancy. *Women Birth*, 33(4):e363–e370.

Wang, C., Wei, Y. & Zhang, X. (2017). A randomized clinical trial of exercise during pregnancy to prevent gestational diabetes mellitus and improve pregnancy outcome in overweight and obese pregnant women. *American Journal of Obstetrics and Gynecology*, 216(4):340–351.

Watson, E.D., Brage, S., White, T., Westgate, Norris, S.A., Mireille, N.M., Van Poppel, M.N.M. & Micklesfield, L.S. (2018). The influence of objectively measured physical activity during pregnancy on maternal and birth outcomes in urban black South African women. *Maternal and Child Health Journal*, 22(8):1190–1199.

Watson, E.D., Norris, S.A., Draper, C.E., Jones, R.A., van Poppel, M.N.M. & Micklesfield, L.K. (2016). "Just because you're pregnant, doesn't mean you're sick!" A qualitative study of beliefs regarding physical activity in black South African women. *BMC Pregnancy and Childbirth*, 16:174.

Watson, E.D., Oddie, B. & Constantinou, D. (2015). Exercise during pregnancy: Knowledge and beliefs of medical practitioners in South Africa: A survey study. *BMC Pregnancy and Childbirth*, 15:245.

Watson, E.D., Van Poppel, M.N.M., Jones, R.A., Norris, S.A. & Micklesfield, L.K. (2017). Are South African mothers moving? Patterns and correlates of physical activity and sedentary behaviour in pregnant black South African women. *Journal of Physical Activity & Health*, 14(5):329–335.

Weir, Z., Bush, J., Robson, S.C., McParlin, C., Rankin, J. & Bell, R. (2010). Physical activity in pregnancy: A qualitative study of the beliefs of overweight and obese pregnant women. *BMC Pregnancy Childbirth*, 10:18.

Whitaker, K.M., Wilcox, S., Liu, J., Blair, S.N. & Pate, R.R. (2016). Pregnant women's perceptions of weight gain, physical activity, and nutrition using Theory of planned behaviour constructs. *Journal of Behavioural Medicine*, 39(1):41–54.

White, R.L., Babic, M.J., Parker, P.D., Lubans, D.R., Astell-Burt, T. & Lonsdale, C. (2017). Domain-specific physical activity and mental health: A meta-analysis. *American Journal of Preventative Medicine*, 25(5): 653–666.

Willcox, J.C., Campbell, K.J., McCarthy, E.A., Lappas, M., Ball, K., Crawford, D., Shub, A., & Wilkinson, S.A. (2015). Gestational weight gain information: seeking and sources among pregnant women. *BMC Pregnancy and Childbirth*, *15*, 164.

Wojtyła, C., Ciebiera, M., Wojtyła-Buciora, P., Janaszczyk, A., Brzęcka, P. & Wojtyła, A. (2020). Physical activity patterns in third trimester of pregnancy - Use of pregnancy physical activity questionnaire in Poland. *Annals of Agricultural and Environmental Medicine*, 27(3):388–393.

World Health Organization (2018). Global action plan on physical activity 2018–2030: more active people for a healthier world. Geneva: Licence: CC BY-NC-SA 3.0 IGO.

World Health Organization (2018). Non-communicable Diseases (NCD) Country Profiles, 2018. Available at: https://www.who.int/nmh/countries/2018/zaf_en.pdf?ua=1. (Accessed May, 2021).

World Health Organization (2018). Physical Activity and Adults: Recommended levels of physical activity for adults aged 18–64 years. World Health Organization: Geneva, Switzerland.

World Health Organization (2019). Available online: www.who.int. (Accessed December, 2019).

World Health Organization (2021). Maternal and child mental health. Available from, https://www.who.int/mental_health/maternal-child/maternal_mental_health/en/. Assessed 03 May, 2021.

World Health Organization. Physical Activity (2017). Available at: http://www.who.int/topics/physical_activity/en/. (Accessed July, 2020).

Xiang, M., Zhang, J., Liang, H., Zhang, Z., Konishi, M., Hu, H., Nishimaki, M., Kim, H. K., Tabata, H., Shimizu, H., Arao, T. & Sakamoto, S. (2019). Physical activity and dietary intake among Chinese pregnant women: an observational study. *BMC Pregnancy & Childbirth*, 19:295.

Yan, W., Wang, X., Kuang, H., Chen, Y., Baktash, M.B., Eskenazi, B., Ye, L., Fang, K. & Xia, Y. (2020). Physical activity and blood pressure during pregnancy: Mediation by anxiety symptoms. *Journal of Affective Disorders*, 264:376–382.

Yin, Y., Huang, Y., Liu, X. & Luo, B. (2019). Assessment of physical activity status among pregnant women in southwestern China. *Frontiers of Nursing*, 6(2):135–141.

Yu. Y., Xie. R., Shen. C. & Shu. L. (2018) Effect of exercise during pregnancy to prevent gestational diabetes mellitus: A systematic review and meta-analysis. *The Journal of Maternal-Fetal & Neonatal Medicine*, 31(12):1632–1637,

Zamani, A. R., Motamedi, N. & Farajzadegan, Z. (2015). Routine programs of health care systems as an opportunity toward communication skills training for family physicians: A randomized field trial. *Journal of Education and Health Promotion*, 4, 71.

Zhang, Y., Dong, S., Zuo, J., Hu, X., Zhang, H. & Zhao, Y. (2014). Physical activity level of urban pregnant women in Tianjin, China: A cross-sectional study. *PLoS One*, 9(10):e109624.

Zinsser, L.A., Stoll, K., Wieber, F., Pehlke-Milde, J. & Gross, M.M. (2020). Changing behaviour in pregnant women: A scoping review. *Midwifery*, 85:102680.

Appendix A: University of Fort Hare's Human Research Ethics Committee (UFH HREC)

FACULTY OF HEALTH SCIENCES
Research Ethics Committee

P.O Box 1054
East London 5200
Tel: +27 (0) 43 704 7594
eseekoe@ufh.ac.za

University of Fort Hare
Together in Excellence

ETHICAL CLEARANCE CERTIFICATE
REC-100118-054

Certificate Reference Number:	**Ref # 2019=06=009=OkaforUB**
Project title:	**Developing of physical activity intervention strategy for pregnant women in Buffalo City Municipality, South Africa**
Nature of Project	Doctor of Philosophy in Nursing Science
Principal Researcher:	Okafor UB
Student Number:	201006014
Supervisor:	Prof DT Goon

On behalf of the Faculty of Health Sciences Research Ethics Committee (FHREC), I hereby give ethical approval in respect of the undertakings contained in the above-mentioned project and research instruments(s). Should any other instruments be used, these require separate authorization. The Researcher may therefore commence with the research as from the date of this certificate, using the reference number indicated above.

Please note that the FHREC must be informed immediately of

- Any material change in the conditions or undertakings mentioned in the document
- Any material breaches of ethical undertakings or events that impact upon the ethical conduct of the research

The Principal Researcher must report to the FHREC in the prescribed format, where applicable, annually, and at the end of the project, in respect of ethical compliance.

FACULTY OF HEALTH SCIENCES
Research Ethics Committee

P.O Box 1054
East London 5200
Tel: +27 (0) 43 704 7594
eseekoe@ufh.ac.za

University of Fort Hare
Together in Excellence

Special conditions: Research that includes children as per the official regulations of the act must take the following into account:

Note: The FHREC is aware of the provisions of s71 of the National Health Act of 2003 and that matters pertaining to obtaining the Minister's consent are under discussion and remain unresolved. Nonetheless, as was decided at a meeting between the National Health Research Ethics Committee and stakeholders on 6 June 2003, university ethics committees may continue to grant ethical clearance for research involving children without the Minister's consent, provided that the prescripts of the previous rules have been met. This certificate is granted in terms of this agreement.

The FHREC retains the right to

- Withdraw or amend this Ethical Clearance Certificate if
  - Any unethical principles or practices are revealed or suspected
  - relevant information has been withheld or misrepresented
  - regulatory changes of whatsoever nature so require
  - the conditions contained in the Certificate have not been adhered to

- Request access to any information or data at any time during the course or after completion of the project.
- In addition to the need to comply with the highest level of ethical conduct principal investigators must report back annually as an evaluation and monitoring mechanism on the progress being made by the research. Such a report must be sent to FHREC monitoring@ufh.ac.za.

The Ethics Committee wishes you well in your research endeavours.

Yours sincerely

Professor Eunice Seekoe
Dean of Faculty of Health Sciences
10 June 2019

Appendix B: Permission from the Eastern Cape Department of Health

Province of the
EASTERN CAPE
HEALTH

Enquiries: Zonwabele Merile Tel no: 083 378 1202

Email: zonwabele.merile@echealth.gov.za

Date: 18 June 2019

RE: Developing physical activity intervention strategy for pregnant women in Buffalo City Municipality, South Africa. (EC_201906_008)

Dear Mrs Uchenna Benedine Okafor

The department would like to inform you that your application for the abovementioned research topic has been approved based on the following conditions:

1. During your study, you will follow the submitted protocol with ethical approval and can only deviate from it after having a written approval from the Department of Health in writing.

2. You are advised to ensure, observe and respect the rights and culture of your research participants and maintain confidentiality of their identities and shall remove or not collect any information which can be used to link the participants.

3. The Department of Health expects you to provide a progress update on your study every 3 months (from date you received this letter) in writing.

4. At the end of your study, you will be expected to send a full written report with your findings and implementable recommendations to the Eastern Cape Health Research Committee secretariat. You may also be invited to the department to come and present your research findings with your implementable recommendations.

5. Your results on the Eastern Cape will not be presented anywhere unless you have shared them with the Department of Health as indicated above.

Your compliance in this regard will be highly appreciated.

SECRETARIAT: EASTERN CAPE HEALTH RESEARCH COMMITTEE

Appendix C: Informed Consent for (Pregnant Women)

ANNEXURE A: Informed Consent Form (Pregnant women)

Department of Nursing Science
Faculty of Health Sciences

University of Fort Hare
Together in Excellence

INFORMATION LEAFLET AND INFORMED CONSENT

PROJECT TITLE: DEVELOPMENT OF PHYSICAL ACTIVITY INTERVENTION STRATEGY FOR PREGNANT WOMEN IN BUFFALO CITY MUNICIPALITY, EASTERN CAPE, SOUTH AFRICA

Primary investigator: UB Okafor, M Cur (University of Fort Hare)

Study Leader: Prof DT Goon, PhD, Department of Health Science, Faculty of Health Sciences, University of Fort Hare, East London.

Dear Research participant,

You are invited to participate in a research study that forms part of my formal PhD-studies. This information leaflet will help you to decide if you would like to participate. Before you agree to take participate, you should fully understand what is involved. You should not agree to take part unless you are completely satisfied with all aspects of the study.

WHAT IS THE STUDY ALL ABOUT?

Physical inactivity is the fourth leading risk factor for non-communicable diseases (NCDs), and a global burden. The benefits of physical activity participation during pregnancy includes reduced risk of excessive gestational weight gain, and conditions such as gestational diabetes; preeclampsia, lower rates of preterm birth; improved sleep; varicose veins, and deep vein thrombosis; reduced length of labour and delivery complications; reduced birth weight reduced fatigue, stress, anxiety, and depression; reduced low back pain, improved well-being; increased heart rate, cardiac output, ventilation, and energy expenditure; and reduced the risk of injury for both the mother and baby.

Notwithstanding the evidence on the benefits of PA during pregnancy, there is a considerable decline in physical activities among pregnant women in developed and developing countries. Understanding the factors impeding on PA during pregnancy is crucial as one of the component of the provision of quality antenatal and obstetric healthcare services to this special populace. However, this requires an empirical understanding of the context-specific factors affecting PA participation during pregnancy. This kind of information is lacking in the Eastern Cape Province.

Despite the global awareness on the importance and health benefits of PA during pregnancy, several studies have reported low prevalence of PA participation among pregnant women in both developed and developing countries. This entails pregnant women do not meet the current PA recommended guideline of 150 min of moderate intensity physical activity per week, or the metabolic equivalent (METs) of 600 MET minutes per week (MET mins/wk). Conversely, only few pregnant women meet the recommended PA guidelines during pregnancy. Some pregnant women and obstetric care providers are uncertain on whether prenatal PA may increase the risk of miscarriage, growth restriction, preterm birth, fatigue or harm to the foetus constitute barriers to being active.

South Africa is a vast country, with large regional or provisional differences, social inequalities, and socio-economic and demographic changes. Notwithstanding the increased in life expectancy, there is escalating trends in chronic diseases and obesity, including among reproductive-age women, which constitute majority of the population of women. The global call to prioritise physical activity participation levels in the general population, entails it is necessary to study the actual status of physical activity in different groups and the factors related to its practice. Research interest for pregnant women is important because pregnancy is a moment in a woman's life, which can have effects on her health in the future. However, pregnant women are often encouraged to reduce their levels of PA and even to stop working because of the belief that PA may reduce placental circulation and, consequently, increase the risk of disorders such as miscarriages, preterm deliveries, and intrauterine growth retardation,

Pregnant women mostly from low-to-middle income country like South Africa are mostly predisposed to adverse pregnancy outcomes probably because of limited access and knowledge on pregnancy and health outcomes during PA participation. They might also be ignorant of the PA recommendations by American College of Obstetrics and Gynaecology. The possible adverse pregnancy health outcomes associated with being physically inactive among pregnant women could have long-standing effects on the healthcare system. Despite empirical information and evidence that indicate that PA is beneficial to pregnant women in the prevention and management of pregnancy induced illnesses and chronic illnesses, scanty data exists on PA participation among pregnant women in South Africa, and by extension in the Eastern Cape. Interestingly, there is a clarion call by the WHO for surveillance and monitoring of disease risk factors, and, PA is inclusive. The South Africa women's pattern of energy expenditure showed that PA are mostly derived from occupation, and commuting by taxi with no PA participation. Understanding the level and dynamics of PA participation among this special population is fundamental in designing intervention strategies to enhance their understanding and participation in PA and exercise.

Despite the clear guidelines and recommendations set by various bodies and institutions, PA participation remains a challenge, not only to the general population in South Africa, but specifically, to the a special population group of pregnant women. Anecdotally, evidence indicates pregnant women in Buffalo City Metropolitan Municipality seldom participate in physical activity or exercise. Perhaps, ignorance, false or unscientific beliefs about physical

activity and pregnancy, lack of awareness concerning PA guidelines during pregnancy, as well as lack of support and encouragement from the health professionals could be the likely reasons. Whilst there are studies to guide interventions and promotion of physical activity among pregnant women in other countries, scanty information exist generally in Africa, and particularly in the South African context. Such information will potentially add to the body of knowledge in this area of maternal health, and further guide PA interventions tailored to pregnant women in South Africa.

This present study is design to assess the level of PA participation during pregnancy, examine the beliefs, sources of information, perceived benefits, barriers, attitudes of pregnant women concerning physical activity and exercise participation in Buffalo City Metropolitan Municipality, Eastern Cape Province. Secondly, the study seeks to examine the knowledge, attitude and practices of health professionals towards physical activity and pregnancy in the setting. Based on the information derived from the findings, a physical activity intervention strategy will be develop to encourage, promote physical activity, and exercise during pregnancy in the context of the Eastern Cape Province.

WHAT WILL YOU BE REQUIRED TO DO IN THE STUDY?

If you decide to take part in the study, you will be required to do the following:

- sign this informed consent form;
- Demographic information: You are will be requested to provide information about obstetric, and maternal health-related status, age, educational level, marital status, household income, race, perceived health condition, and chronic illness.
- complete a Pregnancy Physical Activity Questionnaire (PPAQ): You will be asked to respond to questions based on activities you engage in the last three months, or second and third trimester of your pregnancy. The PPAQ requires you to provide respond to 32 activities including household/care giving (13 activities), occupational (5 activities), sports/exercise (8 activities), transportation (3 activities), and inactivity (3 activities) which you do. At the concluding end of the PPAQ, an open-ended section allows you to add activities not already listed regarding your general physical activities in a day.
- You will provide information on your sedentary behaviour (SB), during pregnancy-how many hours spent on sitting down in total per day (e.g. sitting at work, reading, and watching television).
- You will provide information your beliefs, sources of information, perceived benefits, and barriers towards physical activity and exercise during pregnancy.

ARE THERE ANY CONDITIONS THAT MAY EXCLUDE YOU FROM THE STUDY?

You will not be eligible to participate in this study if you are residing outside Buffalo City Metropolitan Municipality, ii) have pre-existing conditions that would prevent or limit the

performance of PA at the time of recruitment (one or more contraindications for PA according to ACOG, gestational diabetes, hypertension, more than one previous abortion), or, iii) have failed to sign the informed consent.

WHAT ARE THE RISKS INVOLVED IN THIS STUDY? OR CAN ANY OF THE STUDY PROCEDURES RESULT IN PERSONAL DISCOMFORT OR INCONVENIENCE?

Questionnaires: The study and procedures involve no foreseeable physical discomfort or inconvenience to you or your family. Due to the personal nature of the questions, you may experience some emotional discomfort.

WHAT ARE THE POTENTIAL BENEFITS THAT MAY COME FROM THE STUDY?

The benefits of participating in this study are:

- This study is designed to develop physical activity intervention strategy for pregnant women in Buffalo City Municipality, Eastern Cape province, South Africa. In order to inform public health policy concerning the preventative measures for the associated risk factors among the pregnant women.
- You will make a contribution towards broadening of academic knowledge and understanding the importance of physical activity participation during pregnancy.
- The findings of this study will enable the policy makers to understand the problems associated with PA and exercise participation during pregnancy among pregnant women in the Eastern Cape, and understanding is relevant to guide interventions to promote and encourage physical activity during pregnancy as part of maternal healthcare intervention.
- The data may prove useful in epidemiological studies that correlate pregnancy and physical activity among pregnant women in Buffalo City Municipality, Eastern Cape Province, South Africa.

WILL YOU RECEIVE ANY FINANCIAL COMPENSATION OR INCENTIVE FOR PARTICIPATING IN THE STUDY?

Please note that you **will not** be paid to participate in the study.

WHAT ARE YOUR RIGHTS AS A PARTICIPANT IN THIS STUDY?

Your participation in this study is voluntary. You have the right to withdraw at any stage without any penalty or future disadvantage whatsoever. You don't even have to provide the reason/s for your decision. You may also be asked to withdraw from the study if you do not adhere to the study protocol.

HOW WILL CONFIDENTIALITY AND ANONYMITY BE ENSURED IN THE STUDY?

Confidentiality of data will be maintained–in other words your identity will only be known to the researcher. I will remove/mask all identifying data on transcriptions and final report documents (e.g. thesis and journal articles). Thus, your identity will not be revealed during or after the study, even when the study is published or used in any format.

IS THE RESEARCHER QUALIFIED TO CARRY OUT THE STUDY?

The researcher is a qualified Professional Nurse who has previously completed similar research studies. Also, she has received special training in Midwifery and Neonatal nursing from the University of Fort Hare in South Africa.

HAS THE STUDY RECEIVED ETHICAL APPROVAL?

Yes. The proposed study has been approved by the Faculty of Health Sciences' Higher Degrees Committee (HDC) and the Faculty of Health Sciences Research Ethics Committee (FHREC) of University of Fort Hare. All parts of the study will be conducted according to internationally accepted ethical principles.

WHO CAN YOU CONTACT FOR ADDITIONAL INFORMATION REGARDING THE STUDY?

Should you have concerns or queries regarding this study the following people may be contacted during office hours. The primary investigator can be contacted during office hours on her cellular phone: Uchenna Okafor on 071 0836536. The study promoter: Prof DT Goon who can be contacted during office hours on (0) 43 704 7368. Should you have any questions regarding the ethical aspects of the study, you can contact the Chairperson of the Faculty of Health Sciences' Research Ethics Committee, Prof DT Goon, during office hours on (0) 43 704 7368. If you are happy to participate in the study as explained in this information letter, please could you complete and sign the separate informed consent form and return it to the researcher.

DECLARATION: CONFLICT OF INTEREST

There is no any conflict of interest that may influence the study procedures, data collection, data analysis and publication of results.

A FINAL WORD

Your co-operation and participation in the study will be greatly appreciated. Please sign the underneath informed consent if you agree to partake in the study. In such a case, you will receive a copy of the signed informed consent from the researcher.

INFORMED CONSENT

I hereby confirm that I have been adequately informed by the researcher about the nature, conduct, benefits and risks of the study. I have also received, read and understood the above written information. I am aware that the results of the study, including personal details regarding my age, health status, educational level, will be anonymously processed into a research report. I understand that my participation is voluntary and that I may, at any stage, without prejudice, withdraw my consent and participation in the study. I had sufficient opportunity to ask questions and of my own free will declare myself prepared to participate in the study.

Research participant's name: _____ (Please print)

Date: _____

Researcher's name: _____ (Please print)

Researcher's signature: _____

Date: _____

VERBAL INFORMED CONSENT

(Applicable when participants cannot read or write)

I hereby declare that I have read and explained the contents of the information sheet to the research participant. The nature and purpose of the study were explained, as well as the possible risks and benefits of the study. The research participant has clearly indicated that he/she will be free to withdraw from the study at any time for any reason and without jeopardizing his/her relationship with the research team.

I hereby certify that the research participant has verbally agreed to participate in this study.

Research participant's name: _____ (Please print)

Researcher's name: _____(Please print)

Researcher's signature: _____

Date: _____

Appendix D: Informed Consent (Midwives)

ANNEXURE A: Informed Consent Form (Healthcare Providers)

University of Fort Hare
Together in Excellence

Department of Nursing Science
Faculty of Health Sciences

INFORMATION LEAFLET AND INFORMED CONSENT

PROJECT TITLE: DEVELOPMENT OF PHYSICAL ACTIVITY INTERVENTION STRATEGY FOR PREGNANT WOMEN IN BUFFALO CITY MUNICIPALITY, EASTERN CAPE, SOUTH AFRICA

Primary investigator: UB Okafor, M Cur, Nursing Science Department, University of Fort Hare, East London Campus, South Africa.

Study Leader: Prof DT Goon, PhD, Department of Health Science, Faculty of Health Sciences, University of Fort Hare, East London, South Africa.

Dear Research participant,

You are invited to participate in a research study that forms part of my formal PhD-studies. This information leaflet will help you to decide if you would like to participate. Before you agree to take participate, you should fully understand what is involved. You should not agree to take part unless you are completely satisfied with all aspects of the study.

WHAT IS THE STUDY ALL ABOUT?

Physical inactivity is the fourth leading risk factor for non-communicable diseases (NCDs), and a global burden. The benefits of physical activity participation during pregnancy includes reduced risk of excessive gestational weight gain, and conditions such as gestational diabetes; preeclampsia, lower rates of preterm birth; improved sleep; varicose veins, and deep vein thrombosis; reduced length of labour and delivery complications; reduced birth weight reduced fatigue, stress, anxiety, and depression; reduced low back pain, improved well-being; increased heart rate, cardiac output, ventilation, and energy expenditure; and reduced the risk of injury for both the mother and baby.

Notwithstanding the evidence on the benefits of PA during pregnancy, there is a considerable decline in physical activities among pregnant women in developed and developing countries. Understanding the factors impeding on PA during pregnancy is crucial as one of the component of the provision of quality antenatal and obstetric healthcare services to this special populace. However, this requires an empirical understanding of the context-specific factors affecting PA participation during pregnancy. This kind of information is lacking in the Eastern Cape Province.

Despite the global awareness on the importance and health benefits of PA during pregnancy, several studies have reported low prevalence of PA participation among pregnant women in both developed and developing countries. This entails pregnant women do not meet the current PA recommended guideline of 150 min of moderate intensity physical activity per week, or the metabolic equivalent (METs) of 600 MET minutes per week (MET mins/wk). Conversely, only few pregnant women meet the recommended PA guidelines during pregnancy. Some pregnant women and obstetric care providers are uncertain on whether prenatal PA may increase the risk of miscarriage, growth restriction, preterm birth, fatigue or harm to the foetus constitute barriers to being active.

South Africa is a vast country, with large regional or provisional differences, social inequalities, and socio-economic and demographic changes. Notwithstanding the increased in life expectancy, there is escalating trends in chronic diseases and obesity, including among reproductive-age women, which constitute majority of the population of women. The global call to prioritise physical activity participation levels in the general population, entails it is necessary to study the actual status of physical activity in different groups and the factors related to its practice. Research interest for pregnant women is important because pregnancy is a moment in a woman's life, which can have effects on her health in the future. However, pregnant women are often encouraged to reduce their levels of PA and even to stop working because of the belief that PA may reduce placental circulation and, consequently, increase the risk of disorders such as miscarriages, preterm deliveries, and intrauterine growth retardation.

Pregnant women mostly from low-to-middle income country like South Africa are mostly predisposed to adverse pregnancy outcomes probably because of limited access and knowledge on pregnancy and health outcomes during PA participation. They might also be ignorant of the PA recommendations by American College of Obstetrics and Gynaecology. The possible adverse pregnancy health outcomes associated with being physically inactive among pregnant women could have long-standing effects on the healthcare system. Despite empirical information and evidence that indicate that PA is beneficial to pregnant women in the prevention and management of pregnancy induced illnesses and chronic illnesses, scanty data exists on PA participation among pregnant women in South Africa, and by extension in the Eastern Cape. Interestingly, there is a clarion call by the WHO for surveillance and monitoring of disease risk factors, and, PA is inclusive. The South Africa women's pattern of energy expenditure showed that PA are mostly derived from occupation, and commuting by taxi with no PA participation. Understanding the level and dynamics of PA participation among this special population is fundamental in designing intervention strategies to enhance their understanding and participation in PA and exercise.

Despite the clear guidelines and recommendations set by various bodies and institutions, PA participation remains a challenge, not only to the general population in South Africa, but specifically, to the a special population group of pregnant women. Anecdotally, evidence indicates pregnant women in Buffalo City Metropolitan Municipality seldom participate in physical activity or exercise. Perhaps, ignorance, false or unscientific beliefs about physical activity and pregnancy, lack of awareness concerning PA guidelines during pregnancy, as well

as lack of support and encouragement from the health professionals could be the likely reasons. Whilst there are studies to guide interventions and promotion of physical activity among pregnant women in other countries, scanty information exist generally in Africa, and particularly in the South African context. Such information will potentially add to the body of knowledge in this area of maternal health, and further guide PA interventions tailored to pregnant women in South Africa.

This present study is design to examine the knowledge, attitude and practices of health professionals towards physical activity and pregnancy in Buffalo City Metropolitan Municipality. Based on the information derived from the findings, a physical activity intervention strategy will be develop to encourage, promote physical activity, and exercise during pregnancy in the context of the Eastern Cape Province.

WHAT WILL YOU BE REQUIRED TO DO IN THE STUDY?

If you decide to take part in the study, you will be required to do the following:

- sign this informed consent form;
- Provide information on your age, gender, residence of practice, years of practice, speciality, ethnicity, and highest qualification;
- You will be asked to respond to questions based on your beliefs, knowledge and practices towards physical activity and exercise during pregnancy.

ARE THERE ANY CONDITIONS THAT MAY EXCLUDE YOU FROM THE STUDY?

You will not be eligible to participate in this study if you are working as a healthcare provider outside Buffalo City Metropolitan Municipality, and ii) have failed to sign the informed consent.

WHAT ARE THE RISKS INVOLVED IN THIS STUDY? OR CAN ANY OF THE STUDY PROCEDURES RESULT IN PERSONAL DISCOMFORT OR INCONVENIENCE?

The study and procedures involve no foreseeable physical discomfort or inconvenience to you or your family. Due to the personal nature of the questions, you may experience some emotional discomfort.

WHAT ARE THE POTENTIAL BENEFITS THAT MAY COME FROM THE STUDY?

The benefits of participating in this study are:

- This study is designed to develop physical activity intervention strategy for pregnant women in Buffalo City Municipality, Eastern Cape province, South Africa. In order to inform public health policy concerning the preventative measures for the associated risk factors among the pregnant women.

- You will make a contribution towards broadening of academic knowledge and understanding the importance of physical activity participation during pregnancy.
- The findings of this study will enable the policy makers to understand the problems associated with PA and exercise participation during pregnancy among pregnant women in the Eastern Cape, and understanding is relevant to guide interventions to promote and encourage physical activity during pregnancy as part of maternal healthcare intervention.
- The data may prove useful in epidemiological studies that correlate pregnancy and physical activity among pregnant women in Buffalo City Municipality, Eastern Cape Province, South Africa.

WILL YOU RECEIVE ANY FINANCIAL COMPENSATION OR INCENTIVE FOR PARTICIPATING IN THE STUDY?

Please note that you **will not** be paid to participate in the study.

WHAT ARE YOUR RIGHTS AS A PARTICIPANT IN THIS STUDY?

Your participation in this study is voluntary. You have the right to withdraw at any stage without any penalty or future disadvantage whatsoever. You don't even have to provide the reason/s for your decision. You may also be asked to withdraw from the study if you do not adhere to the study protocol.

HOW WILL CONFIDENTIALITY AND ANONYMITY BE ENSURED IN THE STUDY?

Confidentiality of data will be maintained–in other words your identity will only be known to the researcher. I will remove/mask all identifying data on transcriptions and final report documents (e.g. thesis and journal articles). Thus, your identity will not be revealed during or after the study, even when the study is published or used in any format.

IS THE RESEARCHER QUALIFIED TO CARRY OUT THE STUDY?

The researcher is a qualified Professional Nurse who has previously completed similar research studies. Also, he has received special training in Midwifery and Neonatal nursing from the University of Fort Hare in South Africa.

HAS THE STUDY RECEIVED ETHICAL APPROVAL?

Yes. The proposed study has been approved by the Faculty of Health Sciences' Higher Degrees Committee (HDC) and the Faculty of Health Sciences Research Ethics Committee (FHREC) of University of Fort Hare. All parts of the study will be conducted according to internationally accepted ethical principles.

WHO CAN YOU CONTACT FOR ADDITIONAL INFORMATION REGARDING THE STUDY?

Should you have concerns or queries regarding this study the following people may be contacted during office hours. The primary investigator can be contacted during office hours on her cellular phone: Uchenna Okafor on 071 0836536. The study promoter: Prof DT Goon who can be contacted during office hours on (0) 43 704 7368. Should you have any questions

regarding the ethical aspects of the study, you can contact the Chairperson of the Faculty of Health Sciences' Research Ethics Committee, Prof DT Goon, during office hours on (0) 43 704 7368. If you are happy to participate in the study as explained in this information letter, please could you complete and sign the separate informed consent form and return it to the researcher.

DECLARATION: CONFLICT OF INTEREST

There is no any conflict of interest that may influence the study procedures, data collection, data analysis and publication of results.

A FINAL WORD

Your co-operation and participation in the study will be greatly appreciated. Please sign the underneath informed consent if you agree to partake in the study. In such a case, you will receive a copy of the signed informed consent from the researcher.

INFORMED CONSENT

I hereby confirm that I have been adequately informed by the researcher about the nature, conduct, benefits and risks of the study. I have also received, read and understood the above written information. I am aware that the results of the study, including personal details regarding my age, health status, educational level, will be anonymously processed into a research report. I understand that my participation is voluntary and that I may, at any stage, without prejudice, withdraw my consent and participation in the study. I had sufficient opportunity to ask questions and of my own free will declare myself prepared to participate in the study.

Research participant's name: _____ (Please print)

Date: _____

Researcher's name: _____ (Please print)

Researcher's signature: _____

Date: _____

Appendix E: Informed Consent (Experts)

Informed Consent Form: Experts

Department of Nursing Science
Faculty of Health Sciences

University of Fort H
Together in Excellen

INFORMATION LEAFLET AND INFORMED CONSENT

PROJECT TITLE: THE DEVELOPMENT AND VALIDATION OF PHYSICAL ACTIVITY INTERVENTION STRATEGY DURING PREGNANCY FOR ANTENATAL MOTHERS IN BUFFALO CITY METROPOLITAN MUNICIPALITY, SOUTH AFRICA

Primary investigator: UB Okafor, M Cur, Department of Nursing Science, Faculty of Health Sciences, University of Fort Hare, East London.

Study Leader: Prof DT Goon, PhD, Department of Health Science, Faculty of Health Sciences, University of Fort Hare, East London.

Dear Reviewer,

Based on your expertise and knowledge concerning maternal health, you are hereby invited to participate in the validation of physical activity intervention strategy during pregnancy to help promote prenatal physical activity participation among women in Buffalo City Municipality, Eastern Cape Province. This is the third phase of my PhD study titled '**Developing a physical activity intervention strategy for pregnant women in Buffalo City Municipality, South Africa'**. This information leaflet will help you to decide if you would like to participate.

WHAT IS THE STUDY ALL ABOUT?

The physical, psychological and social advantages of participation in physical activity during pregnancy are widely reported in the literature. Despite the many accruable scientific evidence justifying the prenatal physical activity, yet women seldom participate in physical activity during pregnancy. In the South African context, few previous studies conducted to analyse this phenomenon involved relatively small and heterogeneous population in only two provinces and/or urban geographical settings. Therefore, an evaluation of the level, patterns, and associated factors of prenatal physical activity; beliefs, knowledge, attitudes, perceived benefits, and sources of information women received during pregnancy in the context of the Eastern Cape is warranted. Based on the information derived from the findings (Phase 1) (See

Table 1 attached), a physical activity intervention strategy was developed (Phase II) to encourage, promote physical activity, and exercise during pregnancy in the context of the Eastern Cape Province. The final phase of this study is to validate the developed physical activity strategy (Phase III). Whilst there are studies to guide interventions and promotion of physical activity among pregnant women in other countries, scanty information exists generally in Africa, and particularly in the South African context. Such information will potentially add to the body of knowledge in this area of maternal health, and further guide physical activity interventions tailored to pregnant women in South Africa.

WHAT WILL YOU BE REQUIRED TO DO IN THE STUDY?

If you decide to take part in this validation study (developed physical activity intervention strategy), you will be required to do the following:

- sign this informed consent form; and
- provide your expert opinion/comments/suggestions on the developed physical activity intervention strategy to promote prenatal physical activity practice for women in the context of Buffalo City Municipality, Eastern Cape Province.

WHAT ARE THE RISKS INVOLVED IN THIS STUDY? OR CAN ANY OF THE STUDY PROCEDURES RESULT IN PERSONAL DISCOMFORT OR INCONVENIENCE?

Participants will provide comments/suggestions on the validated intervention strategy.

WHAT ARE THE POTENTIAL BENEFITS OF THE STUDY?

The validated physical activity strategy in the context of Eastern Cape will enable policy direction in the promotion and uptake of prenatal physical activity and exercise to improve and maintain maternal health outcomes.

WILL YOU RECEIVE ANY FINANCIAL COMPENSATION OR INCENTIVE FOR PARTICIPATING IN THE STUDY?

Please note that you **will not** be paid to participate in the study.

WHAT ARE YOUR RIGHTS AS A PARTICIPANT IN THIS STUDY?

Your participation in this study is voluntary. You have the right to withdraw at any stage without any penalty or future disadvantage whatsoever. You don't even have to provide the reason/s for your decision.

HOW WILL CONFIDENTIALITY AND ANONYMITY BE ENSURED IN THE STUDY?

Confidentiality of data will be maintained–in other words your identity will only be known to

the researcher. I will remove/mask all identifying data on transcriptions and final report documents (e.g. thesis and journal articles). Thus, your identity will not be revealed during or after the study, even when the study is published or used in any format.

IS THE RESEARCHER QUALIFIED TO CARRY OUT THE STUDY?

The researcher is a qualified Professional Nurse who has previously completed similar research studies. Also, he has received special training in Midwifery and Neonatal nursing from the University of Fort Hare in South Africa.

HAS THE STUDY RECEIVED ETHICAL APPROVAL?

Yes. The proposed study was approved by the University of Fort Hare Health Research Ethics Committee and the Eastern Cape Department of Health before data collection. This latter part of the study will be conducted according to internationally accepted ethical principles.

WHO CAN YOU CONTACT FOR ADDITIONAL INFORMATION REGARDING THE STUDY?

Should you have concerns or queries regarding this study the following people may be contacted during office hours. The primary investigator can be contacted during office hours on her cellular phone: Uchenna Okafor on 071 0836536. The study promoter: Prof DT Goon who can be contacted during office hours on (0) 43 704 7368 or 0798572280. Should you have any questions regarding the ethical aspects of the study, you can contact the Chairperson of the University of Fort Hare Human Research Ethics Committee, Prof DT Goon, during office hours on (0) 43 704 7368 or 0798572280. If you are happy to participate in the study as explained in this information letter, please could you complete and sign the separate informed consent form and return it to the researcher.

DECLARATION: CONFLICT OF INTEREST

There is no any conflict of interest that may influence the study procedures, data collection, data analysis and publication of results in academic journals.

A FINAL WORD

Your co-operation and participation in the study will be greatly appreciated. Please sign the underneath informed consent if you agree to partake in the study. In such a case, you will receive a copy of the signed informed consent from the researcher.

INFORMED CONSENT

I hereby confirm that I have been adequately informed by the researcher about the nature, conduct, benefits and risks of the study. I have also received, read and understood the above written information. I am aware that the results of the study, including personal details will be anonymously processed into a research report. I understand that my participation is voluntary and that I may, at any stage, without prejudice, withdraw my consent and participation in the study. I had sufficient opportunity to ask questions and of my own free will declare myself prepared to participate in the study.

Research reviewer's name: _____ (Please print)

Reviewer's signature: _____

Date: _____

Researcher's name: _____ (Please print)

Researcher's signature: _____

Date: _____

Annexure F: Pregnancy Physical Activity Questionnaire

9364

Office Use Only - ID# ☐☐☐☐

UMASS

Pregnancy Physical Activity Questionnaire

Instructions:
Please use an ordinary No. 2 pencil. *Fill in the circles completely. The Question will be read by a machine so if you need to change your answer, erase the incorrect mark* ***completely****. If you have comments, please write them on the back of the questionnaire.*

Example: During this trimester, when you are NOT at work, how much time do you usually spend:

E1. **Taking care of an older adult**

If you take care of your mom for 2 hours each day, then your answer should look like this... →

- ○ None
- ○ Less than 1/2 hour per day
- ○ 1/2 to almost 1 hour per day
- ○ 1 to almost 2 hours per day
- ● 2 to almost 3 hours per day
- ○ 3 or more hours per day

It is very important you tell us about yourself honestly. There are no right or wrong answers. We just want to know about the things you are doing during this trimester.

1. Today's Date: ☐☐ / ☐☐ / ☐☐☐☐ (Month / Day / Year)
2. What was the first day of your last period? ☐☐ / ☐☐ / ☐☐☐☐ (Month / Day / Year) ○ I don't know
3. When is your baby due? ☐☐ / ☐☐ / ☐☐☐☐ (Month / Day / Year) ○ I don't know

---

During this trimester, when you are NOT at work, how much time do you usually spend:

4. **Preparing meals (cook, set table, wash dishes)**
   - ○ None
   - ○ Less than 1/2 hour per day
   - ○ 1/2 to almost 1 hour per day
   - ○ 1 to almost 2 hours per day
   - ○ 2 to almost 3 hours per day
   - ○ 3 or more hours per day
5. **Dressing, bathing, feeding children while you are <u>sitting</u>**
   - ○ None
   - ○ Less than 1/2 hour per day
   - ○ 1/2 to almost 1 hour per day
   - ○ 1 to almost 2 hours per day
   - ○ 2 to almost 3 hours per day
   - ○ 3 or more hours per day

Page 1

During this trimester, when you are NOT at work, how much time do you usually spend:

6. **Dressing, bathing, feeding children while you are standing**
   - ○ None
   - ○ Less than 1/2 hour per day
   - ○ 1/2 to almost 1 hour per day
   - ○ 1 to almost 2 hours per day
   - ○ 2 to almost 3 hours per day
   - ○ 3 or more hours per day

7. **Playing with children while you are sitting or standing**
   - ○ None
   - ○ Less than 1/2 hour per day
   - ○ 1/2 to almost 1 hour per day
   - ○ 1 to almost 2 hours per day
   - ○ 2 to almost 3 hours per day
   - ○ 3 or more hours per day

8. **Playing with children while you are walking or running**
   - ○ None
   - ○ Less than 1/2 hour per day
   - ○ 1/2 to almost 1 hour per day
   - ○ 1 to almost 2 hours per day
   - ○ 2 to almost 3 hours per day
   - ○ 3 or more hours per day

9. **Carrying children**
   - ○ None
   - ○ Less than 1/2 hour per day
   - ○ 1/2 to almost 1 hour per day
   - ○ 1 to almost 2 hours per day
   - ○ 2 to almost 3 hours per day
   - ○ 3 or more hours per day

10. **Taking care of an older adult**
    - ○ None
    - ○ Less than 1/2 hour per day
    - ○ 1/2 to almost 1 hour per day
    - ○ 1 to almost 2 hours per day
    - ○ 2 to almost 3 hours per day
    - ○ 3 or more hours per day

11. **Sitting and using a computer or writing, while not at work**
    - ○ None
    - ○ Less than 1/2 hour per day
    - ○ 1/2 to almost 1 hour per day
    - ○ 1 to almost 2 hours per day
    - ○ 2 to almost 3 hours per day
    - ○ 3 or more hours per day

12. **Watching TV or a video**
    - ○ None
    - ○ Less than 1/2 hour per day
    - ○ 1/2 to almost 2 hours per day
    - ○ 2 to almost 4 hours per day
    - ○ 4 to almost 6 hours per day
    - ○ 6 or more hours per day

13. **Sitting and reading, talking, or on the phone, while not at work**
    - ○ None
    - ○ Less than 1/2 hour per day
    - ○ 1/2 to almost 2 hours per day
    - ○ 2 to almost 4 hours per day
    - ○ 4 to almost 6 hours per day
    - ○ 6 or more hours per day

14. **Playing with pets**
    - ○ None
    - ○ Less than 1/2 hour per day
    - ○ 1/2 to almost 1 hour per day
    - ○ 1 to almost 2 hours per day
    - ○ 2 to almost 3 hours per day
    - ○ 3 or more hours per day

15. **Light cleaning (make beds, laundry, iron, put things away)**
    - ○ None
    - ○ Less than 1/2 hour per day
    - ○ 1/2 to almost 1 hour per day
    - ○ 1 to almost 2 hours per day
    - ○ 2 to almost 3 hours per day
    - ○ 3 or more hours per day

16. **Shopping (for food, clothes, or other items)**
    - ○ None
    - ○ Less than 1/2 hour per day
    - ○ 1/2 to almost 1 hour per day
    - ○ 1 to almost 2 hours per day
    - ○ 2 to almost 3 hours per day
    - ○ 3 or more hours per day

During this trimester, when you are NOT at work, how much time do you usually spend:

17. **Heavier cleaning (vacuum, mop, sweep, wash windows)**

- ○ None
- ○ Less than 1/2 hour per week
- ○ 1/2 to almost 1 hour per week
- ○ 1 to almost 2 hours per week
- ○ 2 to almost 3 hours per week
- ○ 3 or more hours per week

18. **Mowing lawn while on a riding mower**

- ○ None
- ○ Less than 1/2 hour per week
- ○ 1/2 to almost 1 hour per week
- ○ 1 to almost 2 hours per week
- ○ 2 to almost 3 hours per week
- ○ 3 or more hours per week

19. **Mowing lawn using a walking mower, raking, gardening**

- ○ None
- ○ Less than 1/2 hour per week
- ○ 1/2 to almost 1 hour per week
- ○ 1 to almost 2 hours per week
- ○ 2 to almost 3 hours per week
- ○ 3 or more hours per week

Going Places...

During this trimester, how much time do you usually spend:

20. **Walking slowly to go places (such as to the bus, work, visiting)** ***Not for fun or exercise***

- ○ None
- ○ Less than 1/2 hour per day
- ○ 1/2 to almost 1 hour per day
- ○ 1 to almost 2 hours per day
- ○ 2 to almost 3 hours per day
- ○ 3 or more hours per day

21. **Walking quickly to go places (such as to the bus, work, or school)** ***Not for fun or exercise***

- ○ None
- ○ Less than 1/2 hour per day
- ○ 1/2 to almost 1 hour per day
- ○ 1 to almost 2 hours per day
- ○ 2 to almost 3 hours per day
- ○ 3 or more hours per day

22. **Driving or riding in a car or bus**

- ○ None
- ○ Less than 1/2 hour per day
- ○ 1/2 to almost 1 hour per day
- ○ 1 to almost 2 hours per day
- ○ 2 to almost 3 hours per day
- ○ 3 or more hours per day

For Fun or Exercise...

During this trimester, how much time do you usually spend:

23. **Walking slowly for fun or exercise**

- ○ None
- ○ Less than 1/2 hour per week
- ○ 1/2 to almost 1 hour per week
- ○ 1 to almost 2 hours per week
- ○ 2 to almost 3 hours per week
- ○ 3 or more hours per week

24. **Walking more quickly for fun or exercise**

- ○ None
- ○ Less than 1/2 hour per week
- ○ 1/2 to almost 1 hour per week
- ○ 1 to almost 2 hours per week
- ○ 2 to almost 3 hours per week
- ○ 3 or more hours per week

25. **Walking quickly up hills for fun or exercise**

- ○ None
- ○ Less than 1/2 hour per week
- ○ 1/2 to almost 1 hour per week
- ○ 1 to almost 2 hours per week
- ○ 2 to almost 3 hours per week
- ○ 3 or more hours per week

During this trimester, how much time do you usually spend:

26. **Jogging**
- ○ None
- ○ Less than 1/2 hour per week
- ○ 1/2 to almost 1 hour per week
- ○ 1 to almost 2 hours per week
- ○ 2 to almost 3 hours per week
- ○ 3 or more hours per week

27. **Prenatal exercise class**
- ○ None
- ○ Less than 1/2 hour per week
- ○ 1/2 to almost 1 hour per week
- ○ 1 to almost 2 hours per week
- ○ 2 to almost 3 hours per week
- ○ 3 or more hours per week

28. **Swimming**
- ○ None
- ○ Less than 1/2 hour per week
- ○ 1/2 to almost 1 hour per week
- ○ 1 to almost 2 hours per week
- ○ 2 to almost 3 hours per week
- ○ 3 or more hours per week

29. **Dancing**
- ○ None
- ○ Less than 1/2 hour per week
- ○ 1/2 to almost 1 hour per week
- ○ 1 to almost 2 hours per week
- ○ 2 to almost 3 hours per week
- ○ 3 or more hours per week

Doing other things for fun or exercise? Please tell us what they are.

30. _____ Name of Activity
- ○ None
- ○ Less than 1/2 hour per week
- ○ 1/2 to almost 1 hour per week
- ○ 1 to almost 2 hours per week
- ○ 2 to almost 3 hours per week
- ○ 3 or more hours per week

31. _____ Name of Activity
- ○ None
- ○ Less than 1/2 hour per week
- ○ 1/2 to almost 1 hour per week
- ○ 1 to almost 2 hours per week
- ○ 2 to almost 3 hours per week
- ○ 3 or more hours per week

Please fill out the next section if you work for wages, as a volunteer, or if you are a student. If you are a homemaker, out of work, or unable to work, you do not need to complete this last section.

At Work...

During this trimester, how much time do you usually spend:

32. **Sitting at working or in class**

- ○ None
- ○ Less than 1/2 hours per day
- ○ 1/2 to almost 2 hours per day
- ○ 2 to almost 4 hours per day
- ○ 4 to almost 6 hours per day
- ○ 6 or more hours per day

33. **Standing or slowly walking at work while carrying things (heavier than a 1 gallon milk jug)**
- ○ None
- ○ Less than 1/2 hour per day
- ○ 1/2 to almost 2 hours per day
- ○ 2 to almost 4 hours per day
- ○ 4 to almost 6 hours per day
- ○ 6 or more hours per day

34. **Standing or <u>slowly</u> walking at work <u>not</u> carrying anything**
- ○ None
- ○ Less than 1/2 hours per day
- ○ 1/2 to almost 2 hours per day
- ○ 2 to almost 4 hours per day
- ○ 4 to almost 6 hours per day
- ○ 6 or more hours per day

35. **Walking <u>quickly</u> at work while <u>carrying</u> things (heavier than a 1 gallon milk jug)**
- ○ None
- ○ Less than 1/2 hour per day
- ○ 1/2 to almost 2 hours per day
- ○ 2 to almost 4 hours per day
- ○ 4 to almost 6 hours per day
- ○ 6 or more hours per day

36. **Walking <u>quickly</u> at work <u>not</u> carrying anything**
- ○ None
- ○ Less than 1/2 hour per day
- ○ 1/2 to almost 2 hours per day
- ○ 2 to almost 4 hours per day
- ○ 4 to almost 6 hours per day
- ○ 6 or more hours per day

Thank You

Appendix G: Request and Permission to use the Pregnancy Physical Activity Questionnaire

FW: Pregnancy Physical Activity Questionnaire (PPAQ)

Inbox

Lisa Chasan-Taber <lct@schoolph.umass.edu> Tue, Mar 5, 2019, 2:57 PM

to me

Hi Okafor:
Thank you for your interest in the PPAQ. You have my permission to use it as you described. Attached, please find the questionnaire and instructions for scoring. Below is the reference.

Chasan-Taber L, Schmidt MD, Roberts DE, Hosmer D, Markenson G, Freedson PS. Development and Validation of a Pregnancy Physical Activity Questionnaire. Med Sci Sports Exer 2004 36(10):1750-1760 <>

Best of luck with your research.
Lisa Chasan-Taber

****

Lisa Chasan-Taber, Sc.D.
Professor of Epidemiology
Department of Biostatistics & Epidemiology
School of Public Health & Health Sciences
401 Arnold House
715 North Pleasant Street
University of Massachusetts
Amherst, MA 01003-9304
tele: 413-545-1664
fax: 413-545-1645
email: LCT@schoolph.umass.edu

Textbook: "Writing Dissertation and Grant Proposals:
Epidemiology, Preventive Medicine and Biostatistics"
http://www.crcpress.com/product/isbn/9781466512061

website: http://people.umass.edu/lisact/
From: uchenna uche <ucheysonic@gmail.com>
Sent: Friday, March 1, 2019 6:42 AM
To: Lisa Chasan-Taber <lct@schoolph.umass.edu>
Subject: Request for PPAQ

Dear Professor, Lisa Chasan-Taber,

My name is Uchenna Benedine Okafor. I am currently a Doctoral student in the department of nursing science, Faculty of Health Sciences, University of Fort Hare, in South Africa.

The topic of my study is "**physical activity intervention programme for pregnant women in Bufalo City Municipality, South Africa"**

I read your articles entitled **"Development and Validation of a Pregnancy Physical Activity Questionnaire, Physical Activity and Sleep Quality and Duration During Pregnancy Among Hispanic Women: Estudio PARTO.... and others,** and I am interested in the Pregnancy Physical Activity Questionnaire (PPAQ) you have developed and validated.

I am humbly requesting your permission to use the PPAQ questionnaire for my study.

Thanks in anticipation.

--
Yours sincerely,
Okafor Uchenna.
Nursing Science Dept
University of Fort Hare.

APPENDIX H: BELIEFS, SOURCES OF INFORMATION, PERCEIVED BENEFITS, KNOWLEDGE AND BARRIERS TO PHYSICAL ACTIVITY AND EXERCISE DURING PREGNANCY QUESTIONNAIRE

Study ID: .....
Site: .....
Date: ...../...../.....

INSTRUCTIONS:

Section A.

Please fill in the blanks or tick ( ) the appropriate answers.

Section B.

Please make a tick or write your comments in the appropriate space. You will notice that we do not ask for your name. The information cannot be used to identify individuals. For this reason, we ask that you should be very honest in responding to the questions.
Please answer all the questions to the best of your ability. There are no right or wrong answers.

SECTION A:

Demographic information:

1. What is your Age? ☐

2. Residential Area: Rural ☐ Semi-urban ☐ Urban ☐

3. Racial Group:

Black African ☐ Coloured ☐ White ☐ Indian ☐

4. Marital Status:

Married ☐ Never married ☐ Cohabiting ☐

5. Highest Educational Level:

Primary ☐ Secondary ☐ Tertiary ☐

6. Employment:

Unemployed ☐ Employed ☐

7. Religious affiliation

Christian ☐ Muslim ☐ Other ☐

8. How will you rate the level of support you receive from your family regarding physical activity participation?

Adequate ☐ Moderate ☐ No support ☐

9. Parity: Nulliparous ☐ Primiparous ☐ Multiparous ☐

10. Mode of delivery: Vaginal ☐ Caesarean section ☐ Both ☐

11. Antepartum haemorrhage in first trimester: Yes ☐ No ☐

12. Perceived health condition in pregnancy: Very good ☐ Good ☐ Bad ☐

13. Smoking during pregnancy: Yes ☐ No ☐

14. Alcohol use during pregnancy: Yes ☐ No ☐

15. Pregravid BMI (kg/m²): Underweight (<18.5) ☐ Normal weight (18.5-<24.9) ☐

Overweight (25.0-<29.9) ☐ Obese (>= 30.0) ☐

16. Planned pregnancy: Yes ☐ No ☐

17. Physical activity advice from health professional: Yes ☐ No ☐

18. Physical activity before pregnancy: Yes ☐ No ☐

19: When did you start physical activity during this pregnancy: 1st trimester ☐

2nd trimester ☐ 3rd trimester ☐ Neither trimester ☐

Beliefs, Sources of Information, perceived Benefits, and Barriers towards Physical Activity and Exercise Questionnaire

Section B: Beliefs about Physical Activity and Exercise during Pregnancy

This section solicits your beliefs and sources of information about physical activity and exercise during pregnancy

	Statements	Strongly agree	Agree	Disagree	Strongly disagree	Not sure
1	Physical activity and exercise is not safe for the mother and the foetus					
2	Physical activity may reduce placental circulation					
3	Physical activity or exercise can lead to abortion or miscarriage, preterm birth, intrauterine growth retardation					
4	Regular exercise during pregnancy is harmful					
5	Pregnant woman should not exercise while lying on their back during the first trimester					
6	Pregnant woman should not exercise while lying on their back during the second trimester					
7	Pregnant woman should not exercise while lying on their back during the third trimester					
8	Long periods of standing in one place without moving should be avoided while pregnant					
9	Physical activity increase the body temperature					
10	PA increase the risk of maternal muscle-skeletal injuries and the diversion of maternal oxygen and nutrients to skeletal muscle, rather than to the foetus					
11	Women can continue their regular exercise during pregnancy					
12	Women who never exercised can begin an exercise programme during pregnancy					
13	Physical activity and exercise during pregnancy will improve a woman's labour and delivery					
14	Physical activity and exercise during pregnancy will improve the health of the baby					
15	Physical activity and exercise during pregnancy might make a woman feel more energetic					
16	A pregnant woman can continue to exercise even if she becomes tired					
17	During pregnancy, regular exercise done at least 3 times per week is better than activity done irregularly or less often					
18	Pregnancy is a time to rest					

Section C: Sources of Information about Physical Activity and Exercise during Pregancy

This section solicits information about where you received information about physical activity and exercise and pregnancy

	I received information about physical activity and exercise pregnancy from the following:	Often	Sometimes	Never	Rarely
19	Friends				
20	Family				
21	Other women				
22	Healthcare professionals (doctors, nurses etc)				
23	Media, Television and Radio				
24	Books, Newspapers, Magazines				
25	Others				

Section D: Perceived Benefits of Physical Activity and Exercise during Pregnancy

On a scale of 1-4, provide what you perceived as being the benefits of physical activity and exercise during pregancy

	Statements	Strongly agree	Agree	Disagree	Strongly disagree
26	Participation in physical activity helps improves cardiovascular function				
27	Participation in PA helps reduce new-born weight gain during pregnancy				
28	Participation in PA helps reduce musculoskeletal discomfort				
29	Reduction in the risk of back pain				
30	Participation in PA helps to reduce the incidence of muscle cramps and edema on lower limbs				
31	Physical activity and exercise during pregnancy improves a woman's labour and delivery				
32	Physical activity and exercise during pregnancy improve the health of the baby				
33	Participation in PA helps in lowering mood				
34	Participation in PA decreases the risk of gestational diabetes mellitus				
35	Participation in PA decreases the risk of pregnancy-induced hypertension				
36	Participation in PA helps to decrease risk of complications at birth				
37	Healthy eating and physical activity during pregnancy will improve genral health of the woman				
38	Participation in PA helps to improve self-image				
39	Participation in PA helps in better sleeping patterns				
40	Participation in PA helps to improve respiratory function				

Section F: Knowledge about Physical Activity and Exercise during Pregnancy

This section solicits your knowledge about physical activity and exercise during pregancy

	Statements	Yes	I don't know	No
41	Are you aware of antenatal exercise?			
42	Physical activity in pregancy is beneficial for the baby			
43	Physical activity in pregancy is safe			
44	Healthy eating and physical activity are good			
	The following antenatal exercises can be performed during pregnancy:			
45	Pelvic floor			
46	Muscle strengthening			
47	Back care			
48	Relaxation and breathing			
49	Abdominal exercise			
50	Swiming			
51	Areobics			
	Contraindications of exercise during pregnancy could be:			
52	Swelling of lower extremities			
53	Extreme weight gain or loss			
54	Back pain			
55	Difficulty in breathing			
56	Chest pain			
57	Dizziness			

58	Uterine contractions			
59	Incompetent cervix and preterm labour			
60	Vaginal bleeding			
61	Diabetes			

Section E: Attitude toward Physical Activity and Exercise during Pregnancy

On a scale of 1-4, which describes your attitude towards physical activity and exercise during pregancy

	Statement	Strongly agree	Agree	Disagree	Strongly disagree	Not sure
62	I enjoy engaging in healthy physical activity during pregnancy					
63	Healthy physical activity makes me fit for birth					
64	Healthy physical activity in pregnancy is waste of time					
65	I feel guilty by not doing physical activity during pregnancy					
66	Physical activity harms the health of the baby					
67	I feel tired to exercise					
68	I do not feel like exercising					
69	I have busy schedule					
70	I have children to care for					
71	I am afraid of exercise					
72	I do not have sufficient information on exercise					
73	I dislike physical activity during pregnancy					
74	It is difficult to achieve healthy physical activity					

Section F: Barriers to Physical Activity and Exercise during Pregnancy

On a scale of 1-4, indicate what are the reasons preventing you from participating in physical activity and exercise during pregancy

	Statements	Strongly agree	Agree	Disagree	Strongly disagree
75	Work commitment gives me no time to participate in PA				
76	I feel tired to participate in PA				
77	I have lower energy during pregnancy				
78	I feel ill and have morning sickness				
79	I feel nausea, vomiting and back pain				
80	I feel discomfort during exercise				
81	I have no one to exercise with				
82	I have being advice to avoid exercise during pregnancy				
83	I have no support from my family or friends				
84	My partner and family dislike my participation in exercise				
85	I have conflicting advice about PA and exercise during pregnancy				
86	My culture dislike or disapprove participation in PA or exercise during pregnancy				
87	I don't have transport to go to the Gym for exercise				
88	There are no recreational facilities in my place				
89	I have no money to pay for Gym fee to participate in exercise				
90	I have no accessibility to physical activity facilties				
91	It is not safe to go out for physical activity and exercise in my area				

Annexure I: Structured Interview Guide for Pregnant Women regarding their Beliefs, Sources of Information, perceived Benefits, and Barriers towards Physical Activity and Exercise

Demographic information:

1. What is your Age? ☐

2. Residential Area: Rural ☐ Semi-urban ☐ Urban ☐

3. Racial Group:
Black African ☐ Coloured ☐ White ☐ Indian ☐

4. Marital Status:

Married ☐ Never married ☐ Cohabiting ☐

5. Highest Educational Level:

Primary ☐ Secondary ☐ Tertiary ☐

6. Employment:

Unemployed ☐ Employed ☐

7. Religious affiliation
Christian ☐ Muslim ☐ Other ☐

8. How will you rate the level of support you receive from your family regarding physical activity participation?

Adequate ☐ Moderate ☐ No support ☐

9. Parity: Nulliparous ☐ Primiparous ☐ Multiparous ☐

10. Mode of delivery: Vaginal ☐ Caesarean section ☐ Both ☐

11. Antepartum haemorrhage in first trimester: Yes ☐ No ☐

12. Perceived health condition in pregnancy: Very good ☐ Good ☐ Bad ☐

13. Smoking during pregnancy: Yes ☐ No ☐

14. Alcohol use during pregnancy: Yes ☐ No ☐

15. Pregravid BMI (kg/m^2): Underweight (<18.5) ☐ Normal weight (18.5-<24.9) ☐

Overweight (25.0-<29.9) ☐ Obese (>= 30.0) ☐

16. Planned pregnancy: Yes ☐ No ☐

17. Physical activity advice from health professional: Yes ☐ No ☐

18. Physical activity before pregnancy: Yes ☐ No ☐

19: When did you start physical activity during this pregnancy: 1st trimester ☐

2nd trimester ☐ 3rd trimester ☐ Neither trimester ☐

Interview Questions

1. What is your views about the safety of participating in physical activity and exercise during pregnancy
2. Do you think participating in physical activity during pregnancy is beneficial to your health?
3. What do you think are the benefits of participating in physical activity during pregnancy
4. Would you share with me the things (barriers) that are preventing you from participating in physical activity during pregnancy
5. Tell me whether you are supported to participate in physical activity during pregnancy, and what kind of support?
6. In your opinion, what could be done to encourage you or women to participate in physical activity during pregnancy?
7. How would you describe the period of 'pregnancy' in terms of physical activity?
8. Tell me where you recieved information about physical activity and exercise
9. Tell me what types of antenatal exercises you know can be performed during pregnancy
10. I would like to know if you are aware of any contraindications (complications) to exercise during pregnancy?

Thank you for sharing your thoughts on physical activity during pregnancy.

Annexure J: Structured Interview Guide for Midwives on Physical Activity during Pregnancy

Gender Male Female
Race African Caucasian Coloured Indian
Where do you practice? Urban Semi-urban
How long have been practicing (Years) 1–5 6–10 11–15 16–20 and above

Q1: Please can briefly tell me about yourself?

Q2: As a Midwife working in antenatal clinic, what do you usually do?

Q3: Do you usually have time to talk with your clients one-on-one or in a group about lifestyle modification during pregnancy?

Q5: Do you provide advice or counselling to your clients about the importance of physical activity/exercise during pregnancy?

Q6: What kind of information on physical activity and pregnancy do you provide to your clients?

Q7: What kind of questions do your clients ask about physical activity and exercise during pregnancy?

Q8: Do you usually have individual chat with your clients or group talks on the importance of physical activity and exercise during pregnancy?

Q9: Tell me if you are aware of any specialised body or institution's guidelines or recommendation on physical activity/exercise during pregnancy. [For probe: American College of Obstetricians and Gynaecologists (ACOG), World Health Organization (WHO), Joint Canadian Society for Exercise Physiology (CSEP)/Society of Obstetricians and Gynaecologists of Canada (SOGC), Royal Australian and New Zealand College of Obstetrics and Gynaecology (RANZCOG), International Olympic Committee (IOC), Department of Health & Social Care, UK, Sports Medicine Australia, and the American College of Sport and Medicine].

Q10: What kind of physical activity or exercise classes to offer to your clients during antenatal visit?

Q11: What kind of awareness regarding physical activity during pregnancy do you provide to your clients to encourage them to participate in physical activity?

Q12: Do you think that an inactive (a sedentary) woman, with no pregnancy complications, should start exercise programme during pregnancy?

Q13: What is your views about the safety of participating in physical activity and exercise during pregnancy

Q14: As a healthcare provider, what do you think/know are the contraindications (complications) to physical activity during pregnancy?

Q15: With your experience as professional nurse, how would you describe pregnant women attitude towards exercise?

Q16: What hinders you from providing physical activity advice/counselling to pregnant women during their antenatal clinic visit?

Q17: Given the opportunity, will you be willing to attend a workshop or training on pregnancy and physical activity and exercise?

Q18: Before we conclude, is there anything that you wish to say or add to our conversation?

Thank you for sharing your thought and experiences with me.

Annexure K: Experts Analyses and Comments on the Developed Prenatal Physical Activity Strategy

Dear Participant,

Please provide your comment/critique or no comment on the feasibility of the developed physical activity intervention strategy for the promotion of prenatal physical activity in the health facilities in Buffalo Municipality City, Eastern Cape.

Professional qualification of Participant:……..

Table 2: Developed physical activity intervention strategy

Intervention Strategy 1: Building on Strength	**Comment/critique/No comment**
Training of gynaecologists/obstetrics/midwives/nurses to provide prenatal physical activity counselling during antenatal sessions	
Training of other categories of health providers (physiotherapists/exercise physiologists/biokinetictists) responsible for women's health to prescribe prenatal physical activity during consultation sessions	
Increase focus in health/medical education on morbidity of excess weight gain and physical inactivity during pregnancy.	
Provision of prenatal physical activity campaigns in the community, involving ward-based outreach teams, NGOs and faith-based organisation. To motivate women, make use of popular women as guest speakers and involve the movie industry to provide awareness	
Inclusion of physical activity counselling by trained professionals and classes as one of the compulsory components of antenatal healthcare	
Intervention Strategy 2: Overcoming of weakness	

Application of scientific and technological innovations to provide basic information on the benefits of prenatal physical activity. The use of Mom-Connect, brochures, etc.	
Actively involve support groups (partners, family, and friends) in prenatal care so that others who influence mothers are empowered to ask questions, understand risks, and have the same goals regarding the benefits of prenatal physical activity for maternal health of the mother and the baby.	
Conduct physical exercise classes with duration and intensity consistent with the recommended guidelines for pregnant women to maintain health.	
Intervention Strategy 3: Exploring opportunities	
Negotiate with corporate organisations or companies to include in their products slogans that promote information on prenatal physical activity. For example, refrigerator magnets, grocery plastic bags, sanitary pads, cosmetics, baby products, billboards along the road and public	
Collaborate with cell phone and network companies, for example, Vodacom, MTN, Cell C and 8ta to assist in information dissemination regarding the benefits of prenatal physical activity. They can write information on prenatal physical activity on the airtime slips, provide automatic voice message either when dialling or receiving calls to create awareness on recommended physical activity during pregnancy.	
Conduct more good quality research on effective interventions to promote physical activity during pregnancy	
Educate prenatal care providers on physical activity counselling strategies that	

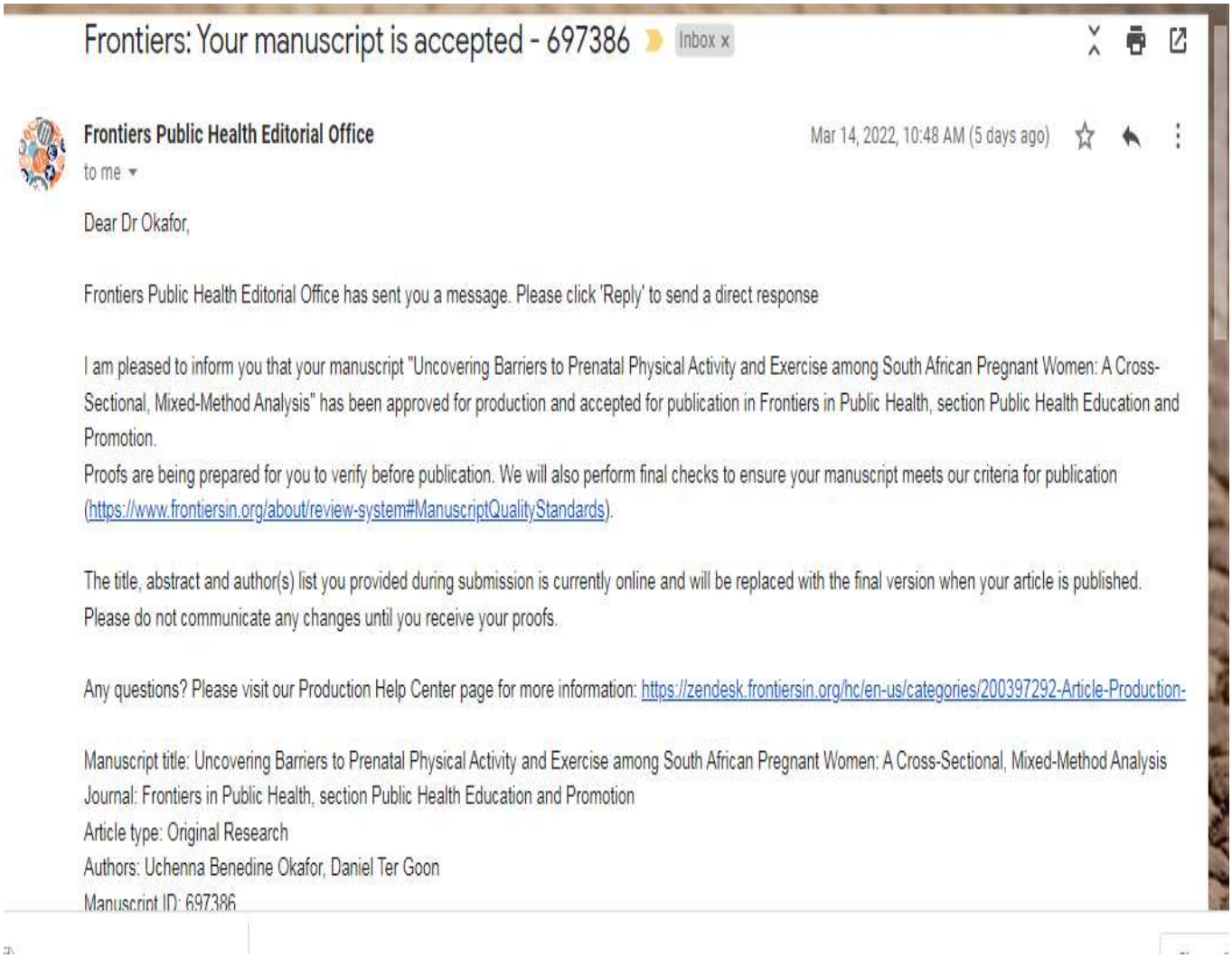
are culturally appropriate, sensitive and effective.	
Create and provide opportunity for pregnant women and other support groups to attend monthly group meetings on physical activity.	
Intervention Strategy 4: Mitigation of threats	
Documenting the misconceptions and clarifications about the safety concerns of prenatal physical activity and making the document accessible to women at the clinics.	
Providing individual face-to-face or groups interviews about the risks of a sedentary lifestyle and physical activity, information about minimal physical activity required for pregnant women, and importance of nutrition during and after pregnancy during routine consultations	
Providing general health education training to the home-based carers and community health workers on the importance and benefits of prenatal physical activity, so that they would in turn, create such awareness to the community about the need to participate in physical activity and exercise during pregnancy.	
Midwives to be trained on prenatal physical activity and exercise prescriptions, contraindications, recommendations and guidelines.	
The government to recruit more midwives at the primary healthcare centres to assist in antenatal sessions, which will include providing antenatal physical exercise classes	
Form a multidisciplinary antenatal physical exercise team involving exercise physiologists and biokineticists to model	

by demonstrating antenatal exercises to women during antenatal clinic visit.	
Build and procure antenatal physical exercise facilities and equipment to encourage and promote prenatal physical activity.	

Thank you for your valuable comments/inputs and suggestions.

Okafor UB

Appendix L



Frontiers: Your manuscript is accepted - 697386 Inbox x

Frontiers Public Health Editorial Office Mar 14, 2022, 10:48 AM (5 days ago)

to me

Dear Dr Okafor,

Frontiers Public Health Editorial Office has sent you a message. Please click 'Reply' to send a direct response

I am pleased to inform you that your manuscript "Uncovering Barriers to Prenatal Physical Activity and Exercise among South African Pregnant Women: A Cross-Sectional, Mixed-Method Analysis" has been approved for production and accepted for publication in Frontiers in Public Health, section Public Health Education and Promotion.

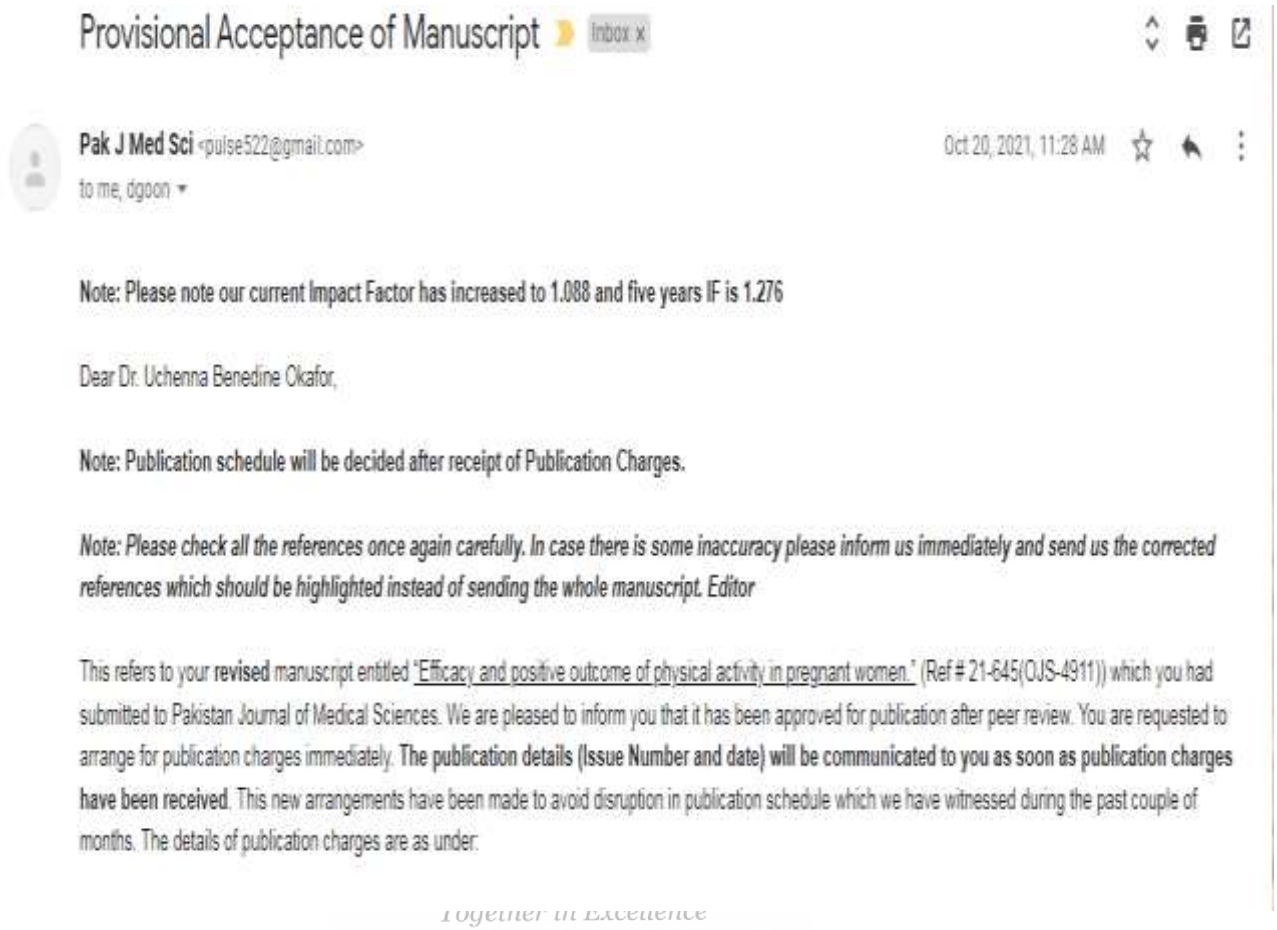
Proofs are being prepared for you to verify before publication. We will also perform final checks to ensure your manuscript meets our criteria for publication (https://www.frontiersin.org/about/review-system#ManuscriptQualityStandards).

The title, abstract and author(s) list you provided during submission is currently online and will be replaced with the final version when your article is published. Please do not communicate any changes until you receive your proofs.

Any questions? Please visit our Production Help Center page for more information: https://zendesk.frontiersin.org/hc/en-us/categories/200397292-Article-Production-

Manuscript title: Uncovering Barriers to Prenatal Physical Activity and Exercise among South African Pregnant Women: A Cross-Sectional, Mixed-Method Analysis
Journal: Frontiers in Public Health, section Public Health Education and Promotion
Article type: Original Research
Authors: Uchenna Benedine Okafor, Daniel Ter Goon
Manuscript ID: 697386

Appendix M



Provisional Acceptance of Manuscript Inbox x

Pak J Med Sci <pulse522@gmail.com> Oct 20, 2021, 11:28 AM

to me, dgoon

Note: Please note our current Impact Factor has increased to 1.088 and five years IF is 1.276

Dear Dr. Uchenna Benedine Okafor,

Note: Publication schedule will be decided after receipt of Publication Charges.

Note: Please check all the references once again carefully. In case there is some inaccuracy please inform us immediately and send us the corrected references which should be highlighted instead of sending the whole manuscript. Editor

This refers to your **revised** manuscript entitled "Efficacy and positive outcome of physical activity in pregnant women." (Ref # 21-645(OJS-4911)) which you had submitted to Pakistan Journal of Medical Sciences. We are pleased to inform you that it has been approved for publication after peer review. You are requested to arrange for publication charges immediately. **The publication details (Issue Number and date) will be communicated to you as soon as publication charges have been received**. This new arrangements have been made to avoid disruption in publication schedule which we have witnessed during the past couple of months. The details of publication charges are as under:

Together in Excellence

Supplementary File 1: Physical Activity and Exercise during Pregnancy in Africa

Okafor and Goon *BMC Pregnancy and Childbirth* (2020) 20:732
https://doi.org/10.1186/s12884-020-03439-0

BMC Pregnancy and Childbirth

RESEARCH ARTICLE Open Access

Physical activity and exercise during pregnancy in Africa: a review of the literature

Uchenna Benedine Okafor[1*] and Daniel Ter Goon[2]

Abstract

Background: Pregnancy is an important phase in a woman's life, with health status at this stage affecting both the woman and her child's life. Global evidence suggests that many women engage in low levels of physical activity (PA) and exercise during pregnancy despite its beneficial effects. This is particularly the case in Africa.

Methods: This article reviews the literature on levels of PA and exercise among pregnant women in Africa, highlighting the level of PA or exercise participation during pregnancy in Africa, including types of PA, factors affecting PA, beliefs about and benefits of prenatal activity, advice or counselling on PA during pregnancy in Africa, and PA interventions proposed to promote the uptake of prenatal PA. Electronic search databases used were Google Scholar, Science Direct, Scopus, EMBASE, ERIC, Medline, Web of Science, EBSCOhost, PubMed, BIOMED Central, and African Journal Online. The basic search terms were: 'Physical activity', 'Exercise', 'Pregnancy', 'Pregnant women' and 'Africa'. A total of 40 references were found. On the basis of an analysis of titles, abstracts and the language of publication (other than English), 11 articles were rejected, and 29 articles were fully read, although two had to be rejected due to a lack of access to the full version. Finally, 27 references were included in the review.

Results: Few studies exist on PA during pregnancy in Africa. The limited data available suggests that, compared to the Western world, pregnant women in Africa do not adhere to the recommendations for PA during pregnancy. Levels of participation in PA during pregnancy are low and decline as the pregnancy progresses. The majority of the studies used direct, objective measures to assess PA during pregnancy. Personal and environmental factors such as lack of time, lack of knowledge, inadequate information from healthcare providers, feelings of tiredness and an absence of social support constituted the main barriers to PA during pregnancy. The types of PA participation among pregnant women varied across studies and geographical settings.

Conclusions: While published data is limited, it seems clear that the participation of pregnant women in PA during pregnancy in Africa is low and declines with advancing pregnancy. There is a need for more studies to examine the dynamics of PA during pregnancy in Africa to guide contextual interventions to improve and promote maternal health on the continent.

Keywords: Physical activity, exercise, pregnancy, Africa

* Correspondence: ucheysonic@gmail.com
[1]Department of Nursing Science, University of Fort Hare, 50 Church Street, 5201 East London, South Africa
Full list of author information is available at the end of the article

Background

Physical activity (PA) as a modifiable health risk factor has been shown to contribute to the maternal health of women and their offspring. Several studies have reported the benefits of PA and exercise during pregnancy, which include reduced risk of excessive gestational weight gain [1–5], decreased risk of gestational diabetes [1, 6–9], and reduced risk of preeclampsia [10–14]. Evidence also indicates that PA during pregnancy lowers rates of preterm births [15, 16], improves sleep [17, 18], reduces the risk of caesarean section and postpartum recovery time [19–21], and reduces length of labour and delivery complications [22]. In addition, PA during pregnancy reduces fatigue, stress, anxiety and depression [10–12, 22–26], reduced lower back pain [10–12, 27], and improves wellbeing [28]. Moreover, it is known to increase heart rate, cardiac output, ventilation and energy expenditure [29, 30], reduce the risk of injury for both mother and baby [3], and improves breastfeeding outcomes [31].

Earlier studies have alluded to the benefits of physical activity for the improvement of maternal health of the mother and the baby. Evidence has shown maternal obesity is a precursor for the development of adverse maternal health outcomes (cardiovascular diseases, metabolic syndromes, and obesity) [32, 33], and the children [34, 35]. Specifically, studies have reported increased risk of fetal death [36, 37], congenital malformations such as neural tube defects [38, 39], macrosomia [40–42], and large-for-gestational-age [36, 43]. Children of obese mothers have increased perinatal complications, which include shoulder dystocia, birth injuries, perinatal asphyxia [38], and hypoglycemia or respiratory distress [38]. In addition, women with excessive gestational weight gain have higher propensity for postpartum weight retention (PPWR) [33]. Therefore, it is important to prevent excessive PPWR during the pregnancy-postpartum period [44]. Previous studies have shown antenatal exercises improves the aerobic fitness of pregnant women [13, 45, 46], and significantly lowers postpartum weight retention [47]. Viewed in this context, obese pregnant women should be provided with adequate education and support concerning prenatal exercise to improve their health outcomes and the baby; and with these manifold benefits, it is recommended that pregnant women, without complications should engage in moderate-to-vigorous PA for at least 150 minutes per week [6].

Notwithstanding the substantial evidence on the benefits of PA during pregnancy, studies have reported considerable declines in physical activity among pregnant women [48–54], with varying degrees of participation shaped by context-specific factors. Pregnant women do not meet the American College of Obstetricians and Gynaecologists (ACOG) recommendation of regular PA during pregnancy for women who are pregnant and healthy to perform 30 minutes or more of light to moderate exercise a day on most, if not all, days of the week [18].

Various factors have been shown to influence PA participation among pregnant women, including low maternal education [55–57], unemployment [58, 59], pregnancy symptoms/discomforts [3, 55, 60–62], multiparity [63], lack of strength or fatigue [3], lack of time [3, 55, 60], lack of motivation [56, 64, 65], and safety concerns or fear [62, 66]. Some studies have reported cultural and religious beliefs [66], lack of social support [61, 67] and other responsibilities [61, 68]. In addition, studies reporting environmental barriers to PA during pregnancy cited lack of access to facilities/resources [67, 69], and bad weather conditions [3, 61, 67]. An empirical understanding of the context-specific factors affecting PA participation during pregnancy in Africa is crucial to inform interventional strategies. This kind of data is rare in Africa.

While there are several studies to guide interventions and the promotion of physical activity and exercise among pregnant women in the USA [3, 25, 65, 70, 71], Canada [63, 72, 73], the United Kingdom [74–76] and other countries around the world [26, 53, 57, 61, 62, 68, 77–83], which indicate varying degrees of PA participation, and suggest the reasons for both participation and non-participation during pregnancy, scant information exist in Africa. A previous review by Mukona et al. [84] identified only two studies conducted in South Africa [56, 85], two studies in Nigeria [86, 87], and one study in Ethiopia [88]. This earlier review reported a low level of physical activity during pregnancy, largely because of lack of knowledge about prenatal activities, lack of facilities at community level and lack of time [86], thus stressing the need for the promotion of physical activity in Africa. The major form of physical activity performed by pregnant women was household activities, and physical activity declined as the pregnancy progressed [86]. In Africa, pregnancy is generally considered a time of confinement and withdrawal, a deeply held belief. While this has traditionally been the case, and is still the case in rural areas, urbanisation has brought about a decline in levels of physical activity, to the detriment of overall country health profiles, and specifically the health profiles of pregnant women. Exercise and general activities generally decrease over the course of the pregnancy, a factor associated with tiredness [85].

The value of PA and exercise in relation to the maternal health of the mother and child should be explored and promoted beyond the matter of merely reducing the direct causes of maternal morbidity; the issue should be seen as a modifiable health risk factor, as is the case with diet [55]. Given the uniqueness of pregnancy in the life cycle of a woman, health behaviours and disease risk factors are important indicators to consider during

pregnancy. Research interest in health during pregnancy ought to be high, since pregnancy is a time in a woman's life which can have lasting effects on her future health. A synthesis of the factors that influence physical activity and exercise during pregnancy in Africa may provide evidence to inform interventions on PA promotion and implementation in antenatal healthcare, which will of course be influenced by context. Despite the clear guidelines and recommendations set by various bodies and institutions, achieving sufficient levels of PA and exercise remains a global challenge, not only to the general population in Africa, but specifically to the population group of pregnant women. To our knowledge, a comprehensive review of PA during pregnancy in Africa does not exist. This knowledge gap is worrisome because the correlates, perceived benefits and barriers to PA participation among pregnant women in Africa may differ considerably from one country to another. Such a review would increase our knowledge of the context-specific issues regarding PA during pregnancy in Africa. This knowledge would help health professionals and policymakers to develop environmental and/or behavioural modification strategies and effective interventions.

Physical activity (occupational, sports, conditioning, household or other activities) is defined as any body movement produced by skeletal muscles that results in energy expenditure [89, 90]. Exercise, on the other hand, is a subcategory of physical activity, and is a planned, structured, repetitive activity to improve or maintain physical fitness [89, 90]. In this review, PA and exercise will be used interchangeably to mean the same thing, as the pregnant woman engages in both for the improvement of maternal outcomes. The purpose of this study was to conduct a narrative literature review on the level of PA or exercise participation during pregnancy in Africa, including types of PA, factors affecting PA, beliefs about and benefits of prenatal activity, advice or counselling on PA during pregnancy in Africa, and lastly, PA interventions proposed to promote the uptake of prenatal PA.

Methods

Search strategy

Our electronic search crossed six databases: Google Scholar, Science Direct, Scopus, EMBASE, ERIC, Medline, Web of Science, EBSCOhost, PubMed, BIOMED Central and African Journal Online databases. These were consulted for any published review articles or original research articles, regardless of year of publication that yielded information on the levels and correlates of PA participation during pregnancy, including the beliefs, perceived benefits, barriers and attitudes of pregnant women concerning PA and exercise participation during pregnancy in Africa. In addition, we extended the search for articles so as to include references of the identified publications in this narrative review.

The search terms used were: 'Physical activity', 'Exercise', 'Pregnancy', 'Pregnant women' and 'Africa'.

The search excluded research articles published in languages other than English and whose full texts were not accessible.

A total of 40 original articles and review articles on physical activity during pregnancy in Africa were included in this narrative review. Of these, 27 studies were finally considered for the analysis [55, 56, 58, 59, 86–88, 91–110]. Figure 1 presents a flow diagram of the procedure that resulted in the final list of articles considered for analyses.

Results

Of the 40 articles retrieved, 27 studies met the inclusion criteria for the narrative review (Fig. 1). Seven studies utilised direct or objective measures to assess PA during pregnancy (accelerometers, pedometers, combined heart rate and accelerometer device, and Borge Rating of Perceived Exertion (RPE) [88, 92–95, 103, 107], and 16 studies employed non-objective or indirect measures [56, 58, 59, 86, 87, 97, 102, 104, 106, 108, 109]. Four studies include the Pregnancy Physical Activity Questionnaire (PPAQ) [58, 86, 100, 101], 11 applied surveys or questionnaires (Global Physical Activity Questionnaire (GPAQ), International Physical Activity Questionnaires, or interviews (Table 1). Notably, the PPAQ is a validated tool for evaluating PA among pregnant women.

Characteristics of included studies

Characteristics of the 27 included studies are displayed in Table 1. Four were prospective cohort studies [92, 94,

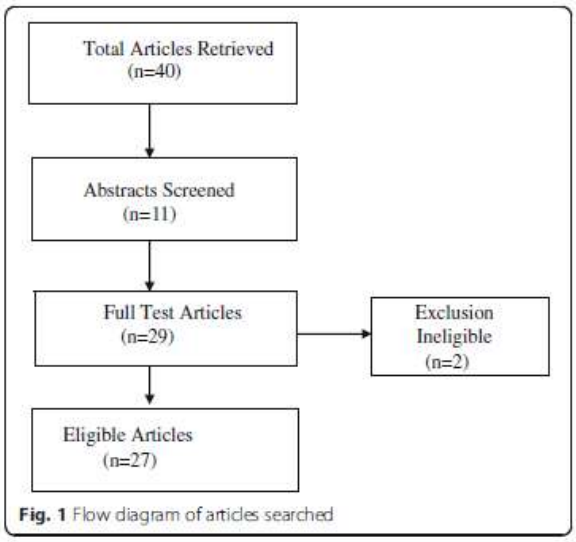


Fig. 1 Flow diagram of articles searched

Table 1 Included studies for literature review

Country/ Author(s)	Settings	Sample and sampling technique	Trimester or gestational period	Design	Measure of PA	Main Findings
South Africa [55]	Soweto (Urban)	13 purposively selected participants aged 19–41 years	3rd (29–33 weeks)	Qualitative	Indirect measure: Semi-structured interviews	• Demonstrated positive beliefs about PA, but participants remained inactive during the prenatal period. • PA limitations included lack of time, lack of finances and inadequate information from healthcare providers. • There was also an absence of social support network to facilitate PA participation. • Findings suggested a holistic approach to improve PA compliance during pregnancy, inclusive of PA education and exercise opportunities within a community setting.
South Africa [56]	Vanguard, Western Cape (Urban)	34 stratified randomly selected participants, aged 17–36 years	All	Qualitative exploratory study	Indirect measure: Interview	• Pregnant women showed an interest in participating in PA during pregnancy and requested more information and a possible intervention programme. • Participants were aware of the benefits of being physically active during pregnancy, but knowledge levels varied. • Participants were unsure of the types of PA recommended for safe practice in pregnancy. • Participants said that they did not receive PA-related advice and information from health care providers. • Participants expressed interest in PA clubs or antenatal PA classes for accessibility to safe and regular PA.
Ethiopia [58]	Mekelle	299 (16–36 years)	All	Cross-sectional	Indirect measure: PPAQ	• Only 8.4% women met the international recommended guideline for PA during pregnancy. • Age group of 26–35 years (AOR: 2.69, 95% CI: 1.07–6.78), attending non-formal education (AOR: 13.50, 95% CI: 2.65–68.91), and unemployment (AOR: 5.23, 95% CI: 1.34–20.38) were significantly associated with a higher risk of sedentary activity status. • Being married (AOR: 0.26, 95% CI: 0.09–0.73), having two children (AOR: 0.13, 95% CI: 0.03–0.59), and traveling an hour or more to health facilities (AOR: 0.31, 95% CI: 0.11–0.89) were significant positive predictors of physical activity participation. • Majority (70.6%) received advice about PA from health professionals • Most common reported reason for not exercising during pregnancy was fear of miscarriage.

Table 1 Included studies for literature review *(Continued)*

Country/ Author(s)	Settings	Sample and sampling technique	Trimester or gestational period	Design	Measure of PA	Main Findings
						• Walking was the most commonly reported mode of exercise (86.3%).
Ethiopia [59]	Tigray	442 (18–38 years)	Not stated	Cross-sectional	Self-administered questionnaire	• Majority (78.1%) of the women were physically active • Generally, expended less total energy during pregnancy 141.23 MET-h/week • Expended highest amount of energy (69.4 MET-h/weeks) on household activities • Primiparous women were 7.68 times more likely to be inactive as compared to multiparous women • Education level of mothers had significant association with women's level of physical activity during pregnancy • Women with history of miscarriage had 8.05 times higher odds of becoming physically inactive during pregnancy as compared to those without history of miscarriage [AOR = 8.045; 95% CI (3.325, 19.465)).
Nigeria [86]	Ibadan (Urban)	453 conveniently selected participants (mean age: 30.89 ± 4.44 years)	2nd & 3rd	Cross-sectional	Indirect measure: PPAQ	• Half the participants were sedentary. • Most of the energy expended by the pregnant women was on household chores. • Number of children, stage of pregnancy, gravidity and employment status had a significant influence on the physical activity levels of the pregnant women. • Increased number of children and gravidity, and advanced stage of pregnancy, significantly predicted increased likelihood of being sedentary.
Nigeria [87]	Ile-Ife (Urban)	189 consecutively selected (mean age: 28.9 ± 4.63 years)	All	Cross-sectional	Indirect measure: Self-administered questionnaire	• Most women had knowledge of pelvic floor muscle strengthening, back care, relaxation and breathing exercises from antenatal exercises. • Swimming and cycling were not known as antenatal exercises. • Most women affirmed antenatal exercises reduced back pain, promoted ability to cope with labour and delivery, and prevented excessive weight gain. • Knowledge about the benefits of antenatal exercises was not influenced by maternal sociodemographic characteristics, but age was found to significantly influence knowledge about contraindications to antenatal exercises. • Knowledge of exercise during pregnancy was influenced mostly

Table 1 Included studies for literature review *(Continued)*

Country/ Author(s)	Settings	Sample and sampling technique	Trimester or gestational period	Design	Measure of PA	Main Findings
						by tiredness, lack of will to exercise, and insufficient information on exercise. • The majority of pregnant women demonstrated inadequate knowledge about antenatal exercises. However, the women had positive attitudes towards exercise.
Ethiopia [88]	Jimma (Urban)	304 conveniently selected participants aged 20–27 years	All	Cross-sectional	Direct measure: Combined Uniaxial Accelerometer and Heart Rate Sensor	• Overall level of PA was low-AEE (kJ/kg/day) and PAL • Most women spent most of their time in sedentary and light intensity activities, with small amounts of moderate to vigorous activity. • Gestational age and degree of adiposity were both independently associated with lower activity and fitness levels, while muscle mass was independently associated with higher activity and muscular fitness levels.
Burundi [91]	Rural/Urban	150 conveniently selected participants aged 18–40 years	All	Quantitative	Indirect measure: Self-administered questionnaire	• Most participants adopted sedentary lifestyles during pregnancy (88.0%), and had a negative view of exercise and PA during pregnancy (84.6%).
Egypt [92]	Kafrelsheikh (Urban)	20 healthy pregnant women aged 20–25 years	2nd & 3rd (20–36 weeks' gestation)	Randomised, controlled trial (RCT)	Direct measure: Pelvic floor muscle (PFM) using Peritron® to measure vaginal squeeze pressure	• Significant differences between both groups in mean PFM at 36 weeks gestation (WG); and a significant correlation between PFM strength at 36 WG and mode of delivery (vaginal delivery; $r = 0.58$, $p < 0.05$; caesarean delivery; $r = -0.49$, $p < 0.05$). • Recommended pelvic floor muscle exercises for health during pregnancy as a safe and inexpensive strategy for increasing the vaginal delivery rate.
Egypt [93]	Cairo (Urban)	100 (50 control group; 50 intervention group). Age: 20–35 years	Not stated	Prospective, interventional and controlled	Direct measure: Supervised exercises (aerobic, stationary cycling, treadmill walking, stretching, pelvic curls, tailor press back bridge, crunches)	• Exercise group exhibited significant improvement in depressive symptoms after the aerobic exercise programme compared to baseline ($p < 0.001$), while the control group demonstrated no significant change over time. • Supervised exercise during pregnancy has a positive effect on antenatal depression as a primary and secondary preventive strategy.
Egypt [94]	Aswan (Urban)	360 (Mean age: 25.± 2.4 years)	10–39 weeks gestation	Prospective Cohort	Direct measure: Supervised regular walking 5 times per week for 30 minutes	• Regular walking significantly reduced the occurrence of preeclampsia (OR = 0.120, 95% CI; 0.015–0.970; $p = 0.037$), postdate pregnancy (OR = 0.274; 95% CI =

Table 1 Included studies for literature review *(Continued)*

Country/ Author(s)	Settings	Sample and sampling technique	Trimester or gestational period	Design	Measure of PA	Main Findings
						0.099–0.759; p = 0.008), excessive weight gain (OR = 0.220; 95% CI = 0.114–0.424; p = 0.000) and caesarean delivery (OR = 0.519; 95% CI = 0.316–0.841; p = 0.007). • Only a small proportion of pregnant women engaged in moderate to high (1.2%) PA during pregnancy.
Egypt [95]	Urban	60 participants, randomly assigned to 30 in the control group and 30 in the intervention group	2nd and 3rd (≥ 14 weeks gestation)	Clinical control trial	Direct measure: Supervised antenatal exercises	• Exercises had no effect on the mode of delivery and maternal activity during gestation in both groups. • Antenatal exercise is very effective in decreasing adverse effects in older primigravida and their offspring.
Egypt [96]	Cairo (Urban)	40 (Age: 25–35 years)	2nd (20–24 weeks)	Prospective, interventional and controlled	Direct measure: Walking on treadmill	• Moderate intensity aerobic exercises were effective in reducing fasting blood glucose and fasting insulin levels in pregnant women at risk of gestational diabetes mellitus in both interventional and control groups.
Egypt [97]	Urban	64		Quasi-experimental prospective study	Indirect measures: Structured interviewing, questionnaire	• Stretching and physical exercise in women with mild preeclampsia promoted positive foetomaternal outcomes and did not pose greater maternal or neonatal risks than among those who did not practice.
Kenya [98]	Kakamega County	306 conveniently selected participants aged 15–40 years	All	Descriptive survey	Indirect measure: Self-administered questionnaire	• About 17% did not know that exercise is useful in pregnancy. • Participants indicated exercise prevented incontinence (80.4%), decreased risk of preeclampsia (71.6%), and decreased risk of gestational diabetes (65.7%) and hypertension (68.6%) • Strong association between the level of education and knowledge on the role of exercise during pregnancy (X^2 = df; 3 = 39.109;p = 0.02)
Kenya [99]	Rongo (Rural)	100 (Age: ≤19–45 ≥ years)	2nd & 3rd	Longitudinal	Indirect measure: International Physical Activity Questionnaire	• Women dedicated 78% of their time to physical work and only 22% to leisure activities per day. • On average, women were active in their 2nd trimester as well as their 3rd trimester of pregnancy. • Habitual PA of pregnant women in the setting included domestic, productive and leisure activities. • Daily energy expenditure was relatively high
Nigeria [100]	Maiduguri (Urban)	398 randomly selected participants 18- >30 years	All	Analytic cross-sectional survey	Indirect measure: Pregnancy Physical Activity Questionnaire (PPAQ)	• Most (86.4%) pregnant women did not participate in PA, and only 14.6% achieved the recommended levels of PA. • PA significantly decreased from 1st trimesters to 2nd and 3rd

Table 1 Included studies for literature review *(Continued)*

Country/ Author(s)	Settings	Sample and sampling technique	Trimester or gestational period	Design	Measure of PA	Main Findings
						trimesters. • Sport/exercise was associated with enhanced physical health and health-related quality of life (HQoL) ($r = 0.142, p < 0.01$). • Pregnant women with sufficient PA were four times more likely to report a high quality of life, physically (OR: 4.33, 95%, CI: 1.36–13.80) • The study recommended sports/ exercise as an important aspect of PA to prevent delivery interventions and improve the physical wellbeing of pregnant women, at least in that setting.
Nigeria [101]	Osun State, south west (Urban)	289 purposively selected participants (mean age: 29.8 ± 5.11 years)	All	Cross-sectional	Indirect measure: PPAQ	• Most participants were involved in light intensity and household PA (1263.6 ± 633.4) and low levels of vigorous intensity PA (6.4 ± 6.8) • Both the mean of participation and the occupational PA were highest in the 2nd trimester. • The 3rd trimester had the highest mean fatigue score. • There was a significant relationship between pregnancy-related fatigue and physical activity.
Nigeria [102]	Enugu (Urban)	350 purposively selected participants	All	Longitudinal cohort	Indirect measure: Self-administered questionnaire	• The majority (82.9%) of the participants practised antenatal exercise, particularly aerobic exercises (76.2%). • The majority exercised less than five days a week (70.0%) and ≥ 30 minutes daily (63.4%). • Most exercised based on self-prescription (39.0%). • Antenatal exercise practice and patterns did not improve postpartum health-related quality of life. • The study recommended improved education and supervision of antenatal exercise for better postpartum health outcomes.
Nigeria [103]	Owerri (Urban)	70 (simple random assignment into exercise and control groups)	2nd (20 weeks gestation)	Randomised, controlled trial	Direct measure: Borge Rating of Perceived Exertion (RPE)	• Exercise in pregnancy significantly lengthened period of gestation. • Exercising women were more likely to carry their pregnancies to full term than those who did not exercise. • Exercise could serve as a means of preventing preterm births.
Nigeria [104]	Urban/Rural	361		Cross-sectional	Indirect measure: Questionnaire	• Pregnant and nursing women demonstrated high engagement in physical exercise, which was undertaken by self-prescription. • Higher education is a significant determinant of exercise participation during pregnancy in Nigeria.

Table 1 Included studies for literature review *(Continued)*

Country/ Author(s)	Settings	Sample and sampling technique	Trimester or gestational period	Design	Measure of PA	Main Findings
Nigeria [105]	Urban	30 (n = 16 control group; n = 14 intervention group) randomly selected participants aged 18–45 years	Not stated	Intervention study	Direct measure: Supervised aerobic exercises	• The study showed that aerobic exercises combined with education on sleep hygiene significantly reduced levels of insomnia and fatigue in pregnant women, which was not possible with the use of education only.
South Africa [106]	Soweto (Urban)	332 (Mean age: 29.5 ± 5.8 years)	2nd & 3rd (14–33 weeks gestation)	Longitudinal cohort	Indirect Measure: Global Physical Activity Questionnaire (GPAQ)	• Half of the women were classified as being active in the 2nd trimester, however, significantly fewer women participated in PA in the 3rd trimester • Total PA decreased significantly as the pregnancy progressed. • Walking for transport constitutes 80% of the total MVPA. • The study showed that pregnant women spent an average of five hours per day sitting.
South Africa [107]	Soweto (Urban)	210 (Mean age: 30.4 ± 5.8 years)	2nd & 3rd (14–33 weeks)	Observational, longitudinal study	Direct measure: Hip-worn triaxial accelerometer (ActiGraph GT3X+, ActiGraph, Pensacola, FL)	• Significant decline in PA from 2nd to 3rd trimester (12.8 ± 4.1 mg vs. 9.7 ± 3.6 mg, $p < 0.01$) with a high prevalence of overweight/obesity and HIV. • PA at 29–33 weeks and changes in PA were inversely associated with weight change at 29–33 weeks ($\beta = 0.24$; 95% CI-0.49; -0.00; $p = 0.05$ and $\beta = -0.36$; 95% CI-0.62; -0.10; $p = 0.01$, respectively) • No significant associations between PA and birth outcomes.
South Africa [108]	Vhembe, Ngovhela (Rural)	59 randomly selected participants aged < 18->30 years	2nd & 3rd	Cross-sectional	Indirect measure: Self-administered questionnaire	• Women demonstrated an average knowledge of types of antenatal exercises, their benefits and contraindications. • Women had no knowledge of pelvic floor exercises. • Antenatal exercise participation was low.
Zambia [109]	Lusaka (Urban)	300 (Mean age: 29.4 years)	All	Cross-sectional survey	Indirect measure: Self-administered questionnaire	• Exercise practice was significantly associated with level of education. • Most of the participants exhibited inadequate levels of knowledge on ideal exercises during pregnancy. • Most reported a lack of knowledge on how to perform antenatal exercises, feelings of fatigue and general discomfort as barriers to exercises participation. • Walking was identified as the most common type of exercise performed by the women. • Participants did not know any specific antenatal exercises; consequently, they were not able to practise correct exercises during pregnancy.

Table 1 Included studies for literature review *(Continued)*

Country/ Author(s)	Settings	Sample and sampling technique	Trimester or gestational period	Design	Measure of PA	Main Findings
Ethiopia [110]	Butajira	247 (15–45 years)	3rd (31–34 weeks	Community-based prospective cohort study	Indirect measure: Global Physical Activity Questionnaire	• About 47.2% women engaged in vigorous physical activities • Low birthweight at term was significantly associated with vigorous physical activity (AOR = 2.48; CI: 1.01–6.09), prolonged standing (AOR = 3.37; CI: 1.14–9.93), and squatting (AOR = 2.61; CI: 1.04–6.54)

RCT Randomised Control Trial; *PPAQ* Pregnancy Physical Activity Questionnaire

97, 105], thirteen were cross-sectional studies [58, 59, 86–88, 91, 98, 100, 101, 104, 108–110], four were longitudinal studies [99, 102, 106, 107], four were randomised controlled trials [92, 95, 96, 103] and two were qualitative exploratory study [55, 56].

Most studies were carried out in Nigeria [86, 87, 100, 102–104], six were conducted in Egypt [92–97], five in South Africa [55, 56, 106–108], two in Kenya [98, 99], four in Ethiopia [58, 59, 88, 110], one each in Burundi [91], and Zambia [109]. The majority of the studies were conducted in urban regions [55, 56, 58, 86–88, 92–97, 100–103, 105–107, 109], three were in rural areas [98, 99, 108], and two were conducted in a combination of urban/rural settings [91, 101, 110].

Trimester or gestational period

Ten studies focused on the second trimester of pregnancy [86, 88, 92, 94–96, 99, 103, 107, 108] nine studies assessed women in the third trimester of pregnancy (87, 89,93,95,96,98,100,108,109] and nine studies (57,89,92, 99,101,102,103,107,110] included all the trimesters or the entire gestational period. Three studies did not state the gestational stage [59, 93, 105].

Level of physical activity participation during pregnancy.

Some of the studies across all trimesters reported declines in PA activity during pregnancy as the pregnancy progressed [59, 99–101, 106, 107]. Regardless of the gestational stage, levels of PA participation were generally low [86, 88, 91, 100, 101, 108].

Types of physical activity participation

The types of PA participation among pregnant women varied across studies and different geographical settings. Most studies reported that pregnant women engaged primarily in sedentary activities (sitting, household chores) [59, 86, 88, 99, 101, 106], walking [94, 106, 109], jogging, aerobics [102], floor exercises, Two studies reported pregnant women had little knowledge concerning the types and benefits of PA participation during pregnancy [98, 101, 109], but at the same time exhibited positive attitudes towards exercise [101].

Factors affecting physical activity participation during pregnancy

Several factors influencing PA during pregnancy are summarised in the review (Table 1). Studies cited lack of time [55], lack of finances [55], lack of knowledge and inadequate information from healthcare providers [55, 56, 59, 109], feelings of tiredness [109] and the absence of social support [55] as factors affecting PA participation during pregnancy. One study found that number of children, stage of pregnancy, gravidity and employment status had a significant influence on levels of physical activity during pregnancy [6].

Beliefs about and benefits of physical activity during pregnancy

Regarding beliefs about and benefits of PA participation, two studies reported that participants had positive beliefs about PA and exercise during pregnancy [55, 88] and two studies reported that participants had negative perceptions of PA and exercise during pregnancy [91, 98, 108]. Three studies reported that exercise prevents incontinence, decreases risk of preeclampsia [94], decreases risk of gestational diabetes [92, 98, 103], hypertension [107] and excessive weight gain [87, 94], decreases the risk of caesarean delivery [87, 94], prevents preterm births [103] and improves depressive symptoms [93]. Two studies found no significant association between PA and birth outcomes [95, 107].

Advice or counselling from health professionals on physical activity participation during pregnancy

Two studies reported that the information provided by health professionals on PA during pregnancy was inadequate [55, 56]. One study stated that pregnant women exercised based on self-prescription [107].

Physical activity interventions

Some studies highlight intervention measures for promoting PA during pregnancy. One study recommended pelvic floor muscle exercises during pregnancy as a safe and inexpensive strategy for increasing the vaginal delivery rate [92], two studies recommended the provision of education and supervision during antenatal exercises for better postpartum health outcomes [55, 93, 102], and one study recommended the provision of PA and exercise opportunities in the community setting [55].

Discussion

In this narrative literature review, we determined the level of PA or exercise participation during pregnancy in Africa, including types of PA, factors affecting PA, beliefs about and benefits of prenatal activity, advice or counselling on PA during pregnancy in Africa, and lastly, PA interventions proposed to promote the uptake of prenatal PA. We found low and patchy levels of knowledge regarding the benefits and types of antenatal exercise that are recommended for pregnant women. Most pregnant women engaged primarily in sedentary activities (sitting, household chores), had little knowledge concerning the types and benefits of PA participation during pregnancy, but at the same time exhibited positive attitudes towards exercise. In addition, lack of time, lack of finances, lack of knowledge and inadequate information from healthcare providers, feelings of tiredness and the absence of social support were factors affecting PA participation during pregnancy. Pregnant women have mixed beliefs about PA participation and its benefits and the information provided by health professionals on PA during pregnancy was inadequate. Intervention measures for promoting PA during pregnancy included the provision of education and supervision during antenatal exercises for better postpartum health outcomes, and provision of PA and exercise opportunities in the community setting. Overall, our findings resonate with findings in other studies on prenatal PA showing low participation in PA during pregnancy, a decline in PA as the pregnancy progresses, amidst lack of PA advice from health providers; it also adds to calls to initiate interventions to encourage and promote PA during pregnancy in the antenatal health care continuum. The findings from this review highlight the need to design interventions that would address the reasons for inactivity during pregnancy. The onus relies on the healthcare providers and policy makers to integrate prenatal activity as part of the antenatal health care service. Pregnant women ought to be educated on the importance of PA for maternal and fetal health; they also need support and motivation to engage in PA during pregnancy. Inter-collaborative support of health providers, partner, family members, friends and organisations is desirable to promote physical activity in the community.

Most of the studies reported low and decreasing levels of PA during pregnancy in Africa [86, 88, 91, 94, 100, 101, 106–108]. This finding is consistent with other studies conducted in different countries, using varying methodological designs and methods for assessing PA, which also observed that few women exercise or participate in PA during pregnancy [48, 52–54, 111]. Reasons for and against participation in PA and exercise varied across countries and was shaped by context-specific factors. Muzigaba et al.'s [56] study on the perceived role and influencers of physical activity among pregnant women from low socioeconomic parts of urban communities reported that 44% of pregnant women in South Africa were physically inactive during pregnancy. Notably, in most developing countries, including Africa, the wave of epidemiological and nutritional transition has changed the lifestyle and the behaviour of people drastically, due to both modernisation and urbanisation, thereby promoting physical inactivity and associated health risks [112]. Understanding the factors influencing PA participation during pregnancy in the African context is important for the development of effective maternal health promotion strategies.

Across studies, types of PA varied across geographical settings. Our review indicate that most pregnant women in Africa participated in light-intensity and household activities [59, 86, 88, 99, 101, 106]. Other studies conducted outside Africa have reported household and occupational activities as the most predominant prenatal activities in pregnancy in China [48, 82], Taiwan [113], Portugal [114], Serbia [57], and Brazil [53]. Anecdotally, in innumerable communities in Africa, pregnant women work extraordinarily long hours in a variety of physically demanding tasks. The predominant means of economic survival, particularly in rural African settings, is subsistence farming and petty trading. Besides this, pregnant women work on farms, care for domestic animals and perform numerous household chores such as caring for children and elders, fetching water, collecting firewood, preparing meals and washing clothes. However, these activities alone are insufficient to produce the desired health benefits. Worryingly, some cultures prevent pregnant women from engaging in any form of physical activity because of cultural or religious beliefs. Given the indisputably positive effects of PA and exercise on maternal health outcomes, there is a need to provide health education or awareness on the importance of PA during pregnancy among reproductive-aged women in order to improve the health of the mother and child. Research to explore the cultural or religious imperatives of PA or exercise during pregnancy in some African cultures is imperative. Currently, few such studies exist.

This narrative review study highlighted the barriers to PA participation among pregnant women in Africa. From an African perspective, an in-depth understanding of the underlying factors preventing wholehearted PA participation among pregnant women might yield important insights about approaches and areas of emphasis in intervention programmes. Such an understanding might go a long way toward improving participation, and might suggest feasible options for the promotion of sustained physical activity and exercise during pregnancy. The findings of this review demonstrate that pregnant women in Africa, primarily do not engage in physical activity because of a lack of time [55], and a lack of knowledge and inadequate information from the healthcare providers [55, 56, 59, 109]. Other studies have reported similar findings elsewhere, indicating a lack of time [60, 115–117], and inadequate knowledge about physical activity [10, 118, 119]. In addition, age, the number of children, stage of pregnancy, and lower level of education, and employment status significantly influenced the level of physical activity during pregnancy in Africa [59, 85, 86, 98, 104, 109]. This proved consistent with other studies that reported age [120], low education [53, 57, 121], pregnancy trimester [122, 123], and employment [121] as correlates affecting physical activity during pregnancy. Women who attain higher level of education are more knowledgeable about PA during pregnancy [48, 59]. Interventions to educate women with lower education are imperative to encourage women to participate in prenatal activity.

Consistent with studies conducted elsewhere, this review found that low maternal knowledge of the benefits of PA during pregnancy [59, 124, 125], pregnancy symptoms/discomforts [3, 61, 62], multiparity [63], fatigue or lack of strength [3, 61], lack of time [3, 61, 67], lack of motivation and self-confidence [64, 65, 67] and fears or safety concerns [62, 66] all hinder PA participation during pregnancy. Interpersonal (social) barriers are cultural and religious beliefs [66], lack of social support [61, 67], and other responsibilities [61, 68]. Some studies have reported environmental barriers to PA during pregnancy, citing lack of access to facilities or resources [67, 69] and bad weather conditions [3, 61, 67]. Clearly, lack of information, motivation, and support for PA or exercise during pregnancy are general barriers, which may be addressed by providing regular advice and counselling on safety, benefits, and types of PA recommended during pregnancy. Health professionals should undertake this as part of antenatal or maternity health care. Understanding other country and regional-specific factors affecting PA during pregnancy is crucial, since contextual knowledge forms a component of quality antenatal and obstetric healthcare services to this special population in Africa. Africa-based information of this kind is scant.

The finding of this review study demonstrated contrasting beliefs about PA and exercise during pregnancy. Whilst two studies indicated pregnant women had positive beliefs about PA and exercise during pregnancy [55, 87], three studies reported opposite perceptions about physical activity and exercise during pregnancy [91, 98, 108]. Beliefs are subjective in nature and vary between cultures. Providing women with the relevant prenatal physical activity advice and recommendations may change their negative perceptions about physical activity and possibly propel them toward engaging in physical activity during pregnancy. Advocacy on the benefits of physical activity during pregnancy is warranted. Interestingly, some of the studies reported women affirming the benefits of physical activity. The majority of studies cited participation in physical activity as helping to decrease the risk of gestational diabetes [92, 98, 103], excessive weight gain [87, 94], and also decreasing the risk of caesarean delivery [87, 94]. The regular prenatal physical activity has physical and psychological health benefits to the pregnant mother. Elsewhere, studies have shown that physically active pregnant women are less likely to exhibit excessive gestational weight gain [3–5], are at reduced risk of gestational diabetes mellitus [1, 6–9], and of developing preeclampsia [10–14]; the forementioned being factors that are likely to have long-term adverse effects on the mother and the child [126, 127]. Other health benefits include reduction of fatigue, stress, anxiety and depression [10–12, 22–26], and reduced lower back pain [10–12, 27]. Despite these health benefits accruable from being physically active during pregnancy, prenatal physical activity of women, in Africa, is reportedly low. Viewed from the clinical and health standpoint, it is important to encourage pregnant women in Africa to participate in PA to promote maternal health outcomes.

Our review indicates that inadequate information from health professions on PA during pregnancy [55, 56] is a factor preventing participation in PA. Also, pregnant women tended to exercise based on self-prescription [102]. Given the beneficial effects of PA on pregnancy outcomes, there is need to encourage and provide proper, safe and sustainable guidelines on PA during pregnancy. Providing information about the advantages of PA during pregnancy and making women aware of existing PA guidelines is important to give women a good understanding of their condition and inform their decision-making. Healthcare providers are important sources of support for PA during pregnancy [67, 128]. They have a crucial role, which includes clarifying the benefits and emphasising the importance of PA during pregnancy [10]. However, as reported in other studies, healthcare providers in Africa provide little or no information regarding PA during pregnancy [116, 129–131].

Watson et al. [55] conducted a study involving urban South African pregnant women, finding that health professionals seldom provide advice or counselling on PA or exercise during pregnancy. Some pregnant women and obstetric care providers are uncertain whether prenatal PA increases the risk of miscarriage, or causes growth restriction, preterm birth, fatigue or harm to the foetus, an uncertainty which constitutes a barrier to being active [132]. Due to this lack of information from professionals, many pregnant women turn to family, friends or the media for advice regarding pregnancy. Healthcare providers are the gatekeepers of accurate information among communities, and can have a strong influence on healthy and safe physical activity levels among pregnant women. The growing rise of non-communicable diseases in Africa warrants the prioritisation of PA counselling in antenatal clinics. Therefore, health professionals working in maternity units should integrate physical activity counselling in the antenatal routine healthcare visit of women. Providing awareness on the importance of PA during pregnancy would undoubtedly facilitate behavioural change. Empirical evidence on sources of information for PA during pregnancy in the context of pregnant women in Africa, where scant data exists, is important to guide PA healthcare interventions.

Some studies in this review recommended the provision of education and supervision during antenatal exercises for better postpartum health outcomes [55, 93, 102], and the provision of PA and exercise opportunities in the community setting [55] as interventionist approaches in promoting physical activity during pregnancy. Given the physical and psychological health benefits of regular physical activity, and when juxtaposed with the low prenatal inactivity of pregnant women in Africa as indicated in this review, interventions are needed to enhance the self-efficacy of pregnant women on increasing their physical activity [133]. Providing prenatal physical activity education to pregnant women is one among other intervention strategies to change the physical activity behaviour of women. Efforts to help pregnant women realise their goal in achieving sufficient physical activity are desirable. In this regard, health professionals working with pregnant women, amidst other specialist disciplines such as exercise physiologists, physiotherapists and biokineticists (who practise exclusively in South Africa and Nambia) in the provision of prenatal physical activity education need to be drawn in, and further provision of exercise programmes and social support within the community would also be helpful. Definably, biokineticists are clinical exercise specialists that prescribe individualised exercise and physical activity for rehabilitation and promotion of health and quality of life [134]. The interventions' components could include one-on-one physical activity during antenatal sessions at the health facilities [135, 136], sharing of information and advice through booklets, leaflets, or websites [135, 136], and a combination of both counselling sessions and information provision without the use of exercise classes [137]. Whatever the outcome of the intervention, it should be tailored to the needs and context of the pregnant woman. There is a scarcity of studies exploring interventions to promote physical activity in Africa; therefore, such studies are needed to guide and promote optimal participation in physical activity during pregnancy among women in Africa.

Limitations and strengths

The limitations of this review should be considered when interpreting the findings. First, the articles reviewed for inclusion were limited to published studies in the English language; it is possible that publications in other languages were not found due to the databases used. It should be noted that there are variations of findings between studies due to the heterogeneity of the methodology used in assessing physical activity and the reported physical activity outcomes; therefore, we reported the results cautiously and relied on what the authors of the included papers had reported. Specifically, the majority of the studies utilised indirect measures (self-reported) rather than objective measurements of PA; therefore, the issue of bias in the reported results cannot be ruled out. In addition, most of the studies were cross-sectional, and data derived from cross-sectional studies cannot establish PA patterns over time, and make it difficult to ascertain causality of the outcome variables. Longitudinal studies are needed to assess PA patterns of pregnant women during pregnancy in Africa. In this regard, the findings reported in these studies should be interpreted with caution. Nevertheless, the dearth of studies reporting on prenatal PA and health outcomes in African countries, calls for concerted research evaluating physical activity during pregnancy, bearing in mind the different cultural, socio-economic and geographic context of Africa. Such information may help to guide contextually tailored interventions to promote prenatal activity among women in Africa. In addition, based on these limitations, we cannot draw firm conclusions on the specific aims of the review and calls for more robust studies, and advocate for future research using objectively measured physical activity and methodological quality studies, which may help foster better data to inform policy and practice. Notwithstanding these limitations, this narrative review has strengths. To our knowledge, this is the first narrative review to comprehensively assess the dynamics of PA participation during pregnancy in Africa. Finally, this review provides quantitative and qualitative information on the level and

correlates of PA participation during pregnancy, including the beliefs, sources of information, perceived benefits, barriers and attitudes of pregnant women concerning PA and exercise participation in Africa. It also considers intervention strategies through descriptive statistics and narrative reporting. Due to the number of studies consulted, and their various geographical settings across Africa, the findings reported in this review paper may be considered comprehensive and reflective of the views of pregnant women in Africa. This review holds the promise of generating well-informed and country-or context-specific PA intervention programmes for pregnancy in Africa. Currently scarce empirical investigations exist on PA during pregnancy in the African context.

Conclusion and implications

The findings of this narrative review are worrying. Most pregnant women in Africa do not participate in PA during pregnancy, largely due to a lack of knowledge on types of PA and exercise recommended for pregnancy, and lack of knowledge regarding the benefits of PA during pregnancy. Generally, research on the levels and correlates of PA participation during pregnancy is scarce. The global call to prioritise PA participation among the general population naturally necessitates further studies on the actual status of PA among different groups and investigations into the factors that hinder and promote it in various settings. Research into these matters among pregnant women in Africa is particularly important because pregnancy is a stage in a woman's life that has far-reaching implications for her own life and the child. The possible adverse health outcomes associated with physical inactivity among pregnant women could have long-term effects on the already economically constrained and over-burdened healthcare systems of most African countries.

Abbreviations

ACOG: American College of Obstetricians and Gynaecologists; AEE: Activity Energy Expenditure; GPAQ: Global Physical Activity Questionnaire; MVPA: Moderate-to- Vigorous Physical Activity; PA: Physical Activity; PAL: Physical Activity Level; PFM: Pelvic Floor Muscle; PPAQ: Pregnancy Physical Activity Questionnaire; PPWR: Post Partum Weight Retention; RCT: Randomised Controlled Trial; RPE: Borge Rating of Perceived Exertion; WHO: World Health Organization

Acknowledgements

This work is based on the research supported wholly by the National Research Foundation of South Africa.

Authors' contributions

UBO coordinated the review, conducted the data extraction and analysis and the drafting of the paper. DTG conducted the search, data extraction, analysis and participated in the drafting of the paper. All authors read and approved the final manuscript.

Funding

UBO received a Doctoral Research Grant from National Research Foundation of South Africa.

Availability of data and materials

All data analysed are included in this article.

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Author details

[1]Department of Nursing Science, University of Fort Hare, 50 Church Street, 5201 East London, South Africa. [2]Department of Public Health, University of Fort Hare, 05 Oxford Street, East London, South Africa.

Received: 12 March 2020 Accepted: 18 November 2020
Published online: 25 November 2020

References

1. da Silva SG, Ricardo LI, Evenson KR, Hallal PC. Leisure time physical activity in pregnancy and maternal-child health: A systematic review and meta-analysis of randomized controlled trials and cohort studies. Sports Med. 2016;47(2):1–23.
2. Muktabhant B, Lawrie TA, Lumbiganon P, Laopaiboon M. Diet or exercise, or both, for preventing excessive weight gain in pregnancy. Cochrane Database Sys Rev. 2015;6:CD007145.
3. Whitaker KM, Wilcox S, Liu J, Blair SN, Pate RR. Pregnant women's perceptions of weight gain, physical activity, and nutrition using Theory of planned behaviour constructs. Behav Med. 2016;39(1):41–54.
4. Dipietro L, Evenson KR, Bloodgood B, Sprow K, Troiano RP, Piercy KL, et al. Benefits of Physical Activity during Pregnancy and Postpartum: An Umbrella Review. Med Sci Sports Exerc. 2019;51:1292–302.
5. Ruchat SM, Mottola MF, Skow RJ, Nagpal TS, Meah VL, James M, et al. Effectiveness of exercise interventions in the prevention of excessive gestational weight gain and postpartum weight retention: a systematic review and meta-analysis. Br J Sports Med. 2018;52(21):1347–56.
6. American College of Obstetricians and Gynaecologists. Physical activity and exercise during pregnancy and the postpartum period. Committee Opinion No 804 Obstet Gynaecol. 2020;135:e178–88.
7. Harrison AL, Shields N, Taylor NF, Frawley HC. Exercise improves glycaemic control in women diagnosed with gestational diabetes mellitus: A systematic review. J Physiother. 2016;62:188–96.
8. Russo LM, Nobles C, Ertel KA, Chasan-Taber L, Whitcomb BW. Physical activity interventions in pregnancy and risk of gestational diabetes mellitus: A systematic review and meta-analysis. Obstetr Gynaecol. 2015; 125(3):576–82.
9. Aune D, Schlesinger S, Henriksen T, Saugstad O, Tonstad S. Physical activity and the risk of preterm birth: A systematic review and meta-analysis of epidemiological studies. BJOG Int J Obstet Gynaecol. 2017;124:1816–26.
10. Thompson EL, Vamos CA, Daley EM. Physical activity during pregnancy and the role of theory in promoting positive behaviour change: A systematic review. J Sport Health Sci. 2017;6:198–206.
11. Harrison AL, Taylor NF, Nora Shields N, Frawley HC. Attitudes, barriers and enablers to physical activity in pregnant women: A systematic review. Physiother. 2018;64:24–32.
12. Puchalski S. Physical activity: Utilizing guidelines to promote health among pregnant women. J Pregn Reprod. 2017;1(2):1–3.
13. Catov JM, Parker CB, Gibbs BB, Bann CM, Carper B, Silver RM, et al. Patterns of leisure-time physical activity across pregnancy and adverse pregnancy outcomes. Int J Behav Nutr Phys Act. 2018;15:68–78.
14. Davenport MH, Ruchat SM, Poitras VJ, Garcia AJ, Gray CE, Barrowman N, et al. Prenatal exercise for the prevention of gestational diabetes mellitus and hypertensive disorders of pregnancy: A systematic review and meta-analysis. Bri J of sports med. 2018;52(21):1367–75.
15. Vamos CA, Flory S, Sun H, DeBate R, Bleck J, Thompson EL, et al. Do physical activity patterns across the life course impact birth outcomes? Matern Child Health J. 2015;19(8):1775–82.

16. Davenport MH, Meah VL, Ruchat S, Davies GA, Skow RJ, Barrowman N, et al. Impact of prenatal exercise on neonatal and childhood outcomes: A systematic review and meta-analysis. Br J Sports Med 2018; 52:1386–96.
17. Baker JH, Rothenberger SD, Kline CE, Okun ML. Exercise during Early Pregnancy is Associated with Greater Sleep Continuity. Behav Sleep Med. 2018;16:482–93.
18. American College of Obstetricians and Gynaecologists. Physical activity and exercise during pregnancy and the postpartum period. Committee Opinion No 650 Obstetr Gynaecol. 2017;126:e135–42.
19. Davenport MH, Marchand AA, Mottola MF, Poitras VJ, Gray CE, Jaramillo Garcia A, et al. Exercise for the prevention and treatment of low back, pelvic girdle and lumbopelvic pain during pregnancy: A systematic review and meta-analysis. Br J Sports Med. 2019;53:90–8.
20. Takami M, Tsuchida A, Takamori A, Aoki S, Ito M. Effects of physical activity during pregnancy on preterm delivery and mode of delivery: The Japan Environment and Children's Study, birth cohort study. PLoS ONE. 2018;13: e0206160.
21. Rajabi A, Maharlouei N, Rezaianzadeh A. Physical activities (exercises or choreses) during pregnancy and mode of delivery in nulliparous women: A prospective cohort study. Taiwan J Obstet Gynecol. 2018;57:18–22.
22. Davenport MH, McCurdy AP, Mottola MF, Skow RJ, MeahV I, Poitras VJ, et al. Impact of prenatal exercise on both prenatal and postnatal anxiety and depressive symptoms: A systematic review and meta-analysis. Br J Sports Med. 2018a;52:1376–85.
23. Cid M, González M. Potential benefits of physical activity during pregnancy for the reduction of gestational diabetes prevalence and oxidative stress. Early Hum Dev. 2016;94:57–62.
24. Vargas-terrones M, Barakat R, Santacruz B, Fernandez-buhigas I, Mottola MF. Physical exercise programme during pregnancy decreases perinatal depression risk: A randomised controlled trial. Br J Sports Med. 2018;53: 348–53.
25. Szegda K, Bertone-johnson ER, Pekow P, Powers S, Markenson G, Dole N, et al. Physical activity and depressive symptoms during pregnancy among Latina women: A prospective cohort study. BMC Preg Childbirth. 2018;18: 252–63.
26. Padmapriya N, Shen L, Soh SE, Shen Z, Kwek K, Godfrey KM, et al. Physical activity and sedentary behaviour patterns before and during pregnancy in a multi-ethnic sample of Asian women in Singapore. Matern Child Health J. 2015;19(11):2523–35.
27. Patrícia V, De Sousa S, Cury A, Eufrásio LS. The influence of gestational trimester, physical activity practice and weight gain on the low back and pelvic pain intensity in low risk pregnant women. J Back Musculoskelet Rehabil. 2019;32:671–6.
28. Barakat R, Pelaez M, Lopez C, Montejo R, Coteron J. Exercise during pregnancy reduces the rate of caesarean and instrumental deliveries: Results of a randomized controlled trial. J Maternal-Fetal Neonatal Med. 2012;25(11):2372–6.
29. Nascimento SL, Surita FG, Cecatti JG. Physical exercise during pregnancy: A systematic review. Current Opinion Obstetr Gynaecol. 2012;24(6):387–94.
30. Ramírez-Vélez R, Aguilar de Plata AC, Escudero MM, Echeverry I, Ortega JG, Salazar B, et al. Influence of regular aerobic exercise on endothelium-dependent vasodilation and cardiorespiratory fitness in pregnant women. J Obstetr Gynaecol Res. 2011;37:1601–8.
31. Nguyen CL, Pham NM, Lee AH, Nguyen PTH, Chu TK, Ha AVV. Physical activity during pregnancy is associated with a lower prevalence of gestational diabetes mellitus in Vietnam. Acta Diabetol. 2018;55:955–62.
32. Linne Y, Neovius M. Identification of women at risk of adverse weight development following pregnancy. Int J Obes (Lond). 2006;30:1234–9.
33. Siega-Riz AM, Viswanathan M, Moos MK, Deierlein A, Mumford S, Knaack J, et al. A systematic review of outcomes of maternal weight gain according to the Institute of Medicine recommendations: birthweight, fetal growth, and postpartum weight retention. Am J Obstet Gynecol. 2009;201:e1–14.
34. Seneviratne SN, McCowan LM, Cutfield WS, Derraik JG, Hofman PL. Exercise in pregnancies complicated by obesity: achieving benefits and overcoming barriers. Am J Obstet Gynecol. 2015 Apr;212(4):442–9.
35. Oken E, Taveras EM, Kleinman KP, Rich-Edwards JW, Gillman MW. Gestational weight gain and child adiposity at age 3 years. Am J Obstet Gynecol. 2007;196:322.
36. Sebire NJ, Jolly M, Harris JP, et al. Maternal obesity and pregnancy outcome: a study of 287, pregnancies in London. Int J Obes. 2001;25:1175–82.
37. Nohr EA, Bech BH, Davies MJ, Frydenberg M, Henriken TB, Olsen J. Prepregnancy obesity and fetal death: a study within the Danish National Birth Cohort. Obstet Gynecol. 2005;106:250–9.
38. Vasudevan C, Renfrew M, McGuire W. Fetal and perinatal consequences of maternal obesity. Arch Dis Child Fetal Neonatal Ed. 2011;96:F378-82.
39. Stothard KJ, Tennant PWG, Bell R, Rankin J. Maternal overweight and obesity and the risk of congenital anomalies: A systematic review and meta-analysis. JAMA. 2009;301:636–50.
40. Weiss JL, Malone FD, Emig D, et al. Obesity, obstetric complications and cesarean delivery rate: a population-based screening study. Am J Obstet Gynecol. 2004;190:1091–7.
41. Andreasen KR, Andersen ML, Schantz AL. Obesity and pregnancy. Acta Obstet Gynecol Scand. 2004;83:1022–9.
42. Rosenberg TJ, Garbers S, Chavkin W, Chiasson MA. Prepregnancy weight and adverse perinatal outcomes in an ethnically diverse population. Obstet Gynecol. 2003;102:1022–7.
43. Ehrenberg HM, Mercer BM, Catalano PM. The influence of obesity and diabetes on the prevalence of macrosomia. Am J Obstet Gynecol. 2004; 191:964–8.
44. Sha T, Cheng G, Li C, Gao X, Li L, Chen C, et al. Patterns of Women's Postpartum Weight Retention and Its Associations with Maternal Obesity-Related Factors and Parity. Int J Environ Res Public Health. 2019;16(22):4510.
45. Kramer MS, McDonald SW. Aerobic exercise for women during pregnancy. Cochrane Database Syst Rev. 2006;3:CD000180.
46. Santos IA, Stein R, Fuchs SC, et al. Aerobic exercise and submaximal functional capacity in overweight pregnant women: a randomized trial. Obstet Gynecol. 2005;106:243.
47. Rooney BL, Schauberger CW. Excess pregnancy weight gain and long-term obesity: One decade later. Obstet Gynecol. 2002;100(2):245–52.
48. Zhang Y, Dong S, Zuo Hu JX, Zhang H, Zhao Y. Physical activity level of urban pregnant women in Tianjin, China: A cross-sectional study. PLoS One. 2014;9(10):e109624.
49. Santo EC, Forbes PW, Oken E, Belfort MB. Determinants of Physical activity frequency and provider advice during pregnancy. BMC Pregn Childbirth. 2017;17:286.
50. Hesketh KR, Evenson KR. Prevalence of U.S. pregnant women meeting 2015 ACOG physical activity guidelines. Am J Prev Med. 2016;51(3):e87–9.
51. Huberty JL, Buman MP, Leiferman JA, Bushar J, Adams MA. Trajectories of objectively-measured physical activity and sedentary time over the course of pregnancy in women self-identified as inactive. Prev Med Reports. 2016;3:353–60.
52. Hayes L, Mcparlin C, Kinnunen T, Poston L, Robso SC, Bell R, et al. Change in level of physical activity during pregnancy in obese women: Findings from the UPBEAT pilot trial. BMC Pregn Childbirth. 2015;15:52.
53. Nascimento SL, Surita FG, Godoy AC, Kasawara KT, Morais SS. Physical activity patterns and factors related to exercise during pregnancy: a cross sectional study. PLoS One. 2015;10:e0128953.
54. Di Fabio DR, Blomme CK, Smith KM, Welk GJ, Campbell CG. Adherence to physical activity guidelines in mid-pregnancy does not reduce sedentary time: An observational study. Int J Behav Nutr Phy Act. 2015;12:27.
55. Watson ED, Norris SA, Draper CE, Jones RA, van Poppel MNM, Micklesfield LK. "Just because you're pregnant, doesn't mean you're sick!" A qualitative study of beliefs regarding physical activity in black South African women. BMC Pregn Childbirth. 2016;16:174.
56. Muzigaba M, Kolbe-Alexander TL, Wong F. The perceived role and influencers of physical activity among pregnant women from low socioeconomic status communities in South Africa. J Phy Act Health. 2014; 11(7):1276–83.
57. Todorovic J, Terzic-Supic Z, Bjegovic-Mikanovic V, Piperac P, Dugalic S, Gojnic-Dugalic M. Factors associated with the leisure-time physical activity (LTPA) during the first trimester of the pregnancy: The cross-sectional study among pregnant women in Serbia. Int J Environ Res Public Health. 2020;17:1366.
58. Hailemariam TT, Gebregiorgis YS, Gebremeskel BF, Haile TG, Spitznagle TM. Physical activity and associated factors among pregnant women in Ethiopia: Facility-based cross-sectional study. BMC Pregnancy Childbirth. 2020;20:92.
59. Gebregziabher D, Berhe H, Kassa M, Berhanie E. Level of physical activity and associated factors during pregnancy among women who gave birth in Public Zonal Hospitals of Tigray. BMC Res Notes. 2019;12:454.
60. Sytsma TT, Zimmerman KP, Manning JB, Jenkins SM, Nelson NC, Clark MM. Perceived Barriers to Exercise in the First Trimester of Pregnancy. J Perinat Educ. 2018;27:198–206.

61. Leppanen M, Aittasalo M, Raitanen J, Kinnunen TI, Kujala UM, Luoto R. Physical activity during pregnancy: Predictors of change, perceived support and barriers among women at increased risk of gestational diabetes. Matern Child Health J. 2014;18(9):2158–66.
62. Put W, Chuan S, Chan L. Physical activity in pregnancy: Attitudes and practices of Hong Kong Chinese women. Hong Kong J Gynaecol Obstetr Midwifery. 2015;15(2):138–47.
63. Da Costa D, Ireland K. Perceived benefits and barriers to leisure-time physical activity during pregnancy in previously inactive and active women. Women Health. 2013;53(2):185–202.
64. Koleilat M, Vargas N, Kodjebacheva G. Perceived barriers to physical activity during pregnancy among participants of the special supplemental nutrition program for women, infants and children (WIC) in Southern California. FASEB J. 2016;30(1 Supplement): 152.1.
65. Babbar S, Chauhan SP. Exercise and yoga during pregnancy: A survey. J Matern-Fetal Neonatal Med. 2015;28:431–5.
66. Chasan-Taber L. Physical activity and dietary behaviours associated with weight gain and impaired glucose tolerance among pregnant Latinas. Adv Nutr. 2012;3(1):108–18.
67. Sui Z, Turnbull D, Dodd J. Overweight and obese women's perceptions about making healthy change during pregnancy: A mixed method study. Matern Child Health J. 2013;17(10):1879–87.
68. Sujindra E, Bupathy A, Suganya A, Praveena R. Knowledge, attitude, and practice of exercise during pregnancy among antenatal mothers. Int J Edu Psychol Res. 2015;1(3):234–7.
69. Halse RE, Wallman KE, Dimmock JA, Newnham JP, Guelfi KJ. Home-based exercise improves fitness and exercise attitude and intention in women with GDM. Med Sci Sports Exer. 2015;47(8):1698–704.
70. Beckham AJ, Urrutia R, Sahadeo L, Corbie-Smith G, Nicholson W. "We know but we don't really know": Diet, physical activity and cardiovascular disease prevention knowledge and beliefs among underserved pregnant women. Matern Child Health J. 2015;19:1791–801.
71. Choi J, Lee JH, Vittinghoff E, Fukuoka Y. mHealth Physical Activity Intervention: A randomized pilot study in physically inactive pregnant women. Matern Child Health J. 2016;20:1091–101.
72. Bisson M, Croteau J, Guinhouya BC, Bujold E, Audibert F, Fraser WD, et al. Physical activity during pregnancy and infant's birth weight: results from the 3D Birth Cohort. BMJ Open Sport Exer Med. 2017;3(1):e000242.
73. Rhodes RE, Blanchard CM, Benoit C, Levy-Milne R, Naylor PJ, Downs SD, et al. Physical activity and sedentary behaviour across 12 months in cohort samples of couples without children, expecting their first child, and expecting their second child. J Behav Med. 2014;37(3):533–42.
74. Benison FC, Weir Z, Carver H, Norman JE, Reynolds RM. Physical activity in pregnant women with Class III obesity: A qualitative exploration of attitudes and behaviours. Midwifery. 2015;31(12):1163–7.
75. Padmanabhan U, Summerbell CD, Heslehurst N. A qualitative study exploring pregnant women's weight-related attitudes and beliefs in UK: The BLOOM study. BMC Pregn Childbirth. 2015;15(1):99.
76. Poston L, Briley AL, Barr S, Bell R, Croker H, Coxon K, et al. Developing a complex intervention for diet and activity behaviour change in obese pregnant women (the UPBEAT trial): assessment of behavioural change and process valuation in a pilot randomised controlled trial. BMC Pregn Childbirth. 2012;13:148.
77. da Silva SG, Evenson KR, da Silva ICM, Mendes MA, Domingues MR, da Silveira MF, et al. Correlates of accelerometer-assessed physical activity in pregnancy—The 2015 Pelotas (Brazil) Birth Cohort Study. Scand Med Sci Sports. 2018;28:1934–45.
78. Poyatos-León R, Sanabria-Martínez G, García-Prieto JC, Álvarez-Bueno C, Pozuelo-Carrascosa DP, Cavero-Redondo I, et al. A follow-up study to assess the determinants and consequences of physical activity in pregnant women of Cuenca, Spain. BMC Publ Health. 2016;16:437.
79. Fantuzzi G, Righi E, Aggazzotti G. A case-control study on leisure time physical activity (LTPA) during the last three months of pregnancy and foetal outcomes in Italy. Health. 2016;8:133–43.
80. Mishra S, Kishore S. Effect of physical activity during pregnancy on gestational diabetes. Ind J Endocrinol Metabol. 2018;22(6):866.
81. Mendinueta A, Esnal H, Arrieta H, Arrue M, Urbieta N, Ubillos I, et al. What accounts for physical activity during pregnancy? A study on the sociodemographic predictors of self-reported and objectively assessed physical activity during the 1st and 2nd trimesters of pregnancy. Int J Environ Res Public Health. 2020;17:2517.
82. Yin Y, Huang Y, Liu X, Luo B. Assessment of physical activity status among pregnant women in southwestern China. Frontiers of Nursing. 2019;6:135–41.
83. Walasik I, Kwiatkowska K, Szymusik I. Physical Activity Patterns among 9000 Pregnant Women in Poland: A Cross-Sectional Study. Int J Environ Res Public Health. 2020;17:1771.
84. Mukona D, Munjanja SP, Zvinavashe M, Stray-Pederson B. Physical activity in pregnant women in Africa: A systematic review. Int Nur Midwifery. 2016;8(4):28–34.
85. Brunette EL, Kotze J, Wood PS, Du Toit PJ, Grant CC. An epidemiological study of physical activity patterns and weight gain in physically active and sedentary pregnant women in Tshwane, South Africa. Afr J Phy Health Edu Recrea Dance. 2012;Supplement(March):132–43.
86. Adeniyi AF, Ogwumike OO, Osinike CI. Physical activity and energy expenditure: Findings from the Ibadan pregnant women's survey. Afr J Reprod Health. 2014;18(2):117–26.
87. Mbada CE, Adebayo OE, Adeyemi AB, Arije OO, Dada OO, Akinwande OA, et al. Knowledge and attitude of Nigerian pregnant women towards antenatal exercise: A cross sectional survey. Obstetr Gynecol. 2014;1:8.
88. Hjorth MF, Kloster S, Girma T, Faurholt-Jepsen D, Andersen G, Kæstel P, et al. Level and intensity of objectively assessed physical activity among pregnant women from urban Ethiopia. BMC Pregn Childbirth. 2012;12:154.
89. Gronwald T, Budde H. Commentary. Physical Exercise as Personalized Medicine for Dementia Prevention? Front. Physiol. 2019;10:726.
90. Herold F, Törpel A, Schega L, Müller NG. Functional and/or structural brain changes in response to resistance exercises and resistance training lead to cognitive improvements—A systematic review. Eur Rev Aging Phys Act. 2019;16:1676.
91. Ngayimbesha A, Berchmans BJ, Stella GM, Nzisabira F. Active lifestyle among pregnant women in Burundi. Am J Sports Sci. 2018;6(3):74–7.
92. El-Shamy FF, EL-Fatal EA. Effect of antenatal pelvic floor muscle exercise on mode of delivery: a randomised control trial. Integr Med Int. 2017;4:187–97.
93. EL-Rafie MM, Khafagy GM, Gamal MG. Effect of aerobic exercise during pregnancy on antenatal depression. Int J Women's Health. 2016;8:53–7.
94. Shady NW, Sallam HF, Ali SS, Abbas AM. The effect of regular daily walking on adverse pregnancy outcomes among overweight primigravidas: a prospective cohort study. Proceedings Obstetr Gynaecol. 2017;7(3):2–9. .
95. Gehan AA, Khadiga SA, Amir GA, Eman A. Efficacy of antenatal exercises on maternal and neonatal outcomes in elderly primigravida. Kasr Al Ainy Med J. 2015;21:109–14.
96. Embay H, Elsayed E, Fawzy M. Insulin sensitivity and plasma glucose response to aerobic exercise in pregnant women at risk for gestational diabetes mellitus. Ethiop J Health Sci. 2016;26(5):409–14.
97. Sahar MY. Impact of physical stretching exercise on feto-maternal outcomes among mild preeclamptic pregnant women in Egypt. Am J Nurs Sci. 2016; 5(3):114–21.
98. Sabiri E, Olutende OM, Wabuyabo IK, Vurigwa E. Knowledge of prenatal exercise among expectant women from selected health facilities, Kakamega County, Kenya. J Phy Act Res. 2018;3(1):55–9.
99. Odiwuor AF, Kimiywe J. Physical activity patterns of pregnant women in Rongo, Kenya. Sch J Arts Hum Soc Sci. 2016;4(2A):139–46.
100. Lawan A, Awotidebe AW, Oyeyemi AL, Rufa AA, Oyeyemi AY. Relationship between physical activity and health related quality of life among pregnant women. Afr J Reprod Health. 2018;22(3):80–9.
101. Mbada CE, Orji OE, Iyiola AM, Adeyemi AB, Afolabi EK, Petronilla OC, et al. Relationship between physical activity and fatigue among Nigerian pregnant women. Women Health Bull. 2019;6(1):e61339.
102. Ojukwu CP, Anekwu EM, Okemuo AJ, Nwabueze JO, John DO, Ezugwu UA, et al. Antenatal exercise practices: Associated factors and correlation with antenatal quality of life. J Appl Life Sci Int. 2018;18(4):1–9.
103. Daniel JA, Nwaogu EI, Ezeugwu CC. Effects of antenatal exercise on length of gestation among women attending antenatal clinic of the Federal Medical Centre Owerri, Southeast Nigeria. Int J Health Rehab Sci. 2015;4(4):212–6.
104. Mbada CE, Adebayo OE, Awotidebe TO. Practice and pattern of antenatal and postnatal exercise among Nigerian women. A cross-sectional study. Int J Women's Health Reprod Sci. 2015;3(2):223–9.
105. TBA SOG. AOF AB. Effects of aerobic exercises on the level of insomnia and fatigue in pregnant women. Internet J Gynaecol Obstetr. 2010;15(1):1–6.
106. Watson ED, Van Poppel MNM, Jones RA, Norris SA, Micklesfield LK. Are South African mothers moving? Patterns and correlates of physical activity

and sedentary behaviour in pregnant black South African women. J Phy Act Health. 2017;14(5):329–35.
107. Watson ED, Brage S, White T, Westgate K, Norris SA, Mireille NM, et al. The influence of objectively measured physical activity during pregnancy on maternal and birth outcomes in urban black South African women. Matern Child Health J. 2018;22(8):1190–9.
108. Maputle MS, Lebese RT, Khoza LB. Perceptions of women regarding physical activity during pregnancy and post-natal period at rural village in Vhembe district of Limpopo Province, South Africa. Afr J Phy Health Edu Recrea Dance 2014;December (Supplement 1:1):51–63.
109. Nkhata LA, Munalula-Nkandu E, Shula H. Exercise practice among women attending antenatal care at the University Teaching Hospital in Lusaka, Zambia. Sci J Publ Health. 2015;3(3):361–5.
110. Legesse M, Ali JH, Manzar MD, Salahuddin M, Hassen HY. Level of physical activity and other maternal characteristics during the third trimester of pregnancy and its association with birthweight at term in South Ethiopia: A prospective cohort study. PLoS ONE. 2020;15(7):e0236136.
111. Gaston A, Cramp A. Exercise during pregnancy: A review of patterns and determinants. J Sci Med Sports. 2011;14:299–305.
112. Tran A, Gelaye B, Girma B, Lemma S, Berhane Y, Bekele T, WM KA. Prevalence of metabolic syndrome among working adults in Ethiopia. Int J Hypertens. 2011;26:193719.
113. Lee CF, Chiang IC, Lin SS, Lin HM, Hsu CJ. Physical activity pattern and related factors among women during pregnancy. Formosan J Med. 2012;16:103–11.
114. Santos PC, Abreu S, Moreira C, Santos R, Ferreira M, Alves O, et al. J. Physical activity patterns during pregnancy in a sample of Portuguese women: A longitudinal prospective study. Iranian Red Crescent Med J. 2016;18:e22455.
115. Fathnezhad-Kazemi A, Hajian S. Factors influencing the adoption of health promoting behaviors in overweight pregnant women: a qualitative study. BMC Pregnancy Childbirth. 2009;19:43.
116. Flannery C, McHugh S, Anaba AE, Clifford E, O'Riordan M, Kenny LC, et al. Enablers and barriers to physical activity in overweight and obese pregnant women: an analysis informed by the theoretical domains framework and COM-B model. BMC Pregnancy Childbirth. 2018;18(1):178.
117. Saligheh M, McNamara B, Rooney R. Perceived barriers and enablers of physical activity in postpartum women: A qualitative approach. BMC Pregnancy Childbirth. 2016;16:131.
118. Hoodbhoy Z, Qureshi RN, Iqbal R, Muhabat Q. Household chores as the main source of physical activity: Perspectives of pregnant Pakistani women. J Pak Med Assoc. 2018;68(4):565–9.
119. Marquez DX, Bustamante EE, Bock BC, Markenson G, Tovar A, Chasan-Taber L. Perspectives of Latina and non-Latina white women on barriers and facilitators to exercise in pregnancy. Women health. 2009;49:505–21.
120. Antosiak-Cyrak KZ, Demuth A. A study of physical activity levels of pregnant women using the Polish version of Pregnancy Physical Activity Questionnaire (PPAQ-Pl). Ginekol Pol. 2019;90:250–5.
121. Merkx A, Ausems M, de Vries R, Nieuwenhuijze MJ. Factors affecting perceived change in physical activity in pregnancy. Midwifery. 2017;51:16–23.
122. Xiang M, Zhang J, Liang H, Zhang Z, Konishi M, Hu H, et al. Physical activity and dietary intake among Chinese pregnant women: an observational study. BMC Preg Childbirth. 2019;19:295.
123. De Haas S, Ghossein-Doha C, Van Kuijk SMJ, Van Drongelen J, Spaanderman MEA. Physiological adaptation of maternal plasma volume during pregnancy: a systematic review and meta-analysis. Ultrasound Obstet Gynecol. 2017;49:177–87.
124. Ribeiro CP, Milanez H. Knowledge, attitude and practice of women in Campinas, São Paulo, Brazil with respect to physical exercise in pregnancy: A descriptive study. Reprod Health. 2011;8(1):1–7.
125. Weir Z, Bush J, Robson SC, McParlin C, Rankin J, Bell R. Physical activity in pregnancy: A qualitative study of the beliefs of overweight and obese pregnant women. BMC Pregn Childbirth. 2010;10:118–35.
126. Catalano PM. Author's reply. BMJ. 2017;31:356:j1631.
127. Neiger R. Long-Term Effects of Pregnancy Complications on Maternal Health: A Review. J Clin Med. 2017;6(8):76.
128. Goodrich K, Cregger M, Wilcox S, Liu J. A qualitative study of factors affecting pregnancy weight gain in African American women. Matern Child Health J. 2013;17(3):432–40.
129. Hayman M, Reaburn P, Alley S, Cannon S, Short C. What exercise advice are women receiving from their healthcare practitioners during pregnancy? Women and Birth 2020; e357-e362.
130. De Vivo M, Mills H. "They turn to you first for everything": insights into midwives' perspectives of providing physical activity advice and guidance to pregnant women. BMC Preg Childbirth. 2019;19:462.
131. Yamamoto A, McCormick M, Burris H. US provider-reported diet and physical activity counselling to pregnant and non-pregnant women of childbearing age during preventative care visits. Matern Child Health J. 2014;18(7):1610–8.
132. Coll CV, Domingues MR, Gonçalves HH, Bertoldi AD. Perceived barriers to leisure-time physical activity during pregnancy: A literature review of quantitative and qualitative evidence. J Sci Med Sport. 2017;20(1):17–25.
133. Chan CWH, Au Yeung E, Law BMH. Effectiveness of physical activity interventions on pregnancy-related outcomes among pregnant women: A systematic review. Int J Environ Res Public Health. 2019;16(10):1840.
134. Ellapen TJ, Strydom GL, Swanwpoel HHM, Hammill H, Paul Y. Biokineticist's: A South African Health Profession evolving from Physical Education and Sport." In Sport and Exercise Science, edited by M. Merc. Available online https://www.intechopen.com/books/sport-and-exercise-science (accessed on 16 Jul 2020).
135. Sagedal LR, Øverby NC, Bere E, Torstveit MK, Lohne-Seiler H, Småstuen M, et al. Lifestyle intervention to limit gestational weight gain: The Norwegian Fit for Delivery randomised controlled trial. BJOG. 2017;124:97–109.
136. Ozdemir S, Bebis H, Ortabag T, Acikel C. Evaluation of the e_cacy of an exercise program for pregnant women with low back and pelvic pain: A prospective randomized controlled trial. J Adv Nurs. 2015;71:1926–39.
137. Asc O, Rathfisch G. Effect of lifestyle interventions of pregnant women on their dietary habits, lifestyle behaviors, and weight gain: A randomized controlled trial. J Health Popul Nutr. 2016;35:7.

Publisher's Note

Supplementary File 2: Prenatal Physical Activity and Exercise Advice and counselling by Healthcare Providers

healthcare

MDPI

Review

Physical Activity Advice and Counselling by Healthcare Providers: A Scoping Review

Uchenna Benedine Okafor [1,*] and Daniel Ter Goon [2]

[1] Department of Nursing Science, University of Fort Hare, 50 Church Street, East London 5021, South Africa
[2] Department of Public Health, University of Fort Hare, 5 Oxford Street, East London 5021, South Africa; dgoon@ufh.ac.za
* Correspondence: 201006014@ufh.ac.za

Abstract: *Background:* Despite scientific evidence on prenatal physical activity and exercise, synthesized evidence is lacking on the provision of prenatal physical activity and exercise advice and counselling by prenatal healthcare providers. The scoping review seeks to fill this gap by synthesizing available literature on the provision of prenatal physical activity and exercise advice and counselling by prenatal healthcare providers to women during antenatal visits. *Methods:* The Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) search framework for scoping reviews was applied to retrieve original research articles on the prenatal physical activity and exercise practices of healthcare providers with pregnant women, published between 2010–2020, and available in English. The search databases included Google Scholar, PubMed, Science Direct, Scopus, EMBASE, The Cumulative Index for Nursing and Allied Health Literature (CINAHL), BIOMED Central, Medline and African Journal Online. Studies that fulfilled the eligibility criteria were retrieved for analysis. *Results:* Out of the 82 articles that were retrieved for review, 13 met the eligibility criteria. Seven of the articles were quantitative, four qualitative, one mixed-method and one controlled, non-randomised study, respectively. Three themes emerged as major findings. Healthcare providers affirmed their responsibility in providing prenatal physical activity advice and counselling to pregnant women; however, they seldom or rarely performed this role. Major barriers to prenatal physical activity and exercise included insufficient time, lack of knowledge and skills, inadequate or insufficient training, and lack of resources. *Conclusion:* This review highlights salient features constraining the uptake of prenatal physical activity and exercise advice/counselling by prenatal healthcare providers in both community and clinical settings. Prenatal physical activity advice and counselling are key components to the promotion of physical activity adherence during and post-partum pregnancy; this requires adequate knowledge of physical activity prescriptions and recommendations, which are personalised and contextual to environment. Research is needed to examine the prenatal physical activity advice and counselling from prenatal healthcare providers on issues hindering effective delivery of the aforementioned in the context of promoting prenatal physical activity in clinical or community settings.

Keywords: prenatal physical activity; exercise; prenatal care providers; advice; counselling

Citation: Okafor, U.B.; Goon, D.T. Physical Activity Advice and Counselling by Healthcare Providers: A Scoping Review. *Healthcare* **2021**, *9*, 609. https://doi.org/10.3390/healthcare9050609

Academic Editor: José Carmelo Adsuar

Received: 6 April 2021
Accepted: 12 May 2021
Published: 19 May 2021

1. Introduction

Maternal physical activity and exercise are beneficial to health and the health advantages of prenatal physical activity are widely reported in the literature. The clinical relevance of prenatal physical activity practice is incontestable. Prenatal physical activity and exercise practice lowers maternal weight gain [1,2]; decreases the risk of gestational diabetes mellitus [3–7], birth complications [8], fatigue, stress, anxiety and depression [9–11]; lowers back pain [5,7] and enhances sleep [12]. Maternal physical activity also improves breastfeeding outcomes [13]. Pregnant women can achieve these benefits by regular engagement in physical activity and exercise.

Generally, there is growing interest in physical activity counselling as a form of preventive health and treatment [14]. Scientific evidence has sufficiently proved that prenatal physical activity and exercise participation is beneficial for the mother and child [15–17]; therefore, the provision of physical activity and exercise advice and counselling to women, arguably, is a key component of antenatal service in maternal and clinical settings. However, one question begs examination. Do prenatal healthcare providers offer prenatal physical activity advice and counselling to pregnant women during antenatal sessions? Research studies have shown that women receive minimal or no advice or counselling from health care professionals on prenatal physical activity and exercise [18], or the advice they receive is unclear and conflicting [19]. Seemingly, there is a lack of synthesized evidence on whether the prenatal healthcare providers are knowledgeable and offer advice or counselling on prenatal physical activity and exercise to pregnant women or not. Such information and data are important as they inform strategies to improve prenatal physical activity practice. Information dissemination is a necessary strategy in changing the perception and behaviour of individuals on a particular course toward a more desirable direction or action. As gatekeepers of health concern primarily in prenatal and maternal care, prenatal healthcare providers, thus, serve as important sources of support, information and advice about prenatal physical activity and exercise [20,21]. Conversely, pregnant women regard the prenatal healthcare advice from their healthcare providers as reliable and credible [22–24], and they may feel motivated to make lifestyle changes; and in this case, prenatal physical activity practice for healthy pregnancy and birth, it would be beneficial. Notably, the majority of studies on prenatal physical activity counselling are based on women's reports of prenatal care provider advice and counselling [23,25–29]. Therefore, the synthetization of evidence on this particular topic from the perspective of the prenatal care providers may serve to inform a best practice model on prenatal physical activity advice and counselling for prenatal healthcare providers working in primary antenatal healthcare services.

1.1. Scoping Review Research Question

The provision of prenatal physical activity advice and counselling is a challenge to prenatal healthcare providers. Therefore, this review seeks to answer two questions:

What are the knowledge, attitude and practice of prenatal healthcare providers regarding prenatal physical activity advice and counselling?

What barriers do prenatal healthcare providers encounter in offering prenatal physical activity advice and counselling?

1.2. Review Objective

The objective of this scoping review was to synthesize published studies in order to assess the knowledge, attitude and practices of prenatal healthcare providers in offering prenatal physical activity and exercise advice and counselling to women during antenatal sessions; and to further identify and characterize barriers to prenatal physical activity counselling.

2. Methods

2.1. Search Strategy

The Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) Searches for scoping reviews [30] was selected as a search tool. This was a scoping review, as opposed to systematic review; therefore, it was not registered in the Prospective Register of Systematic Reviews (PROSPERO). Nonetheless, it was registered in the Open Science Framework (https://osf.io/dp8wn) (accessed on 11 May 2021). The electronic search databases included Google Scholar, PubMed, Science Direct, Scopus, EMBASE, The Cumulative Index for Nursing and Allied Health Literature (CINAHL), BIOMED Central, Medline and African Journal Online. These databases were searched to retrieve articles published from prenatal healthcare providers' perspectives on prenatal physical activity

and exercise advice and counselling published from January 2010 to December 2020. The search was updated in March 2021. The search terms and key words used were: "Prenatal physical activity", "Prenatal exercise", "Pregnancy", "Pregnant women", "Prenatal care providers", "Healthcare providers", "Advice", "Counselling", "Knowledge", "Attitudes", "Practices" and "Barriers". During the data sources search process, the articles were sorted by year of publication, and then, only the first 10 pages of the search were considered because of multiple similarities (duplicates) and unrelated articles (not about prenatal physical activity counselling/not from prenatal healthcare providers). We included MeSH terms in the initial phase of the search strategy, but there was no improvement in the search and they were not utilized in the final search strategy.

2.2. Eligibility Criteria

As this is a scoping review, the PCC (Population/Concept/Context) framework recommended by JBI [31] was utilized to identify eligible studies. The population (P) was the prenatal healthcare providers (prenatal healthcare providers (obstetricians/gynaecologists, midwives and nurses); while the concept (C) was quantitative/qualitative studies assessing the perspectives of healthcare providers on prenatal physical activity/exercise/advice and counselling/knowledge/attitudes/practices/barriers. Pertaining to the context (C), the search process was conducted between 1 January 2010 to 31 December 2020. Only cohort, cross-section studies assessing the knowledge, attitudes, practices, and barriers of prenatal healthcare providers regarding physical activity and exercise advice and counselling across countries were included for screening and synthesis.

The exclusion criteria included non-peer-reviewed, other reviews (editorial, commentaries), book chapters, editorials, letters, and conference abstracts; abstracts without full text, articles on experiences of pregnant women regarding healthcare providers' advice on prenatal physical activity and exercise; articles published before 2010, and those not available in English.

2.3. Selection Process

The PRISMA guidance on conducting and reporting scoping reviews selection process was utilized to search for articles. Scoping reviews summarise results of studies encompassing varying methodologies to identify gaps in the literature and to decipher knowledge about a phenomenon of interest [30]. Applying the eligibility criteria, two independent reviewers searched and retrieved articles in the databases. The retrieved articles were assessed for eligibility and duplication. Articles that did not meet the set criteria and were found to be duplicated were removed.

2.4. Data Extraction and Analysis

The titles and abstracts of the articles were screened independently by two authors (UBO and DTG) to ensure they met the eligibility criteria set for the study. The authors further performed a full text screening on the identified eligible studies from the title and abstract screening process. Based on the full text review of the selected articles, the data were further extracted in line with the objective of the study. The data were analysed applying a modified approach to thematic analysis [32]. Given the heterogeneity of the retrieved studies, a narrative, qualitative summary was provided in the form of text and tables (Table 1) to ensure comparisons among studies, assess individual study quality, rigour and theme identification [33]. Two independent authors reviewed the table and each included study. Each article was read several times and the common themes from the included studies were identified, named and recurrent themes defined. In addition, the themes were further discussed and a consensus was reached regarding the final analysis. The synthesis of the included articles' findings that emerged from the search reflected the author(s), year of publication, setting/country, research design, sample, outcome measure(s), highlight of the main findings on prenatal healthcare providers on prenatal physical activity and exercise advice and counselling, and as well the limitations.

Table 1. Summary of articles on knowledge, attitude and practices of prenatal care health providers regarding prenatal physical activity advice.

Country	Study Design	Sample and Sampling	Outcome Measure(s)	Findings	Limitations
USA [23]	Qualitative study	11 prenatal healthcare providers	Provider perceptions on physical activity counselling during prenatal care visits.	Most healthcare providers reported offering prenatal physical activity counselling during prenatal visit. Walking and swimming were the physical activities. recommended. Healthcare providers understood the benefits of prenatal physical activity counselling during pregnancy. Barriers to prenatal physical activity counselling included a lack of patient interest, lack of time, lack of training, and the low socioeconomic status of the patient. Providers were familiar with the ACOG guidelines. Advocated for further training on prenatal physical activity counselling.	Small sample size. Limited generalisability of findings. Self-reported information subject to recall and social desirability bias.
USA [34]	Cross-sectional descriptive study	Convenient sample of 93 healthcare providers.	Knowledge, beliefs, and practices of obstetric healthcare providers toward exercise during pregnancy.	Healthcare providers exhibited positive beliefs and attitudes about exercise during pregnancy. Providers recommended exercise to their pregnant patients (90%) and believed women with uncomplicated pregnancies can safely practice exercise (89%). Providers offered prenatal physical activity advice; however, the advice did not always align with the ACOG recommendations on prenatal physical activity because the providers were not familiar with the ACOG guidelines.	Non-randomisation of sample. Potential recall bias. Use of the ACOG guidelines.
USA [35]	Cross-sectional descriptive study	Convenient sample of 188 healthcare providers (91 obstetricians, 40 midwives, and 57 family medicine physicians)	Beliefs, attitudes, knowledge, self-efficacy and barriers.	Majority of the healthcare providers agreed that prenatal physical activity improves the general health of the mother and baby, and reduce excessive weight gain. They stressed the need for discussing physical activity with pregnant women; however, only about two-thirds did so with their patients. Over 40% providers were not confident with the physical activity information they had provided to women. Slightly over half of the healthcare providers offered in-office physical activity counselling, 90% accurately described the types of exercises generally considered safe for pregnant women, and 85% correctly identify the ACOG's absolute contraindications to antenatal physical activity. Lack of time was a common barrier, and providers felt they received inadequate training.	Low response rate. Small sample from localised area. Potential recall bias.

Table 1. *Cont.*

Country	Study Design	Sample and Sampling	Outcome Measure(s)	Findings	Limitations
USA [36]	Cross-sectional, retrospective study	31 Obstetricians	Association between obstetric providers' discussions about exercise and pregnant woman exercise behaviours.	Obstetric providers' discussion of exercise associated with patient behaviour. Obstetric providers' ages, private insurance, number of pregnant patients seen per month; pregnant patients with complications were not associated with exercise discussion with pregnant patients.	Small sample size. Recall bias due to self-report.
USA [37]	Qualitative study	Convenience sample of 52 obstetrician/gynaecologists, midwives and nurse practitioners.	Knowledge, attitudes, and practices of prenatal care providers regarding prenatal physical activity counselling.	Providers had no training on prenatal physical activity, but relied on their own personal experiences. Prenatal physical activity was not a priority.	Small sample size. Recall bias due to self-report.
United Kingdom [38]	Multiphase mixed methods	10 randomly selected midwives	Roles, responsibilities, and barriers in providing physical activity advice and guidance to pregnant women; and any opportunities in changing pregnant women's physical activity behaviour.	Midwives' daily challenges affected their morale and ability to provide antenatal physical activity counselling. Midwives did not provide adequate information about prenatal physical activity. Less priority was accorded to physical activity. Barriers to prenatal physical activity advice and guidance included a lack of training, knowledge, confidence, time, and resources. Suggestions to address barriers included professional development and training, inter-professional collaboration, encouraging a support network, and challenging misconceptions about prenatal physical activity.	Small sample from localised area.
United Kingdom [39]	Descriptive online survey	59 Midwives	Midwives understanding of the NICE physical activity guidelines, and the physical activity guidance provided to women during pregnancy.	Midwives had misplaced confidence in their knowledge of the NICE physical activity guidelines for pregnancy. The positive role of exercise and benefits to mother and baby were recognised by 24% of the midwives. The majority of midwives (91%) knew about the contraindications to exercise during pregnancy, and 59% felt confident answering questions about prenatal physical activity.	Small sample size. Participants skewed to those who felt confident in their knowledge about physical activity and pregnancy. Overestimation of the findings from the midwives based on prior information about the survey.

Table 1. *Cont.*

Country	Study Design	Sample and Sampling	Outcome Measure(s)	Findings	Limitations
England [40]	Cross-sectional descriptive study	192 Midwives	Barriers and facilitators associated with implementation of national guidelines for physical activity in obese pregnant woman.	Midwives perceived as not having the ability, proficiency or competency to implement, discuss and counsel women effectively on physical activity. Physical activity was not a priority. Midwives recognised their role to advise obese pregnant women about physical activity, but expressed concerns about the sensitive nature of the topic. Midwives advocated for routine prenatal physical counselling in clinical practice.	Poor response rate might result to error and bias.
South Africa [41]	Cross-sectional, descriptive study.	Convenience sample of 96 Medical Practitioners (MPs): General Practitioners (n = 58), Obstetricians/Gynaecologists (n = 33), other Specialists (n = 5).	Knowledge, attitudes and beliefs of South African MPs towards prenatal exercise.	Majority of the medical practitioners believed prenatal exercise is beneficial, but were unaware of the recommended exercise guidelines. They lacked accurate specifics about exercise prescription. Most MPs (94%) recommended moderate exercise during pregnancy. Few practitioners provided advice as well as individualised exercise prescription. Providers were not familiar with the ACOG guidelines for exercise during pregnancy. About 71% expressed a desire to attend a continuous professional development workshop on prenatal physical activity, if provided.	Low response rate. Response and selective bias. Exclusion of practitioners working in the public sector.
Brazil [42]	A controlled, non-randomized study	Doctors and nurses: Intervention group (22); Control group (20)	Effect of an educational intervention upon improving the knowledge and practices of health professionals concerning physical activity during pregnancy.	No difference in the knowledge scores between the control group and the intervention group. Compared to the control group, women in the intervention group were more likely to receive guidance regarding leisure-time walking.	Non randomisation of the sample in both groups.
Norway [43]	Cross-sectional descriptive study	65 Midwives	Midwives' practice and views about gestational weight gain and regular physical activity and nutrition.	Physical activity advice provided at least once throughout gestation. About 32.3% midwives based their advice on personal sport/exercise experience.	Small sample size. Recall bias due to self-report.
Sweden [44]	A qualitative study	Purposive sample of 41 midwives	Swedish midwives experience about prenatal physical activity counselling; and the facilitators and barriers during pregnancy.	Barriers to prenatal physical counselling included a lack of resources and cultural expectations of the women about physical activity during pregnancy. Midwives considered the topic as sensitive for some women, especially overweight and obese women. Individualised counselling approach applied.	

Table 1. *Cont.*

Country	Study Design	Sample and Sampling	Outcome Measure(s)	Findings	Limitations
Finland [45]	Descriptive qualitative approach.	Convenience sample of 11 public health nurses.	Public health nurses' experiences of physical activity counselling.	Level of knowledge and skills about physical activity counselling was inadequate. Barrier to prenatal physical activity included women's attitudes towards exercise, lack of time, inadequate resources, and insufficient skills. Providers suggested fmulti-professional collaboration from different healthcare areas, such as physiotherapists, physical education instructors, and dieticians. They advocated further training in physical activity.	Small sample size.

3. Results

3.1. Search Outcome

The search provided 82 articles. Of these, 61 articles were removed because of nc meeting the eligibility criteria or being duplications. Out of the remaining 21 articles, further eight were excluded because they were not original articles, and did not address th objective of the scoping review. Therefore, 13 articles (seven quantitative, four qualitativ one mixed methods, andone1 controlled, non-randomised study) were included in th review for analysis. Figure 1 presents a diagrammatic flow chart of the procedure for th articles' search process and the articles screened for eligibility.

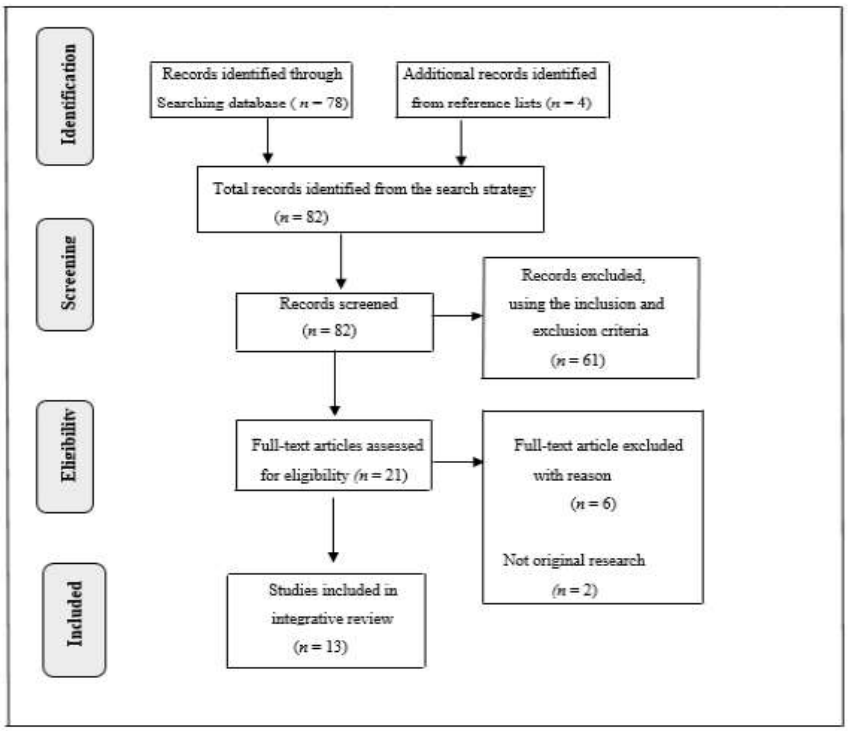


Figure 1. PRISMA flow diagram showing the search process for the included articles.

3.2. Characteristics of Reviewed Articles

Table 1 presents the characteristics of the 13 included studies. Most of the studies were conducted in the USA [23,34–37], three studies were conducted in the United Kingdom [38–40], and one each in South Africa [41], Brazil [42], Norway [43], Sweden [44], and Finland [45] respectively. Seven were quantitative studies [34–36,39–41,43], four qualitative [23,37,45], one a mixed methods study [38] and one a controlled, non-randomised study [42]. Most of the prenatal healthcare providers were midwives [37–40,43,44], obstetrician/gynaecologists [34,36,37,41] and nurses [34,37,45].

3.3. Themes Emerging from Studies Reviewed

3.3.1. Providers' Knowledge

Two studies reported that the providers perceived that they have a role and responsibility in providing prenatal physical activity advice and counselling [35,38,41]. Regarding the providers' knowledge of various physical activity guidelines, two studies highlighted that providers were not familiar with the IOM [23,43] and four studies revealed the same regarding ACOG [34,39,41] guidelines. However, one study indicated provider's familiarity with ACOG guidelines [23]. Furthermore, prenatal physical activity and exercise advice and counselling was limited and inconsistent with the then-current prenatal physical activity guidelines [23].

3.3.2. Providers' Attitudes

Regarding providers attitudes to prenatal physical activity and exercise, two studies reported that providers believed exercise during pregnancy is beneficial [34,35], whilst one study held a contrary view that vigorous exercise is not beneficial during pregnancy [34]. In addition, one study reported that providers provide individualised counselling during antenatal visits [35]. Three studies reported that providers routinely provide some counselling on physical activity and exercise during prenatal visits [23,34,35]. One study found that providers did not receive training in antenatal physical activity counselling [35]. Six studies indicated that providers advocated training on prenatal physical activity [23,34,38,40,41,46].

3.3.3. Providers' Practices

One study reported that prenatal care providers recommended exercise to their pregnant patients [34] and provided duration and intensity recommendations for patients [23]. The specific types of exercise prenatal healthcare providers recommended during pregnancy included walking and swimming [23]. One study reported that providers did describe the benefits of prenatal physical activity to women [23] and they discouraged contact sports [23].

3.4. Barriers to Prenatal Physical Activity Counselling

Several barriers to prenatal physical activity and exercise are synthesised in this review (Table 1). Studies cited insufficient time [23,35,38,40,44,47], lack of knowledge and skills [35,38,40] inadequate or insufficient training [23,37,38,44,45], lack of resources [35,38,40,44], lack of patient interest [23], and difficulty in counselling women with low levels of education or income or those from varying socio-cultural backgrounds [23,44] as barriers.

4. Discussion

This scoping review assessed the knowledge, attitudes and practices of prenatal healthcare providers in offering prenatal physical activity and exercise advice and counselling to women during antenatal sessions; and further identified and characterized the barriers to prenatal physical activity counselling. Studies on the perspectives of prenatal healthcare providers regarding physical activity counselling can inform about the unique needs of providers for appropriate interventions. Such studies are rare across countries. The review found that providers perceived that they have a role and responsibility in providing prenatal physical activity advice and counselling to pregnant women. However, the review also

revealed that the providers have inadequate or no knowledge on various physical activity guidelines. This explains further why healthcare providers' advice and counselling, in some instances, is limited and inconsistent with the then-current prenatal physical activity guidelines [23]. Prenatal healthcare providers are uniquely positioned to offer counselling and advice to pregnant woman on various health issues. They are key sources of support, information and advice about prenatal physical activity and exercise [20,21]. Women may be motivated to engage in physical activity and exercise if the healthcare providers, themselves, are knowledgeable and can offer accurate and scientific evidence-based prenatal physical activity information. This stressed the need to empower healthcare providers on prenatal physical activity education and to provide effective prenatal physical activity advice and counselling to patients; therefore, prenatal physical activity should be included in the training and curriculum of medical and health professionals concerned with maternal healthcare of women.

This review reveals prenatal care providers' lack of knowledge about physical activity guidelines or recommendations during pregnancy as stipulated by specialised bodies and institutions such as the American College of Obstetricians and Gynaecologists (ACOG) [48], the World Health Organization (WHO) [49], the Joint Canadian Society for Exercise Physiology (CSEP)/Society of Obstetricians and Gynaecologists of Canada (SOGC) [50] and the American College of Sports Medicine (ACSM) [51]. For example, a study among midwives in the United Kingdom showed that midwives could not provide accurate information about physical activity recommendations during pregnancy, even though most midwives could confidently answer questions [39]. Previous studies elsewhere have reported similar findings, showing healthcare providers' ignorance of physical activity/exercise guidelines [41,52–54]. If the prenatal care providers directly working with pregnant women were ignorant of the physical activity guideline, then, maternal physical activity would be jeopardised, as women would not be motivated to initiate, engage in and maintain physical activity and/or exercise as a long-life health activity.

The review highlights that providers believed exercise during pregnancy is beneficial to the mother and the baby [48], and to help achieve the desired outcome effectively, the providers used individualised physical activity counselling during antenatal visits [48]. Providing individualised physical activity counselling is an important step in navigating the constraining barriers to prenatal physical activity practice. Such an approach offers prenatal care providers with an opportunity to assess patients based on their specific issues affecting physical activity participation during pregnancy. Our review showed that only a few studies highlighted that prenatal care providers routinely provide some counselling on physical activity and exercise during prenatal visits [23,34,35]. Therefore, as one of the striking features of this review, the prenatal care providers advocated prenatal physical activity training [23,34,38,40,41,46]. Prenatal care providers need training on physical activity counselling and advice in order to render effective, better, evidence-based physical activity care in the antenatal practice. In addition, there is need to institutionalise prenatal physical activity as part of the mandatory antenatal care service to promote the attitude of prenatal care providers towards physical activity and exercise counselling for pregnant women.

Notably, this review highlights lack of time, and lack of knowledge and skills as the major constraining factors to prenatal physical activity counselling. A previous systematic review identified lack of time, lack of knowledge or training in physical activity counselling and lack of perceived success in changing patient behaviours as the three most cited barriers to physical activity intervention in the primary care setting [55]. In antenatal care, healthcare providers are saddled with other responsibilities, which include medical and pregnancy assessment, the conducting of antenatal tests, procedures, and bookings [56]. In some instances, they may offer counselling to women on smoking, alcohol intake and nutrition. Previous studies have shown that pregnant women who received physical activity counselling from their health providers during prenatal visits achieved higher physical activity levels compared to those who were not counselled [57–59]. However,

this scoping review indicated that prenatal care providers rarely provide physical activity education and counselling to pregnant women during their antenatal visit. Even when the information is provided, it is inadequate or lacking in scientific content, because they have no scientific knowledge [23,34,39,41,43] nor training [23,24,37,38,45] regarding physical activity during pregnancy. This is concerning as inactive pregnant women are therefore limited information, and are likely not to be motivated to engage in physical activity. A previous study in South Africa reported that inaccurate information at the antenatal clinics impeded the ability of the health providers to provide physical activity advice to pregnant women [60]. Thus, this entails that, despite scientific evidence highlighting the benefits of prenatal physical activity, it appears that such evidence is not translatable to clinical practice. The barriers to prenatal physical activity counselling by prenatal care providers, as highlighted in this review, call for context-specific educational interventions to encourage women to practice physical activity during pregnancy.

5. Limitations, Strengths and Implications

The review was limited to articles published only in the English language; therefore, the possibility of other published but relevant studies in other languages having been excluded cannot be ruled out. In addition, the review focused exclusively on prenatal healthcare providers (obstetricians/gynaecologists, midwives and nurses). Therefore, the findings reported in this review cannot be extrapolated to other healthcare providers attending to women's health. Notwithstanding these limitations, this scoping review is the first attempt to provide an overview of available evidence on prenatal physical activity counselling by prenatal healthcare providers from across multiple countries. Such studies are limited in developing countries, including Africa. The findings of this review call for concerted efforts in prenatal physical activity advice and counselling to promote the uptake of prenatal physical activity participation. This review underscores the need for prenatal care providers to prioritize the topic of physical activity and exercise during antenatal care in order to encourage pregnant women to engage in prenatal physical activity during pregnancy. Therefore, interventions to support prenatal care providers to play this key function of offering adequate counselling of physical activity pertaining to its importance, prescription and guidelines are crucial, in order to improve maternal and fetal health [50]. More studies on prenatal healthcare providers' perspectives regarding the provision of physical activity and exercise counselling to pregnant women during pregnancy are warranted.

6. Conclusions

The findings of this scoping review highlight key salient points. Healthcare providers affirmed their responsibility in providing prenatal physical activity advice and counselling to pregnant women; however, they seldom or rarely performed this role. The most common barriers to prenatal physical activity counselling identified in this review are the lack of time and the requisite skill and training to advise or counsel pregnant women about prenatal physical activity during antenatal visits. Consequently, providers expressed the desire for training to improve their knowledge on prenatal activity advice or counselling. There is a need to prioritise physical activity counselling in maternal and clinical settings to encourage women to initiate and engage in physical activity during pregnancy for improved health outcomes. Prenatal care providers need time, knowledge and skill to perform this task effectively.

Author Contributions: U.B.O. coordinated the review, data extraction, analysis and the drafting of the paper. D.T.G. conducted the search, data extraction, analysis and participated in the drafting of the paper. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Acknowledgments: This study was supported by the Govan Mbeki Research and Development Centre, University of Fort Hare.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Dipietro, L.; Evenson, K.R.; Bloodgood, B.; Sprow, K.; Troiano, R.P.; Piercy, K.L.; Vaux-Bjerke, A.; Powell, K.E. Benefits of physical activity during pregnancy and postpartum: An umbrella review. *Med. Sci. Sports Exerc.* **2019**, *51*, 1292–1302. [CrossRef]
2. Ruchat, S.M.; Mottola, M.F.; Skow, R.J.; Skow, R.J.; Nagpal, T.S.; Meah, V.L.; James, M.; Riske, L.; Sobierajski, F.; Kathol, A.J.; et al. Effectiveness of exercise interventions in the prevention of excessive gestational weight gain and postpartum weight retention: A systematic review and meta-analysis. *Br. J. Sports Med.* **2018**, *52*, 1347–1356. [CrossRef]
3. Harrison, A.L.; Taylor, N.F.; Shields, N.; Frawley, H.C. Attitudes, barriers and enablers to physical activity in pregnant women: A systematic review. *Physiotheraphy* **2018**, *64*, 24–32. [CrossRef]
4. Aune, D.; Schlesinger, S.; Henriksen, T.; Saugstad, O.; Tonstad, S. Physical activity and the risk of preterm birth: A systematic review and meta-analysis of epidemiological studies. *BJOG Int. J. Obstet. Gynaecol.* **2017**, *124*, 1816–1826. [CrossRef]
5. Davenport, M.H.; Ruchat, S.M.; Poitras, V.J.; Garcia, A.J.; Gray, C.E.; Barrowman, N.; Skow, R.J.; Meah, V.L.; Riske, L.; Sobierajski, F.; et al. Prenatal exercise for the prevention of gestational diabetes mellitus and hypertensive disorders of pregnancy: A systematic review and meta-analysis. *Br. J. Sports Med.* **2018**, *52*, 1367–1375. [CrossRef] [PubMed]
6. Catov, J.M.; Parker, C.B.; Gibbs, B.B.; Bann, C.M.; Carper, B.; Silver, R.M.; Simhan, H.N.; Parry, S.; Chung, J.H.; Haas, D.M.; et al. Patterns of leisure-time physical activity across pregnancy and adverse pregnancy outcomes. *Int. J. Behav. Nutr. Phys. Act.* **2018**, *15*, 68–78. [CrossRef]
7. Thompson, E.L.; Vamos, C.A.; Daley, E.M. Physical activity during pregnancy and the role of theory in promoting positive behavior change: A systematic review. *J. Sport Health Sci.* **2017**, *6*, 198–206. [CrossRef]
8. Barakat, R.; Pelaez, M.; Lopez, C.; Montejo, R.; Coteron, J. Exercise during pregnancy reduces the rate of caesarean and instrumental deliveries: Results of a randomized controlled trial. *J. Matern. Fetal Neonatal Med.* **2012**, *25*, 2372–2376. [CrossRef]
9. Davenport, M.H.; McCurdy, A.P.; Mottola, M.F.; Skow, R.J.; Meah, V.L.; Poitras, V.J.; Garcia, A.J.; E Gray, C.; Barrowman, N.; Riske, L. Impact of prenatal exercise on both prenatal and postnatal anxiety and depressive symptoms: A systematic review and meta-analysis. *Br. J. Sports Med.* **2018**, *52*, 1376–1385. [CrossRef] [PubMed]
10. Vargas-Terrones, M.; Barakat, R.; Santacruz, B.; Fernandez-Buhigas, I.; Mottola, M.F. Physical exercise programme during pregnancy decreases perinatal depression risk: A randomised controlled trial. *Br. J. Sports Med.* **2018**, *53*, 348–353. [CrossRef]
11. Cid, M.; González, M. Potential benefits of physical activity during pregnancy for the reduction of gestational diabetes prevalence and oxidative stress. *Early Hum. Dev.* **2016**, *94*, 57–62. [CrossRef] [PubMed]
12. Baker, J.H.; Rothenberger, S.D.; Kline, C.E.; Okun, M.L. Exercise during Early Pregnancy is Associated with Greater Sleep Continuity. *Behav. Sleep Med.* **2018**, *16*, 482–493. [CrossRef]
13. Nguyen, C.L.; Pham, N.M.; Lee, A.H.; Nguyen, P.T.H.; Chu, T.K.; Ha, A.V.V.; Duong, D.V.; Duong, T.H.; Binns, C.W. Physical activity during pregnancy is associated with a lower prevalence of gestational diabetes mellitus in Vietnam. *Acta Diabetol.* **2018**, *55*, 955–962. [CrossRef] [PubMed]
14. Sooknarine-Rajpatty, J.; Auyeung, A.B.; Doyle, F. A systematic review protocol of the barriers to both physical activity and obesity counselling in the secondary care setting as reported by healthcare providers. *Int. J. Environ. Res. Public Health* **2020**, *17*, 1195. [CrossRef] [PubMed]
15. Barakat, R.; Pelaez, M.; Cordero, Y.; Perales, M.; Lopez, C.; Coteron, J.; Mottola, M.F. Exercise during pregnancy protects against hypertension and macrosomia: Randomized clinical trial. *Am. J. Obstet. Gynecol.* **2016**, *214*, 649.e1–649.e8. [CrossRef] [PubMed]
16. Gaston, A.; Cramp, A.; Prapavessis, H. Enhancing self-efficacy and exercise readiness in pregnant women. *Psychol. Sport Exerc.* **2012**, *13*, 550–557. [CrossRef]
17. Moyer, C.; Reoyo, O.R.; May, L. The influence of prenatal exercise on offspring health: A review. *Clin. Med. Insights Women's Health* **2016**, *9*, 37–42. [CrossRef]
18. Smith, D.M.; Cooke, A.; Lavender, T. Maternal obesity is the new challenge; a qualitative study of health professionals' views towards suitable care for pregnant women with a Body Mass Index (BMI) $\geq$ 30 kg/m^2. *BMC Pregnancy Childbirth* **2012**, *12*, 157. [CrossRef] [PubMed]
19. Weir, Z.; Bush, J.; Robson, S.J.; McParlin, C.; Rankin, J.; Bell, R. Physical activity in pregnancy: A qualitative study of the beliefs of overweight and obese pregnant women. *BMC Pregnancy Childbirth* **2010**, *10*, 18. [CrossRef]
20. Goodrich, K.; Cregger, M.; Wilcox, S.; Liu, J. A qualitative study of factors affecting pregnancy weight gain in African American women. *Matern. Child. Health J.* **2013**, *17*, 432–440. [CrossRef]
21. Sui, Z.; Turnbull, D.; Dodd, J. Overweight and obese women's perceptions about making healthy change during pregnancy: A mixed method study. *Matern. Child Health J.* **2013**, *17*, 1879–1887. [CrossRef] [PubMed]
22. Ferrari, R.M.; Siega-Riz, A.M.; Evenson, K.R.; Moos, M.K.; Carrier, K.S. A qualitative study of women's perceptions of provider advice about diet and physical activity during pregnancy. *Patient Educ. Couns.* **2013**, *91*, 372–377. [CrossRef] [PubMed]

23. Whitaker, K.M.; Wilcox, S.; Liu, J.; Blair, S.N.; Pate, R.R. Pregnant women's perceptions of weight gain, physical activity, and nutrition using Theory of Planned Behaviour constructs. *J. Behav. Med.* **2016**, *39*, 41–54. [CrossRef] [PubMed]
24. Leiferman, J.; Sinatra, E.; Huberty, J. Pregnant women's perceptions of patient provider communication for health behaviour change during pregnancy. *Open J. Obstet. Gynecol.* **2014**, *4*, 672–684. [CrossRef]
25. Santo, E.C.; Forbes, P.W.; Oken, E.; Belfort, M.B. Determinants of physical activity frequency and provider advice during pregnancy. *BMC Pregnancy Childbirth* **2017**, *17*, 286. [CrossRef]
26. Vinturache, A.E.; Winn, A.; Tough, S.C. Recall of prenatal counselling among obese and overweight women from a Canadian population: A population based study. *Matern. Child Health J.* **2017**, *21*, 2092–2101. [CrossRef]
27. Stengel, M.R.; Kraschnewski, J.L.; Hwang, S.W.; Kjerulff, K.H.; Chuang, C.H. "What my doctor didn't tell me": Examining health care provider advice to overweight and obese pregnant women on gestational weight gain and physical activity. *Women's Health Issues* **2012**, *22*, e535–e540. [CrossRef] [PubMed]
28. Emery, R.L.; Benno, M.T.; Salk, R.H.; Kolko, R.P.; Levine, M.D. Healthcare provider advice on gestational weight gain: Uncovering a need for more effective weight counselling. *J. Obstet. Gynaecol.* **2018**, *38*, 916–921. [CrossRef]
29. Dalhaug, E.M.; Haakstad, L.A.H. What the health? Information sources and maternal lifestyle behaviors. *Interact. J. Med. Res.* **2019**, *8*, e10355. [CrossRef]
30. Tricco, A.C.; Lillie, E.; Zarin, W.; O'Brien, K.K.; Colquhoun, H.; Levac, D.; Moher, D.; Peters, M.D.; Horsley, T.; Weeks, L.; et al. PRISMA Extension for Scoping Reviews (PRISMAScR): Checklist and Explanation. *Ann. Intern. Med.* **2018**, *169*, 467–473. [CrossRef]
31. Peters, M.D.J.; Godfrey, C.; Mcinerney, P.; Soares, C.B.; Khalil, H.; Parker, D. Chapter 11: Scoping reviews. In *Joanna Briggs Institute Reviewer's Manual*; Aromataris, E., Munn, Z., Eds.; The Joanna Briggs Institute: Adelaide, Australia, 2017.
32. Braun, V.; Clarke, V. Using thematic analysis in psychology. *Qual. Res. Psychol.* **2006**, *3*, 77–101. [CrossRef]
33. Dieterich, R.; Demirci, J. Communication practices of healthcare professionals when caring for overweight/obese pregnant women: A scoping review. *Patient Educ. Couns.* **2020**, *103*, 1902–1912. [CrossRef] [PubMed]
34. Bauer, P.W.; Broman, C.L.; Pivarnik, J.M. Exercise and pregnancy knowledge among healthcare providers. *J. Women's Health* **2010**, *19*, 335–341. [CrossRef] [PubMed]
35. Leiferman, J.; Gutilla, M.; Paulson, J.; Pivarnik, J. Antenatal physical activity counselling among healthcare providers. *Open J. Obstet. Gynecol.* **2012**, *2*, 346–355. [CrossRef]
36. May, L.E.; Suminski, R.R.; Linklater, E.R.; Jahnke, S.; Glaros, A.G. Exercise during pregnancy: The role of obstetric providers. *J. Am. Osteopath. Assoc.* **2013**, *113*, 612–619. [CrossRef]
37. Stotland, N.E.; Gilbert, P.; Bogetz, A.; Harper, C.C.; Abrams, B.; Gerbert, B. Preventing excessive weight gain in pregnancy: How do prenatal care providers approach counselling? *J. Women's Health* **2010**, *19*, 807–814. [CrossRef] [PubMed]
38. De Vivo, M.; Mills, H. "They turn to you first for everything": Insights into midwives' perspectives of providing physical activity advice and guidance to pregnant women. *BMC Pregnancy Childbirth* **2019**, *19*, 462. [CrossRef]
39. Hopkinson, Y.; Hill, D.M.; Fellows, L.; Fryer, S. Midwives understanding of physical activity guidelines during pregnancy. *Midwifery* **2018**, *59*, 23–26. [CrossRef]
40. McParlin, C.; Bell, R.; Robson, S.C.; Muirhead, C.R.; Araújo-Soares, V. What helps or hinders midwives to implement physical activity guidelines for obese pregnant women? A questionnaire survey using the Theoretical Domains Framework. *Midwifery* **2017**, *49*, 110–116. [CrossRef] [PubMed]
41. Watson, E.D.; Oddie, B.; Constantinou, D. Exercise during pregnancy: Knowledge and beliefs of medical practitioners in South Africa: A survey study. *BMC Pregnancy Childbirth* **2015**, *15*, 245. [CrossRef]
42. Malta, M.B.; Carvalhaes, M.D.; Takito, M.Y.; Tonete, V.L.P.; Aluísio, J.D.; Barros, A.J.D.; de Lima Parada, C.M.G.; D'Aquino Benício, M.H. Educational intervention regarding diet and physical activity for pregnant women: Changes in knowledge and practices among health professionals. *BMC Pregnancy Childbirth* **2016**, *16*, 175. [CrossRef]
43. Haakstad, L.A.H.; Mjønerud, J.M.F.; Dalhaug, E.M. MAMMA MIA! Norwegian midwives' practices and views about gestational weight gain, physical activity, and nutrition. *Front. Psychol.* **2020**, *11*, 1463. [CrossRef] [PubMed]
44. Lindqvist, M.; Mogren, I.; Eurenius, E.; Edvardsson, K.; Persson, M. "An on-going individual adjustment": A qualitative study of midwives' experiences counselling pregnant women on physical activity in Sweden. *BMC Pregnancy Childbirth* **2014**, *14*, 343. [CrossRef] [PubMed]
45. Issakainen, M.; Schwab, U.; Lamminpää, R. Qualitative study on public health nurses' experience and assessment of nutritional and physical activity counselling of women with gestational diabetes. *Eur. J. Midwifery* **2020**, *4*, 37. [CrossRef]
46. de Jersey, S.; Guthrie, T.; Tyler, J.; Ling, W.Y.; Powlesland, H.; Byrne, C.; New, K. A mixed method study evaluating the integration of pregnancy weight gain charts into antenatal care. *Matern. Child Nutr.* **2019**, *15*, e12750. [CrossRef]
47. Lindsay, A.C.; Wallington, S.F.; Greaney, M.L.; Machado, M.M.T.; De Andrade, G.P. Patient–provider communication and counselling about gestational weight gain and physical activity: A qualitative study of the perceptions and experiences of Latinas pregnant with their first child. *Int. J. Environ. Res. Public Health* **2017**, *14*, 1412. [CrossRef] [PubMed]
48. American College of Obstetricians and Gynaecologists. Physical Activity and Exercise During Pregnancy and the Postpartum Period: ACOG Committee Opinion, Number 804. *Obstet. Gynaecol.* **2020**, *135*, e178–e188. [CrossRef]
49. World Health Organization. WHO Homepage. Available online: www.who.int (accessed on 29 March 2021).

50. Mottola, M.F.; Davenport, M.H.; Ruchat, S.M.; Davies, G.A.; Poitras, V.; Gray, C.; Garcia, A.J.; Barrowman, N.; Adamo, K.B.; Duggan, M.; et al. No. 367-2019 Canadian Guideline for Physical Activity throughout Pregnancy. *J. Obstet. Gynaecol. Can.* **2018**, *40*, 1528–1537. [CrossRef]
51. Pescatello, L.S.; Arena, R.; Riebe, D.; Thompson, P.D. *ACSM's Guidelines for Exercise Testing and Prescription*, 9th ed.; American College of Sports Medicine: Baltimore, MD, USA, 2014; ISBN 9781609136055.
52. Alahmed, Z.; Lobelo, F. Correlates of physical activity counselling provided by physicians: A cross-sectional study in Eastern Province, Saudi Arabia. *PLoS ONE* **2019**, *14*, e0220396. [CrossRef]
53. Kime, N.; Pringle, A.; Zwolinsky, S.; Vishnubala, D. How prepared are healthcare professionals for delivering physical activity guidance to those with diabetes? A formative evaluation. *BMC Health Serv. Res.* **2020**, *20*, 8. [CrossRef]
54. Din, N.U.; Moore, G.F.; Murphy, S.; Wilkinson, C.; Williams, N.H. Health professionals' perspectives on exercise referral and physical activity promotion in primary care: Findings from a process evaluation of the National Exercise Referral Scheme in Wales. *Health Educ. J.* **2015**, *74*, 743–757. [CrossRef] [PubMed]
55. Hebert, E.T.; Caughy, M.O.; Shuval, K. Primary care providers' perceptions of physical activity counselling in a clinical setting: A systematic review. *Br. J. Sports Med.* **2012**, *46*, 625–631. [CrossRef] [PubMed]
56. Willcox, J.C.; Campbell, K.J.; van der Pligt, P.; Hoban, E.; Pidd, D.; Wilkinson, S. Excess gestational weight gain: An exploration of midwives' views and practice. *BMC Pregnancy Childbirth* **2012**, *12*, 102. [CrossRef] [PubMed]
57. Joy, E.A.; Mottola, M.F.; Chambliss, H. Integrating exercise is medicine®into the care of pregnant women. *Cur. Sports Med. Rep.* **2013**, *12*, 245–247. [CrossRef]
58. Sinclair, M.B.; Liddle, D.; Hill, A.; Stockdale, D.; Stockdale, M. Motivating pregnant women to eat healthily and engage in physical activity for weight management: An exploration of routine midwife instruction. *Evid. Based Midwifery* **2013**, *11*, 120–127.
59. Aittasalo, M.; Raitanen, J.; Kinnunen, T.I.; Ojala, K.; Kolu, P.; Luoto, R. Is intensive counselling in maternity care feasible and effective in promoting physical activity among women at risk for gestational diabetes? Secondary analysis of a cluster randomized NELLI study in Finland. *Int. J. Behav. Nutri. Phys. Act.* **2012**, *9*, 104. [CrossRef] [PubMed]
60. Watson, E.D.; Norris, S.A.; Draper, C.E.; Jones, R.A.; van Poppel, M.N.M.; Micklesfield, L.K. "Just because you're pregnant, doesn't mean you're sick!" A qualitative study of beliefs regarding physical activity in black South African women. *BMC Pregnancy Childbirth* **2016**, *16*, 174. [CrossRef]