



**ASSESSMENT OF MOTHERS AND PRESCHOOL-AGE CHILDREN'S
FOOD AND NUTRITION SECURITY STATUS: A CROSS-SECTIONAL
CASE STUDY OF NORTH CENTRAL ZONE, NIGERIA**

by

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**Submitted in fulfilment of the academic requirements for the degree of
DOCTOR OF PHILOSOPHY (HUMAN NUTRITION)**

in

Discipline of Dietetics and Human Nutrition

School of Agricultural, Earth and Environmental Sciences

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University of KwaZulu-
Natal Pietermaritzburg

South Africa

SEPTEMBER 2023

PREFACE

The research contained in this thesis was completed by the candidate while based in the Discipline of **Dietetics and Human Nutrition**, School of Agricultural, Earth and Environmental Sciences of the College of Agriculture, Engineering and Science, University of KwaZulu-Natal, Pietermaritzburg, South Africa, under the supervision of Dr Annette Van Onselen and Prof. Unathi Kolanisi. This research was financially supported by the candidate.

The contents of this work have not been submitted in any form to another university and, except where the work of others is acknowledged in the text, the results reported are due to investigations by the candidate.



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7/09/2023

As supervisors of the candidate, we agree to the submission of this dissertation



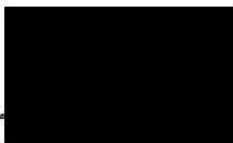
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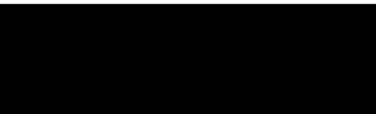
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(v) Where I have used material for which publications followed, I have indicated in detail my role in the work.

(vi) This thesis is primarily a collection of material, prepared by myself, published as journal articles or presented as a poster and oral presentations at conferences. In some cases, additional material has been included.

(vii) This thesis does not contain text, graphics or tables copied and pasted from the internet, unless specifically acknowledged and the source being detailed in the thesis and in the References sections.



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DECLARATION 2: CONFERENCES AND PUBLICATIONS

My role in each paper and presentation is indicated. *Indicates the corresponding author.

1. Bosede A. Omachi*, Annette Van Onselen, Unathi Kolanisi. The Food and Nutrition Security Status of Nigerian Children towards Achieving the Sustainable Development Goals – A Review. This was presented virtually at the 10th Annual Conference of the Family and Consumer Sciences Society of Nigeria (FACCSO), held from the 7th to 10th November 2021. Presented by Bosede A. Omachi.
2. Bosede A. Omachi*, Annette Van Onselen, Unathi Kolanisi. The impact of the food environment on food acquisition and usage among Nigerian women. This was presented virtually at the 2021 Postgraduate Research and Innovation Symposium (PRIS), College of Agriculture, Engineering and Science, University of KwaZulu-Natal, held from 9th and 10th December 2021. Presented by Bosede A. Omachi.
3. Bosede A. Omachi*, Annette Van Onselen, Unathi Kolanisi. Full but Empty Plate: Way Forward in Improving Food and Nutrition Insecurity in Africa. This was presented virtually at the South Africa Sweden University Forum (SASUF) workshop, held on the 22nd of September 2022. Presented by Bosede A. Omachi.
4. Bosede A. Omachi*, Annette Van Onselen, Unathi Kolanisi. The Household Food Security, Feeding Pattern and Nutritional Status of Preschool Children in North Central Nigeria. Poster presentation (virtual) at the 22nd International Congress of Nutrition (22nd IUNS-ICN), held in Tokyo, Japan, from 5th to 8th December 2022. Presented by Bosede A. Omachi
5. Bosede A. Omachi*, Annette Van Onselen, Unathi Kolanisi. Nutrition Knowledge and Maternal Dietary Intake in Niger State, Nigeria. Poster presentation (in-person) at the 2023 Nutrition Congress, between the 18th and 20th April, 2023, at the Lord Charles Hotel, Somerset-West, Western Cape. Presented by Bosede A. Omachi.
6. Bosede A. Omachi*, Annette Van Onselen, Unathi Kolanisi. Evaluation of Food and Nutrition Security Status of Nigerian Preschool Children towards Achieving the Sustainable Development Goals 1, 2, 3 – Review. *Afr. J. Food Agric. Nutr. Dev.* 2022; 22(10):21952–21971. <https://oroidi.org/doi/10.18697/orajfand.115.22520>.

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8. Bosede A. Omachi*, Annette Van Onselen, Unathi Kolanisi. Nutrition Knowledge and Health Vulnerability of Mothers of Preschool Children in North Central, Nigeria (under review for *PLoS ONE*).
9. Bosede A. Omachi*, Annette Van Onselen, Unathi Kolanisi. Food Insecurity and Vulnerability of Food Environment among Nigerian Mothers in the Post-Pandemic Era – A Review (to be submitted to *Journal of Nutrition Education and Behavior*).



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ABSTRACT

Child and maternal nutrition are essential to any country's food and nutrition security, encompassing all the components of maternal and child growth, well-being, development, and productivity, as contained in the modified UNICEF 2020 conceptual framework on determinants of maternal and child nutrition. According to the World Health Organization (WHO) and Centers for Disease Control and Prevention (CDC), preschool children are regarded as being between 3 and 5 years old. This period entails intensive cognitive development in children, where developmental milestones that help shape their personality, interpersonal relationships, and thinking patterns are fostered; hence, the need to consume healthy meals following the recommended minimum dietary diversity requirements of at least five to eight food groups per day for children is a bedrock for positive health outcomes. The prevalence of nutrition-related maternal and child morbidity has continued to increase in recent times across many low- and middle-income countries (LMICs) owing to several complex multifactorial and interrelated determinants. The complexity and interconnectedness of the determinants of maternal and child nutrition in developing countries, such as Nigeria, are yet to be well conceptualised and have become a public health issue due to the emerging triple burden of malnutrition (TBM) and the prevalence of diet-related non-communicable diseases ravaging the nation. Therefore, this study assessed the food and nutrition security status of mothers and their preschoolers in North Central Nigeria.

A cross-sectional descriptive design and a multi-stage sampling technique were used to recruit 450 mother-child pairs (preschool children aged 3-5 years) across the North South senatorial district in Niger State, North Central Nigeria. Sociodemographic information and biodata of mothers and their preschoolers were collected using semi-structured questionnaires. Feeding patterns of mother-child pairs were assessed using a qualitative food frequency questionnaire based on 24-hour and 7-day dietary recall. The dietary diversity of households, mothers, and children was assessed using the Household Dietary Diversity Score (HDDS), Minimum Dietary Diversity Score for Children (MDD_C), and Minimum Dietary Diversity Score for women of reproductive age (MDD_W), respectively, as recommended by the Food and Agriculture Organization (FAO), Family Health International (FHI) and World Health Organization (WHO). The Household Food Insecurity Access Scale (HFIAS) was used to assess the food insecurity status of the participants. Anthropometric indices of the preschoolers

were assessed based on weight-for-age, height-for-age, and weight-for-height indicators, while maternal anthropometry was assessed using body mass index (BMI) and waist/hip ratio. Maternal nutrition knowledge was assessed using a Likert-type scale. Retrieved information was analysed using SPSS version 28. Descriptive statistics are presented in tables and charts, while regression models were used for inferential statistics, with statistical significance being considered at a 95% confidence interval with a p-value of < 0.05 .

The study was conducted in two phases: the first phase considered an in-depth narrative literature review that evaluated the food and nutrition security status of preschool children in North Central, Nigeria, as well as the food insecurity and vulnerability of the food environment among Nigerian mothers. This study explored the literature using a qualitative approach and an overview of online sources, peer-reviewed articles, books, and other publications and relevant reports from official websites to investigate the concept of the food environment, food acquisition and utilisation complexities among Nigerian women, and the prevalence of food and nutrition insecurity and its determinants among preschool children. This review found that the global prevalence of the Triple Burden of Malnutrition (TBM) is alarming, especially among developing nations, affecting more women than men. Food acquisition and utilisation are important determinants of women's food and nutritional security status. Full but empty plates have continued to be a dilemma among women from countries undergoing urbanisation and nutrition transitioning; hence, poor nutrient intake has been reported to account for the high risk of maternal morbidity and mortality related to nutritional causes in most developing countries, such as Nigeria. This revealed that the interconnectedness of the food environment to food acquisition and utilisation in addressing food insecurity and malnutrition as an innovative concept is yet to be well understood and explored in many studies across Nigeria. It also elucidates the drivers of poor dietary diversity, meal quality, and food consumption patterns among preschool children and possible health outcomes of compromised feeding patterns and the risk of non-communicable diseases and malnutrition among the study participants. In addition, the review also focused on the drivers of the food environment, food acquisition, nutrient utilisation, and the prevalence of TBM among women across the six geopolitical zones in the country. The high prevalence of malnutrition and diet-related non-communicable diseases in this study accounts for the high maternal and child morbidity and mortality rates, especially in many rural and poor households across the nation, thus becoming a significant public health concern. Some factors found to significantly impact food utilisation

among women were food literacy, poverty, insurgence, lack of support systems, seasonality, and family size. To mitigate these challenges, efforts should be geared towards improving both the community and consumer food environments, thus ensuring the consumption of nutrient-dense meals for optimal health outcomes and well-being, especially among women and preschool children living in rural areas, urban slums, and low-income households across the six geopolitical zones of the nation and among other developing nations experiencing food and nutrition insecurity around the world.

The second phase was the experimental section and was divided into two parts: the first part explored the socioeconomic status, household food security status using the HFIAS and the feeding patterns of the preschool children using the qualitative 24 hour and 7-day dietary recall. Dietary diversity was assessed using the MDD_C, while the anthropometric indicators for under-five children were used to categorise the children into stunting, wasting, underweight, and normal weight. The results showed that the majority (76.4%) of the preschool children were from rural communities; more than half (51.8%) of the children were from mothers who had only Islamic education (no formal education), and only a few (1.2%) of the children were born to single mothers. Almost all (95.6%) of the children were from Islamic religious homes, and the majority (71.6%) of the mothers were unemployed, while 83.8% of the monthly household income was below N18,000 (\$40), which is far below the national minimum income range of N36,000. Most (73.6%) of the children were from male-headed households. The predominant ethnic group was Nupe (68.4%), whereas the least dominant was Gwari (<1%). Most (98.8%) of the preschool children were from food-insecure households, and almost half (42.4% and 40.2%) of the preschool children were either moderately food insecure or severely food insecure, respectively. The severity of food insecurity increased with parity, and its prevalence was higher among children from multiparous and grand multiparous households. The most consumed food group among preschoolers was cereal-based food products, while the least consumed food groups were fruits and vegetables. This study also showed that over half (60.0%) of the preschoolers did not meet the minimum dietary diversity score (MDD_C) recommended for their age. The anthropometric indices of the preschool children showed that half (50.0%) of the children were stunted (height-for-age), 21.0% had wasting (weight-for-height), and 29.0% were underweight (22.2% were severely underweight) (weight-for-age). The logistic regression model showed that the socioeconomic status of mothers, such as education, income, religion, occupation, employment status, means of waste disposal, source

of potable water (water suitable for human consumption), and water treatment methods, were associated with the household food insecurity status of the children and were associated with inadequacy in children's MDD ($p < 0.05$).

The second part of the experiment explored the contribution of maternal nutrition literacy to the nutritional status of mothers in Niger State, North Central Nigeria. The results showed that the majority (63.8%) of the mothers were between 26 and 35 years old. More than half (51.6%) of the mothers did not know what a balanced diet was based on the definitions provided in the questionnaire. Social media or online information was the most explored source of nutritional information among mothers (36.4 %). Fifty-four per cent of the mothers indicated that their nutrition literacy had no positive impact on their dietary quality. The food consumption pattern showed that fruits/vegetables, and dairy products were the least consumed food groups among the mothers (7.1% and 9.1%, respectively). More than half (57.6%) of the mothers were within the normal BMI range, and the mean waist/hip ratio was 0.82 ± 0.08 . The regression model showed that place of residence, occupation, source of potable water, and method of waste disposal were significantly associated with adequacy of maternal minimum dietary diversity. Although nutrition knowledge has been reported to influence dietary quality among mothers, this study showed that other intrinsic factors besides nutrition knowledge significantly impacted the dietary quality and nutritional status of mothers in the study area. Therefore, to optimise health outcomes among mothers, stakeholders at all levels must implement programs and policies that address issues such as insurgency, inflation, climate change, disparity in wealth distribution, and seasonal vulnerability.

In conclusion, the prevalence of food and nutrition insecurity was high among the participants due to poor socioeconomic status and poor food environment, thereby compromising the meal quality and consumption frequency of mothers and their preschoolers. Most mothers adopted the consumption of ultra-processed foods and beverages as coping strategies to salvage the impact of hunger and starvation, thereby predisposing them to the risk of TBM and NCDs among mothers and their preschool children. To mitigate these challenges, efforts should be geared towards addressing the determinants of food and nutrition insecurity with a multidimensional approach at the grassroots level and involving all stakeholders and policymakers, to enable a sustainable food system through nutrition-sensitive agriculture at the household and community level. Draught resistant and improved variety crops should be used to mitigate climate change impact on food access and affordability and thus, enhance adequate

consumption of nutrient-dense meals for optimal health outcomes among the participants and across most food insecure developing nations.

ACKNOWLEDGEMENTS

I want to sincerely thank the following individuals and organisations for their support and contribution to the success of this study and thesis:

- Dr Annette Van Onselen for her motivation and immense contribution throughout the study. Thank you for the excellent supervision and promptness.
- Prof. Unathi Kolanisi for the insightful comments, contributions, and positive criticism, which encouraged me to widen my knowledge on various perspectives.
- The University of KwaZulu-Natal for the remission of fees.
- Staff of the discipline of Dietetics and Human Nutrition for assistance provided throughout the study.
- The community heads and gatekeepers of the selected communities in Niger State, North Central, Nigeria, for approval to conduct data collection among the mothers and their preschool children.
- Nutrition focal persons at the basic Health centres in the various communities that ensured maximum cooperation by the mothers and information provided during the focus group discussion exercise.
- Evangelist Theophilus Audu Latiko for translating research tools used for data collection.
- Mr Ndaliman Banki, Mr Taiwo, and Mrs Ejim for assistance with the recruitment of field workers for the data collection and focus group discussion exercise.
- Dr and Dr (Mrs) Sanusi, Fezile, Yolisa, the Olusanyas and Zinhle my research mentors who selflessly and tirelessly contributed to my mentorship as a researcher.
- My research assistants (DLCF crew and Federal Polytechnic Bida students) who selflessly assisted with data collection in the various local government area visited.
- My husband, Paul and children, David, Delight, and Daniella, thank you for being there through the thick and thin. Your love and understanding made this research a huge success story.
- To my siblings Bamidele Oluwayemisi and family, Aduloju Emmanuel and family and Oluwatosin Aduloju, in-laws, the Adeotis, Mummy Edu, Mummy Nwosu and my parents, Engr and Mrs Aduloju, thank you for your prayers and encouragement.
- Lastly, I am grateful to God for the sufficiency of His grace to bring this study to completion.

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ABBREVIATIONS

ACF:	Administration of Children and Families
ACAPS:	Assessment Capacities Project
AFSB:	African Food Security Brief
BMI:	Body Mass Index
CILSS-CH:	Interstate Committee for Drought Control in the Sahel Cadre Harmonisé
DBM:	Double Burden of Malnutrition
DFRRI:	Directorate of Food, Roads and Rural Infrastructure
ECA:	Economic Commission for Africa
EWEC:	Every Woman Every Child
FAO:	Food and Agriculture Organization
FEWS NET:	Famine Early Warning System Network FFP:Food for Peace
FFQ:	Food Frequency Questionnaire
FHI:	Family Health International
FNIS:	Food and Nutrition Insecurity
FSIN:	Food Security Information Network
GAM:	Global Acute Malnutrition
GDP:	Gross Domestic Product
GHI:	Global Hunger Index
GIEWS:	Global Information and Early Warning System on Food and Agriculture
GNAFC:	Global Network Against Food Crises
GSEMA:	Gombe State Emergency Management Agency

HDDS:	Household Dietary Diversity Score
HFIAS:	Household Food Insecurity Access Scale
HLPE:	High-level Panel Expert on Food Security and Nutrition
ICF:	International Classification of Functioning, Disability and Health
IFAD:	International Fund for Agricultural Development
IFPRI:	International Food Policy Research Institute
IPC:	Integrated Food Insecurity Phase Classification
INDDEX:	International Dietary Data Expansion Project
IOM:	Institute of Medicine
LMICs:	Low-and Middle-Income Countries
MAD:	Minimum Acceptable Diet
MDD-W:	Minimum Dietary Diversity for Women
MDD_C:	Minimum Dietary Diversity for Children
MUAC:	Mid-Upper Arm Circumference
NALDA:	National Agriculture and Land Development Authority
NDHS:	Nigeria Demographic Health Survey
NPC:	National Population Census
NSPAN:	National Strategic Plan of Action for Nutrition
OCHA:	Office for the Coordination of Humanitarian Affairs
SDGs:	Sustainable Development Goals
SOML-PforR:	Saving one million lives programme for results
SWOC:	The State of the World's Children

TBM: Triple Burden of Malnutrition

UNICEF: United Nations Children's Fund UN: United Nation

USAID: United States Agency for International Development

WFP: World Food Programme

WHO: World Health Organization

CHAPTER 1: INTRODUCTION, PROBLEMS AND SETTINGS

1.1 Introduction and Background of the Study

Malnutrition and food insecurity are major public health concerns in many developing countries, particularly for women and children in rural communities (Food and Agriculture Organization [FAO] *et al.* 2019 Sunuwar *et al.* 2019). These conditions are responsible for a significant proportion of maternal and under-five morbidity and mortality in the affected communities; for instance, approximately one-third of infant and child mortality is attributed to malnutrition and food and nutrition insecurity in developing nations (Kalu & Etim 2018).

Food security was defined at the 1996 World Food Summit as a situation in which all people, at all times, have physical and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (FAO 1996; 2015; FAO *et al.* 2019). Nutrition security is consistent access, availability, and affordability of food and beverages that promote well-being, prevent diseases and if needed, treat disease, particularly among racial or ethnic minorities, lower income, rural and remote populations, including tribal communities and insular areas (Ingram 2020; FAO *et al.* 2022).

Food and nutrition insecurity is defined as a lack of access to the types and amounts of food and beverages necessary for each household member to lead an active and healthy lifestyle, disease prevention and disease management, especially among the marginalised members of society (Babu & Gajanan 2022). People are faced with moderate food insecurity when they are uncertain of their ability to obtain food and have been forced to reduce the quality and/or quantity of food they consume due to lack of money or other resources at some point in time within the year. Severe food insecurity means that individuals have the likelihood of running out of food, experiencing hunger, and, in the most extreme cases, have gone for days without eating, thereby putting their health and well-being at risk (FAO, ECA 2021; FAO *et al.* 2022). However, consistent, and equitable access to healthy, safe, and affordable foods among people will promote optimal health and well-being and consequently ensure the nutrition security of the populace and nation at large (USDA 2022).

Maternal and child nutrition has been identified as one of the key determinants of health and the outcome of human development that has a long-term influence on the quality of life, especially in later years (Ayieko & Anyango 2011; Alaofè & Asaolu 2019; FAO *et al.* 2019; Niles *et al.* 2020; Mori *et al.* 2021; Victora *et al.* 2021). Therefore, adequate nutrition is essential for appropriate development and good health for women and children because it does not only affect their physiological development but also their social and productive life and the society at large (Adesuyi 2016; Nurliyana *et al.* 2016; Fadare *et al.* 2019; Chakona 2020). It is pivotal for favourable pregnancy outcomes among mothers and thus improves the chances of child survival within the first 1000 days of life (Marshall *et al.* 2022).

Adequate nutrition is a practice required for addressing malnutrition issues, diet-related non-communicable diseases, food, and nutrition insecurity among vulnerable members of society, thus enhancing positive health outcomes, well-being, and nutritional status among these groups (FAO 2022; FAO, IFAD 2021). The nutritional status of a mother is an important indicator of her overall health and that of her child (Senbanjo *et al.* 2013; Jemide *et al.* 2016; Senbanjo *et al.* 2019; Waswa *et al.* 2021), and the nutritional status of children is a strong indicator of any country's food and nutrition security status. The poor nutritional status of children is a predictor of poor mental and cognitive development, academic performance, and retarded growth, which is often irreversible if no intervention is provided within the windows of opportunity during their lifecycle (Ahmed *et al.* 2016; Luan *et al.* 2018; Akombi *et al.* 2019; Nzefa *et al.* 2019; Senbanjo *et al.* 2019).

The first year of a child's life is fundamental and critical for their future development, therefore, children's nutrient intake continues to be impacted by several factors such as breastfeeding, complementary feeding adopted by caregivers, the type, quality, and quantity of food items such child is introduced to, maternal or caregivers socioeconomic factors, and household food security status (Hart *et al.* 2010; Ayieko & Anyango, 2011; Ickes *et al.* 2017; Karmacharya *et al.* 2017; Alaofè & Asaolu, 2019; FAO *et al.* 2019a). According to the World Health Organization (WHO) and the Centers for Disease Control and Prevention (CDC), preschool children are those between 3 and 5 years old. This period involves intensive cognitive development in children where developmental milestones that help shape their personality, interpersonal relationships, and thinking patterns are fostered; hence, the need to consume healthy meals following the recommended minimum dietary diversity requirements of at least

5 to 8 food groups per day for children is a bedrock for positive health outcomes (Vinod *et al.* 2011; Klein *et al.* 2016; Charach *et al.* 2017).

For mothers, malnutrition expresses itself as undernourishment and over nourishment, either as overweight or obesity, micronutrient deficiency such as anaemia and other disease burdens attributed to compromised dietary lifestyles and inadequate nutrition (Lavie *et al.* 2014; Trivedi *et al.* 2015; Keates *et al.* 2017; Pipe, 2018; Atanasova *et al.* 2022). Adequate maternal and child nutrition is essential for the overall health and nutritional status of both. Studies in many countries have reported a strong association between maternal undernourishment, especially during pregnancy and lactation, and high rates of low birth weight, failure to thrive, and increased risk of susceptibility to childhood illnesses and mortality (Black *et al.* 2008, 2013; Hart *et al.* 2010; Okubo *et al.* 2014; Nwaru *et al.* 2015; Mannan *et al.* 2016; Shamah-Levy *et al.* 2017; Chakona 2020).

Globally, almost 3 billion people could not afford healthy foods in 2020 and thus were undernourished, affecting more women and children than men (FAO *et al.* 2019, 2022; FAO, IFAD, 2021). Approximately 281.6 million of these people were undernourished, and from Africa, 346.4 million Africans (more than 25%) suffered from severe food insecurity, and 452 million (about 33.7%) suffered from moderate food insecurity (FAO *et al.* 2022). According to Thomas and Turk (2023), approximately 40% of the Nigerian population is identified as food insecure and the majority of these people are women and under-five children. Similarly, the acute food unsecured population rose by about 5.4 million people to 17 million over the past year (almost 9% of the respective population) (Thomas and Turk 2023). The Global Food Security Index (GFSI) rating shows that Nigeria ranked 94th out of 113 nations in 2019, which puts the country below Ethiopia, Niger, and Cameroon. Nigeria has also overtaken India as the world's most impoverished country (Otekunrin *et al.* 2019; Ayinde *et al.* 2020; Wudil *et al.* 2023).

The Levels and Trends in Child Malnutrition 2021 report reported that many malnourished children and women worldwide reside in Africa and Asia (UNICEF 2021). However, 18.7% (115.7 million) of the undernourished people in Africa live in West Africa (FAO, ECA, 2021). Similarly, in many developing countries, women from low socioeconomic households and rural communities are most affected by this monster, while their children are also not spared (Faruque *et al.* 2008; Murray *et al.* 2020; FAO, ECA, *et al.* 2021).

In recent times, malnutrition has continued to express itself as either a dual or triple malnutrition burden among households in many low- and middle-income countries, such as Nigeria, and has been attributed to the increased prevalence of food and nutrition insecurity and compromised dietary intake (Powell *et al.* 2017; Shamah-Levy *et al.* 2017; Akanbiemu 2019; UNICEF 2019). A paradoxical double burden of malnutrition among people in the same household is a phenomenon in which one individual is underweight while the other is overweight within the same household (Kimani-Murage *et al.* 2015; Mahmudiono *et al.* 2018; Anik *et al.* 2019; Kushitor *et al.* 2020; Popkin *et al.* 2020). That is, the double burden of malnutrition (DBM) is defined as the coexistence of maternal overweight and obesity along with child undernutrition within the same household, whereas the triple burden of malnutrition (TBM) refers to the coexistence of over nutrition, undernutrition and micronutrient deficiencies (Sunuwar *et al.* 2019). This recent manifestation of TBM has a strong association with the pattern of nutrition shift from indigenous healthy meals to Westernised ultra-processed (nutrient-deficit) foods, which is associated with poverty, unhealthy food environments, food illiteracy, poor socioeconomic status, the disparity in wealth distribution among gender, a high prevalence of food insecurity, low physical activity level attributed to the availability of modern, convenient transportation facilities, sedentary lifestyles and transition to consumption of Westernised and fat-dense food items and sugar-sweetened beverages (Widener *et al.* 2011; Abizari *et al.* 2017; Ruel *et al.* 2017; Parker *et al.* 2018; Akanbiemu 2019; Baye *et al.* 2021). This nutritional shift is accelerating the obesity epidemic, other diet-related non-communicable diseases and mortality among mothers and under-five children both in developed and developing nations (Doak *et al.* 2005; Kandala & Stranges, 2014; Duran *et al.* 2015; Nnyepi *et al.* 2015; Bjelland *et al.* 2021).

Studies have shown that countries undergoing a rapid transition in socioeconomic development and urbanisation often face changes in food acquisition, consumption, and nutrient utilisation patterns, and food habits, and therefore risk over- and undernutrition, i.e., DBM (Gulliford *et al.* 2003; Doak *et al.* 2005; Ihab *et al.* 2013; Kandala & Stranges, 2014; Ruel *et al.* 2017; Tacoli, 2017; Anik *et al.* 2019). At the same time, TBM is fast becoming an epidemic and thus needs urgent attention, especially among low- and middle-income countries and food insecure households in many developing countries like Nigeria (Abdu *et al.* 2018a; FAO, ECA, 2021; FAO, IFAD, 2021; Kibemo *et al.* 2022).

Nigeria is the most populous country in sub-Saharan Africa and is estimated to be approximately one-fifth of the total population in the region. It has the largest gross domestic product (GDP) in Africa, yet it is still ranked among the poorest and most undernourished nations in the world (USAID 2021; Abubakar *et al.* 2022). Despite its gross domestic product being the largest in Africa, approximately 40% of its 206 million people live in poverty and social conditions that exacerbate poor health (Muhammad & Sidique 2019; Sanusi *et al.* 2019; Yahaya *et al.* 2021; Abubakar *et al.* 2022). Sachs *et al.* (2019) reported that Nigeria ranks 159th out of 162 countries striving towards achieving the 2030 sustainable development goals (SDGs). Previous studies have indicated numerous determinants of malnutrition and food insecurity, including the unavailability of food diversity, consumption of insufficient, unsafe, non-nutritious food, poor income and purchasing power of members of households. Moreover, unpredictable climatic conditions, seasonal flooding and conflicts or communal clashes often limit the agricultural productivity and income of this region (Nupo *et al.* 2013; Rother *et al.* 2016; Kandeepan *et al.* 2016; Abizari *et al.* 2017; Kah, 2017; Adelaja & George 2019; Famine Early Warning Systems Network (FEWS NET), 2020; Steiner & Kralovec 2020; Baye *et al.* 2021; Waswa *et al.* 2021).

In 2019, conflict in the northeastern part of Nigeria displaced more than 1.8 million people, predominantly women and children, within the country and forced nearly 240,000 people to flee to neighbouring countries for asylum, thereby straining food resources in the region. The incessant violence across the nation has disrupted agricultural and income-generating activities, reducing household purchasing power and access to food, consequently predisposing mothers and children to increased risk of food and nutrition insecurity, maternal and child malnutrition, morbidity, and mortality from preventable causes (Kah 2017; Adelaja & George 2019; Steiner & Kralovec 2020). Although food insecurity can affect anyone, its effect on women and children deserves special attention because of their social, physiological, and psychological vulnerability (Saaka 2016; Sanusi *et al.* 2019; Samuel *et al.* 2020; Yahaya *et al.* 2021). Maternal and child malnutrition (under-nutrition) is a major public health problem in Nigeria, especially among rural dwellers, low-middle-income earners, and food-insecure households (Jemide *et al.* 2016; Sani Nass *et al.* 2021; Yahaya *et al.* 2021). Therefore, this study assessed the nutrition and food security status of mothers and their preschool children (3-5 years), in North Central Nigeria. Preschool children were chosen because this period entails intensive cognitive development in children where developmental milestones that help shape their

personality, interpersonal relationships, and thinking patterns are fostered, also, most nutrition intervention programmes like school feeding do not take them into account.

1.2 Statement of the Problems

The proportion of food-insecure households, especially mothers and children, is on the increase and varies across the six geopolitical zones of the nation because of several intrinsic factors that have continued to undermine government efforts towards reducing poverty and hunger and ensuring the well-being of women and children, thereby aggravating the prevalence of TBM and the maternal and child morbidity and mortality rate attributed to poor dietary lifestyle. The prevalence of underweight and stunting among children (preschool), overweight or obesity and hidden hunger among women is increasingly in many sub-Saharan African countries like Nigeria (Lindsay *et al.* 2012; Sasson 2012; African Union Commission 2015; Sola *et al.* 2016; STATS SA 2019; FAO *et al.* 2021).

Studies report that the health and physical consequences of child malnutrition, which include delayed physical growth and motor development, lower intellectual quotient (IQ), greater behavioural problems, deficient social skills, susceptibility to contracting illnesses and diseases, and absenteeism in school, among others (Moreira *et al.* 2014; EWEC 2015; Kalu & Etim 2018; Johnson & Markowitz 2018; Tarekegn *et al.* 2022). Child malnutrition may also lead to higher levels of chronic illnesses in adulthood, which may have intergenerational effects, as malnourished females are more likely to give birth to low birth weight babies (Black *et al.* 2013; Piperata *et al.* 2013; Moreira *et al.* 2014; EWEC 2015; Nwaru *et al.* 2015; Robson *et al.* 2015; Motbainor *et al.* 2016, 2017; Adinma *et al.* 2017; Shamah-Levy *et al.* 2017; Johnson & Markowitz 2018; Tarekegn *et al.* 2022). However, findings from some population-based studies have found that food insecurity is associated with increased body mass index (BMI) and an increased risk of overweight or obesity in adult women in both industrialised and developing countries (Adams *et al.* 2003; Ivers & Cullen 2011), but not all studies have reported this relationship. Studies in developing countries among adults and children have produced mixed results, for example, in Malaysia, household food insecurity was found to be associated with obesity among rural women (Shariff & Khor 2005), whereas in Trinidad and Tobago, household food insecurity was associated with being underweight among adults (Gulliford *et al.* 2003). In Guatemala, the BMI of women from households classified as moderate to severe food insecure was significantly lower than that of women from food-secure households (Chaparro 2012).

Nigeria is one of the countries with highest burden of malnutrition among under-five children and women of reproductive age in the world, causing a significant obstacle to achieving better maternal and child health outcomes and the relevant SDGs (Alaba et al. 2023). Similarly, the complexity and interconnectedness of the impact of the food system/environment, maternal nutrition knowledge, and nutrient adequacy on the overall health outcome and well-being of mothers and their preschool children in North Central Nigeria are yet to be well conceptualised and explored, and thus little progress has been made towards achieving the food and nutrition security status of these vulnerable groups, especially in regions experiencing chronic food deficit due to insurgency. Therefore, there is a need to identify and tackle the problems of food and nutrition insecurity (FNIS) and malnutrition among this vulnerable group. Also, the emerging concept of the impact of the food environment and food literacy on the food and nutrition security status of mothers and preschool children in Nigeria is yet to be explored. Therefore, this study seeks to navigate the food and nutrition security status of these vulnerable groups from this emerging concept, thereby shedding more light on not just increasing food availability to a population but enhancing nutrition security among mothers and preschool children who are often neglected. This study also seeks to provide scientific information and create awareness at grassroots as well as among stakeholders and policymakers on the contribution of the food environment, nutrition education on food acquisition and nutrient utilisation in enhancing optimal health outcomes as illustrated in Figure 1.1.

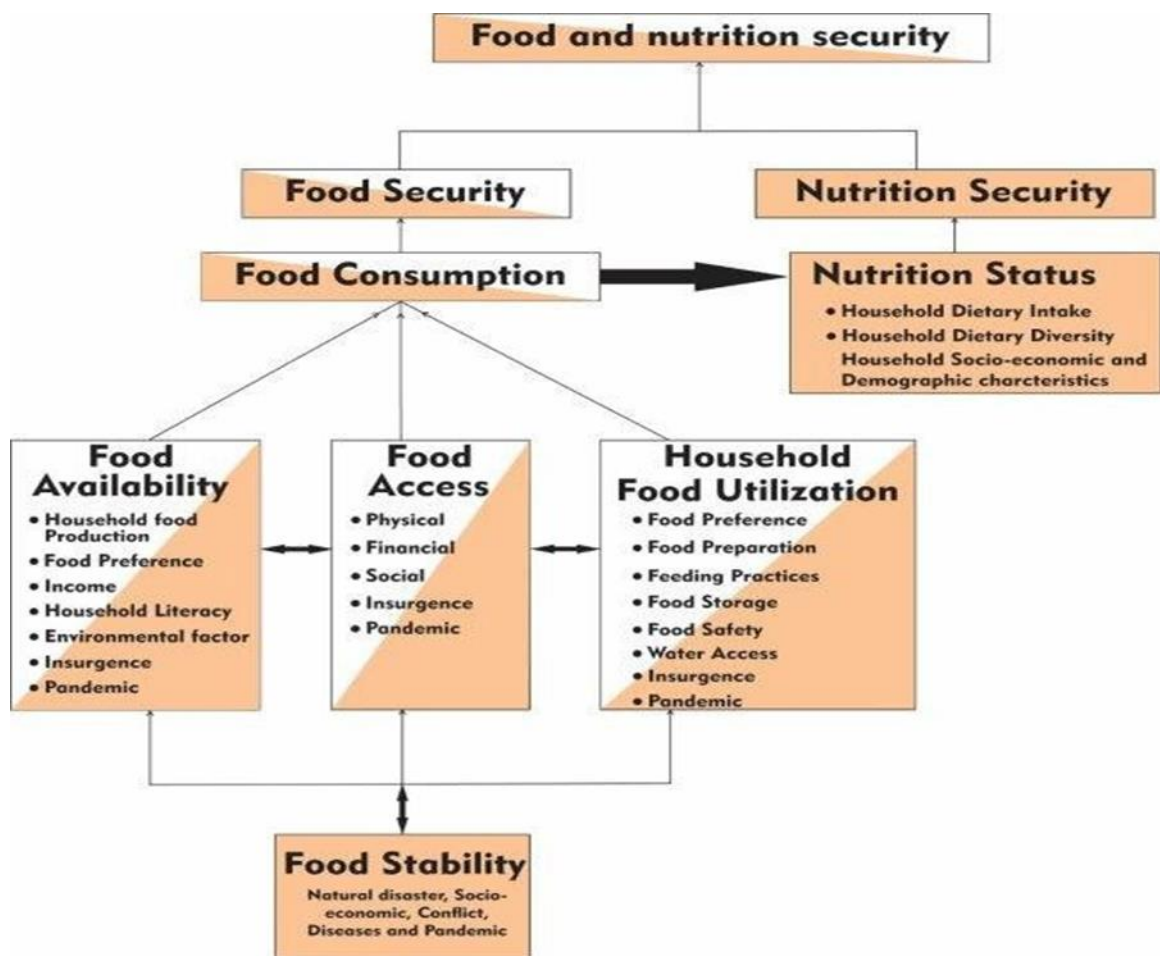


Figure 1.1: Conceptual framework of multidimensional facets of food and nutrition security and its interconnectedness with the nutritional status of individuals

1.3 Justification

Food insecurity and malnutrition is an important global public health problem, having adverse consequences for individuals in both resource-poor and resource-rich households across Nigeria, although its implications vary across family setting or type, geographical location, climatic vulnerability, cultural or religious beliefs and socioeconomic status of households (FAO 1997; FAO 2011, FAO 2017; FAO *et al.* 2019; FAO, ECA 2021; FAO, IFAD. 2021; FAO *et al.* 2022). The determinants of FNIS are multifaceted and complex and thus deserve a holistic approach to addressing the underlying factors and root causes, thereby focusing not just on food production as a goal but as a tool for improving healthy living, especially among mothers and preschool children, thus ensuring adequate dietary intake and prevention of diseases which are themselves caused by a set of underlying factors. These underlying factors

include: household food insecurity, poor maternal or child caring practices and lack of access to basic healthcare services including lack of safe water supply and unhealthy living environment, as illustrated in Figure 1.1 (Berhanu, Mekonnen, & Sisay 2018). In turn, these underlying causes are influenced by economic, political, and sociocultural conditions (Tsedeke, Tefera, & Debebe 2016).

The current insurgency and economic crisis in Nigeria are further fuelling food and nutrition insecurity challenges among women and their children. Households are faced with hikes in food prices due to several factors such as economic meltdown, devaluation of the Nigerian naira, border closure against the importation of staple foods to ameliorate food shortage experienced by the teeming population. Furthermore, the removal of the fuel subsidy has negatively impacted on the cost of production of essential commodities needed for healthy living (Kah 2017; Adelaja *et al.* 2019; Abubakar *et al.* 2022).

The incessant increase in food prices, despite wage or salary increase for civil servants across the nation, has not in any way improved the food and nutrition security status of the masses because of several multifaceted and complex underlying factors that exacerbate food and nutrition insecurity in the nation (Muhammad *et al.* 2019; Bai *et al.* 2021; Omotayo *et al.* 2022). Disruption of income generation and reduction in agricultural activities owing to insurgency and communal clashes ravaging the northern regions, from which most of the food supply to the nation comes, has distorted household purchasing power for safe and nutritious healthy foods. Thus, a large proportion of households have exhausted their limited resources and are in an increasingly precarious situation of food insecurity, hunger, and starvation. Studies have reported a strong association between household food security and the nutritional status of mothers and under-five children, this being a key indicator of the general well-being and health status in a population especially those experiencing food crisis (Bahn *et al.* 2020; Bai *et al.* 2021; Chigozirim *et al.* 2021; FAO, IFAD 2021). Epidemiological research has also established a positive association between household food (in) security, maternal nutrition, and socioeconomic factors with childhood growth indicators such as weight gain, apical growth, survival, and susceptibility to infections (Dubois *et al.* 2006; Okubo *et al.* 2014; Jemide *et al.* 2016; Bhuyan & Sahoo 2017; Kalu & Etim 2018; Owino 2019; Ogunniyi *et al.* 2021; Obayelu & Adeleye 2021; Kibemo *et al.* 2022). Among mothers and children, poor dietary lifestyle practices are attributable to poverty, household food insecurity, poor education, food or nutrition knowledge, poor food environment, seasonality, pandemics, conflicts and climatic

vulnerability that consequently results in preventable causes of diet-related non-communicable diseases and disability-adjusted life years (Cobb *et al.* 2015; Abizari *et al.* 2017; Kalu & Etim 2018;; Swinburn *et al.* 2019; Ogot 2020; Baye *et al.* 2021; Waswa *et al.* 2021; Atanasova *et al.* 2022).

According to a recent report from the United States Agency for International Development (USAID) there is significant regional variation of malnutrition in Nigeria, with some of the poorest indicators found in the northern part of the country. The estimated prevalence of chronic malnutrition, for example, in the Northern region is higher compared with the Southern region. The Northwest has the highest proportion of children who are stunted (55%), followed by the Northeast (42%) and North Central (29%). At the state level, Kebbi state has the highest proportion of stunted children (61%), while Enugu State has the lowest proportion (12%) (USAID *et al.* 2018; USAID *et al.* 2021). Several studies have documented findings on the pattern of dietary intake and health outcomes among women and children in many states in Nigeria. These studies have indicated regional variation in the prevalence of nutritional outcomes across the country but there is scanty information on the food and nutrition security status of mothers and preschool children in North Central, Nigeria, and especially in Niger State.

1.4 Aim and Objectives

1.4.1 Aim

To investigate and describe the pattern of household food and nutrition security status of mothers and preschool children (3 to 5 years old) in Niger state, North Central Nigeria, thereby providing baseline information for workable intervention programmes and humanitarian assistance that could reduce the prevalence of diet-related maternal and child morbidity and mortality in the study area.

1.4.2 Objectives

1. To determine the nutritional status (based on anthropometry and dietary intake), dietary diversity and food security status of preschool children (3 to 5 years old) in Niger State, North Central Nigeria.
2. To describe the household food security, food adequacy, and nutrient intake pattern among the mothers of preschool children in Niger State, North Central Nigeria.

3. To assess the dynamics of nutrition knowledge on the food security and nutritional status of mothers of preschool children in Niger State, North Central Nigeria.
4. To evaluate the association between food environment and food acquisition, utilisation, and health outcomes of mothers and their preschool children in Niger State North Central Nigeria.

1.5 Scope of Study

Nigeria is divided into six geo-political zones, namely, North-west, Northeast, North Central, South-south, South-east, and South-west. However, this study will be limited to mothers and preschool children from the North Central Zone of Nigeria, which is the largest geopolitical zone in the country and under-studied in terms of scientific outputs and due to security threats and insurgence presently occurring in major parts of the country.

1.6 Knowledge Gap

Although several similar studies have been conducted in other geopolitical zones in Nigeria, the impact of food environment, sources of nutrition information, insurgence and pandemic on the food and nutrition security status of mothers and their preschool children in Niger State, North Central Nigeria still remains a grey area which this study aims to explore.

1.7 Outline of Dissertation or Thesis Structure

Each chapter is mostly self-contained, containing a literature review, materials and methods, results and discussion (as one section or separated into two sections) and conclusions. The description, application and user-assessment of the web-based data and information system (Chapter 2) are central to all chapters. The result of each chapter is one or more web-based screens devoted to one or more aspects of the chapter.

Chapter 1: Introduction and background of the study, the knowledge gap and the rationale for the study.

Chapter 2: Literature review of food and nutrition security from a global perspective with emphasis on Nigerian women and preschool children.

Chapter 3: Research methodology, target population, sample size, sampling techniques and ethical approval.

Chapter 4: Household food security status and how it impacts the adequacy of preschool children's dietary intake in Niger State, Nigeria.

Chapter 5: The interrelationship between maternal nutrition knowledge, dietary patterns, and health status.

Chapter 6: Food insecurity and the effects of the food environment on food choices and health outcomes of mothers.

Chapter 7: Integrates the work and provides conclusions and documentation of the contributions of this research. Future teaching, learning and research possibilities are proposed.

1.8 Referencing Style

The referencing style used in this dissertation is according to the guidelines used in the Discipline of Human Nutrition, University of KwaZulu-Natal, Pietermaritzburg.

Table 1.1: Summary of research publication outputs and their Status

Authors	Title of Research Articles	Publication Status
Bosede A. Omachi*, Annette Van Onselen, & Unathi Kolanisi	Evaluation of Food and Nutrition Security Status of Nigeria, Preschool Children Towards Achieving the Sustainable Development Goals 1, 2, 3 – A Review.	Published in <i>Afr. J. Food Agric. Nutr. Dev</i> (AJFAND) 2022
Bosede A. Omachi*, Annette Van Onselen, & Unathi Kolanisi	The Household Food Security and Feeding Pattern of Preschool Children in North Central Nigeria.	Published in MDPI (<i>Nutrients</i>) Journal, 2022
Bosede A. Omachi*, Annette Van Onselen, & Unathi Kolanisi	Nutrition Knowledge and Health Vulnerability of Mothers of Preschool Children in North Central, Nigeria	Under review with <i>PloS ONE</i> Journal, November 2022
Bosede A. Omachi*, Annette Van Onselen, & Unathi Kolanisi	Food Insecurity and Vulnerability of Food Environment among Nigerian Mothers in the Post-pandemic Era – A Review	Work in progress. To be submitted to the <i>Journal of Nutrition Education and Behaviour</i>

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CHAPTER 2: LITERATURE REVIEW

This chapter has been published as:

Bosede A. Omachi*, Annette Van Onselen, Unathi Kolanisi: Evaluation of Food and Nutrition Security Status of Nigerian Preschool Children Towards Achieving the sustainable Development Goals 1,2,3-A Review. *African Journal of Food, Agriculture and Nutrition Development* 2022; 22(10):21952–21971. <https://orcid.org/10.18697/orajfand.115.22520>.

2.1 Introduction

Hunger, food shortage and nutrition insecurity have become a global public health issue in recent times. The Food and Agriculture Organization (FAO) reports that in 2019 about 690 million people worldwide were hungry and food insecure (FAO *et al.* 2020b). Worldwide the FAO indicates that more than 3 billion people cannot afford a healthy diet. This is linked to the high rate of food and nutrition insecurity, especially in sub-Saharan Africa (FAO *et al.* 2020a). In sub-Saharan Africa, about 239 million people are reported to be undernourished and food insecure, which is high compared with other regions (FAO *et al.* 2019b). Also, studies have shown that the prevalence of food insecurity and hunger is usually higher among women and under-5 children than among men in underdeveloped countries compared to developed countries (Gebremedhin, 2000; FAO *et al.* 2020).

Nigeria is the most populous country in sub-Saharan Africa and has approximately one-fifth of the total population in this region. It spends about N1.3 billion (\$3,158,715.30) of its revenue on importing essential food items annually. However, over 75% of its populace, including women and children, live in poor households with limited or no access to the nutrient-dense food (healthy foods) needed for a healthy and active life (Abu & Soom 2016). In addition, the Administration of Children and Families (ACF) (2015) reported that Nigeria's global acute malnutrition (GAM) rate was 14%, which is higher than the West and Central African median (Abu & Soom 2016). The country has, over the years, launched several policies and intervention programmes such as Operation Feed the Nation, Lower River Basin Development Authorities, Green Revolution, regulatory bodies such as the Directorate of Foods, Roads and Rural Infrastructure (DFRRI) and National Agricultural and Land Development Authority (NALDA), the zero hunger initiative. aimed at eliminating undernutrition by 2025 ahead of the 2030 SDGs deadline, Feed For Peace (FFP), the National Strategic Plan of Action for Nutrition (NSPAN) from 2014-019, and Saving One Million Lives Programme for Results (SOML-PforR) (National Population Commission (NPC) 2018) and a host of other programmes in a bid to address the issue of food insecurity and achieve the sustainable development goals (SDGs) of ending hunger, promoting food and nutrition security, and improving nutrition among vulnerable groups by promoting sustainable agriculture (Otaha 2013; Sustainable Development Solution Network 2017; Hepburn 2018; Sachs *et al.* 2019; United Nations 2019; Abubakar *et al.* 2022). There is increased interest in improving all Nigerians' nutritional status

by prioritizing the most vulnerable groups, such as children, women, and the elderly. There is still continuous neglect of the outcomes of the contribution of food adequacy versus nutrient sufficiency and their intersection towards achieving food and nutrition security amongst women who are the custodians of food and care.

Many of the previous national programs and interventions implemented to address the situation were only supply-driven and aimed at increasing agricultural production and food supply without much focus on nutrient adequacy and sufficient intake among the vulnerable members of society (FAO *et al.* 2017, 2018; FAO, IFAD *et al.* 2021; FAO *et al.* 2022). Quality food intake is essential for an active and healthy life, especially for women of reproductive age and for growing children. This can be achieved by providing safe, nutritious, and sufficient food by navigating a healthy food environment that caters to overall well-being (McGuire 2015; FAO 2016; WHO & FAO 2019; FAO *et al.* 2019b, 2021, 2022). However, food insecurity (FI) and nutritional deficiency diseases among women remain unaddressed, especially among those from the low and lower-middle-income class and among women in the northern states of the country because of inadequacy in food and nutrient intake attributed to variations in food environments and its drivers across the nation (USAID *et al.* 2018; Muhammad & Sidique 2019; Abubakar *et al.* 2022).

The overall aim of this review was to explore the dynamics of the food environment and nutrition insecurity in Nigeria after the pandemic with a focus on food acquisition, food adequacy, consumption patterns and nutrient sufficiency among women, and elucidate women's contribution to food access with government policies geared towards addressing food insecurity and the emerging triple burden of malnutrition (TBM).

2.2 Global Perspective and Prevalence of Food and Nutrition (In) Security

Despite the increasing number of hungry, malnourished, and food-insecure people across the planet, it is worrisome that micronutrient deficiencies are still contributing significantly to the prevalence of a double burden of malnutrition ravaging many of the developing countries. It has hindered Africa's food and nutrition security, especially in the sub-Saharan regions (FAO 2010, 2011, 2015, 2017; FAO *et al.* 2019a; FAO & WFP 2020; FAO, ECA. 2021). The FAO reported that one in every nine persons suffers from hunger globally; that is, about 8.9% of the world's population is hungry, with high prevalence in Africa and Asia, where many of the

undernourished and food-insecure people live (FAO 2018, 2019a; FAO, ECA, 2021). In 2021, The State of the Food Security and Nutrition in the World (SOFI) recorded that the number of undernourished people around the world was about five times higher in 2020 than in the last two decades. More than half and about one-third of these populations are found in Asia and Africa respectively as shown in Figure 2.1 (FAO, IFAD 2021). One in every three people in the world did not have access to adequate healthy food in 2020 due to the impact of the COVID-19 lockdown on households, and national and global markets. Unfortunately, the consequence of this was more severe among women than men, who suffered about 10% higher prevalence of moderate to severe food insecurity (FAO, IFAD. 2021; FAO *et al.* 2022).

In Africa, over 70% of the populace has been reported to be undergoing stress and are in food crises, with nearly 30% of women of reproductive age (15 years to 49 years) being anaemic in 2019 (Food Security Information Network [FSIN] 2017; FAO, ECA, 2021; Global Network Against Food Crises [GNAFC] & FSIN 2021). The impact of the COVID-19 lockdown across the globe has been predicted to increase the number of undernourished and food insecure people to about 840 million globally by 2030, affecting mainly the low- and middle-income countries (LMICs), with women being the most vulnerable (Abdu *et al.* 2018b; FAO *et al.* 2019a, 2020a; FSIN 2021).

This review used a narrative approach and an overview of online sources, peer-reviewed articles, books, and other publications to investigate the concept of household food security, food adequacy and nutrient sufficiency complexities amongst Nigerian women and their under-five children.

Map 1.2
Numbers of people in IPC/CH Phase 3 or above (or equivalent) by region, 2020



Source: FSIN, GRFC 2021.

Figure 1.6
Numbers of people in IPC/CH Phase 3 or above (or equivalent), by region, 2016-2020
 Data from 39 countries common to all editions of the GRFC 2017-2021

	2016	2017	2018	2019	2020
Eurasia	31.3	36.5	36.8	36.9	45.6
East Africa	25.9	29.3	28.4	27.7	32.9
Central America and Haiti	3.2	3.3	3.6	7.8	11.8
Central and Southern Africa	22.3	23.4	25.2	30.2	40.2
West Africa and the Sahel, Cameroon and Libya	11.5	18.1	11.4	12.6	24.8

Source: FSIN, GRFC 2017-2021

Figure 2.1: Global prevalence of people with undernourishment for 2020

Source: FSIN 2021

2.3 The Evolution of Food and Nutrition Insecurity in Nigeria

In 2000, Heads of State across the globe reached a consensus at a meeting held in New York to support and be committed to achieving food security and alleviating hunger by halving the population of undernourished persons by 2015. However, the proportion of undernourished and hungry people worldwide has continued to rise geometrically, especially in sub-Saharan Africa and in low-and middle-income countries generally (LMICs) (FAO 2015; FAO *et al.* 2019a; FAO, IFAD 2021; FAO, ECA, 2021; FAO, 2021; 2022). The African Food Security Briefs (AFSB) estimated that approximately one in three people in sub-Saharan Africa is undernourished (Akerele *et al.* 2013; Akerele 2015). Similarly, out of the 22 developing countries that FAO or IFAD have studied, more than 166 million people were reportedly

undernourished because of food insecurity, representing nearly 40% of this population (FAO *et al.* 2019a; Rupa & Helvetas 2019; von Grebmer *et al.* 2019).

Nigeria has experienced food and nutrition insecurity (FNIS) over many years, with a high prevalence of various forms of malnutrition, predominantly affecting women and children across different socio-economic strata and geopolitical zones. The discovery of oil in 1970 was the origin of food insecurity because the nation became heavily dependent on it and neglected agricultural productivity, so food production dropped drastically despite the population density in the nation. Food was imported to meet these increasing demands, thereby cushioning the impact of malnutrition and hunger (Adeagbo 2012; United States Energy Information Administration 2015). Nigeria overtook South Africa as Africa's largest economy in 2013, with GDP growing from \$169.48 billion in 2010 to \$522.64 billion in 2014 (Trading Economics 2014). This development cushioned the economy's 24th position globally, just behind Poland and Norway, and leap-frogging Belgium and Taiwan. The GDP per capita substantially rose to \$2,689 from an initial estimate of \$1,555 (Matemilola & Elegbede 2017). The oil boom in Nigeria helped to maintain relatively steady economic growth in the face of a global financial meltdown because it had the largest natural gas reserves in Africa and is the continent's biggest oil exporter (United States Energy Information Administration, 2015; Sola *et al.* 2016). This status, unfortunately, did not put more money in the pockets of the masses; instead, the wealth disparity between the rich and the poor (IFAD 2012; Naisbitt & Naisbitt 2016). For example, the discovery of oil in most of the south-south region of the country has distorted agricultural activities and there are frequent oil spillages in such areas. Simultaneously, agricultural activities in the north are affected by extreme weather conditions such as drought during the dry season and flood during the rainy season, and recently by bandit attacks and vandalisation of farmlands (Matemilola & Elegbede 2017). Although Nigeria prides itself as the giant of Africa, with its economy being the largest in 2014, the poverty rate in the country is alarming (Omorogiuwa *et al.* 2014). It ranked among the world's most deficient, food-insecure, and undernourished nations (FAO 2016b; International Food Policy Research Institute [IFPRI] 2017).

In 2012, the Global Hunger Index ranked Nigeria 40th out of 79 nations, while the 2011 Human Development Index (UNDP) placed Nigeria in 156th position of FI out of 187 countries (Matemilola & Elegbede 2017; Osabohien *et al.* 2018). The Global Hunger Index score for

Nigeria over the years was 40.6 (2000), 34.1 (2006), 32.0 (2012), and 29.2 (2020); although these figures appear to be decreasing, the country is still categorised as severely food insecure and in need of intervention (Global Hunger Index 2020: Nigeria 2020). Of the 20 countries that experienced acute food insecurity (FI) in 2020 using the food insecurity experience scale (FIES), Nigeria had the highest prevalence (31.4%). It also had a high combined prevalence (74.4%) of moderate and severe FI. Northern Nigeria accounted for the highest prevalence among the countries, as indicated in Figure 2.2 and Figure 2.3. FAO also reported that FI prevalence in the country in 2020 was three times higher than in 2019 due to the pandemic and increased security threats to lives (FAO, IFAD 2021). Nigeria had the largest increase observed, especially in severe food insecurity, showing a threefold increase in 2020 compared to 2019, as indicated in Figure 2.2.

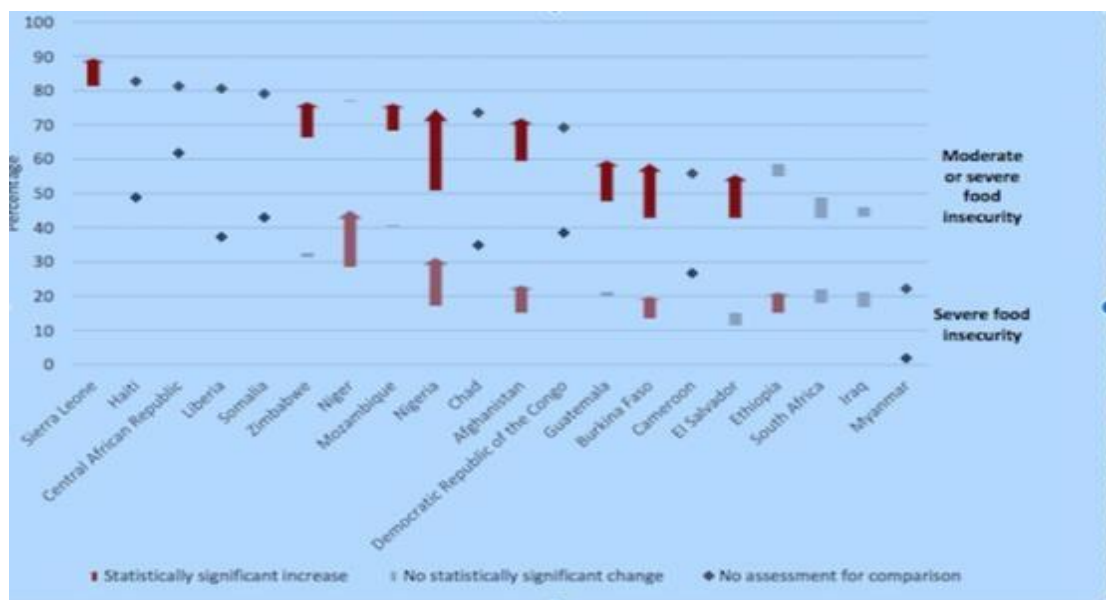


Figure 2.2: Change in the prevalence of annual food insecurity in 2020 compared with 2019

Source: FAO 2020

2.4 The Effects of Food Quantity versus Food Quality on Nutrition Wellbeing among Mothers and Children

Food intake in both quality and quantity impacts the nutritional status of women. Therefore, it is an essential predictor of their overall health outcomes and of their children and the household at large (EWEC 2015). Consuming an adequate proportion of nutritious food with individual body requirements is imperative for maintaining healthy living and food security. Good nutrition is essential for attaining and maintaining optimal health and preventing non-communicable diet-related diseases (NCDs) among women; thus, adequate intake of safe and nutritious food ensures the nutrition security of women and their households and communities. The nutritional quality of the food consumed from the available food environment affects people's optimal health in such a community (Day & Pearce 2011; Beuchelt & Badstue 2013). Food is considered adequate when it satisfies dietary needs regarding individuals' age, living conditions, health status, occupation, and sex, among others. Therefore, energy-dense food and nutrient deficits can contribute to diet-related non-communicable diseases.

Nutritionally adequate food should be safe for human consumption and free from adverse substances harmful to human health, such as contaminants from industrial or agricultural processes and wastes that include pesticides, hormones, or veterinary drugs, and be culturally acceptable to the populace (United Nation 2010; Reddy & Anitha, 2015; Alonso *et al.* 2018; Owino 2019; Chakona 2020; Reddy & van Dam, 2020; Ribeli & Pfister 2022). Nutrient sufficiency is the comparison between the nutritional requirement of individuals and their overall intake of the household food environment. It is crucial for human growth and development because inadequate or excessive nutrient intake increases the risk of poor health outcomes and varying degrees of malnutrition among the vulnerable, predominantly women from poor socioeconomic and wealth indexes. Therefore, nutritional adequacy depends on the consumption of food variety across all food classes in the right proportion regarding individual body needs (Hatløy *et al.* 1998; Schmeer & Piperata 2017; Shamah-Levy *et al.* 2017; South *et al.* 2019).

The adequacy of food and nutrients are essential components of food acquisition and nutrient utilisation that are increasingly affecting the health outcomes of households across many LMICs such as Nigeria. The type of food acquired and consumed by people depends on what is readily available and affordable in the community or household food environment and

consequently impacts the overall health status of the vulnerable, especially women and growing children (Doak *et al.* 2005; Richardson *et al.* 2014; Popkin 2015; UN general assembly 2015, FAO 2016a; Popkin *et al.* 2020). Therefore, unhealthy food environments such as unhealthy meals and poor feeding habits, combined with suboptimal food choices and nutrient malabsorption, have been associated with the current TBM among women of reproductive age and children in developing countries such as Nigeria. This has become a public health concern (Lukan, 2015; Global Panel on Agriculture and Food Systems for Nutrition 2016; Turner *et al.* 2020).

The FI situation in Nigeria does not mean a reduction in food availability and accessibility altogether because the amount of food available and consumed in a household does not implicitly translate to optimal food utilisation and dietary quality of meals because of an existing gap between household food basket, preference, and nutrition knowledge in addressing nutrition-related, non-communicable diseases among women and under-five children, especially from rural communities and northern regions of the country (Gulliford *et al.* 2003; Bhattacharya *et al.* 2004; Garasky *et al.* 2004; Schmeer & Piperata, 2017; Ivers & Cullen 2011; Otaha 2013; Beuchelt & Badstue 2013; Eme *et al.* 2014; Abdu *et al.* 2018b; Parker *et al.* 2018; Adams *et al.* 2020; Christian *et al.* 2020; Samuel *et al.* 2020).

Factors that predict poor health outcomes among women and children in food-insecure countries like Nigeria are predominantly poor food systems, poor food environments, nutrition transition, globalisation, poor socio-economic status and political instability, corruption, insecurity or conflicts, pandemic, poor technological know-how, and shift from agricultural productivity to non-agricultural activities (Obayelu 2013; Eme *et al.* 2014; GNAFC 2020; Kah 2017; Adelaja & George 2019; Niles *et al.* 2020; Obayelu & Osho 2020; Samuel *et al.* 2020; UN Women Headquarters 2020; World Bank 2020a; Abay *et al.* 2021; Obayelu & Akpan 2021; Abubakar *et al.* 2022). Similarly, monotonous dietary consumption patterns and over-dependence on starchy staples, with little or no intake from dairy products, animal protein, and the substitution of fruits and vegetable consumption for more convenient foods that are less nourishing are common practices across food insecure households in Nigeria which impact negatively on women and children's health and nutritional status (Nwajiuba & Okechukwu 2008; Labadarios *et al.* 2011; Ijarotimi 2013; Asomugha *et al.* 2017; Ukegbu & Ogu 2017; Díez *et al.* 2017, 2019; Obayelu & Osho 2020).

The aforementioned factors rapidly transform the national food system and both the community and local food environments of households, thus, consequently increasing the risk of DBM and TBM not only in Nigeria but also across sub-Saharan African countries.

2.5 Factors Informing Mothers' Food Choices and Consumption Patterns in Nigeria

2.5.1 Nutrition Knowledge

Nutrition knowledge is essential for healthy lifestyle practices and food choices for healthier living among households, especially among women and their children. It is also essential for optimal food acquisition preparation and consumption of balanced diets among individuals and households (Byrd-Bredbenner *et al.* 1982; Dollahite *et al.* 2003; Kaliamoorthi 2013; Jemide *et al.* 2016; Sunuwar *et al.* 2019; Egg *et al.* 2020; Katenga-Kaunda *et al.* 2020, 2022; Gallegos *et al.* 2022; Oyewole & Ejoh, 2022). Good maternal nutrition knowledge is necessary in addressing nutritional needs across the lifecycle, reducing the risk of food insecurity, malnutrition, and other diet-related diseases among vulnerable members of society (Al-Shookri *et al.* 2011; Beuchelt & Badstue 2013; Jemide *et al.* 2016; Akerele *et al.* 2017; Powell *et al.* 2017; Fadare *et al.* 2019; Otieno 2021).

Therefore, it is pertinent that food handlers and caregivers understand the concept and components of food and how they interact during processing and preparation for optimal nutrient utilisation (WHO & FAO 2003; Popkin 2012; Franco *et al.* 2015; Legbara & Selepe 2017; FAO *et al.* 2019a; WHO & FAO 2019). Consumers' preference for convenient and less healthy food and beverages has increased since the inception of the nutrition transition. The nutrition transition has been attributed to globalisation and urbanisation with significant implications for the food systems and consumer food environment across the various socio-economic classes in Nigeria, which has posed a significant threat to the attainment of the minimum recommended dietary intake for optimal health outcomes among the vulnerable (Gulliford *et al.* 2003; Doak *et al.* 2005; Faber *et al.* 2015; Nnyepi *et al.* 2015; Sha An Ali *et al.* 2020; Brug *et al.* 2021).

Many women have fallen prey to poor dietary intake, both in quality and quantity, in a bid to optimise a healthy lifestyle because of inadequate nutrition information or misconstrued knowledge about components of healthy foods and their recommended daily intake. The impact of unhealthy dietary lifestyles, and insufficient dietary intake are drivers of TBM, mortality

and food insecurity among women and children, especially among those who do not have nutrition knowledge background from low- and middle-income households, rural communities and urban slums across the nation (Piperata et al. 2013; Faber et al. 2015; Nwaru et al. 2015; Akanbiemu et al. 2016; Adinma et al. 2017; Akerele *et al.* 2017; Shamah-Levy *et al.* 2017; Adewusi & Nwokocha, 2018; Sani Nass *et al.* 2021; Yahaya *et al.* 2021).

In developing countries where nutrition transition is rapidly emerging, most women and households across the socioeconomic strata consume cereal-based diets with little food from other sources due to ignorance and financial constraints impacted by the economic downturn (Legbara & Selepe 2017). However, there is a need to have health consciousness and basic knowledge of the nutritional sources of essential nutrients from various food groups when purchasing food for own consumption. Nutrition education is vital in building an enabling food environment because it facilitates disseminating appropriate nutrition information to the public. This message can be channelled through several approved media such as printable copies of dietary guidelines, nutrition manuals, food pyramids and nutrition educators to individuals, groups, organisations, or the public via healthcare centres and citadels of learning to reach the learned and unschooled (Byrd-Bredbenner et al. 1982; Dollahite *et al.* 2003; Legbara & Selepe 2017; Sunuwar *et al.* 2019; Fadare *et al.* 2019; Katenga-Kaunda *et al.* 2020; Gallegos *et al.* 2022).

The challenge facing Nigeria is misinformation about nutrient requirements across different age groups, especially with the increasing prevalence of overweight and obesity. Many women are falling prey to the dilemma of not knowing what to eat and what not to eat. Hence, to avoid over nutrition, they are exposed to other diet-related diseases, such as micronutrient deficiency and organ dysfunction attributed to nutrient toxicity from mineral and vitamin overload (FSIN 2017; Legbara & Selepe 2017; GNAFC & FSIN 2021). In order to make the right nutrition decisions about food acquisition within the food environment, women and mothers need adequate information, counselling, support, and access to nutritious, safe, affordable, and sustainable foods (Al-Shookri *et al.* 2011; EWEC 2015; de Vries-Ten Have *et al.* 2019; UNICEF 2019; UNICEF & SWOC 2019; Mori *et al.* 2021).

Educating and influencing women to make healthy food choices through education systems that deliver nutrition-specific interventions and ensure nutrition-friendly food environments for healthy and food secure citizens is paramount to achieving food security (Byrd-Bredbenner *et*

al. 1982; Jemide *et al.* 2016; Karmacharya *et al.* 2017; UNICEF 2019, 2021a; Egg *et al.* 2020; Obayelu & Osho, 2020; Xu *et al.* 2020; Obayelu & Adeleye 2021).

2.5.2 Food Environment

The food environment is the collective physical, economic, policy and socio-cultural surroundings, opportunities and conditions that influence people's food and beverage choices and nutritional status (Swinburn *et al.* 2011, 2013). The Global Panel on Agriculture and Food Systems for Nutrition (2016) and the FAO (2016a) described the food environment as a collection of food available to people in their neighbourhood daily with regard to nutrient sufficiency in quality and quantity, safety, price, proximity to consumers and marketing (FAO 2016; Franco *et al.* 2015). The food environment is the interface between the food chain supply system and the dietary habits of individuals and households because it mediates people's food acquisition. The consumption pattern in the broader food system encompasses dimensions such as external factors that influence the type of food available, price variation, nutritional information and labelling, and socio-cultural norms of the consumers (Turner *et al.* 2018, 2020). The food environment comprises two broad groups: community food environment (market-based) and consumer food environment (non-market-based). The community food environment entails the types and quantities of food commodities available in open markets or retail outlets. In contrast, the consumer food environment (non-market driven) comprises foods that are available in storage, which are obtained either from their own production, wild-harvested foods and/or in-transfer (gifts) (Franco *et al.* 2015; Diez 2016; Turner *et al.* 2018, 2020).

In Nigeria, the food environment includes both the market and non-market food environments. The non-market environment plays a significant role among farming and low-income households across the various zones in the country. The non-market environments are also referred to as traditional food environment because household food storage is mainly from own production and in-kind transfers (Widener *et al.* 2011; Swinburn *et al.* 2013; FAO, 2016; Parker *et al.* 2018; Turner *et al.* 2018).

The drivers of non-market food environments (in-transfer and own production) are the predominant means of food acquisition and utilisation among farming households; this method of acquiring household food often impacts the pattern of food consumption, nutrient sufficiency

and the nutritional status of individuals, predominantly women and children within these households (Caspi *et al.* 2012; Dubowitz *et al.* 2012; Black *et al.* 2014; Richardson *et al.* 2014; Franco *et al.* 2015; Herforth & Ahmed 2015; Azeredo *et al.* 2016; FAO 2016b; Díez *et al.* 2017; Menezes *et al.* 2017; Ndlovu *et al.* 2018; Adams *et al.* 2020; Downs & Demmler 2020; Zhao *et al.* 2020).

Food commodities in storage are usually from the same food class, even though they might not always be the exact food items; for instance, a household that planted yam or potatoes might be gifted corn or rice from another farming household. Over time, this food acquisition pattern impairs dietary quality and, therefore, compromises individuals' and communities' health status (Garasky *et al.* 2004; Nackers & Appelhans 2013; Menezes *et al.* 2017; Pérez *et al.* 2017; Díez *et al.* 2019; Paul *et al.* 2019; Gravina *et al.* 2020; Turner *et al.* 2020; Zhao *et al.* 2020; Chang *et al.* 2022; Downs *et al.* 2022). The concept of food environment identifies food acquisition, consumption, and nutritional status as the structural drivers of the food environment, and it also considers food availability, affordability, food choices, seasonality, and proximity to the market as critical dimensions in determining the suitability of the food environment at the community and consumer level, as illustrated in Figure 2.4 (Cobb *et al.* 2015; Duran *et al.* 2015; Popkin 2015; Díez *et al.* 2016; Pérez *et al.* 2017; Bilal *et al.* 2018; Shim *et al.* 2019; Gustafson *et al.* 2021; Oladele *et al.* 2022; Acciai *et al.* 2022).

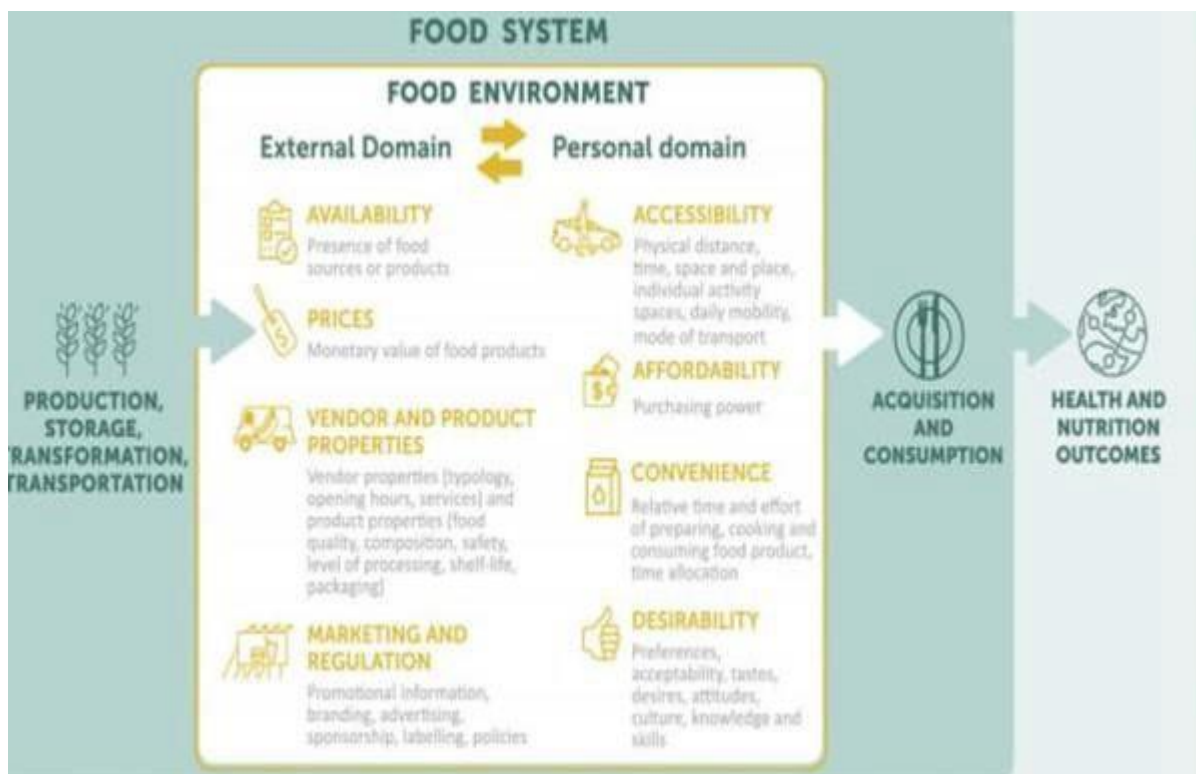


Figure 2.4: Conceptual framework of food environment and its interface with the food system

Source: Turner *et al.* (2018)

Navigating the food environment with emphasis on dietary intake in quality and quantity and its impact on the nutritional status is a predictor of overall health outcomes of women, children, and households, so is a potential tool in addressing the food and nutrition insecurity problem in Nigeria (EWEC 2015; Franco *et al.* 2015; Turner *et al.* 2018, 2020). Therefore, if the local food environment is a mass influence acting on all neighbourhoods, and subsequently, on the population's diet, we should understand different food environments in different cultural settings thus gaining a sense of food and nutrition security/insecure (Swinburn *et al.* 2011; Caspi *et al.* 2012; Franco *et al.* 2015; Menezes *et al.* 2017; Paul *et al.* 2019; Gravina *et al.* 2020; Owoo, 2020).

2.5.3 Behaviour Factors (Socio-Cultural Norms, Food Preference and Values)

The ultimate effect of consumers' behaviour on the food environment depends largely on their existing food preferences, level of nutrition knowledge, and the type of food. When the label is visible, easy to understand and not misleading, it can positively affect consumer choices. Evidence shows that well-designed packaging and labels can positively affect all consumers regardless of whether they are rich or poor and highly educated or not (High Level of Expert on Food Security and Nutrition [HLPE] 2017); however, food warning labels, nutrition

information and summary indicator approaches (e.g., Nutri Score) are more strongly associated with healthier purchases (Odoms-Young *et al.* 2016).

Socio-cultural beliefs, religion, and customs play a significant role in the nutritional well-being of women in Africa and Nigeria in terms of food preference and food-sharing within the household and communities. For example, pregnant and lactating mothers are prohibited from consuming certain classes of food due to cultural, family and religious taboos believed to have a future effect on children after birth, possibly and during developmental milestones; hence such women are deprived of nourishing meals and therefore stand the risk of malnutrition (Nwajiuba & Okechukwu 2008; Reddy and Anitha 2015; Agada & Igbokwe 2016; Alonso *et al.* 2018; Ifeanyi *et al.* 2019; Reddy and van Dam 2020). Prohibited foods are usually of animal origin (eggs, meat, snails, and fish), but these beliefs and habits are nutritionally harmful and could pose threats to the well-being and overall health outcome of women and the unborn children especially the uneducated rural dwellers in Nigeria (Ayevbomwan *et al.* 2016; Agada & Igbokwe 2016; Achón *et al.* 2017; Alonso *et al.* 2018).

The Fulani ethnic group in Nigeria do not consume red meat, fruits and vegetables in their regular menu plan as pastoral farmers. This peculiarity emphasises the complexity of generational practices concerning healthy food consumption and, consequently, the incidence of protein-caloric malnutrition and hidden hunger among women and children (Reddy & Anitha 2015; Agada & Igbokwe 2016; Alonso *et al.* 2018; Reddy & van Dam 2020).

2.5.4 Environmental Factors (Seasonality, Price, Conflict, Pandemic and Natural Disaster, Climate Change)

Affordability is a great challenge to navigating the food environment for healthy food in terms of nutrient adequacy and sufficiency, especially among middle-and low-income households (FAO 1997; UNICEF 1998, FAO 2011; FAO *et al.* 2019a, UNICEF 2019; WHO & FAO 2019; Kirk *et al.* 2019; Bai *et al.* 2021; Chigozirim *et al.* 2021; FAO, IFAD 2021; FAO *et al.* 2022; Omotayo *et al.* 2022).

Women and families from wealthy households who can afford healthy foods usually have better access to food availability and dietary diversity and therefore have a better chance of accessing healthy food environments for healthier living (FAO 2011; Akerele 2015; Kirk *et al.* 2019; Adeyemi & Akerele 2021; Mekonnen *et al.* 2021; Omotayo *et al.* 2022).

However, the danger among these economically stable households is increased access to supermarkets, convenience stores, and fast-food chains, which often reflects changes in consumer demand for the supply and consumption of low-nutrient foods, leading to the prevalence of overweight and obesity in LMICs like Nigeria (Asfaw 2008; Hawkes 2008; Babatunde *et al.* 2010; Babatunde & Qaim 2010; FAO 2011; Abdul Majid *et al.* 2016; FAO 2016a; Tacoli 2017; Kelleher 2018; FAO *et al.* 2019; Etea *et al.* 2019; Lee *et al.* 2020; Obayelu & Osho 2020; Xu *et al.* 2020; Kansime *et al.* 2021; Bjelland *et al.* 2021; Kinyoki *et al.* 2021; Picchioni *et al.* 2021; Sawyer *et al.* 2021; Victora *et al.* 2021; Chang *et al.* 2022). Another environmental factor that influences the food environment is poor policies that do not favour value-adding technology and investment in own food processing industries (FAO 2006; Laslett *et al.* 2012; Swinburn *et al.* 2013; Akerele 2015; International Food Policy Research Institute (IFPRI), 2016; Adinma 2017; Maredza *et al.* 2017; Lee *et al.* 2020; CARE Policy Report 2020; HLPE 2020; Omotayo *et al.* 2022). For instance, there are millions of farmers, food producers and consumers, with only a few food processors and marketers globally. Many of these companies manufacture ultra-processed foods because of their low production cost, long shelf-life, and high retail value, making them highly profitable. Hence, they have increasingly sought new markets in LMICs, including sub-Saharan Africa. As a result, such foods are now ubiquitous and found even in remote areas in Nigeria, leading to the increasing rate of NCDs and TBM in the nation (Jones 2015; UNICEF 2019). Poor policies also negatively impact the food system, food and nutrition sustainability, price volatility, political stability and conflict resolution with grave implications on national and community food stability, acquisition and nutrient utilisation, food biodiversity, and nutrient enhancement, consequently affecting the overall food security and health status of women and children (McGuire 2015; FAO, 2016b; FAO *et al.* 2020a, FAO, IFAD, 2021; Ware *et al.* 2021; Babu & Gajanan, 2022a; FAO *et al.* 2022).

Conflicts and insurgence through ethno-religious clashes have had devastating effects on the country's agricultural activities and food production throughout the six regions of the nation. Most of the conflicts are over land boundaries which often disrupt agricultural activity (Metu *et al.* 2016; Rother *et al.* 2016; FAO *et al.* 2017; Kah 2017; Matemilola & Elegbede 2017; Adelaja & George 2019; Steiner & Kralovec 2020; FAO, USAID 2021).

Similarly, conflict and civic unrest has also negatively impact the country's economy (gross domestic product (GDP) at about 2.5% lesser than what it should have been in 2021 (UNICEF 2023). The Boko Haram-related insurgency in north-eastern Nigeria has increased displacement and disrupted harvests and income earning opportunities, leading to very high food prices, particularly in Borno state. The Armed Conflicts Location and Event Data Project (ACLED) data has documented that the most significant incidence of Boko Haram attacks was in 2020, displacing thousands of predominantly women and children, disrupting farming and reducing the harvest of staple crops (Metu *et al.* 2016; Rother *et al.* 2016; Kah 2017; Adelaja & George 2019; FAO & WFP 2020; FAO-GIEWS 2020; Steiner & Kralovec, 2020; FAO, USAID, 2021). In some other states, the intercommunal conflicts between farmers and herders, non-state armed groups, and regular armed forces has intensified, reduced farming and trading activities (IOM 2020).

The North Western and North Central states of Nigeria have experienced insecurity due to village raids, kidnapping, and cattle rustling, which has compromised the food environment causing food crises and the risk of malnutrition. These areas are hard to reach with humanitarian assistance. Therefore, most people are driven from their homes into neighbouring countries like the Republic of Niger where they seek asylum (Kah 2017; Adelaja & George 2019; Assessment Capacities Projects (ACAPS), 2020; Institute of Medicine (IOM) 2020; Steiner & Kralovec 2020; FAO, USAID 2021). These communal clashes and insurgencies have prevent farmers from accessing their fields, resulting in reduced crop production, depleted food environment, poor revenue generation and purchasing power, and invariably poor food accessibility and food insecurity in most households (FSIN 2017; Adelaja & George 2019; GNAFC & FSIN 2021). This violence has led to the displacement of over 2.7 million people in some of the Northeastern states such as Adamawa, Borno and Yobe. Similarly, communal clashes in the Northwestern and North Central regions and natural disasters in 2020 have also contributed to large scale displacement of people (Kah 2017; Adelaja & George 2019; ACAPS 2020; FAO-GIEWS 2020; Ayosanmi *et al.* 2022). Many of these people are women and children from households who have lost their male breadwinners, assets and sources of livelihood and, therefore, are in severe food crisis and are at risk of malnutrition, infectious disease and death if unassisted by humanitarian services agencies (Matemilola & Elegbede 2017; Adelaja & George 2019; George *et al.* 2020). Also, about 0.8 million people are currently

forecast to be in an Emergency (CH Phase 4), with eight Local Government Areas in Borno state and one in Adamawa (FSIN 2017; GNAFC & FSIN 2021).

Other forms of civic unrest experienced in other parts of the country, especially in the southern zones, include fighting, vandalism of assets and infrastructure without declaring war, the premeditated pervasion of poverty where the rich oppress the poor, End SARS saga (police brutality), intimidation of the ordinary citizens by politicians, domestic violence among women and children (Otaha 2013; Muhammad & Sidique 2019; Abubakar *et al.* 2022).

Climate shock is also an environmental factor significantly affecting the food environment, including floods, storms, drought, and extreme heat. These cause a loss of agricultural productivity, significantly impacting women and children from the poorest households. Thus, climate-related disasters cause severe food crises, with drought accounting for about 80% of damage and losses in agriculture, dramatically altering what food is available to children and families, as well as quality and price (Ringler *et al.* 2010; Ruane *et al.* 2013; Beuchelt & Badstue 2013; FAO 2018; Fudjumdjum *et al.* 2019; Rupa & Helvetas 2019; von Grebmer *et al.* 2019; UNICEF 2019; Steiner & Kralovec 2020; UNICEF 2021a; FAO, USAID 2021).

Global warming, also known as climate change, is another factor influencing the food environment and food security globally because it is responsible for ecosystem degradation and biodiversity loss in sub-Saharan Africa and most developing countries. Global warming is described by Behnassi and Yaya (2011) as “a time bomb” that is already ticking and waiting to explode, which has begun to manifest in global temperatures and unpredictable weather patterns, thereby depleting food stores, altering the natural physical and biological systems (ecosystem) and increasing the risk of malnutrition, diet-related chronic diseases among food insecure people (Behnassi *et al.* 2011). Climate change also impacts the output and distribution of agricultural produce at the community and consumer food environment level, regarding accessibility and affordability of healthy foods throughout Nigeria’s food chain supply system (Turner *et al.* 2018; FAO *et al.* 2019; FAO *et al.* 2020).

Many residents nationwide are beginning to feel this impact because of their geographical locations and low adaptive capacity. However, the effect is more drastic and severe among the poor small-scale rural household farmers, primarily women and children, because of the reduced per capita food consumption index associated with a poor household food basket

(Akerle 2016; Obayelu and Osho 2020; FAO *et al.* 2021). The impact of natural disasters such as drought, flood, and landslides are more pronounced in areas where agricultural activities largely depend on rainfall (Ilaboya *et al.* 2012). While drought and poor yield constitute a significant threat to food availability in the northern zone, excessive rains or floods have significantly impacted soil nutrients through leaching of topsoil and loss of farm produce to erosion which has aggravated the recent hike in food prices across the nation.

In 2020, Adamawa State, among other states, experienced disrupted agricultural activity due to floods, with many people being rendered homeless. These floods had a devastating impact on food availability across the nation because of this region's prominent role in grain production (FSIN, 2021). Gombe State Emergency Management Agency (GSEMA) statistics indicated that almost 1000 farms within the state were affected by floods, resulting in the loss of tons of crucial local food crops like cassava, yams, maize, sugarcane, and vegetables. The flood also led to the displacement of about 2.8 million people and aggravated food shortages and high-cost food commodities (Adebayo & Ojo, 2012; Ilaboya *et al.* 2012; Africa, 2016).

Seasonality is an essential environmental factor that reduces agricultural productivity and affects the community and local food environment. It usually determines the availability, accessibility, and affordability of food crops for human consumption and adequate utilisation. The cost of staples, especially cereal stocks and perishable commodities like tomatoes, was severely depleted in Nigeria due to climate change and weather vulnerability, which exacerbated high market reliance. Similarly, the consumption pattern of food among many households also depends primarily on what is abundant and cheap, especially in rural communities and among middle and low-income earners in the face of economic recession and wealth disparity (Akerle *et al.* 2016; Integrated Food Security Phase Classification (IPC) 2020; FAO *et al.* 2020; Obayelu and Osho 2020; Owoo 2020).

2.5.5 Socio-Economic Status and Geographical Location of the others and Children

Poor social status, lack of autonomy and decision-making power often prevent girls from staying longer in school to achieve better livelihoods and independence for themselves and their households. This is a significant challenge to food acquisition and utilisation with an overall consequence on the health status of women and children as they navigate the food system and environment for optimal health and nutrition outcomes (UNICEF 2019).

Studies have shown that urban residents, especially women, often rely less on starchy carbohydrates and consume more meat and other proteins, fruits, and vegetables (among more affluent households). They also tend to consume more food outside the home due to time-bound issues, better income opportunities and the availability of modern retail outlets (Lukan 2015; Hawkes, Harris, and Gillespie 2017). Hence, they shop more for ultra-processed foods, which endangers their health. Furthermore, city life also accounts for more sedentary jobs, less time and energy spent on domestic chores and greater use of public transport to get around, thereby reducing the physical activity level and increasing the risk factor for overweight and obesity than women from rural communities (Popkin *et al.* 2015; UNICEF 2019).

Similarly, families living in cities often source their food from large retailers, such as supermarkets. As they have a higher wealth index and social class, much of what they buy is packaged, processed or ultra-processed. For example, Research from Kenya shows that people shopping in supermarkets buy fewer unprocessed staples (fresh fruits and vegetables, etc.) and more processed food (Swimburn *et al.* 2013; Turner *et al.* 2018). Therefore, food-insecure urban residents may be especially vulnerable to poor health outcomes and diet-related non-communicable diseases associated with poor access to nutrient-dense foods and diets high in refined and processed foods (Popkin 2014; Gupta *et al.* 2016).

Women from rural settings tend to buy cheap foods regardless of their nutritional value, often consisting of starchy staples with little or no animal or dairy sources. Secondly, meal frequency is often compromised among these women because they must ration food to make up for food shortages or limited resources; hence, they are at risk of hidden hunger and acute malnutrition (UNICEF 2019; FSIN 2021). It is worth noting that the food environments in Nigeria vary significantly across the geopolitical zones; for example, women from southern regions of the country have more dietary diversity than women from the northern zone, which explains why the prevalence of micronutrient deficiency is higher in the north than the south (Ajao 2013; NNHS 2018; UNICEF 2020; FSIN 2021). Meanwhile, the southwest and southeast regions have had relatively stable climatic conditions and good soil characteristics for agriculture. They also have the highest level of educated citizens who often seek opportunities outside the agriculture sector, the impact of which is felt in reduced agricultural productivity, overconsumption of processed food and shift from indigenous nutrient-rich food (Matemilola & Elegbede 2017). These nutrition transitions and agricultural shifts negatively impact the

region's food and nutrition security status, and consequently the health outcomes of the primarily vulnerable women and children (FAO *et al.* 2019).

In summary, the significant factors that contribute to the triple burden of malnutrition, diet related non-communicable diseases and food insecurity among women in Nigeria are: unhealthy food environments and food chain system, wealth disparity, the high prevalence of infectious diseases, poor and misconstrued nutrition information, poor quality and monotonous food, and poor access to healthcare services and humanitarian interventions due to heightened levels inter-communal conflict, seasonal vulnerability and geographical location (FSIN 2021).

2.6 The Trend of Food Insecurity among Nigerian Women and Children

Recent statistics have shown that half (50%) of the Nigerian population, especially women, are surviving on less than \$1.9 per day, while food insecurity prevalence is about 40% among the low-income urban households and rural areas (Erokhin *et al.* 2020; Ayinde *et al.* 2020; Wudil *et al.* 2023). The burden of food insecurity and undernutrition falls disproportionately on women from low- and middle-income settings or countries (LMIC), basically because they have higher nutrient requirements per unit of body mass relative to their age groups and physiological state (pregnancy and lactation) yet consume less (Mahmudiono *et al.* 2018). Also, women usually have lower social and economic status than men, limiting their access to nutrient-rich foods, increasing their risk of infectious diseases, and reducing access to quality healthcare services (Girard *et al.* 2012).

Similarly, the prevalence of poverty and hunger is more pronounced among rural women in Nigeria than urban women because of limited household food stores usually experienced during planting seasons which is attributed to inadequate and outdated post-harvest processing techniques and poor food chain supply system; these have combined with poverty to form an almost insurmountable challenge to food preservation and storage needed for food availability all-round the year. Similarly, unpredictable variations in climate change also contribute to food shortages associated with poor yield among farming households (Bhattacharya *et al.* 2004; Maitra & Rao 2015; Maitra & FAO 2018; Okon 2018; Abubakar *et al.* 2022). It is important to note that the forms of malnutrition and food insecurity experienced in the southern region of the country are more related to overweight and obesity, unlike chronic undernutrition and hidden

hunger that are more prevalent in the northern region (Chinnakali *et al.* 2014; FEWS NET & USAID 2017).

The National Bureau of Statistics reported that obesity was becoming a public health problem in Nigeria, where 17% of women were overweight, and 8% were obese (Nigeria Bureau of Statistics, 2018). Similarly, Kandala and Stranges (2014) revealed that the combined overweight or obesity prevalence in Nigeria was 20.9%, with variation across different states ranging from 10.5% in Yobe state to 50.2% in Lagos state. Variation in the forms of malnutrition and FI prevalence across the six geopolitical zones in the country has been established by several studies. Over nutrition and its associated complications are higher among women from south and southeast regions than women from other regions. Furthermore, rural women are more prone to food insecurity and hunger than urban women (Nwajiuba & Okechukwu 2008; Ajao *et al.* 2010; NPC *et al.* 2014; Chinnakali *et al.* 2014; NPC & ICF Macro 2015; Asomugha *et al.* 2017; USAID *et al.* 2018; Joshi *et al.* 2019).

In the Southeastern region, Asomugha reported that in 2017 about 11.6% of women suffered from chronic under-nutrition, while 14.2% and 5.7% were either overweight or obese, respectively. In Abia State, 30.1% and 9.1% were overweight and obese, respectively. The researchers have opined that this is due to over-dependence on starchy staples, which is the bulk of the diet in this region, and migration from healthy meals to Westernised energy-dense diets associated with affluence (Asomugha *et al.* 2017).

Communities endowed with natural resources such as oil, gold, tin, and coal are usually more vulnerable to hunger and malnutrition due to environmental pollution (oil spillage), rendering the ecosystem and vegetation in such areas unsuitable for agricultural activities. Furthermore, poor access to healthcare facility centres due to poor road networks and lack of potable water supplies consequently meaning that about 80% of the residents, primarily women, are unable to afford adequate healthy food and optimal health services (Akinyele 2009; Matemilola & Elegbede 2017).

The FI situation and its challenges is worse in the country's northern region due to recurrent insecurity and insurgency. Secondly, the impact of climate change, kidnapping, cattle rustling, and intra-communal clashes ravaging many communities has also negatively impacted women with children's nutritional status (USAID *et al.* 2018; UNICEF 2019; GNAFC & FSIN 2021).

The prevalence of food and nutrition insecurity is high because of the inability to access adequate, nutritious and safe food. The destruction of lives and farmlands has reduced agricultural activities drastically in the affected communities and thus increasing the risk of food crisis (OCHA & West and Central Africa Regional Working Groups 2016; UNICEF & SWOC 2019; GNAFC & FSIN 2021).

Regional variation exists in FI and malnutrition prevalence among women across different sociocultural settings. For instance, Zamfara State had the highest prevalence of FI while Delta state had the least prevalence (Fig.2.2 above); other northern states like Kano, Katsina, Plateau and some North Central regions are also being affected by food crises and varying degrees of TBM because of security threats from cattle rustlers and herders attacking the areas (Owusu *et al.* 2011; Obayelu 2013; Kandeepan *et al.* 2016; Benson *et al.* 2017; Meh *et al.* 2019; Zhou *et al.* 2019; Boero *et al.* 2021; FAO, ECA, *et al.* 2021; Sani Nass *et al.* 2021; Smith *et al.* 2022). Action against hunger (2019) and FSIN (2017) reported that the number of food insecure and malnourished people in northern Nigeria is 3.8 million, of which 1.1 million are women and children located in various IDP centres across these regions. A report by Sahel and West Africa Club (SWAC/OECD) (2020) estimated that about 4.3 million people in North-eastern Nigeria, predominantly women, are in a crisis of food insecurity or worsening situations of malnutrition related to undernutrition, obesity, and hidden hunger exacerbated by conflict and insecurity (Amare *et al.* 2018; CILSS-CH 2020; FAO *et al.* 2020; Raghupathi & Raghupathi 2020; Ayosanmi *et al.* 2022).

2.7 Malnutrition Burden among Women and Under-Five Children in Nigeria

Maternal nutrition is a critical determinant of food security and the risk of non-communicable diet-related diseases with a long-term impact on the quality of life among women of reproductive age, especially in their later years (Ayieko & Anyango 2011). Maternal nutrition also directly impacts women's reproductive roles and physiologic functions; thus, it is expedient that women consume sufficient, safe, nutritious food in the right proportion and varieties required for optimal overall well-being and productivity (Beuchelt & Badstue 2013).

Poor diet in quality and quantity negatively impacts the nutritional status of under-five children, women and their social and reproductive health, and quality of life even in old age and, therefore, forms an essential predictor of their individual and household overall health

outcomes, and the health outcomes of society at large (EWEC 2015). Other factors that impair food utilisation are globalisation which is migration from indigenous foods to ultra-processed food, poor nutrition knowledge, household food preference, seasonality, and family size (Tadesse Tantu *et al.* 2017; Berhanu *et al.* 2018; Kibemo *et al.* 2022).

Malnutrition often occurs among Nigerian women and under-five-year-old children when nutrient intake is below the minimum dietary requirement for age, physiological state, and reproductive responsibilities. Maternal nutrient insufficiencies, food insecurity and malnutrition are attributed to disparity in income distribution and autonomy among women, poor food environment, and poor dietary diversity (Obayelu & Orosile 2015). Similarly, misconceived, and misconstrued nutrition information on ideal food choices, cultural and religious beliefs on food myths, and taboos that prohibit women's consumption of nutritionally adequate diets, increase the burden of infection and non-communicable diseases, especially among those from poor households and rural communities (Byrd-Bredbenner *et al.* 1982; Fadare *et al.* 2019; Jemide *et al.* 2016; Karmacharya *et al.* 2017; Powell *et al.* 2017; Otieno 2021).

Similarly, poor diets contribute to gender inequality by reducing learning potential, increasing reproductive and maternal health risks, and lowering productivity among women more than men. These impacts perpetuate intergenerational cycles of malnutrition and inequity because children of malnourished mothers are more likely to suffer stunting, cognitive impairments, weakened immunity and a higher risk of disease and death within the first 1000 days and throughout the life cycle (UNICEF 2019).

The consequences of food insecurity and malnutrition are driven by several factors like price, convenience, preference, availability, and promotional information rather than safety and nourishment, thus contributing to the intake of less nutritious and cheaper staples as the more significant part of the daily dietary pattern of Nigerians and thereby increasing the risk of overweight and obesity and some cardiovascular diseases (FAO *et al.* 2020). The health impact translates to a high disease burden ranging from the triple burden of malnutrition (TBM), diet-related non-communicable diseases such as cancer, obesity, hypertension, and various heart diseases, to mention a few, and maternal mortality rate, the severity of this burden is more prominent among women from rural communities, resource vulnerable households and also among those from northern zones of the country experiencing conflict and insecurity (Akerele

2015; Asomugha *et al.* 2017; USAID *et al.* 2018; FAO *et al.* 2020a; Obayelu & Osho 2020; Owoo 2020; FAO, IFAD, 2021).

Some other health outcomes associated with food and nutrition insecurity identified among Nigerian women are: iron deficiency anaemia, poor eyesight as a result of vitamin A deficiency, overweight and obesity, chronic undernutrition, poor academic attainment due to mental impairment in childhood with a grievous consequence on life expectancy, high morbidity, and mortality rate among women and also increased dependency ratio, which in turn impact negatively on the economy of the nation (Ijarotimi 2013; UNICEF 2019; GNAFC & FSIN 2021).

In recent times, diet-related non-communicable diseases (NCDs) such as diabetes, obesity, hypertension, and some cancers have replaced infectious diseases as the number one cause of mortality globally and also among Nigerian women due to the transition from indigenous meals to more Westernised diets associated with affluence and influence of education and exposure resulting in high mortality rate attributed to cardiovascular diseases (UNICEF 2019; FAO, IFAD, 2021; GNAFC & FSIN 2021).

Women and under-five children are more vulnerable to micronutrient deficiencies, particularly iron-deficiency anaemia. This unmet nutritional need for iron is linked to being poor and lacking power and access to resources. Malnourished mothers confront significant risks. These include a compromised immune system, greater risk of dying in childbirth, lower productivity, and capacity to generate income, and difficulty in caring for their families (UNICEF 2019).

In Nigeria, Micronutrient Initiative (MI, 2013) reported that almost 63% of women of childbearing age are anaemic, and 31% are iodine deficient. Similarly, USAID (2018) and World Bank (2016) reported that 7% of women of reproductive age suffer from acute malnutrition. Also, more than half (57.8%) of women of reproductive age and 71% of children are anaemic (USAID *et al.* 2018; GNAFC & FSIN, 2021). About 12.7% of mothers had serum ferritin levels < 12mgorml, suggesting iron deficiency; 28.1% were zinc deficient, while 30.7% had varying degrees of iodine deficiency (Asomugha *et al.* 2017; USAID *et al.* 2018). Similarly, FI and malnutrition also impacted the GDP for 2020 by dropping by 1.8% (IMF world economic outlook); this drop in GDP is attributed to the nation's economic vulnerability to international oil prices since the inception of COVID-19 pandemic (Boero *et al.* 2021). Similarly,

unemployment and underemployment rates, disruption in the supply of basic services, global oil price, and decline in Nigerians' remittance were also impacted negatively and thus increased the poverty index (McGuire 2015; FAO & WFP 2020).

In addition, the widespread violence across the northern region has contributed about 2.2 million people, predominantly women and children, to the numbers of internally displaced persons who are currently experiencing the risk of food crises and famine in the nation (FAO 2017; FAO *et al.* 2020b; FAO & WFP 2020; FSIN 2021; FAO, ECA, 2021; GNAFC & FSIN 2021). The health costs of poor nutrition and food insecurity are enormous and account for the high morbidity (nutrition-related non-communicable diseases) and mortality rate (low life expectancy), and TBM among women in Nigeria (Senbanjo *et al.* 2013, 2019; Alaofè & Asaolu, 2019). Also, the national GDP is affected negatively, increasing the economic cost of medical and healthcare services expended on disease prevention and management (Ayieko & Anyango 2011; FAO *et al.* 2020).

2.8 The Dynamics of Women Accessing Food and Food Distribution in Nigeria

The dynamics of women's ability to access food distribution through a healthy food environment is multi-faceted and challenging to address because of its complexity. Some of these dynamics are discussed below.

2.8.1 Poor Socioeconomic Status and Economic Shocks

The socioeconomic statuses that impact food acquisition and distribution among women are educational levels and wealth index because these impact purchasing power and decision-making ability regarding food procurement in quantity and quality, meal planning and preparation to meet the dietary requirement of every member of the household.

Access to quality education among women is poor compared to men. This is consistent with the National Demographic and Health Survey report in 2013, which stated that 38% of Nigerian women, compared with 21% of men aged 15-49, had no formal education (USAID *et al.* 2018). Also, Asomugha *et al.* (2017) reported that more men had formal education in the South East and Northern part of Nigeria than women. The authors opined that this could be because of the common practice and belief that women's education is a waste of family resources since it ends up in the kitchen. Consequently, most girls are married off at an early age, which ultimately

affects their educational aspirations, job opportunities, income generation, food intake, and access to quality healthcare services for optimal health outcomes (Ajao *et al.* 2010; Asomugha *et al.* 2017; Save the Child 2020).

Women face much discrimination in seeking a well-paid job due to gender inequality, especially as unmarried women, or single mothers are seen as irresponsible. Women are not allowed to take up managerial roles in some societies, organisations, and political offices because it is seen as an aberration for women to take the lead or rule over men. This consequently denies them the opportunity to afford better incomes to sustain their families and provide basic food needs. Thus, increased health, psychological, and emotional burdens predispose them to a higher risk of food insecurity and malnutrition (Onisanwa 2014; Baba *et al.* 2015; UNICEF 2019; Arikpo *et al.* 2020; Lawanson & Umar 2021). They also face a disproportionate burden of work since they are more responsible for child feeding and care aside from their career pursuits, which subjects them to more vulnerability to unpaid family labour or informal jobs. At the same time, the quest for better livelihood among women in entrepreneurship, academia, and leadership puts extra stress on them, subjecting them to the challenge of adequately feeding themselves and their children. Therefore, due to lack of necessary support from a spouse or family network, coupled with a lack of access to sufficient, affordable healthy foods, women often rely on convenience or fast foods, predisposing them to a high risk of NCDs and TBM (UNICEF 2019).

Low income, combined with the high cost of food, diminishes women's access to food in many households due to the economic downturn and the impact of the COVID-19 pandemic nationwide. Thus, the number of poor and vulnerable members of society, especially women, increases and intensifies the risk of food insecurity and malnutrition among middle- and low-income earners (GNAFC & FSIN 2021).

It is a fact that an improved wealth index is usually an expression of quality education. Therefore, women with poor educational status may not obtain a well-paid job and therefore risk income disparity and poor food and nutrition status. In contrast, women who have adequate access to good education and wealth distribution have been found to spend all or a significant fraction of their income on feeding and meeting their children's needs and, thus, have better chances of food adequacy and nutrient sufficiency than those who do not have access to income (IFPRI 2009; Matemilola & Elegbede 2017).

The onset of COVID-19 disrupted food supply chains due to border closures, shipping delays and suspension of air traffic. At the same time, during the COVID-19 lockdown, movement restrictions affected the flow of farm produce to markets, putting further pressure on food prices, at least in the initial stages of restrictions (UNICEF 2019; GNAFC & FSIN 2021). The impact of COVID-19 on women's food and nutrition security status is enormous and a great concern. In the preliminary projected report on COVID-19 by Global Economic Outlooks, the pandemic may add 83 to 132 million more people to the global statistics of undernourished persons in 2020. This is expected to affect more women and children from developing countries like Nigeria (FAO *et al.* 2020). Movement restrictions in conflict-affected communities have added a further layer of economic hardship to fragile livelihoods by constraining access to agricultural inputs and income opportunities or natural resources in Nigeria (FSIN 2021). The World Bank estimated that the COVID-19 shock pushed about 5 million more Nigerians, especially women and children, into poverty and food crises in 2020 because of the global economic slowdown that caused a sharp fall in the prices of crude oil, which accounted for 93% of exports from Nigeria (World Bank (WB) 2020).

2.8.2 Poor Dietary Diversity

Dietary diversity is a health indicator of the nutritional status of any population because it depicts the quality of the diet consumed in a household or community; hence, it is a valuable instrument for assessing the food security status of individuals, households, communities, and nations at large. Therefore, dietary diversity is the number of foods consumed for a productive and healthy life over time (Oldewage-Theron & Kruger 2008; Rah & Oshang 2010; Ajao *et al.* 2010; Obayelu 2015; Akerele *et al.* 2016; Owoo 2020).

A healthy food environment and dietary quality also ensure sufficient consumption of different nutrients across the various food groups, which are nutritionally balanced and helpful in preventing malnutrition and infectious and non-communicable diseases among the populace. Dietary quality can be achieved through home-gardening and small-scale animal husbandry at no extra cost to cater for household nutritional requirements (FAO 2013; Jones, Shrinivas & Bezner-Kerr 2014).

Overdependence on monotonous staples from starchy grains and root and tuber crops at the expense of other food groups that are rich in essential micronutrients predispose women to the

triple burden of malnutrition and food insecurity, and other adverse health outcomes. The situation is most prevalent among farming households with growing children and women from middle-to low-income earners across the country because of poverty, inflation in prices of staples, variation in food availability, diversity and preference within the food environment across the different sociocultural and geographical settings (Ajao 2010; Obayelu 2015).

Foods from other plant sources, especially fruits and vegetables (indigenous leafy vegetables) and those of animal origin (dairy, aquatic, and meat products) contain a wide range of bioactive compounds, antioxidants, dietary fibres, phytochemicals and essential micronutrients that can help to alleviate hidden hunger, reduce inflammatory disorders, improve the immune system and metabolic functions, and ensure healthy living among children and women of reproductive age (John *et al.* 2007; Rah & Oshang 2010; WHO 2013; Asomugha *et al.* 2017; Owoo 2020; FAO *et al.* 2021).

Sadly, the consumption rate of these food groups among women is affected by seasonality and price, increasing the risk of non-communicable diseases like diabetes, colon cancer, obesity, and diseases of public health importance such as iron-deficiency anaemia, iodine deficiency disorders, and vitamin A deficiency disorder (Abizari *et al.* 2017; Kirk *et al.* 2019; Waswa *et al.* 2021).

Several studies have also reported a strong link between dietary diversity, food environment and nutrition security among women (FAO United Nation 2010; Franco *et al.* 2015; Díez *et al.* 2016; FAO 2008, 2016; Akerele *et al.* 2017; FAO & National Human Right Commission Nepal 2017; Bilal *et al.* 2018; Turner *et al.* 2018, 2020; Obayelu & Osho 2020; FAO, IFAD 2021; Atanasova *et al.* 2022). Obayelu and Akpan (2021); and Obayelu and Osho (2020) have observed that food security and nutrient sufficiency among women and children from low-income urban and rural centres is significantly associated with the food available within their local or consumer food environment regarding quality and consumption patterns and household socioeconomic status (wealth index). The authors also opined that the quality of food consumed is equally determined by the gender of the household head, income status, dependency ratio, marital status, educational level of caregiver, and seasonality of food found in the community. These findings are similar to those of Ndungu and Chege (2019) and Waswa *et al.* (2021) from their studies conducted in Nairobi. Hence, ensuring optimal health outcomes and food security among women through regular consumption of different varieties of food is imperative. Other

factors associated with poor dietary intake are low maternal education, low wealth score, young maternal age, lack of formal occupation among mothers, and low maternal exposure to media, such as television, newspaper, or radio (GNAFC & FSIN 2021).

2.8.3 Family Size

One factor that significantly impacts food insecurity among women in Nigeria is large family size and parity. For instance, Nigeria's total fertility rate (TFR) is 5.3 births per woman. The unmet need for family planning is high (18%), and women's unmet needs for contraceptives are low at 12%. This varies across urban and rural settings (20% and 18% respectively) (NPC 2018; USAID 2018).

Secondly, Global Childhood Report (2021) documented that the prevalence of adolescents (15-19 years) married in 2019 in Nigeria was 22.8%, while their birth rate as of 2018 was 105.4 per 1000 girls aged 15-19 years. This is high and contributes significantly to the high fertility rate and its impending complications, aside from the high risk of poor health and malnutrition (Save the Child 2020).

Early marriage and childbirth negatively impact women's health status attributed to poor educational status, lack of income generation potential, and autonomy to its distribution, often affecting their access to quality food and healthcare services and increasing their risk of health and malnutrition challenges (NPC 2018). The high household fertility rate increases the per capita head food consumption, placing an immense burden on the already constrained household food basket and depleted reserves, thereby affecting per capita food access and allocation (intake) within the household, especially women from polygamous and extended family settings and those from poor households (Ajao *et al.* 2010; Harris-Fry *et al.* 2015; Suweis *et al.* 2015). Maitra and Rao (2015) reached a different conclusion from their study, finding that larger household sizes are less likely to be food-insecure because the number of breadwinners, including women that a household can depend on for sustenance is higher; hence, more income is available to secure sufficient nutritious food for every member of the family. However, this depends on the socio-economic status of the breadwinners (Maitra & Rao 2015).

2.8.4 Gender Inequality and Household Head

Studies have shown that female-headed households are often more vulnerable to poverty, food insecurity, and hunger than a male-headed households since women cannot often command labour within and outside their household (Agricultural Development Bank (ADB) 2013). However, Bhuyan and Sahoo (2017) conducted a study in India which posed a contrary view. Furthermore, women farmers across the geopolitical zones in Nigeria often lose control over the market niches, resources, and products they traditionally manage once these resources and products become lucrative because of unequal distribution of assets and resources between women and men. Women's dependency on sustenance and income opportunities reduces access to quality food and healthcare facilities (Beuchelt & Badstue 2013; Baba *et al.* 2015; Abu & Soom 2016). Another factor is income and wealth distribution inequalities between females to their male counterparts, which are also significantly associated with hunger, malnutrition, and food insecurity among Nigerian women and female children (Candel 2014).

Conventional systems of food-sharing and distribution within the family are evident across all ethnic groups in Nigeria because intra-family food distribution is usually related to hierarchical positions (Agada & Igbokwe 2016). Male-figure and income-earning household members are given priority in terms of the quantity and quality of the meal served. As such, mothers and young children usually receive a smaller share of food relative to their nutritional needs or go hungry in times of shortage, thereby predisposing them to food insecurity and nutrient deficiency diseases and disorders (Alonso *et al.* 2018). Otaha (2013) in suggested that if women have equal access to resources with men, yield and productivity can increase by 20% to 30%, boosting the total agricultural output by 2.5% to 4% in developing countries (Otaha 2013). Therefore, raising women's social and economic status will cause a decline in poverty and enhance food security and overall well-being (Matemilola & Elegbede 2017).

2.8.5 Price of Healthy Foods

Price is a strong indicator of food access because it determines affordability, consumption patterns, and sustainability. Therefore, to ensure adequate food consumption and nutrient sufficiency, efficient institutions must be implemented to subsidise and reduce losses along the food supply chain and food system, especially among small-scale producers (FAO, 2019).

In addition, regulatory bodies must be in place to monitor unnecessary hikes in the prices of food items along the food distribution chain due to poor road networks and value-adding costs. Another contributory factor is the influence of retailers on produce price since they often mediate between farmers and consumers in rural communities of Nigeria and, therefore, determine market price to the advantage of the farmers and consumers (FAO 2011; Kirk *et al.* 2019; Bai *et al.* 2021; Chigozirim *et al.* 2021; Mekonnen *et al.* 2021; FEWS NET & USAID 2022; Omotayo *et al.* 2022). Similarly, The State of Food Insecurity in the World (SOFI) (2020) indicated that healthy diets are about 60% more expensive than the cost of an energy-dense diet globally and about five times higher than the cost of an energy-sufficient diet in developing countries (FAO *et al.* 2019, 2020; FAO, IFAD, 2021). This considerable cost has pushed more women and families into an acute food crisis and severe malnutrition situation, which is more predominant among people from rural communities and those from middle- and low-income earning urban centres (Abu & Soom 2016).

The cost of healthy food also widens the food insecurity gap among rural and urban dwellers across the geopolitical zones of the country (Tibesigwa & Visser 2016). Affordability is a problem among mothers who understand the importance of eating nutritious food. Cost constraints determine what they can feed themselves and their children, regardless of its nutritional value (UNICEF 2019). In northern Nigeria, grains that are the most commonly consumed staples are nearly 80% higher in price than they used to be. This is due to seasonal vulnerability, climate change and insurgency, all of which drastically affect agricultural activities and yield. Consequently, over 5.8 million people are in a severe food crisis, predominantly women and children, who can no longer easily afford these staples (OCHA & West and Central Africa Regional Working Groups 2016; USAID 2018; GNAFC & FSIN 2021).

2.8.6 Inadequate Storage Facilities and Low Technological Expertise

Inadequate and insufficient storage facilities for highly perishable food items such as fruit and vegetables, grains, and tubers have contributed to the risk of food insecurity among women because of food scarcity and shortage usually experienced during off-seasons (planting seasons). Usually, most of these items suffer losses during the glut period due to a lack of adequate storage facilities and preservation techniques appropriate for the shelf stability of these commodities (Matemilola & Elegbede 2017). Hence, the impact of inadequate storage

facilities and processing equipment ultimately deepens the crises of food insecurity, hunger, and starvation across the nation, especially during dry and planting season when inflation in the price of staples is usually at its peak. The brunt of this usually falls on women more than other members of the household (Matemilola & Elegbede 2017). Food processing is an essential aspect of the food system and value-adding process that transforms agricultural produce from their original forms into other forms to enhance diversity, prevent wastage, and preserve their nutrients for safe consumption (FAO *et al.* 2019; FAO *et al.* 2020).

In Nigeria, the food processing techniques and value-adding chain in the food system are grossly inadequate and outdated, therefore farmers are compelled to dispose of their produce or consume a significant fraction of their harvest within the glut period. Consequently, this inadequacy impacts the availability and sustainability of the food environment among the small-scale farm holders who are the primary producers of food across the nation (Nwajiuba & Okechukwu 2008; Ilaboya *et al.* 2012; FAO 2021). Therefore, to sustain food security through a sustainable healthy food environment in Nigeria, efforts should be geared towards addressing the problem of excessive wastage along the production chain, especially during the glut period, which will also reduce the extra burden and emotional stress on women who engage in post-harvest activities besides other household chores at the expense of their health and dietary intake. Similarly, the value-adding technique regarding available indigenous foods should be a significant component of the food system since it can reduce TBM and NCDs at no extra cost (Matemilola & Elegbede 2017).

Another challenge is that most women engage in small-scale farming because of the lack of funds for mechanised farming or large-scale animal husbandry. Besides, mechanized farming depends mainly on power, primarily diesel and fuel, as an alternative to electricity, which has become a mirage for successive governments in Nigeria. Therefore, most agricultural products are processed manually in farms far away from homes to ease self-transportation via trekking or ferrying to neighbouring markets and cities to minimise cost (Nwajiuba & Okechukwu 2008; Matemilola & Elegbede 2017). These processes require energy, such as power, fuel, and risk, which are eventually factored into overhead costs, making them unaffordable for many middle- and low-income earners, predominantly rural communities. However, alternative sources such as solar energy, biofuel, and other agriculture-based energy sources, should be explored to

support cost-efficient food processing and storage, thus ensuring food security among women and their households (Behnassi *et al.* 2011).

In summary, poverty, hunger and malnutrition, inadequate diets, land degradation, water scarcity, poor infrastructures, social inequalities and insurgence, biodiversity loss, and climate change fundamentally affect the way food is being produced, distributed, and consumed and, therefore, contribute significantly to the problem of food insecurity among the women (Ringler *et al.* 2010; Beuchelt & Badstue 2013; FAO 2016; von Grebmer *et al.* 2019; Adelaja & George 2019; FAO, USAID *et al.* 2021).

2.9 Women's Role in Food and Nutrition Security in Nigeria

Nigeria is a naturally endowed agrarian state, with over 70% of its economically active populace being farmers (Muhammad-Lawal *et al.* 2016). These farmers, including women, are primarily small-scale subsistence farmers totalling about 14 million, with an average farm size of 1 hectare in the south and 3 hectares in the north (Adegbite & Nakajima 2011).

Agriculture has remained the most significant non-oil contributor to the national economy, accounting for 41.84% of the GDP in 2009 and employing almost 70% of the national workforce. Even though the Federal Government is neglecting the sector as result of the discovery of a commercial quantity of petroleum resource in the 1970s, the centrality of agriculture to the Nigerian economy cannot be over-emphasised if women and their households are to be food secure (Adene & Oguntade 2006). However, the challenge of FI lies in the kind of crops cultivated in the country's various regions which vary significantly regarding topography, soil characteristics, and climate vulnerability.

The vital role of women in the food and nutrition security status of any society at the household level and national development cannot be overemphasised because they are a significant player in food production, planning and preparation, income generation, and as well as providers of care for their families (USAID 2007; FAO 2008; IFPRI 2009; Aguirre 2015; EWEC 2015; FAO & National Human Right Commission Nepal 2017; Federal Republic of Nigeria & UNICEF 2022).

The contribution of women to global food production and food and nutrition security requires attention since they are a significant player in agriculture in sub-Saharan African (SSA)

countries (Baba et al. 2015). Researchers have reported that about 73% of women in the SSA region are involved in various farm activities such as cash cropping, arable and vegetable gardening, while 16% and 15% are either involved in post-harvest activities, animal husbandry/ or agroforestry activities, respectively (Ogunlela *et al.* 2009; Baba *et al.* 2015).

In Nigeria, women comprise 60-80% of the agricultural labour force (Owolabi-Merus 2015). Women are the most affected by food insecurity and its varying health outcomes because of multifaceted factors such as gender inequality, poor socioeconomic status, and insecurity (Quisumbing *et al.* 1995; Baba *et al.* 2015; Owolabi-Merus 2015). Baba *et al.* (2015) reported that in Nigeria rural women have virtually taken over the production and processing of arable crops such as grains, oilseeds, and vegetables; hence, they are responsible for as much as 80% of the staple food items consumed even at urban centres. However, these significant contributions have not translated into their own food and nutrition security status.

2.10 The Political Gaps in Addressing Food and Nutrition Security in Nigeria

Food insecurity has persisted in Nigeria because of inefficient policies affecting agricultural activities, trade, economics, gender inequality, and other related sectors. The situation worsens when the focus of policy objectives, structures, and institutions is designed and implemented without adequate public interest consideration. Such policies tend to disenfranchise the vulnerable masses and pave the way for political leaders' corruption and the looting of government funds (Ilaboya *et al.* 2012). Inconsistency in policies due to reshuffling in governance, with inadequate monitoring and evaluation systems, also contribute to the food crises experienced across the thirty-six federation states. However, the severity varies across socioeconomic classes and geographical locations (Matemilola & Elegbede 2017).

Poor governance also manifests as a lack of strategy to transform land use laws, unregulated importation duties and tariffs, poor maintenance and monitoring of food quality along with the food supply chain system from production to final consumers through the retail outlets, inadequate financing of agricultural research institutions, and industries, and lack of implementation of research output to enhance agricultural produce yield in quantity and quality (Matemilola & Elegbede 2017).

Other limitations in policies are: the lack of a conducive environment for foreign and home-based investors and food manufacturing companies regarding tax duty waivers for new

companies to stabilise and break even, electricity supply and other basic amenities which can enhance the production of healthy diets at cost-friendly prices for easy accessibility among low- and medium- income earning households as is the case in other developing countries (Akinyele 2009; Food and Agriculture Organization of the United Nations 2011; Matemilola & Elegbede 2017).

2.11 Conclusion

The conundrum of the interconnectedness of the food system and environment in attaining food and nutrition security among women and households in Nigeria remains a challenge that must be addressed to achieve the SDGs. Therefore, adopting appropriate multi-dimensional interventions and approaches can play a significant role in resolving this longstanding challenge. Consumption of traditional food is a potent way to foster dietary diversity in a healthy food environment; this can be achieved by supporting the production, processing, marketing, and consumption of neglected and underutilised foods. Many of these foods are high in minerals, nutrients, and vitamins, are highly resistant to poor weather conditions, and can adapt favourably to climate change, thus protecting agricultural biodiversity and nutrient adequacy.

Investing in the local food environment also can generate fair profits for smallholders and enhance nutrient sufficiency through consuming healthy foods at little or no extra cost all year round to ensure food and nutrition security among women and their households.

Quality education and gender equality are integrated components in achieving sustainable livelihoods through support systems as obtainable in other developing African countries like Ghana and South Africa. An educational support system should be in place to foster quality education and job opportunities among females to enhance an enabling environment for decision-making, income generation and autonomy regarding food acquisition and utilisation for sustainable food security and good health outcomes.

Similarly, basic knowledge of food nutrition, the benefits of healthy foods regarding disease prevention and management among women, and how to navigate the dynamics of the food chain supply system and food environment towards healthy food in Nigeria is pivotal to addressing the triple burden of malnutrition. This knowledge must be harnessed because of its overall impact on women's nutritional status and national food security status.

The nutritional status of women in Nigeria is a strong indicator of its food and nutrition (in) security status, posing potential grave consequences on women's life expectancy, productivity, and economic development. Recently, this situation has been worsened by the impact of conflict, insurgence, and pandemics ravaging the six geopolitical regions.

Scholars have indicated that most women spend a large proportion of their income on household wellness such as feeding, clothing, health, and education, compared to men on the same income status. Hence, there is a higher tendency for women who earn more money and have control over income to be more food secure in their households. Also, food-based approaches involving agricultural interventions can help alleviate food crises, reduce poverty, and improve dietary intake to abate the prevalence of micronutrient deficiencies among women.

2.12 Recommendations

Food and nutrition insecurity is a complex phenomenon challenging sub-Saharan African countries resulting in outcomes that require a multifaceted-dimensional approach, such as: (1) Girl-child education and empowerment, through implementing an education support system that is gender-sensitive such as scholarships and bursaries for quality education, career advancement, and better job opportunities for girls from the low-income earning households. (2) Nutrition-smart agriculture, which is a move from a crop- or livestock-specific viewpoint to a farming systems perspective that encourages the farming household to adopt an approach where women can make decisions about resource allocation within the households. (3) Women's equal right to improved varieties (high-yield seedlings) essential for sustainable food production and nutrition security can transcend into good nutritional status among women. (4) Adoption of modern technology in agriculture productivity to assist small-holder farmers in enhancing value-adding technology and improving the food supply chain of healthy foods at affordable prices throughout the year across the nation.

Increasing availability and adequate consumption of diversified micronutrient-rich foods through home gardening and small-scale animal husbandry as a sustainable approach to food and nutrition security will assist women and households to take ultimate responsibility for their dietary quality and consumption pattern at no extra cost. Price control strategies can prevent incessant self-induced hikes in the cost of commodities to enable sustainable access to nutritious and safe food necessary for healthy living, food security, and good health outcomes.

Food quality control systems must be in place to control, evaluate and monitor the quality of food items and the food chain supply system from production to grocery outlets to ensure the final consumers' access to dietary quality at a controlled price.

Solutions to other threats to food security such as climate change, soil degradation, and over-dependence on natural resources, can be harnessed by government and humanitarian agencies as a potential tool to curb the depletion of food stores and ecosystems, which will ensure food and nutrition security of children, women, households, and the community at large.

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CHAPTER 3: BACKGROUND TO STUDY DESIGN AND STUDY SITE

3.1 Introduction

Terr Blanche *et al.* (2006) defined research methodology as the science of organizing research that details techniques employed in studying the research problem. The research methodology has to be systematic, justifiable and, most importantly, answer the research question. Brynard *et al.* (2014) maintained that research methodology serves as a guide that helps the researcher decide on the entire process of the study. Therefore, this chapter explains the research methodology and techniques used to collect and analyse data to address research questions and achieve the study's goals. The chapter outline includes the study area description, research methodology describing the study design, sample population, sample selection, data collection, validity, and method of reliability as well as ethical considerations.

3.2 Research Methodology

The study adopted a mixed research approach, combining qualitative and quantitative methods to acquire data. The quantitative research approach is defined as a type of research involving large representative samples and a well-structured data collection method, where collected data can be expressed in numbers and is usually used to test hypotheses (Sheard, 2018). Welman *et al.* (2005) stated that qualitative research methods are characterized by in-depth methods of data collection in the form of key informants, for example, using focus group discussions (FGD) to collect data through structured interviews. One of the most beneficial aspects of conducting research using mixed approaches is the possibility of triangulation, i.e., examining the same phenomenon using several means (methods, data sources and researchers). The rationale for applying both approaches is to ascertain the participant's accounts in an in-depth manner through their words (through interviews).

Secondly, the researcher analysed and compiled statistical data using SPSS version 28.0 to expose the factual dynamics of food and nutrition security among mothers and their preschool children in Niger State, Nigeria. This approach also assisted in looking at the research questions from different angles and clarifying unexpected findings and/or potential confounders.

3.3 Description of the Study Area

The study was carried out in the North Central Zone of Nigeria (Figure 3.1). Nigeria is the most populous country in Africa, with an estimated population of over 200 million people. It comprises 36 states, further divided into six geopolitical zones, namely the South-West, South-East, South- South, North-East, North-West, and North Central Zones. The North Central comprises seven states, namely, The Federal Capital Territory (FCT) Abuja, Benue State, Kwara State, Kogi State, Plateau State, Nassarawa State, and Niger State. Niger State is the largest state in the country in terms of land mass, with its capital in Minna. Other major cities in the state are Bida, Kontagora and Suleja. The state was formed in 1976 when the then Northwestern State was divided into Niger State and Sokoto State. The Nupe, Gbagyi, Kamuku, Kambari, Hun-Saare, Hausa and Koro form the majority of the numerous indigenous tribes of Niger State. The state is named after the River Niger and lies on coordinates 10000'N 6000'E. The land span is about 76,363km² (29,484 sq mi). It is bordered to the north by Zamfara State, to the west by Kebbi State, to the south by Kogi State, to the southwest by Kwara State, northeast by Kaduna State and the southeast by the FCT. The State also has an international boundary with the Republic of Benin. It comprises 25 local government areas and 274 political wards with a population figure of 3,950,249 based on the 2006 Census (Wikipedia & Encyclopedia, 2006; State Bureau of Statistics & State Planning Commission, 2011).

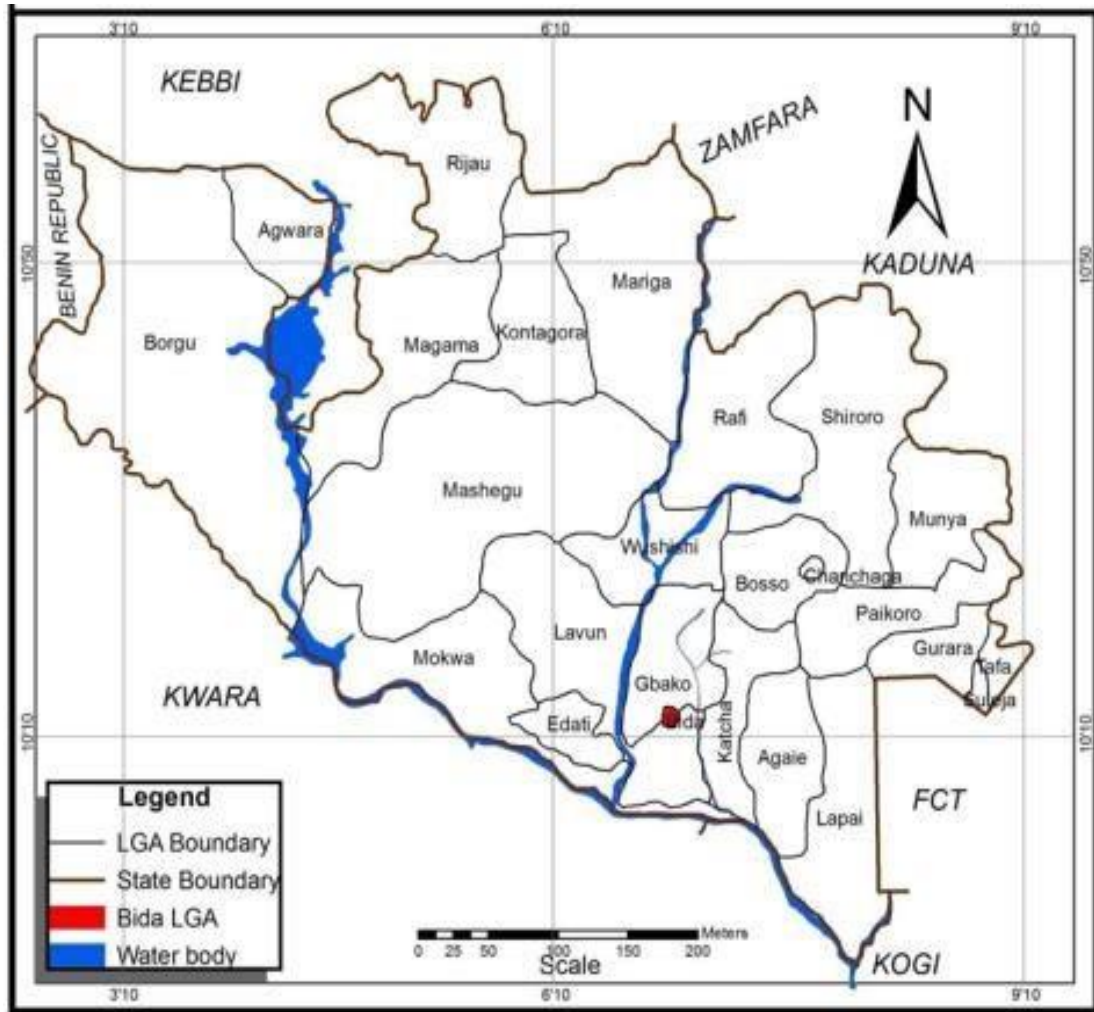


Figure 3.1: Niger State Map Showing Various LGAs
 Source: (Idowu et al., 2020)

3.4 Study and Research Design

A mixed method was used, combining a quantitative descriptive, cross-sectional design with a qualitative design. Thus, quantitative and qualitative data were concurrently collected from participants and analysed (FoodRisc Resource Centre, 2016). The quantitative data were collected using a descriptive and cross-sectional design. The findings were integrated during the interpretation phase of the study, and equal priority was given to both types of research.

The design for this study was exploratory and descriptive to ensure that insight and detailed information on participants' usual dietary practices and experiences was obtained rather than just seeking the causal factors often obtained in explanatory research (Creswell & Plano Clark, 2018).

3.5 Target Population

The participants for this study were women of reproductive age (15 years to 45 years) who were mothers and their preschool children (3-5 years) across the selected political wards within the 25 local government areas in Niger state. Mother-child pairs were randomly chosen from the same household in the selected wards (see sampling technique below).

3.5.1 Exclusion Criteria

Children who were ill (already diagnosed with chronic diseases or protein-energy malnutrition) and had difficulty communicating, and children with congenital malformations and/or physical deformities that hindered height measurements at the time of data collection, were excluded from the study. If a selected household had more than one child aged 3-5 years, only the youngest child was included in the survey to avoid multiple entries from same household. Also, mothers with cardiovascular disease (hypertension, diabetes among others) and terminal ailments such as cancer, stroke, organ dysfunctions, and AIDS that could confound the study variables were excluded, because this could affect dietary intake and health status of the participants which will have been compromised because of ill-health.

3.5.2 Inclusion Criteria

All women of reproductive age who had children within the preschool age bracket and were willing to participate in the study within the selected political wards were included. However, if there was more than one woman within the same household (polygamous setting), the older woman with a preschooler was enrolled because decision-making in terms of meal plan and choice lies with them, especially when everyone eats from the same pot.

3.6 Sampling Technique

A multistage sampling technique was used to enroll the study participants (the mother-child pair). One of the states in the North Central zone of Nigeria was selected by the multi-stage cluster sampling method. There are three senatorial districts in the state, namely, Niger East, Niger North, and Niger South. For this study, Niger South was selected by purposive sampling because it is a major farming communities that is not a flash points of Boko Haram terrorist attacks in the state. Simple random sampling was used to select five local government areas (LGAs) out of the eight LGAs. The systematic random sampling technique used was to

calculate sampling interval K^{th} , obtained by dividing the total number of women with preschool age children across the senatorial districts with the minimum sample size calculated (n). Five political wards and their primary healthcare facilities were selected based on the national population records available at the five selected local government area headquarters. The total number of households was also obtained. Eighteen households with preschool children based on the national population census (NPC) record in each political ward across the five LGAs were randomly selected for this study.

3.7 Sample Size Determination

The minimum sample size was estimated using the single proportion formula (Cochran, 1977):

$$n = \frac{Z^2 P \times (1-P)}{d^2}$$

where $p = 48.0\%$, the proportion of food insecurity in rural households in North Central, Nigeria from the previous study (Adepoju & Adejare, 2013) $z = 1.96$ (at 95% confidence level), and d is and desired level of precision = 0.05%. Inputting the variables the calculated minimum sample size (n) was:

$$n = \frac{1.96^2 \times 0.48 \times (1-0.48)}{0.05^2} = 384$$

A 20% nonresponse rate was added because of the seclusion of women from the sight of men or strangers (*purdah*) practiced in the study area and the high illiteracy level among the women $(384+76.8) = 460.8$, therefore n was approximately 461. Eleven participants were excluded from the analysis because of missing data. Therefore, data was collected and analysed from 450 participants.

3.8 Data Collection

A semi-structured interviewer-questionnaire administered in a face-to-face manner was used to collect the data from mothers of preschool children (aged 3-5 years) (Appendix F to I). Research assistants who were fluent speakers of the local languages (Nupe) and the principal investigator were involved in the data collection process. The data was collected over a four month period (March to June, 2022) which is the lean period (planting season) in the study

area. Ten research assistants were involved in this study and were trained by the lead researcher for two weeks regarding the study protocol, administration of questionnaires, anthropometry measurements and documentation of findings. Before the survey, a pilot study was conducted to review the questionnaire to adapt the phrases and definitions to the local context. The trained research assistants filled in the questionnaires during door-to-door interviews with the mothers and their preschool children. Prior to the interview, verbal informed consent and assent were obtained from unlearned mothers for both mothers and their preschool children. Written consent was obtained from learned mothers who volunteered to participate in the study by appending their signatures on the questionnaires after explaining the study's objectives and confirming that the information would be kept confidential. Also, written informed consent was obtained from the parents or legal guardians of the children. The questionnaire was developed from the Nigeria Demographic and Health Survey (NDHS) and relevant literature based on the study objectives and subdivided into six (6) sections; **section A**; socioeconomic and demographic factors, **section B**; child feeding and caring practices, **section C**; maternal health factors and household feeding practices and food security, **section D**; household wealth assets and **section E**; anthropometrics measurements of both mother and preschool child while **section F** assessed the nutrition knowledge of the mothers. The questionnaire was translated into the Nupe language which is the major local language spoken in the area, for ease of data collection. Household Dietary Diversity Scores (HDDS) and Household Food Insecurity Access Scale (HFIAS) tools were used to measure household dietary diversity and food security status among the participants (Appendix F and H).

3.8.1 Household Dietary Diversity Scores (HDDS)

Household dietary diversity score (HDDS) of the mothers and their preschool children were determined using a qualitative 24-hour dietary recall and a one-week (7-days) food frequency questionnaire (FFQ) (WFP, Vam Food Security Analysis, 2015; Moga *et al.* 2022). The participants recalled all foods and drinks consumed by the frequency of consumption of each food group by mother-child pair in the previous one week. The HDDS tool showed both household food availability and food access on the premise that households consume a variety of foods when they have the means to acquire them (Appendix F and H). The tool inquires about 17 food groups aggregated to 10 for analysis for the mothers, according to the FAO guidelines (FAO, 2021; FAO & EU, 2013; FAO & FHI 360, 2016). The ten food groups are (1) starchy staples; (2) dark and green leafy vegetables; (3) vitamin A-rich fruits and vegetables; (4) other

fruits and vegetables; (5) organ meats or offal; (6) meat or fish; (7) eggs; (8) legumes, nuts, and seeds, (9) milk and milk products, and (10) sweets or snacks. The score is the sum of the food groups consumed by mothers from a total of 10. Households were classified into insufficient-dietary diversity (fewer than or equal to five food groups) and sufficient dietary diversity (greater than five food groups). The preschool children were assessed on nine food groups and classified as sufficient or insufficient following the FAO Dietary Guideline for Under-fives (FAO, 2021; International Dietary Data Expansion Project (INDDEx), 2018; Sema et al., 2021). Consumption of fewer than five food groups per week was insufficient, while consumption of five or more food groups were classified as sufficient.

3.8.2 Household Food Insecurity Access Scale (HFIAS)

The HFIAS is a continuous measure of the degree of food insecurity mostly related to access in the household in the past 30 days (Salarkia *et al.* 2014) (Appendix F and H). The standardised HFIAS questionnaire was used. The HFIAS is composed of nine specific questions subdivided into three themes of food insecurity: (1) experiencing anxiety and uncertainty about the household food supply; (2) insufficient quality of diet, including variety and preferences of the type of food; and (3) insufficient food intake or reducing the quantity of food consumed. The questions address the situation of all household members and do not distinguish adults from children or men from women or adolescents. The nine questions represent a generally increasing level of severity of food insecurity and nine “frequency-of-occurrence” questions were asked as a follow-up to each question to determine how often the condition occurred. The mother or caregiver who was responsible for food acquisition and meal preparation within a household was asked to describe how often a condition had occurred in the past 30 days if the response to the condition described in the corresponding occurrence question was yes. For each frequency-of-occurrence question, a score was assigned to each household: 1 if the response was ‘rarely’ (condition having happened once or twice in the past 30 days); 2 if it occurred ‘sometimes’ (3–10 times in the past 30 days) or 3 if the answer was ‘often’ (occurred for more than ten times in the past 30 days). Households were assigned a score of 0 to 27 based on their response to the nine questions (yes or no) and frequency of occurrence (rarely, sometimes, and often). Households were classified into diverse levels of food insecurity based on their response to the nine questions: 0 was assigned if the household responded “no” to all occurrence questions, and a maximum score of 27 was given as a sum to a household whose response to

all nine frequency-of-occurrence questions was “often”. Households were classified as food secure.

(HFIAS = 0–1), mildly food insecure (HFIAS = 2–7), moderately food insecure (HFIAS = 8–11), and severely food insecure (HFIAS > 11) (Salarkia et al., 2014). A high HFIAS score indicates a household’s poor access to food and significant household food insecurity.

3.8.3 Child Anthropometry

The nutritional status of children under the age of five is a good proxy indicator of a household’s nutrition status and health over a sustained period. Standing height was measured in triplicate using a calibrated rod and measuring tape to the nearest millimetre by trained research assistants. An average was then determined and recorded. The children stood against the wall on a level floor without shoes, hats or other head wear and the heels placed together when height was being measured. With the calibrated rod placed behind the child and the child standing with his or her back straight on the wall, a flat board was placed on the head of the child perpendicular to the calibrated markings on the rod. The height was then read and recorded. This was done twice and the average recorded. Standing height was used to calculate height-for-age (HAZ) Z-Scores (SD scores below or above a reference mean or median value). The 2006 WHO Anthro 3.2.1 software was used to convert the weight, height, and age of a child (years) into height-for-age (HAZ), weight-for-age (WAZ), and weight-for-height (WHZ) Z-scores to assess malnutrition considering sex. Anthropometric classifications were based on global standards: < -3 SD, < -2 SD, and \geq -2 SD. Children with HAZ, WAZ, and WHZ below -2 SD of the median of the reference population were considered as stunted, underweight and wasted, respectively. The WHO clear cut-off points were used to classify the children as severe stunting (HAZ = < -3), moderate stunting (HAZ = -3 to < -2), mild stunting (HAZ = -2 to -1), and normal (HAZ = \geq -1). These classes have different implications for the food and nutrition situation of the household. For example, a child with a low HAZ (<-2) is stunted and is gaining insufficient height relative to their age, implying long-term malnutrition and poor health.

The measurement for mid-upper arm circumference (MUAC) was taken on the left upper arm using a MUAC tape (shakir’s strip) (Appendix K) by the trained research assistants. For each child, the left arm was flexed (bent slightly in its range of movement) and the olecranon and acromium process were identified. The mid-point between these two points was identified and

the Shakir's strip (MUAC tape) was wrapped around the mid-point and the measurement recorded to the nearest 1 mm. The children were classified according to WHO growth standards and guidelines. The four classes are severe wasting (MUAC < 115 mm), moderate malnutrition (MUAC 115–125 mm), possibly or mildly malnourished (MUAC 125–135 mm), and nutritionally normal (MUAC > 135 mm). A MUAC of <125 mm shows the child is wasted, implying acute malnutrition.

3.8.4 Maternal Anthropometry

Mothers' weight and height were obtained to compute their body mass index (BMI), while waist and hip circumferences were measured and extrapolated using REIDEA Body Measure Tape 60 in measuring tape (Appendix K). Maternal weight was obtained using the bathroom-weighing scale (OMRON BCM-500) by trained research assistants. The mothers were asked to stand still on the scale and when the display was stable, weight was recorded. The weight was measured in kilogram (Kg) with the mothers wearing light clothing, without shoes or headwear. The measurements were done thrice for each and the average weight (to the nearest 0.1 kg) taken and recorded. Accuracy was ensured by recalibrating the weighing scale every day before the commencement of weighing using a known weight.

Height in metres (m²) was measured using a stadiometer following similar protocol as used for the children. Participants were asked to stand with their feet together, flat on the baseboard of the stadiometer, heels placed centrally against the back plate, and their arms hanging loosely by their sides. The participant's head was sloped to the horizontal. In this position, standing height of each woman was measured and recorded. The waist and hip circumferences of the mothers were measured using the REIDEA Body measuring tape (USA) by the researcher and research assistants. The mothers were asked to stand straight with their feet together (there is an increase in size when the legs are apart). The tape measure was drawn and extended at the participant's back and then was fitted round enough to take up the slack but not to compress the skin. Before the readings were taken, it was ensured that the tape was level at the front and back, and that the participant was relaxed and breathing quietly. Measurements were taken to the nearest 0.1 inch. The measurements were done in triplicate and an average determined and recorded. The waist and hip circumferences were measured with the mothers wearing minimal clothing, standing straight but not pulling in their stomachs. The waist circumference was measured halfway between the lower ribs and the iliac crest. A waist circumference greater

than 80 cm in women has been associated with increased risk factors for cardiovascular disease. Hip circumference was measured at the largest circumference around the buttocks.

Body mass index (BMI) and waist-hip ratio of the mothers were computed. BMI is an indicator of body size and composition; it helps in predicting nutritional status (underweight, normal weight and overweight or obesity). However, the waist-hip ratio was additionally used because it has been suggested as being superior to BMI in predicting cardiovascular disease (CVD) risk. Waist-hip ratio measures abdominal adiposity and the risk of coronary heart disease (CHD). This is because increased visceral adipose tissue is associated with metabolic abnormalities, including decreased glucose tolerance, reduced insulin sensitivity and adverse lipid profiles, which are risk factors for type-2 diabetes and CVD (Cao *et al.* 2018). Institute of Medicine (IOM) BMI classification was used. Mothers with less than $< 18.5 \text{ kg/m}^2$ are classified as underweight, those within 18.5 kg/m^2 and 24.9 kg/m^2 as within the normal BMI range, those between 25.0 kg/m^2 to 29.9 kg/m^2 as overweight, and those above 30.0 kg/m^2 as obese. For women, according to WHO, the normal range for waist/hip ratio is ≤ 0.85 . Therefore, women with ≤ 0.80 are classified as at low risk of cardiovascular disease, those between 0.81 to 0.85 as at moderate risk and those with ≥ 0.86 as high risk.

3.8.5 Nutrition Knowledge

The nutritional knowledge or perception of the mothers was assessed using 12 semi-structured questions embedded in the study questionnaires which assessed the meaning of healthy diets, constituents of healthy diets, the importance of each food group to human health, symptoms of nutritional deficiency, sources of nutritional information to individual mothers, and relevance of acquired information to individual dietary habit. These questions were developed by the researcher with input from experienced senior colleagues within the field of nutrition and food security within and outside the University of KwaZulu-Natal to improve the content validity. The adequacy of the mothers' knowledge was assessed using the Likert scale as follows; strongly agree = 5, agree = 4, undecided = 3, disagreed = 2 and strongly disagreed = 1. Responses within the cut-off point of 3.5 are classified as good, while those below the cut-off point are classified as poor (Joshi *et al.* 2015) (Appendix F and H).

3.8.6 Triangulation of Data

A projective method of qualitative data collection using food group picture charts was used to collect information on meal quantity or portion size and frequency of meal consumption of commonly available food items in the neighbourhood usually prepared and served by the mothers of preschool children (Appendix G, I, and J). About 5-7 preschool children were purposively selected with their mothers from each community, and interviewed separately with the help of an interpreter on what kind of food they frequently eat at home on a weekly basis, the quantity of such food (especially animal protein and fruits) per meal, food preference and dislikes and why they answered the way they did. The information retrieved was used simultaneously to corroborate their mothers' previously filled FFQ to validate the reliability of the data and to assist during the interpretation of findings. A projective technique using pictorial food charts during interviews was used for data collection among the preschool children (Appendix G, I, and J). This is an indirect method commonly used in qualitative research. It allows the researcher to tap into respondents' deep motivation, beliefs, attitudes, regular practice and values. This method is typically used in conjunction with direct questioning in qualitative research.

3.9 Reliability of Data

The questionnaire was pre-tested and validated by a statistician to ascertain data reliability, while a pilot study was conducted to test the level of precision. To enhance reliability, the research instruments were pre-tested among selected women in Kangi-Makun village (a farming settlement) in Bida, Niger State, Nigeria, to ensure that the respondents would be in a position to comprehend all items therein and to minimise the risk of misinterpretation of concepts and terminologies. This was in line with social research experts (Babbie & Mouton, 2001: 244) who suggest that pilot-testing of data collection instruments provides a way to mitigate a possibility of error in designing the instruments. Quantitative data collected were comprehensively coded and themes were identified. All interviews were voice-recorded and the data collected were comprehensively transcribed. Subsequently, themes were systematically identified. More reliability was also ensured by the use of different data collection methods including a survey, interview schedules, and document reviews. Confounders were eliminated using inferential statistics (linear regression and correlation coefficient). A bias is an interference in the outcome of research by predetermined ideas,

thereby making samples collected not a true representative of the entire population. Bias was eliminated by triangulation (using more than one research methods or data sources to develop a comprehensive understanding of a phenomenon).

3.10 Validity

Validity determines whether the research measures what it truly intends to measure (Mathison, 1988). To increase validity, this research used triangulation as a strategy (Mathison, 1988). Triangulation has the potential to eliminate bias and consequently allows the dismissal of plausible rival explanations in such a way that an accurate proposition about some social phenomenon can be made (Gunawan, 2015). To ensure validity, this study gathered views and opinions from experts within and outside the university community, from different groups of stakeholders including preschool children, nutrition focal persons (key informants) and mothers/ caregivers of the children under study. The researcher asked a series of questions with a similar dimension while attempting to establish the consistency of the responses. Different methods of analysis were also applied to enhance validity.

3.11 Data Analysis

Data entry and analysis were accomplished using SPSS version 28.0. Anthropometric indices were extrapolated from the variables obtained. Descriptive statistics were used to describe the percentages and frequency of sociodemographic characteristics and other relevant variables in the study. Bivariate and multivariable logistic regression analysis were used to identify the factors associated with maternal and preschoolers' food insecurity and nutrition status. Both crude and adjusted odds ratios and corresponding 95% confidence intervals were computed to assess the strength of the association between the outcome and independent variables. All independent variables that were associated with the outcome variables (minimum dietary diversity and anthropometric indices) in chi-square (with p-value < 0.05) were included in the final multivariable logistic analysis. A p-value < 0.05 was considered to declare the result as statistically significant. Chi-square was used to determine the statistical significance of the dependent variables. Bivariate and multivariable logistic regression analyses were used to identify the factors associated with maternal nutrition status and minimum dietary diversity adequacy. All independent variables associated with the nutritional status at $p < 0.05$ were considered statistically significant.

3.12 Ethics Considerations and Permissions Granted

Ethical approval was obtained from the College of Agriculture, Sciences and Engineering UKZN Biomedical Research and Ethics Review Committee (BREC) with protocol number BRECor00003392or2021 (Appendix A) and the National Health Research Ethics Committee (NHREC) in Nigeria (NHRECor01or01or2007-11or01or2022) (Appendix B). In addition, permission was obtained from the gatekeepers of each community where the study was conducted through verbal consent, and letters of permission were obtained from chairpersons of each local government area (Appendix C). Verbal and written informed consent were obtained from each participant before the interview after explaining the purpose of the study before enrolment, while written informed consent was obtained from the parents or legal guardians of the children. Assent was also obtained from consenting preschoolers before their measurement was taken and during the projective interview section (Appendix E).

3.13 Conceptual Framework

The conceptual framework of the study (Figure 3.2) shows the statement of problem, objective of the study, methodology, key findings and expected outcomes.

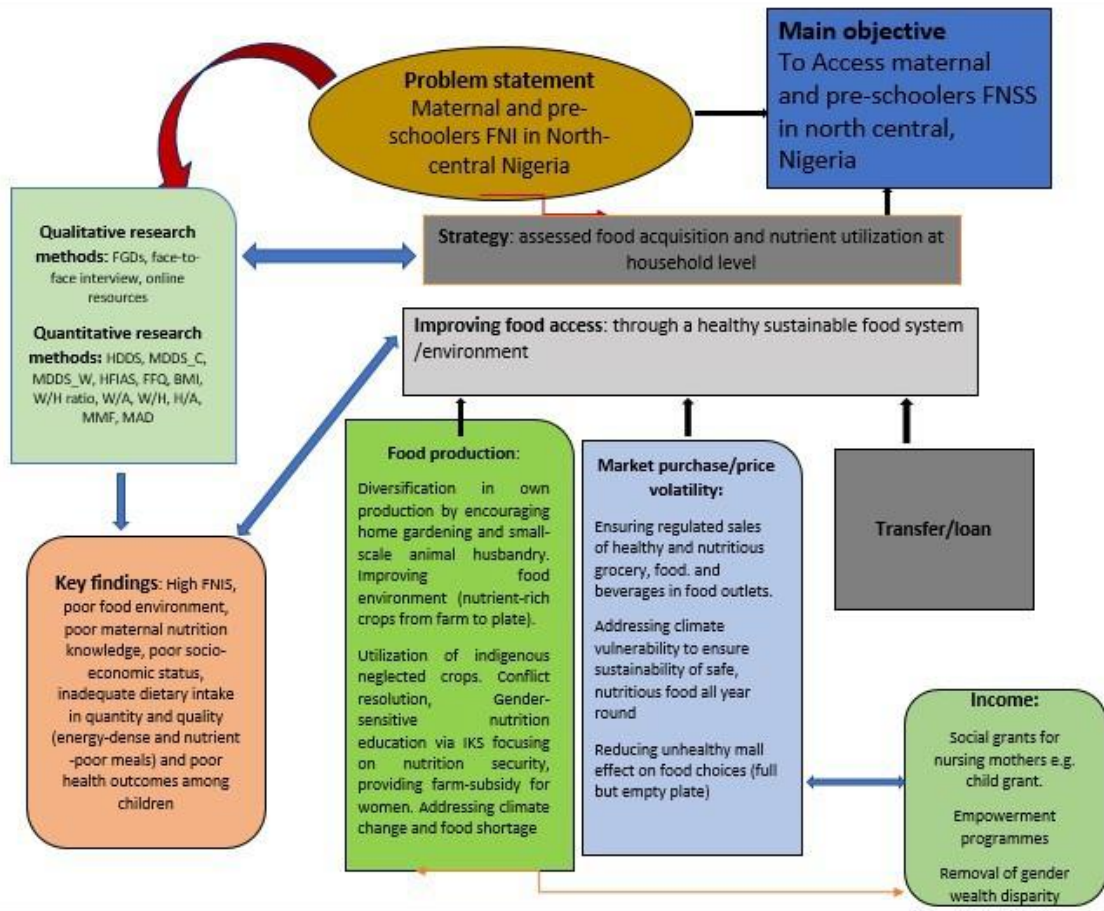


Figure 3.2: Conceptual framework of the study

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CHAPTER 4: THE HOUSEHOLD FOOD SECURITY AND FEEDING PATTERN OF PRESCHOOL CHILDREN IN NORTH CENTRAL NIGERIA

This chapter has been published:

Omachi, B.A.*; Van Onselen, A.; Kolanisi, U, The Household Food Security and Feeding Pattern of Preschool Children in North Central Nigeria. *Nutrients*. 2022, 14, 4112. <https://doi.org/10.3390/nu14194112>. The published paper is presented in the following pages according to *Nutrients* journal author's guidelines.

4.1 Abstract

Children's feeding patterns and health outcomes are important determinants of any country's food and nutrition security status. This study assessed the household food security and feeding patterns of preschoolers in Niger State, Nigeria. A cross-sectional descriptive design and a multi-stage sampling technique were employed to analyse 450 preschool children from selected local government areas. Household food security was measured using the HFIAS nine-item questionnaire, and feeding patterns were evaluated using the qualitative food frequency questionnaire (FFQ). The mean age of the preschoolers was 3.71 ± 0.80 years. The majority (61.30%) of the children consumed cereal-based products, while fruits and vegetables were the least consumed (16.40%). More than half (59.80%) of the preschoolers met their minimum dietary diversity. Almost all (98.80%) of the children were from food-insecure households, with 40.3% being severely food insecure. Parity, religion, and having a breadwinner and source of potable water, were significantly associated with the adequacy of minimum dietary diversity (MDD) among the preschoolers (F value = 5.528, $p \leq 0.05$). The contribution of poor feeding patterns and household food insecurity to the overall health outcome of preschoolers cannot be overlooked. Hence, nations must prioritise improving the availability, accessibility, and utilisation of food to better meet the nutritional needs of preschool children.

Keywords: preschoolers; food insecure; minimum dietary diversity; feeding pattern; Niger State; Nigeria

4.2 Introduction

Africa is ranked second to Asia as the continent with the highest number of malnourished children in the world, with an increase in the number of triple burdens of malnutrition (TBM) (the coexistence of undernutrition, over nutrition, and hidden hunger within the same household) cases (UNICEF 2019; UNICEF *et al.* 2019). The prevalence of TBM among children in many low- and middle-income countries (LMICs) due to a compromised dietary intake is alarming and has significantly contributed to the high prevalence of childhood illnesses and mortality in these regions. A global burden of disease study reported that diets lacking adequate nutrients are now the leading cause of death worldwide across all age groups (UNICEF 2019).

Similarly, scholars have identified several factors attributed to poor health outcomes and the poor nutritional status of school children, some of which are compromised dietary intake and poor feeding patterns and hygiene practices (Akanbiemu 2019). Other determinants of poor health among growing children are household food (in)security status, poor socioeconomic status, the wealth index of the caregiver and family heads, and unhealthy food environments at the community and household level across all sociocultural settings in many developing countries (Aurino *et al.* 2020).

The trend and level of childhood malnutrition in the world shows that two out of five under-five children are stunted, and more than one-quarter are either wasted or overweight. In West Africa, 27.7% of under-five children are stunted, 7.5% are wasted, which is higher than the global estimates (21.3%, 6.9% respectively), while about 1.9% of these children are overweight, although this is lower than the global estimate (5.6%). However, this prevalence is an indication that many children consume insufficient healthy foods (UNICEF *et al.* 2020).

The consumption of unhealthy food among children such as monotonous starchy staples with limited animal protein and fruits and vegetables, and the overconsumption of sugar-sweetened beverages (SSB) and highly processed fatty and salted snacks, often starts during the complementary feeding period (4–6 months of life) (Bonis-Profumo 2021; Orkusz 2022). In West Africa, only 34% of children are exclusively breastfed, thus depriving them of good nutrition. Furthermore, during the introduction of complementary feeding, more than three in four children between 6 and 23 months of age did not meet their minimum dietary requirements (UNICEF 2019).

Nigeria, the most populous country in Africa, faces an enormous burden of malnutrition among preschool children and thus occupies the second position globally (FAO *et al.* 2017; UNICEF 2018). About 14 million under-five children are stunted in the country. This implies that one out of three Nigerian children are malnourished (Omotesho *et al.* 2019) that is, most children are deprived of essential nutrients for optimal development and productivity. Malnutrition also accounts for 33.0% of the under-five mortality rate annually. This prevalence varies across the nation, with higher under-five mortality rates in the northern region (USAID *et al.* 2018; Ezeh *et al.* 2021). Malnutrition among children has been attributed to suboptimal food intake during the developmental stages of the life cycle. For instance, in Nigeria, only 17% of infants are exclusively breastfed, while 18% of children aged 6–23 months are fed with minimum acceptable diets due to maternal and household food insecurity, especially among rural communities (Sani Nass *et al.* 2021; Omotayo *et al.* 2022). The resultant effect is severe acute malnutrition (SAM) which is more pronounced among under-five children, especially in the north-eastern and north-western geopolitical zones of the country, where about 50% of under-five children are stunted (Ezeh *et al.* 2021; Sani Nass *et al.* 2021). The dietary guidelines for Americans recommend that preschool children consume between 1300 and 1800 kcal/day for healthy growth. This should cut across food groups such as grains, fruits, vegetables, milk, meat, and beans. For instance, the intake of about 14.5 to 24 g/day of protein, 1 to 2.5 cup eq/day of vegetables, 1 to 1.5 cup eq/day of fruits 2 to 2.5 cup eq/day of dairy products, and 400 µg of vit. A are recommended for under-five children (USDA 2020). However, the household food deficit across many households in Nigeria has resulted in inadequate intake among preschool children.

According to the World Health Organization (WHO) and the Centres for Disease Control and Prevention (CDC), preschool children are between 3 and 5 years old. This period entails intensive cognitive development in children where developmental milestones that help shape their personality, interpersonal relationships, and thinking patterns are fostered; hence, the need to consume healthy meals following the recommended minimum dietary diversity requirements of at least 5 to 8 food groups per day for children is a bedrock for positive health outcomes (Vinod *et al.* 2011; Klein *et al.* 2016; Charach *et al.* 2017).

The inadequate intake of healthy food among under-five children in Nigeria is complex and multifactorial, ranging from poor dietary diversity among households, poor wealth index, food illiteracy, high dependency ratio, conflicts, seasonality, and geographical location, among

others (Obayelu *et al.* 2020, 2021; Owoo 2020; Omotayo *et al.* 2022). Consequently, inadequately fed children, especially preschoolers, may not develop to their full potential both physically and mentally before starting formal education, thus impairing school attendance and intelligence quotients for good academic performance, and eventually leading to poor labour productivity and a reduction in the economic growth of the nation (Jesmin *et al.* 2011; Rodríguez *et al.* 2017; Obayelu *et al.* 2018; USAID *et al.* 2018; Aurino *et al.* 2020).

The continuous destruction of lives, communities, and farmlands poses a severe threat to food availability and affordability, resulting in economic shocks, insecurity, and constant hikes in food commodity prices across the nation, which have affected several households in both urban and rural communities across the six geopolitical zones (Rother *et al.* 2016; Kah 2017; Omotayo *et al.* 2022). Hence, Nigeria faces food accessibility and affordability crises, severely impacting its citizens' food and nutrition security status (Kah 2017; Owoo 2018; Adelaja *et al.* 2019; Béné 2020).

Conflicts have cumulatively affected the food and nutrition security status of the nation because of reduced animal and crop husbandry, and thus increased the risk of hunger and TBM among the vulnerable masses, mostly children across the northern geopolitical zones (Eme 2014; Kah 2017; Steiner *et al.* 2020). Consequently, this impacts household food security, feeding patterns, and health outcomes of preschool children. Studies have shown that no community or household can sustain healthy food availability if there is an insecurity of lives and property (Banwat *et al.* 2012; Ezeh *et al.* 2021; Kansiime *et al.* 2021). Moreover, the global economic downturn has affected several countries, and its impact on low- and middle-income countries (LMICs) like Nigeria is evident in the increased poverty rate among the population (Obayelu *et al.* 2020; Ogunniyi *et al.* 2020; Omotayo *et al.* 2022). Generally, low incomes, rising food prices, poor policies and governance, growing demand, and changes in consumption patterns not commensurate with production and distribution have implications for households' food security status (Kah 2017; Osabohien *et al.* 2018; Ogunniyi *et al.* 2021; Omotayo *et al.* 2022). Poverty reduces the affordability of safe and nutritious healthy foods across the different socioeconomic classes, although this impact varies from region to region. Poverty and poor dietary intake are higher in the northern region than in the southern region because of the incessant Boko Haram attacks in the northern region (Thomas *et al.* 2020; Owoo *et al.* 2020; Obayelu *et al.* 2020, 2021). Recent reports show that about 73 million (about 36.5%) persons in Nigeria cannot afford three consecutive meals per day because of the high poverty rate,

national food-deficit, and high cost of available staples (Fadare *et al.* 2018; Chigozirim *et al.* 2021; Ogunniyi *et al.* 2020; Ogunniyi *et al.* 2021; Omotayo *et al.* 2022). Moreover, one out of every three Nigerian children is malnourished and about 44 % are stunted, 32 % underweight, and 11 % wasted (USAID *et al.* 2018; Omotesho *et al.* 2019). Hence, there is a need to create data-based awareness of the risk of poor nutrition, hunger, starvation, illnesses, and untimely deaths in the country, especially in badly affected regions. In 2019, about 60% of the disposable income of Nigerians was spent on food expenditure, so many low- to middle-income families, especially those with preschool children, are not meeting their basic needs for a healthy and productive life. This is largely due to suboptimal food intake in both quality and quantity as the country battles insurgency and economic shocks (Adelaja *et al.* 2019; Chigozirim *et al.* 2021; Omotayo *et al.* 2022). Thus, increasing the risk of various forms of malnutrition and food and nutrition insecurity among preschool children (Akerele 2015; Owoo 2020).

Reports on food security and the feeding patterns of children in the northern geopolitical zones are scarce, especially in Niger State, with an increase in the number of triple burdens of malnutrition (TBM) and mortality among under-five children. There is an urgency for national and geopolitical government initiatives and policies that are practicable to combat poor feeding practices and their consequences among preschoolers. Therefore, this study assessed the household food security and feeding patterns of preschoolers in Niger State, Nigeria.

4.3 Materials and Methods

4.3.1 Target Population

In this cross-sectional descriptive study, a total of 450 preschool children in Niger State, one of the states in the northcentral zone of Nigeria, were selected by the multi-stage cluster sampling method. There are three senatorial districts in the state, namely, Niger East, Niger North, and Niger South. For this study, Niger South was selected by purposive sampling because it is one of the major farming communities not enlisted among the flash points of Boko Haram terrorist attacks in the state. Simple random sampling was used to select five local government areas (LGAs) out of the eight LGAs.

Systematic random sampling was used to select five political wards each and their primary healthcare facilities based on the national population records available at the five selected local

government area headquarters. The total number of households was also obtained. Eighteen households with preschool children based on the national population census (NPC) record in each political ward across the five LGAs were randomly selected for this study.

4.3.2 Sample Size

The minimum sample size for the study was estimated using the formula established by Cochran and colleagues for population-based cross-sectional studies $n = z^2p(q)d^2$ [41], where n is the sample size to be determined, z is the z -score of 1.96 at a 95% confidence level, p is the estimated proportion of an attribute that was present in the population (48.0%, the proportion of the food insecure population in rural households in North Central, Nigeria from previous study) (Adepoju *et al.* 2013), d is the desired level of precision 5%, and q is $1 - p$, considering a 20% nonresponse rate and among the preschool mothers. Eleven participants were excluded in the analysis because of incomplete data.

4.3.3 Procedures for Data Collection

Household food security was measured using the HFIAS nine-item questionnaire associated with the experience of food insecurity within the household over 30 days. Before the survey, a pilot study was conducted to review the questionnaire to adapt the phrases and definitions to the local context by using semi-structured in-depth interviews.

Trained research assistants filled in the questionnaires during door-to-door interviews with the mothers and their preschool children. Based on the HFIAS questionnaire scores, households were grouped into four categories of food access (in)security: secure (0–1), mildly food insecure (2–7), moderately food insecure (8–14), and severely food insecure (15–27). Supplementary questions concerning meal frequency and preference were evaluated using the qualitative food frequency questionnaire (FFQ), while the demographics and socio-economic characteristics of the households, mothers, and their preschool children were also completed in the interviews to assess the household food preference, feeding patterns, biodata, and anthropometric indices of the preschoolers.

4.3.4 Statistical Analysis of the Results

Data obtained were coded and analysed with SPSS version 28. Descriptive analyses were presented in frequency and %ages, chi-square was used to determine the statistical significance

of the dependent variables, while a linear regression model was used for inferential statistics at $p \leq 0.05$. Bivariate and multivariable logistic regression analyses were used to identify the factors associated with maternal nutrition status and minimum dietary diversity adequacy. All independent variables associated with the nutritional status at $p < 0.05$ were considered statistically significant.

4.4 Results and Discussion

Four hundred and fifty preschool children were recruited for this study. The socioeconomic and demographic characteristics of the preschool children and their mothers are listed in Tables 4.1 and 4.2. The majority (55.0%) of the preschool children were males, while 45% were females; this finding is consistent with a similar study conducted in Benue State by Omotesho *et al.* (2019) where more than half (55.4%) of the children were males. It is also consistent with another study completed in Southwest, Nigeria by Akanbiemu *et al.* (2016) where 53.3% of the children were males. The male predominance observed in the current study is in contrast with a South African study by Chakona (2020) where more than half (56.0%) of the children were females. The mean age of the children is 3.71 ± 0.80 years, which is higher than the one year and few months recorded by Omotesho *et al.* (2019) and Chakona (2020), respectively, but similar to the findings of Akanbiemu *et al.* (2016) where the mean age of the children was 4.3 ± 1.3 years.

More than two-thirds (76.4%) of the preschool children and their mothers were from rural areas, which is not in agreement with a study conducted in Ethiopia, where about two-thirds of the mothers resided in urban centres (Teshome *et al.* 2022). This could be because the study participants were predominantly from the rural area of the state. Almost all (95.6%) of the children came from households that practice Islam, which is similar to the findings of Ahmed *et al.* (2022), where about two-thirds of the mothers and their children practiced Islam as a religion. This could be because the study area and Niger State at large are Muslim dominated. However, in Tege die District, north-eastern Ethiopia, most (85.3%) of the mothers belonged to the orthodox religion (Teshome *et al.* 2022).

Table 4.1: Sociodemographic Characteristics of the Preschool Children

Variable	Frequency	%age
Residential Area		
Urban	106	23.6
Rural	344	76.4
Sex		
Female	248	55.0
Male	202	45.0
Ethnic Group		
Nupe	308	68.4
Gwarri	04	0.9
Hausa	113	25.1
Yoruba	15	3.3
Others	10	2.2
Religion		
Christianity Islamic	16	3.6
Traditional	430	95.6
	4	0.8
Breadwinner		
Father only	331	73.6
Mother only	13	2.9
Both parents	104	23.1
Grandparents	02	0.4
Method of water treatment		
Boiling	108	24.0
Use of water guard	36	8.0
Allowing water to settle	32	7.1
None	274	60.9

Table 4.2: Sociodemographic Characteristics of the Mothers

Variable	Frequency	%age
Maternal age group		
15-25 years	89	19.4
26-35 years	287	63.8
36-45 years	67	14.9
> 46 years	07	1.6
Marital status		
Married	442	98.2
Single	08	1.8
Employment status		
Actively employed	92	20.4
Retired	21	4.7
Unemployed	322	71.6
Casual worker	15	3.3
Parity		
Primiparous	33	7.3
Multiparous	286	63.6
Grand multiparous	131	29.1
Occupation		
Civil servant	20	4.4
Artisan	19	4.2
Full housewives	123	27.4
Self-employed or petty trading	206	45.8
Farming	82	18.2
Income range (N)		
< 33000	377	83.8
33000-50000	62	13.8
51000-100000	05	1.1
101000-150000	06	1.3

The majority (73.6%) of the preschool children came from households where fathers were the breadwinners, and 42.7% had casual farm labour as their occupation, with a monthly income less than \$100 (N33,000), which is similar to the report of Akanbiemu *et al.* (2016) where the average household per capital income was \$43.4 (<N18,000). However, a study conducted in southwest Nigeria, in contrast, reported that 38.6% of the children's fathers were traders and the majority (54.8%) of them earned less than \$48.2 (N20,000) monthly (Yahaya *et al.* 2021). The poor household income in the study area could be because many fathers are either small-scale farmers or menial workers who are often poorly paid. This explains why most of the children were from food-insecure households, because income contributes significantly to the food and nutrition security status of the vulnerable members of a household.

The mothers in the study were predominantly unemployed housewives (71.6%), which is similar to the reports by Teshome *et al.* (2022) and Ahmed *et al.* (2022) where 57.3% and 46.9% of the mothers, respectively, were housewives and unemployed. The unemployment status and poor income of mothers and caregivers are social determinants that often negatively impact the available disposable income needed to acquire safe and nutritious food, especially among households with preschool children in food-insecure communities. Less than half (45.6%) of the mothers of these preschool children never had any formal education besides Arabic education; this finding is similar to the study conducted in TegeDie District, north-eastern Ethiopia, where about two-thirds (60.3%) of the mothers had neither formal education nor Arabic education (Teshome *et al.* 2022). In contrast, Ahmed *et al.* (2022) and Akanbiemu *et al.* (2013) reported that almost half (45.4% and 42.8%) of mothers had primary school and secondary education, respectively, as their highest educational status. The poor educational status of mothers in the current study could be attributed to early marriage and childbirth, which is a common practice in the northern region of Nigeria. In addition, religious and cultural beliefs among the Northerners that girl-child education is a waste of resources are also a factor. This poor disposition towards female education contributes to the poor feeding practices and dietary patterns among preschool children since quality education improves income status and empowers women to make healthy food choices, purchase sufficiently safe and healthy foods, and adopt good nutritional practices that enhance positive health outcomes and food security among children (Powell *et al.* 2017; Owoo 2020; Omotayo *et al.* 2022).

In addition, the educational status of the breadwinner, caregiver, and household head has been associated with household food security status, dietary diversity, feeding patterns, and the

anthropometric status of the preschoolers (Ashgar 2013; Fadare *et al.* 2018; Rosas *et al.* 2020). This is consistent with other findings which suggest that educated household heads or caregivers are more aware of the possible advantages of healthy food habits and eating practices (Powell *et al.* 2017). Similarly, food literacy enables mothers to make informed decisions on food acquisition, meal plans, and processing and preparation to ensure the optimal growth and development of their children (Rosas *et al.* 2020). Education and food literacy also enhance the households and individual food and nutrition security, and eventually, favourably impact the academic performance of children, labour productivity in adulthood, gross domestic product (GDP) of the nation (Begley *et al.* 2019; Khorramrouz *et al.* 2020). Almost all (98.2%) of the mothers were married, which agrees with the findings of Akanbiemu *et al.* (2016), Teshome *et al.* (2022), and Ahmed *et al.* (2022), where 93.8%, 90.7%, and 92.5% of the participants, respectively, were married.

However, this contrasts with a study conducted among farming households in Southwest, Nigeria where only 60% of the participants were married (Omotayo *et al.* 2022). The high proportion of children from legally married families in the study area could be because Islam frowns on premarital affairs and childbirth outside wedlock. The majority (70.9%) of the children were from multiparous mothers (2–4 children), which is consistent with the findings of Karcz *et al.* (2021) and Ahmed *et al.* (2022) where more than 80% and 65.7% of the participants were multiparous mothers. High parity among low-income-earning households contributes to food insecurity and poor feeding patterns among younger children because parity is a strong predictor of the quality of the preschool children's diet (Akerele 2015; Rasty *et al.* 2015). Owoo (2020) and Ware *et al.* (2021) reported that the number of growing children in a household affects the quantity and quality of meals available per capital head consumption for optimal growth and development, thus increasing their vulnerability to food and nutrition insecurity since available resources are spread more thinly across the dependent members of the households.

The prevalence of food security among preschool children in Niger State is shown in Figure 4.1. The majority (98.9%) of the households were food-insecure, ranging from mildly (16.2%), moderate (42.4%), to severely food insecure (40.3%), while few (1.1%) were food secure. This is in tandem with the findings of Yahaya *et al.* (2021), Akanbiemu *et al.* (2016) and Omotayo *et al.* (2022) where 63%, 80.9%, and 78% of children, respectively, in a study conducted in southwest Nigeria were food insecure. A similar report by Macharia *et al.* (2018) also showed

that most children were from food-insecure households. However, the report by Yahaya *et al.* (2021) showed a higher prevalence (36.0%) of food-secure children, this could be because of the high maternal educational status, women empowerment, and low parity obtainable in the southern region of Nigeria as compared with the northern region. There is also variation in the prevalence of food security among urban and rural dwellers as opined by Akanbiemu *et al.* (2016). This corroborates the fact that the prevalence of food insecurity in the country varies across the geopolitical zones and places of residence and therefore is higher in the northern region than in the southern region and also among rural areas than urban areas (Owoo 2020; Obayelu *et al.* 2021).

Most of the mothers of the preschool children admitted that they had experienced food insecurity or worry of not having food to eat due to lack of money and food deficits, and some said their households ate nothing some days due to lack of income to acquire food (Table 4.3), which is similar to the report by Yahaya *et al.* (2021) where 24.8% and 7.8% were food insecure with moderate-to-severe hunger, respectively. However, Etana and Tolossa (2017) reported a similarly low trend of food security (12.4%) among the urban participants in Ethiopia. The high prevalence of food insecurity in the study area must have accounted for why many preschoolers could not meet their minimum dietary diversity (MDD) and minimum meal frequency (MMF). The high prevalence could be attributable to the poor educational status, unemployment status, insufficient income, and low financial empowerment (high poverty level) experienced by the mothers, as opined by Akerele *et al.* (2015), Etana *et al.* (2017), Fadare *et al.* (2018) and Ogunniyi *et al.* (2020). Similarly, most mothers indicated that their household experienced various forms of anxiety of food sufficiency and hunger due to a lack of resources to access sufficient food to meet their needs adequately or due to food shortages within the previous month, as shown in Table 4.3.

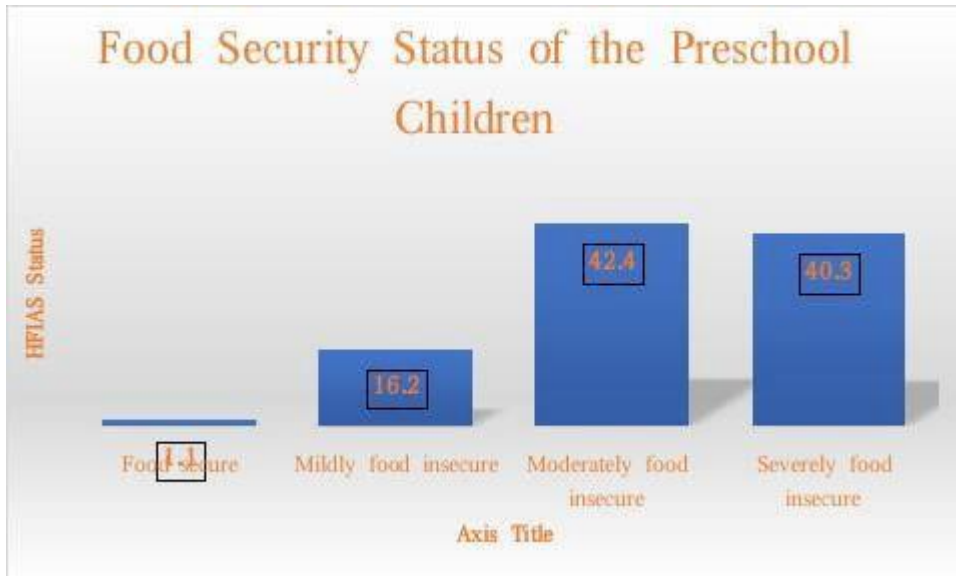


Figure 4.1: The Prevalence of Food Security among the Preschool Children in the Study Area

Table 4.3: Household Food Insecurity Access Score (HFIAS) of the Preschool Children

HFIAS questions	NO		Yes						Total	
			How often did this happen in a month?							
	Freq	%	Rarely	Sometimes		Often		Freq	%	
			Freq	%	Freq	%	Freq	%	Freq	%
1. Did you worry that your household would not have enough food?	163	36.6	85	18.5	77	17.1	125	27.8	450	100
2. Was anyone unable to eat a preferred food because of lack of resources?	119	26.4	90	20.0	108	24.0	133	29.6	450	100
3. Did anyone eat a limited variety of food due to lack of resources?	130	28.9	105	23.3	105	23.3	110	24.4	450	100
4. Did anyone eat what they did not want because of lack of resources?	148	32.9	120	26.7	84	18.7	98	21.8	450	100
5. Did anyone eat less than needed because of the lack of enough food?	112	24.9	104	23.1	137	30.4	97	21.6	450	100
6. Did anyone eat fewer meals per day because of insufficient food?	92	20.4	71	15.8	131	29.1	156	34.7	450	100
7. Was there no food in the house because of lack of resources?	96	21.3	84	18.7	111	24.7	159	35.3	450	100
8. Did anyone go to bed without food?	143	31.8	40	8.9	117	26.0	150	33.3	450	100
9. Did anyone go without food throughout the day and night without any food?	202	44.9	45	10.0	169	37.6	34	7.6	450	100

Moreso, Omotesho *et al.* (2018), Ezeh *et al.* (2021), Kandeepan *et al.* (2016) and Sani Nass *et al.* (2021) opined that household food insecurity contributes significantly to severe acute malnutrition and micronutrient deficiency disorders among under-five children, while Ahmed *et al.* (2022) found that the household’s food security status affected the quality of complementary food of 6–23-month-old children.

The feeding pattern of the preschool children over a 7-day recall is indicated in Figure 4.2. The food frequency consumption pattern showed that cereal was the most consumed, followed by root and tubers among the preschool children; this is similar to the findings of Ahmed *et al.* (2022) who reported the same trend of food consumption among 6–23-month-old Ethiopian children. Cereal food was most consumed about three to six times a week (61.4%).

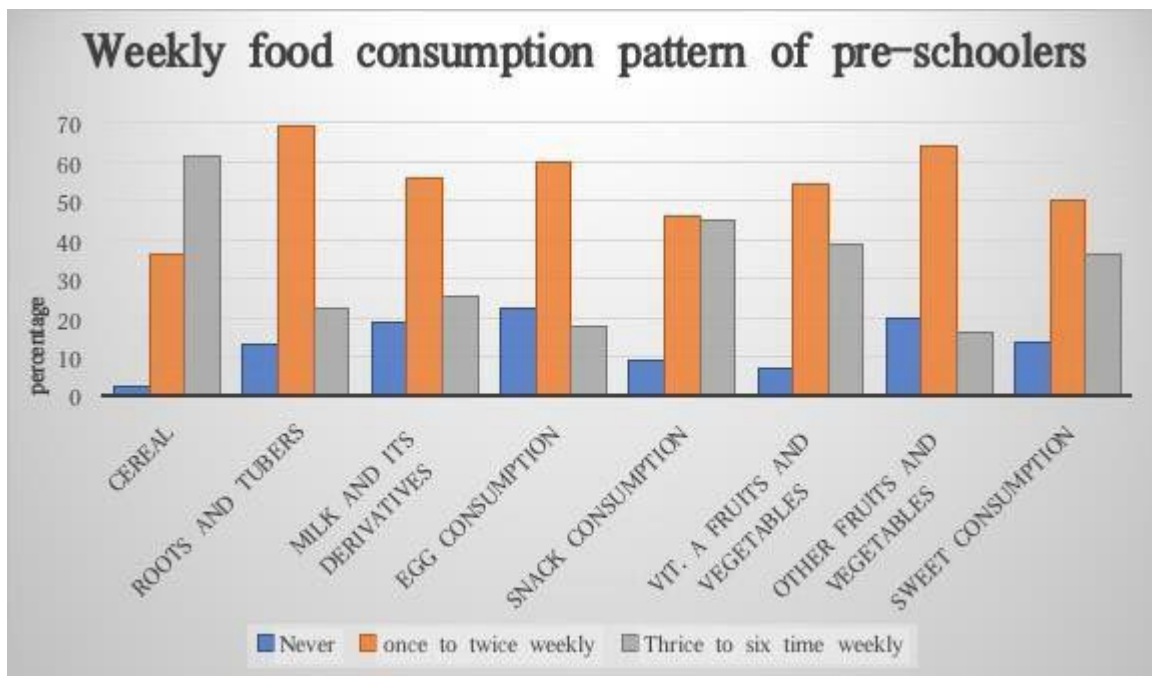


Figure 4.2: Weekly food consumption patterns of the preschool children in Niger State, Nigeria

Most of the mothers indicated that the starchy staples such as cereals and root and tubers were the most preferred food by the households and thus the most consumed by the preschoolers, (Figure 4.3). This could be because cereal crops such as rice, millet, and maize are the most cultivated staple food in the study area and thus the most affordable. In the interview held with some of the children, starchy staples such as rice-based and millet-based meals were identified as frequently consumed food groups on a daily basis, which could be because of cultural food preferences and the type of food commonly cultivated among farming communities in Niger State. This is in tandem with the findings of Ahmed *et al.* (2022) who reported a similar food consumption pattern among children in Shashemene Ethiopia. Reddy and Dam (2020) affirmed that culture and identity play a vital role in food selection, acquisition, consumption, and ultimately nutritional status in any society, which is in contrast with a similar study conducted in Uganda by Nabuuma *et al.* (2018) where white roots and tubers with bananas were the most consumed food among children.

However, Niger State is one of the major producers of rice and millet in Nigeria. Fruit and vegetable consumption was very insufficient among the preschoolers. Webb and Lewis (2005), Grimm *et al.* (2014), Duran *et al.* (2015), Reddy and Dam (2020), Woodside *et al.* (2021), and Ahmed *et al.* (2022) also indicated the same trend of low fruit and vegetable consumption among children. The low consumption in the study area could be attributed to factors such as poor nutrition knowledge of the health benefits of fruits and vegetables and the impact of seasonality on affordability, because most mothers during the interview mentioned “we consume fruits only when they are readily available since we pick them from the neighborhood”, while others indicated consumption only during the Ramadan fast. When asked the reason for consumption, the children mentioned “to quench hunger pangs” indicating that many homes do not purchase fruits for consumption but rather engage in wild harvesting (pluck from trees) during gluts. Therefore, these responses showed that there is poor maternal knowledge on the importance of fruits and vegetables to health, which explains why the children seldomly consume them in the study area, especially among the rural dwellers and low-income households.

The number of children who met their minimum dietary diversity (MDD) and MMF was low compared with those not meeting theirs, as indicated in Figure 4.4, which is not consistent with the findings of Ahmed *et al.*, (2022) who reported that the majority (61.7%) of the children met their MMF, while 42.5% met their MDD.

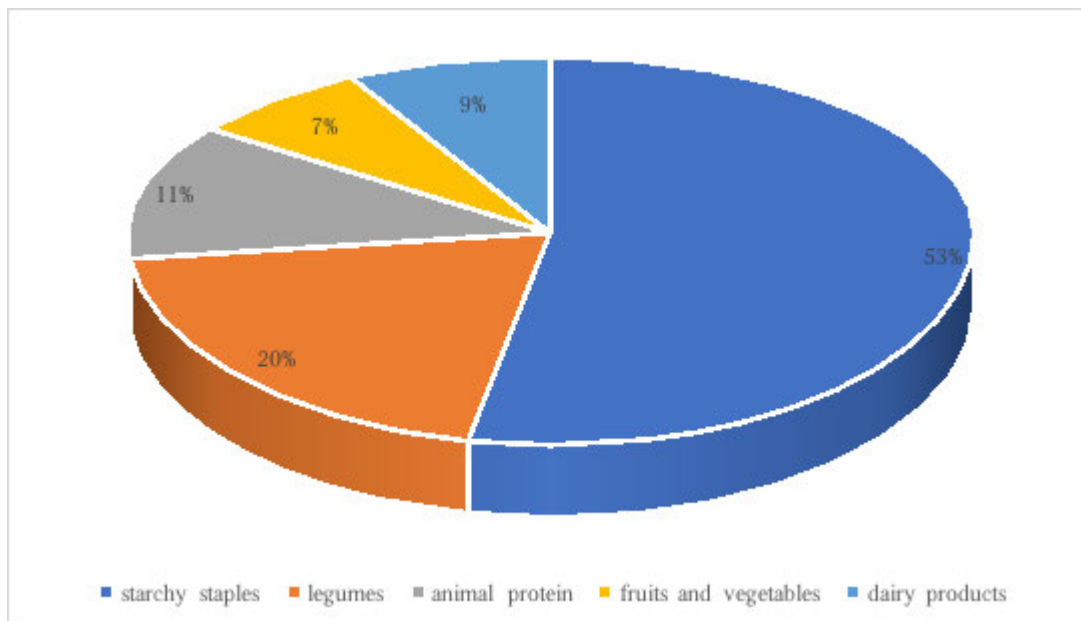


Figure 4.3: Most consumed food group by the preschool children in Niger State, Nigeria

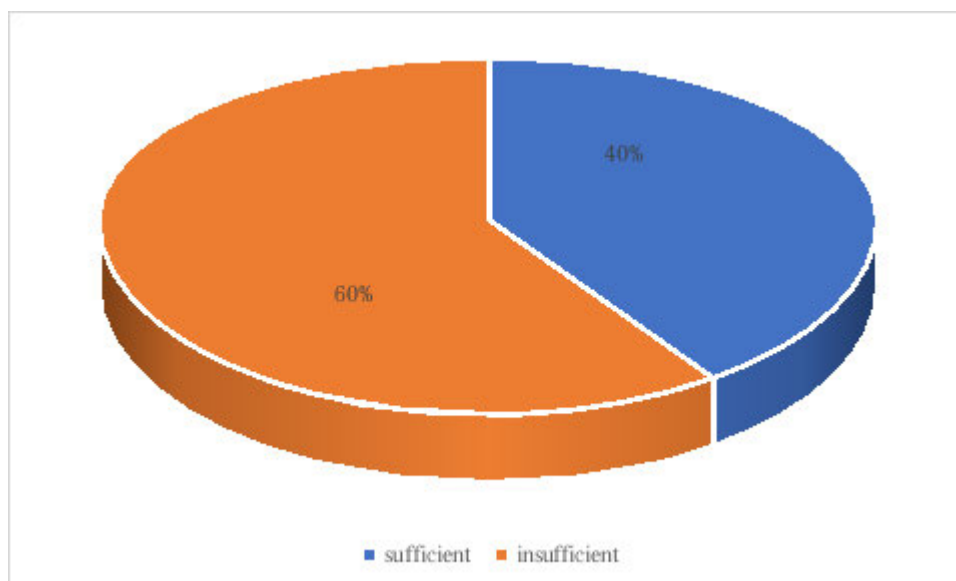


Figure 4.4: Proportion of preschool children meeting their minimum dietary diversity (MDD_C)

A study by Macharia *et al.* (2018) reported that although infants' feeding practices were inappropriate, most of the children were able to meet their MMF. Similarly, the household food security status and minimum meal frequency (MMF) of consumption among the preschoolers were significantly associated with the adequacy of their minimum dietary diversity (MDD) (p

< 0.05), as shown in Tables 4.4–4.6, which is similar to the trend reported by Ahmed *et al.* (2022) where the food security status of households influenced the (MDD) and meal frequency (MMF) of the children.

Table 4.4: Minimum Dietary Diversity Intake Vs Weekly Food Frequency Consumption Patterns of Preschoolers

Weekly food frequency intake of food groups by the preschool children					
	Never	1 to 2 times a week	3 to 6 times a week	Chi-square	p-value
Insufficient	-	207 (76.9%)	62 (23.1%)	32.38	.000
Sufficient	-	169 (93.4%)	12 (6.63%)		

MDDS=Minimum dietary diversity score. Footnote: Insufficient intake is 0 to 4 food groups, sufficient intake is 5 to 8 food groups, never is never eating anything, 1 or 2 times is eating at least 1 to 4 food groups in the week, 3 to 8 time is eating between 5 to 8 food groups in the week ($p < 0.05$).

Table 4.5: Minimum Dietary Diversity Score and Household Food Security Status of the Preschool Children

MDDS	Food	Mildly food	Moderately	Severely food	Chi-square	p-value
		Freq (%)	Freq (%)	Freq (%)	Freq (%)	
Insufficient		1 (0.55)	20 (11.05)	66 (36.46)	94 (51.93)	18.721
Sufficient		4 (1.49)	53 (19.70)	125 (46.47)	87 (32.34)	

MDDS=Minimum dietary diversity score. Footnote: Insufficient intake is 0 to 4 food groups, sufficient intake is 5 to 8 food groups, never is never eating anything, 1 or 2 times is eating at least 1 to 4 food groups in the week, 3 to 8 time is eating between 5 to 8 food groups in the week ($p < 0.05$).

Table 4.6: Weekly Food Frequency Consumption Patterns of the Preschoolers and their Food Security Status

Food groups	Frequency of weekly food consumption	Household Food Security Status				F-value	Chi-square	p-value
		Food secure Freq (%)	Mildly food insecure Freq (%)	Moderately food insecure Freq (%)	Severely food insecure Freq (%)			
Cereals	Never	-	2 (18.20)	-	9 (81.80)	4.38	17.88	.007
	Once to twice per week	2 (1.23)	16 (9.82)	79 (48.47)	66 (40.48)			
	Thrice to six times per week	3 (1.09)	55 (19.93)	112 (40.580)	106 (38.41)			
Roots and tubers	Never	2 (3.45)	12 (20.69)	19 (32.76)	25 (43.10)		23.39	.001
	Once to twice per week	1 (0.34)	33 (11.30)	135 (46.23)	123 (42.12)			
	Thrice to six times per week	2 (2.0)	28 (28.0)	37 (37.0)	33 (33.0)			
Egg consumption	Never	3 (2.97)	13(12.87)	41 (40.59)	44 (43.57)		21.31	.002
	Once to twice per week	1 (0.37)	36 (13.38)	127 (47.22)	105 (39.03)			
	Thrice to six times per week	1 (1.25)	24 (30.0)	23 (28.75)	32 (40.00)			
Vit. A rich fruits and vegetables	Never	2 (6.45)	10 (32.26)	9 (29.03)	10 (32.26)		22.32	.001
	Once to twice per week	2 (0.82)	39 (15.98)	116 (47.54)	87 (35.66)			
	Thrice to six times per week	1 (0.57)	24 (13.71)	66 (37.71)	84 (48.00)			
Snack consumption	Never	2 (4.88)	9 (21.95)	10 (24.39)	20 (48.78)		22.58	.001
	Once to twice per week	2 (0.97)	21 (10.14)	104 (50.24)	80 (38.64)			
	Thrice to six times per week	1 (0.49)	43 (21.29)	77 (38.12)	81 (40.1)			

In this study, parity, religion, household breadwinner, and portable water source for household use were strong predictors of a child’s minimum dietary diversity adequacy (F value = 5.528, $p < 0.000$), as indicated in Table 4.7. In a similar study conducted by Balistreri (2018) and Ware *et al.* (2021), parity and family size were significantly associated with children’s food security status. Other factors reported to significantly affect the adequacy of under-five children’s dietary intake in both quality and quantity among Nigerians as reported by Akanbiemu *et al.* (2016), Akanbiemu (2019), Fadare *et al.* (2018), Owoo (2018, 2020), Obayelu and Akpan (2021), Yahaya *et al.* (2021), and Omotayo *et al.* (2022) were household socioeconomic status, maternal/caregiver food literacy, geopolitical location, family structure and high dependency ratio, seasonality, conflicts, affordability due to hike in food prices, poor policy, and bad governance.

Table 4.7: Regression Co-efficient of the Socioeconomic Status of the Household as Predictors of Adequacy of Minimum Dietary Diversity of the Preschool Children

Predictors	Unstandardised β	p-value	F-value
Parity	.0175	.000	5.528
Religion	-0.285	.017	
Household breadwinner	-0.062	.021	
Source of portable water for household	-0.046	.039	

4.5 Conclusions and Recommendations

This study has shown that children’s feeding patterns, household socioeconomic status, and dietary diversity are important indicators of food and nutrition security status among preschool children from low- and middle-income households in Niger State, Nigeria. Many of the preschool children could not meet their minimum dietary intake of between 5 to 8 food groups and MMF because they were majorly from food-insecure households. The poor dietary diversity among preschool children was attributed to the food insecurity and poor socioeconomic status of the household. Most of their mothers had poor educational status and were unemployed, and thus were financially incapacitated to provide adequately for the preschool children’s dietary needs. The frequency of consumption of food groups such as root and tubers, eggs, snacks, and vit. A-rich fruits and vegetables were significantly associated with the food security status of the preschool children. At the same time, socioeconomic factors such as parity, religion, breadwinner, and source of potable water for household use were predictors of minimum dietary diversity of the preschoolers. Poor income, parity, and food

deficits depleted the available resources in the household and overstretched the meagre disposable income available to afford sufficiently safe, nutritious food for healthy living for preschool children. Some of the factors that could contribute to the low consumption of animal protein, fruits, and vegetables among the respondents are hikes in food prices attributed to insecurity challenges faced by these farming communities, thereby compromising the dietary quality of growing children. Compromised feeding patterns of preschool children could be detrimental to the overall health and nutrition security status of under-five children in Nigeria and many developing countries. Therefore, stakeholders and policymakers should prioritise improving the availability, accessibility, and utilisation of nutritious food to better meet the nutritional needs of preschool children, especially among resource-limited communities. In addition, strategies geared towards improving the security situation of the country and fostering food production must be adopted. Investment in nutrition-sensitive programmes such as value-adding technology along the food chain system to enhance the availability and affordability of nutrient-dense staple foods among rural dwellers must be explored.

Mothers should be enlightened on the health and economic benefits of home gardening and small-scale animal husbandry in improving insecurity, dietary diversity among preschool children from poor households, thereby ameliorating the food and nutrition insecurity, childhood morbidity, and mortality prevalent in rural communities in many developing countries such as Nigeria.

4.6 Limitation of the Study

This study's inability to quantify the preschool children's meals using a 24 h dietary recall is a major limitation because at the time this study was conducted Nigeria did not have a food composition database. Secondly, the study did not cover children from communities under the threat of Boko Haram attacks. However, further studies should explore the possibility of quantifying the essential nutrients consumed by the preschoolers in Niger State with regards to the recommended nutrient intake (RNI), estimated energy requirement (EER), the estimated average requirement (EAR), recommended dietary allowance (RDA), adequate intake (AI), reference intake range for macronutrients (Ris), and tolerable upper intake level (UL) appropriate for this age group.

Institutional Review Board Statement: The study was conducted in accordance with the declaration of Helsinki, and the protocol was approved by the National Health Research Ethics

Committee (NHREC) in Nigeria (NHRECor01or01or2007-11or01or2022) and the Biomedical Research Ethics Committee (BREC), University of KwaZulu-Natal, South Africa (protocol number BRECor00003392or2021).

Informed Consent Statement: All participants gave their informed consent and volunteered to participate in the study.

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CHAPTER 5: NUTRITION KNOWLEDGE AND HEALTH VULNERABILITY OF MOTHERS OF PRESCHOOL CHILDREN IN NORTH CENTRAL, NIGERIA

This chapter has been submitted for publication with the title: Nutrition knowledge and health vulnerability of mothers of preschool children in North Central Nigeria. The submitted manuscript in *Plos ONE* journal is presented in the following pages.

5.1 Abstract

Maternal nutrition knowledge is essential for optimal health outcomes among mothers and their households because food acquisition, meal planning, and preparation are usually the responsibility of women in most households in Africa. However, poor nutrition knowledge often influence nutrient intake among women of childbearing age thereby resulting poor health outcomes such as in low maternal pre-pregnancy BMI, anaemia-induced mortality. This study therefore explores the contribution of nutrition knowledge to the health status of preschool children's mothers in Niger State, North Central Nigeria. The study is a descriptive cross-sectional design using a quantitative data collection method. A multi-stage sampling technique was used to recruit 450 mothers of preschool children across Niger state, Nigeria. Chi-square and linear regression were used to test the level of statistical significance (at $p < 0.05$). Socioeconomic and demographic information, anthropometric indices and nutrition knowledge were obtained using semi-structured questionnaires. Feeding patterns were also assessed using a qualitative 7-day dietary recall. The results showed that the majority (63.8%) of the mothers were within 26-35 years, and more than half (51.6%) of the mothers lacked knowledge of a "balanced diet". Fruits, vegetables, and dairy products were the least consumed food group among the mothers (7.1% and 9.1%, respectively). Ethnicity, place of residence, occupation, and method of waste disposal were significantly associated with maternal minimum dietary diversity adequacy ($p < 0.05$). More than half (57.6%) of the mothers were within the normal BMI range, and the mean waist to hip ratio was 0.82 ± 0.08 . Social media or online was the most (36.4%) explored source of nutrition information among the mothers. This study shows no significant association between nutrition knowledge and adequacy of minimum dietary diversity among the mothers of preschool children ($p = 0.09$, $\chi^2 = 13.682$). However, it is recommended that effort should be geared towards ensuring that quality nutrition information are made available to women using indigenous knowledge system to pass across information on health benefits of indigenous underutilised crops that are readily accessible to foster compliance, with health healthy eating habits at grass root level and among low income earners from food insecure households and countries across Africa and beyond.

Conclusion: Dietary diversity among mothers was associated with the socioeconomic status and BMI of the mothers, which were strong determinants of meal quality and health outcomes in Nigeria and other developing countries experiencing food insecurity.

Keywords: Meal quality, minimum dietary diversity, feeding pattern, nutrition knowledge, Niger state, Nigeria.

5.2 Introduction

Maternal nutrition refers to the nutritional needs of women throughout their reproductive lives. It is a potential tool in preventing the under- or over-consumption of nutrients that could lead to diet-related non-communicable diseases (Tessema *et al.* 2020). Food is an essential determinant of an individual or household's nutritional status. Hence, knowledge about dietary needs among mothers is essential for good health and overall nutritional status especially when available resources are limited. Often mothers do not know the importance of varieties and how to balance the food plate/diet in the correct proportion needed to meet their dietary needs (Tessema *et al.* 2020).

Maternal nutrition knowledge is essential for optimal health outcomes among mothers and their households because food acquisition, meal planning, and preparation are usually the responsibility of women in most households in Africa (Kushitor *et al.* 2020). However, poor nutrition knowledge and nutrient intake among women of childbearing age result in low maternal pre-pregnancy BMI, anaemia-induced mortality, increased susceptibility to infections and poor pregnancy outcomes like low birth weight (LBW) and failure to thrive in infants (Kominiarek & Rajan, 2016; Kushitor *et al.* 2020).

Women of childbearing age are a significant proportion of nutritionally disadvantaged groups globally because of the extra-nutrient demand in response to physiological changes (Kominiarek & Rajan, 2016). Poor feeding patterns, socioeconomic status, suboptimal food systems and environment, inadequate dietary diversity, infections and short-interpregnancy spacing often aggravate the risk of malnutrition and mortality among this vulnerable group (Popkin *et al.* 2020).

Food choices and consumption patterns are strong predictors of overall health, wellness, and pregnancy outcomes among women of reproductive age (Bhandari *et al.* 2016). The impact of poor dietary intake among mothers is severe for both the mother and child, resulting in increased maternal and child morbidity and mortality (Abdu *et al.* 2018b).

Poor feeding habits among mothers have been linked to urbanisation and nutrition transitioning which is common in developing countries like Nigeria. It has increased the consumption of nutrient-poor foods and beverages nationwide (Quaidoo *et al.* 2018). Over-consumption of energy-dense, ultra-processed food among mothers has been associated with an increased risk of

ischaemic heart disease, stroke, atherosclerosis, insulin resistance diabetes, chronic kidney disease, osteoporosis, some cancers, and excessive weight gain (Kushitor *et al.* 2020; Christian & Dake, 2021).

The outcomes of the poor dietary pattern are all forms of malnutrition as well as increased risk of cardiovascular diseases (such as diabetes and obesity), poor breast milk secretion, colon cancer, chronic heart diseases (CHD), among others (Appiah *et al.* 2021). Poor meal quality also increases the risk of micronutrient deficiency diseases of public health importance which are iron deficiency anaemia, Vit. A deficiency disorder, iodine deficiency disorder, and zinc deficiency (Kominiarek & Rajan, 2016).

Nutrition literacy, socioeconomic status, parity, demography, affordability, and culture significantly influence the quality of a woman's diet and overall health (Bhandari *et al.* 2016). However, among these factors, nutrition literacy (knowledge) has a strong influence on nutrition practices regarding food acquisition, handling, preparation, processing, preservation and consumption pattern among women and their household members (Khorramrouz *et al.* 2020).

Adequate nutrition knowledge is significant for tackling malnutrition and various diet-related non-communicable diseases across all groups because it influences healthy food habits and adequate nutrient intake and utilisation, especially among mothers (Bailey *et al.* 2019). However, misconstrued nutrition information can negatively impact feeding habits and health outcomes among these vulnerable groups (Hundera *et al.* 2015; FAO, IFAD *et al.* 2021).

In Africa, one in every five people was hungry in 2020, and about 5% to 20% of women are undernourished, having a low body mass index (BMI) attributable to chronic hunger (Kushitor *et al.* 2020; FAO, IFAD, *et al.* 2021). Similarly, the Africa regional overview of food security and nutrition 2021 reported that about 29.4 million people, predominantly women with dependent children, were undernourished, while 21.4% (43 million) people were food insecure in 2020 (FAO, ECA, *et al.* 2021). The prevalence of anaemia among women in Africa was the highest (51.8%), while the prevalence of adult obesity was 12.8%. However, among pregnant women, anaemia prevalence was 57%, which is attributed to inadequate dietary diversity and poor feeding patterns (FAO, ECA, *et al.* 2021; World Health Organization 2021).

In sub-Saharan Africa, Tikuye *et al.* reported that, in 2018 the prevalence of chronic and acute undernutrition among women was 10–20% and 20–25%, respectively (Tikuye *et al.* 2018). The Food and Agriculture Organization (FAO) 2021 report showed that about 18.7% of people, primarily women in the West Africa region, are poor and hungry, with about 68.3% (274 million) people being moderately or severely malnourished (Tikuye *et al.* 2018; FAO, ECA, *et al.* 2021). Anaemia, Vitamin A and Zn deficiencies among women in Africa range from 21% to 80%, while anaemia prevalence among women in West Africa is alarming at 51.8% (Kushitor *et al.* 2020; FAO, IFAD, *et al.* 2021). A study in Ghana revealed that 57% of the women were anaemic and overweight, a form of a double burden of malnutrition (Kushitor *et al.* 2020).

The trend of triple burden of malnutrition (that is, the coexistence of undernutrition, overnutrition and micronutrient deficiency within the same individual, household, community, and population) and other preventable diet-related diseases among women in low- and middle-income countries (LMICs) like Nigeria is alarming (Christian & Dake, 2021). In 2016, the prevalence of overweight was 5% among adults in Nigeria (FAO, ECA, *et al.* 2021).

In Nigeria, malnutrition among mothers has continued to rise in recent times. Asomugha *et al.* 2017 reported that about 11.6% of women suffered from chronic undernutrition, while 14.2% and 5.7% of women of childbearing age were either overweight or obese, respectively. Similarly, about 12.7% of mothers had iron deficiency anaemia in Nigeria (Asomugha *et al.* 2017). This prevalence remains a considerable challenge (Popkin *et al.* 2020; FAO, IFAD, *et al.* 2021). The national prevalence of malnutrition among women of reproductive age was 11%. At the same time, overweight/obesity was 28%. However, this varies across the sociodemographic and geopolitical zones within the country, with the highest prevalence of malnutrition reported in the northern and rural regions due to an increase in poverty and inflation rate (USAID 2021; Central Bank of Nigeria 2022; Emejo 2022; Onwuka 2022).

Poor financial status, food illiteracy and overdependence on starchy staples are significant problems among many households in Nigeria, causing malnutrition (Amare *et al.* 2018). Consequently, maternal malnutrition resulting from poor intake and poor dietary knowledge is a major predictor of poor health outcomes, such as maternal and child morbidity and mortality in most developing countries, especially in rural areas and among the low- and middle-income earners in urban centres across the nation (Adinma *et al.* 2017; Adewusi & Nwokocha,

2018; Meh *et al.* 2019). A study conducted in South-South, Nigeria revealed that the proportion of mothers who knows the classes of food was low (35.0%) (Jemide *et al.* 2016).

The outcome of poor maternal knowledge and intake is often expressed as low maternal nutritional status, low pre- pregnancy BMI and pregnancy weight gain, obesity, diabetes, coronary heart disease, hypertension, and high maternal and infant morbidity and mortality (Fadare *et al.* 2019). Moreover, poor dietary intake among women in Nigeria has been attributed to the high poverty rate, high food prices, high parity and family size (especially in the northern region), inadequate nutrition knowledge, cultural food fads, seasonality, poor food systems and supply chain (Asomugha *et al.* 2017; Adeyemi & Akerele 2021; Central Bank of Nigeria 2022; Onwuka 2022). Other factors are educational status, taste, convenience, income, and religious beliefs.

Additionally, the quality and sources of nutrition information among Nigerian mothers also play a significant role in the feeding pattern and health outcomes of mothers and their household members. This varies significantly across the different social classes, age groups, educational status, wealth index and demography in the country (Egg *et al.* 2020; Khorramrouz *et al.* 2020). Some identified sources of nutrition information are television, radio, newspapers and social media platforms, religious gatherings, family members and friends, educational books and visuals and health professionals, nutrition education interventions and campaigns, and academic workshops/institutions (Jemide *et al.* 2016; Quaidoo *et al.* 2018; Egg *et al.* 2020).

Although the causes of nutrition-related health problems across all age groups are widely documented, their prevalence and influence of demography on the nutrition and health status of mothers differ from one region to another in North Central Nigeria is not well documented. Hence, there is scanty information on the relationship between the nutrition knowledge of mothers and their health vulnerability in Niger State, Nigeria. Therefore, this study aims to assess the nutrition knowledge of mothers of children aged 3-5 years and their health status in Niger State, North Central Nigeria.

5.3 Materials and Methods

5.3.1 Study Location

Niger State is the country's largest state in the North Central geopolitical zone, with its capital in Minna. Other cities include Bida, Kontagora and Suleja. The Nupe, Gbagyi, Kamuku,

Kambari, Hun-Saare, Hausa and Koro form the most numerous indigenous tribes of Niger State. The State is named after the river Niger and lies on coordinates with latitude 90 55'50.450 N and longitude 50 35'57.120 E, and its land span is about 76,363km² (29,484 sq.m). It is bordered to the North by Zamfara State, West by Kebbi State, South by Kogi State, southwest by Kwara State, North-East by Kaduna State and southeast by the FCT. The State also has an International Boundary with the Republic of Benin. It comprises 25 Local Government Areas (LGAs) and 274 political wards with a population figure of 3,950,249 (Wikipedia & Encyclopedia, 2006; State Bureau of Statistics & State Planning Commission, 2011).

5.3.2 Study Population

The study participants were mothers of preschool children (3-5years) who had lived in the selected communities for at least three or more months before data collection.

5.3.3 Eligibility Criteria and Recruitment

5.3.3.1 Exclusion Criteria

Mothers with cardiovascular diseases, and terminal ailments such as cancer, stroke, HIV or AIDS, and congenital malformation were excluded from the study.

5.3.3.2 Inclusion Criteria

All mothers of preschool children who lived in the selected LGAs and consented to participate in the study were recruited. Where there was more than one mother within the same household with preschool children (polygamous setting), the older mother was enrolled on the study because decision-making regarding meal plans and choice lies on them.

5.4 Study Design

A cross-sectional study was conducted among the mothers of preschool children from the selected LGAs in Niger State between February and May 2022.

5.5 Sample Size

Four hundred and fifty mothers of preschool children were recruited. The sample size was determined using the formula: $n = z^2 \times p(q) / d^2$ (Cochran, 1977), where n is the minimum calculated sample size, z is the z-score of 1.96 at a 95% confidence level, p is 48.0%, the

proportion of food insecure population in rural households in North Central, Nigeria from the previous study (Adepoju & Adejare, 2013), d is 5%, the desired level of precision and q is $1-p$. 20% nonresponse rate among the mothers of the preschool children were added due to high illiteracy rate and seclusion of women from public gathering or strangers (purdah practice) which is a common practice in the study area, however eleven participants were excluded from the study due to incomplete data.

5.6 Sampling Technique and Procedure

A multi-stage sampling technique was used to enrol the mothers across the twenty-five LGAs in Niger State, North Central Nigeria. First, the twenty-five LGAs were stratified into various political wards. Wards from each LGA were selected by a systematic sampling method using a sampling interval K_{th} obtained by dividing the total number of women with the minimum calculated sample size (n). The first ward was selected randomly, and subsequent wards were selected at every K_{th} interval. Within the selected wards, the total number of mothers of preschool children was obtained using their registration at the health facility centres. Then, the calculated minimum sample size was proportionally allocated to the selected wards based on the number of households with children. Mothers of preschool children were selected from each household using a simple random sampling technique. Quantitative data on nutritional knowledge, eating habits and anthropometry indices via face-to-face interviews were collected from the mothers of the preschool children in the selected LGAs across Niger state.

5.7 Data Preparation and Statistical Analysis

The Data collected were analysed with SPSS version 28.0. Body Mass Index (BMI) and waist/hip ratio were extrapolated from the collected variables. Descriptive statistics in the form of percentages and frequencies were used to present the information on sociodemographic characteristics, BMI, waist-hip ratio and feeding patterns of the mothers in the study. Bivariate and multivariable logistic regression analyses were used to identify the factors associated with maternal nutrition status and minimum dietary diversity adequacy. All independent variables associated with the nutritional status at $p < 0.05$ were considered statistically significant. Chi-square was used to determine the statistical significance of the dependent variables, while a linear regression model was used for inferential statistics at $p \leq 0.05$. Bivariate and multivariable logistic regression analyses were used to identify the factors associated with maternal nutrition status and minimum dietary diversity adequacy.

5.8 Anthropometry

Weight in kg was obtained using the bathroom-weighing scale (OMRON BCM-500), height in m² was measured using a stadiometer and waist-hip circumference was measured using a measuring tape. BMI of the mothers and waist-hip ratio was computed. Institute of Medicine (IOM) BMI classification was used. Mothers with less than < 18.5kg/m² are classified as underweight, those within 18.5 kg/m² and 24.9 kg/m² are within the normal BMI range, mothers between 25.0 kg/m² to 29.9 kg/m² are overweight while mothers with BMI range above 30.0 kg/m² are obese. For women, waist-hip ratio, according to WHO, the normal range is ≤ 0.85 . Therefore, women with ≤ 0.80 are at low risk of cardiovascular disease, those 0.81 to 0.85 are at moderate risk while those with ≥ 0.86 are at high risk of cardiovascular disease.

5.9 Minimum Dietary Diversity Scores for Women (MDDS_W)

The minimum maternal dietary diversity score (MDDS_W) was estimated using the qualitative method of a weekly food frequency consumption questionnaire (7-day recall). The tool inquires 10 food groups which are aggregated for analysis. The 10 food groups are (1) starchy staples; (2) dark and green leafy vegetables; (3) Vitamin A-rich fruits and vegetables; (4) Other fruits and vegetables; (5) Organ meats or offal; (6) Meat and/or or fish; (7) Eggs; (8) Legumes, nut and seeds; (9) Milk and milk products (10) Sweet or snack. The score is the sum of the food groups consumed by mothers from a total of 10. Households were classified into insufficient-dietary diversity (less than or equal to five food groups) and sufficient dietary diversity (greater than five or equal to 10 food groups).

5.10 Nutrition Knowledge

The nutritional knowledge of the mothers was assessed on 12 structured questions on the meaning of healthy diets, constituents of healthy diets, the importance of each food group to human health, symptoms of nutritional deficiency, sources of nutritional information to individual mothers and the relevance of the acquired information to individual dietary habit, the mothers' responses were classified as either correct or incorrect from the available options. Experienced senior researchers in Human Nutrition within and outside the University of Kwazulu-Natal, South Africa, validated the questionnaires. The mother's responses were also assessed using the Likert scale as strongly agreed = 5, agreed = 4, undecided = 3, disagreed = 2

and strongly disagreed =1. Responses within the cut-off point of 3.5 are classified as good, while those below the cut-off point are classified as poor.

5.11 Ethical Consideration

This study was reviewed and approved by the Biomedical Research Ethics Review Committee of the University of Kwazulu-Natal, South Africa (protocol number BRECor00003392or2021) and the National Health Research Committee in Nigeria (NHREC) (Approval Number; NHRECor01or01or2007-11or01or2022). Verbal informed consent and assent were also obtained from unlearned mothers. Written consent was obtained from learned mothers who volunteered to participate in the study by appending their signatures on the questionnaires after explaining the study's objectives.

5.12 Results and Discussion

5.12.1 Socioeconomic and Demographic Characteristics of the Mothers

Four hundred and fifty mothers participated in this study; the majority (63.8%) of the mothers were 26–35 years old. Most (76.4%) mothers were rural dwellers and from the Nupe (68.4%) ethnic group (Table 5.1). The mean age of the mothers was 28.14 ± 6.03 years, and almost all (98.2%) were married. About one-third (45.0%) never had any formal education besides Islamic education. The majority (63.6%) of mothers were multiparous (Table 5.1). Maternal age, ethnicity, occupation, income, and method of contraception were significantly associated with maternal nutrition knowledge ($p < 0.05$) as indicated in Table 5.1.

Table 5.1: Association between socioeconomic and demographic characteristics of mothers and nutrition knowledge of the mothers of preschool children

Variables	Frequency (n=450)	%age (%)	χ^2	P-value
Age group			81.623 ^a	<.001*
15-25 years	89	19.8		
26-35 years	287	63.8		
36-45years	67	14.9		
> 46 years	07	1.5		
Ethnic group			15.592 ^a	0.004*
Nupe	308	68.4		
Gwari	04	0.9		
Hausa	113	25.1		
Yoruba	15	3.3		
Others	10	2.3		
Marital status			1.792 ^a	0.181
Married	442	98.2		
Single	08	1.8		
Parity			.554 ^a	.758
Primiparous	33	7.3		
Multiparous	286	63.6		
Grand multiparous	131	29.1		
Occupation			47.259 ^a	<0.001*
Civil servant	20	4.4		
Artisan	19	4.2		
Full housewives	123	27.4		
Self-employed or petty trading	206	45.8		
Farming	82	18.2		
Income range			8.812 ^a	0.032*
<#33,000	377	83.8		
#33,000-#50,000	62	13.8		
#51,000-#100,000	05	1.1		
#101,000-#150,000	06	1.3		
Residential area			0.347 ^a	0.556
Urban	106	23.6		
Rural	344	76.4		
Source of potable water			6.923 ^a	0.074
Protected	197	43.8		
Unprotected	253	56.2		
Method of contraception			27.506 ^a	<0.001*
Natural	416	92.4		
Scientific	34	7.6		
None	--	--		

The values in asterisk are statistically significant at $p < 0.05$

5.12.2 Knowledge of Balanced Diet among the Mothers

In Figure 5.1 and Figure 5.2, more than half (51.6 % and 54%, respectively) of the mothers had poor definitions of a balanced diet or healthy eating and lacked basic nutrition knowledge.

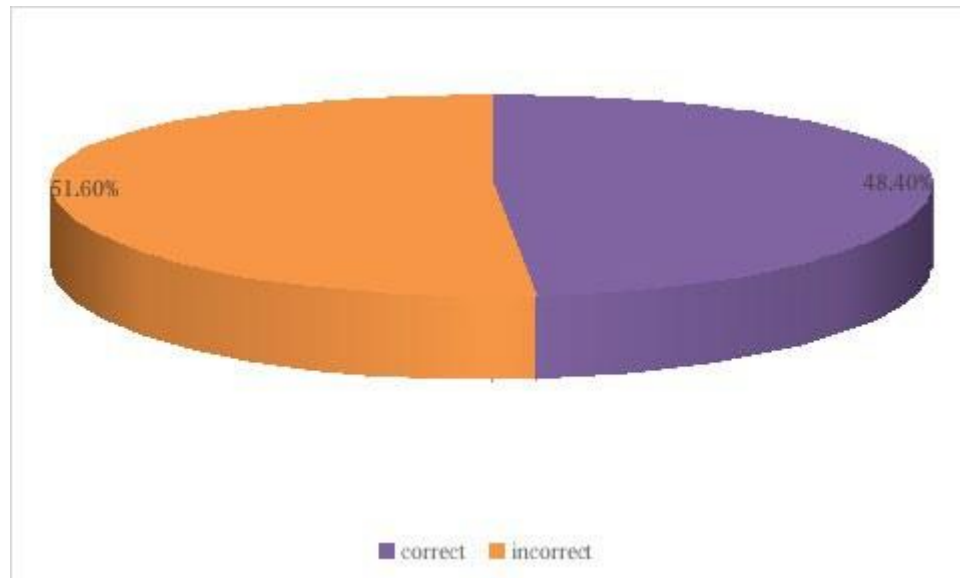


Figure 5.1: The proportion of mothers who could define a balance diet

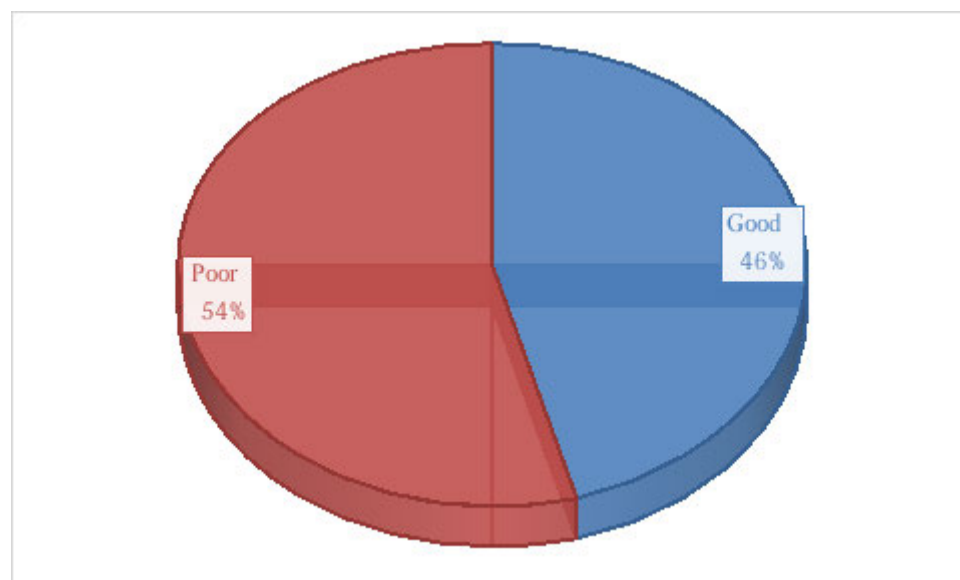


Figure 5.2: The proportion of mothers with basic nutrition knowledge score

5.13 Sources of Nutrition Information among the Mothers

Among all the sources of nutrition information available to the mothers, online/social media was the most employed on nutrition issues (36.4%). Traditional media such as television, radio, billboards, and poster advertisements were the second most used source of nutrition information, while few (19.6%) mothers sought nutrition information from either the community health workers or community women’s gatherings. Families/relatives’ forums were the least explored medium of nutrition information among the mothers as indicated in Figure 5.3.

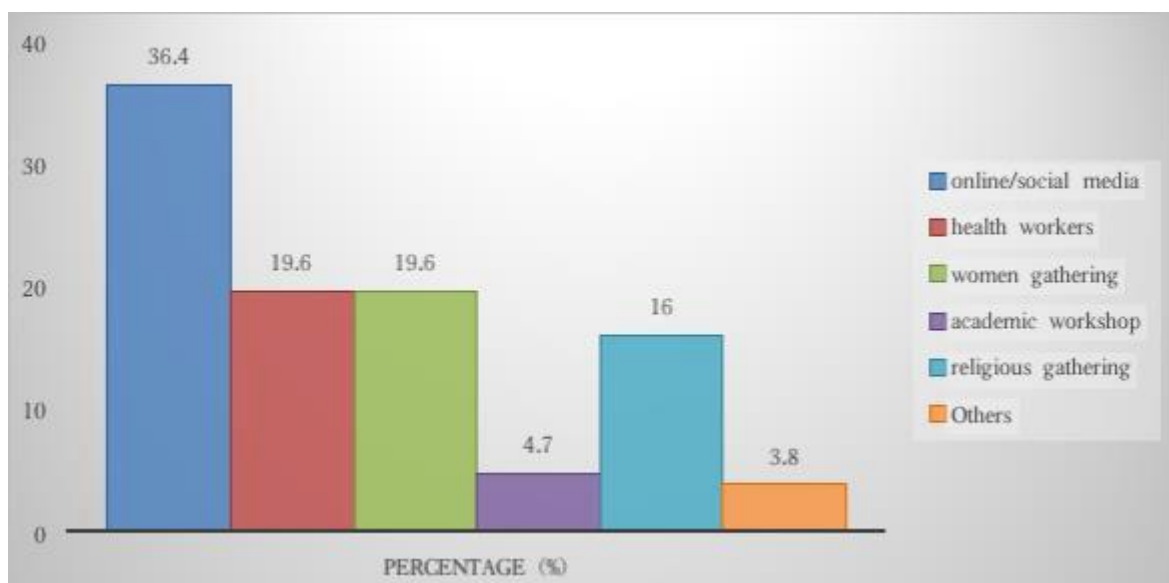


Figure 5.3: Maternal sources of nutrition information

5.14 Meal Quality of the Mothers of the Preschool Children

5.14.1 Feeding Pattern, Consumption Pattern and Minimum Dietary Diversity of the Mothers

The feeding pattern of the mothers based on 7-day dietary recall was captured in Table 5.2 and Figure 5.4. Table 5.2 showed that about 62.9% of mothers consume starchy staples between three to six times daily. In comparison, only 26.9% of the mothers had sweets and snacks between three to six times daily. These starchy staples usually consist of rice and fermented beverages such as ‘pap’ and ‘Kunu’ from millet grains. Fruits, vegetables, and dairy products were the least consumed food groups (7.1% and 9.1%, respectively), as indicated in Figure 5.4.

About half (50.7%) of mothers did not meet up with their minimum dietary diversity (MDDS_W) as recommended by FAO, FHI 360 (FAO & FHI 360, 2016), as indicated in Figure 5.5 while Figure 5.6 showed the proportion of mothers who met the minimum dietary intake based on place of residence.

Table 5.2: Weekly Food Consumption Pattern for Mothers

Food Groups	NEVER		YES				Total Yes	
	N	%	1 to 2 weekly		3 to 6 times		N=450	%
			N	%	N	%		
Starchy staples	19	4.2	148	32.9	283	62.9	431	95.8
Dark green vegetable	39	8.7	244	54.2	167	37.1	411	91.3
Vit. A fruit and vegetables	98	21.8	273	60.7	79	17.6	352	78.2
Offal and organ consumption	100	22.2	264	58.7	86	19.1	350	77.8
Other fruits and vegetables	88	19.6	291	64.7	71	15.8	362	80.4
Meat and fish consumption	56	12.4	229	50.9	165	36.7	394	87.6
Egg consumption	101	22.4	282	62.7	67	14.9	349	77.6
Legumes, nuts, and seed consumption	40	8.9	211	46.9	199	44.2	410	91.1
Milk and milk derivatives	100	22.2	260	57.8	90	20.0	350	77.8

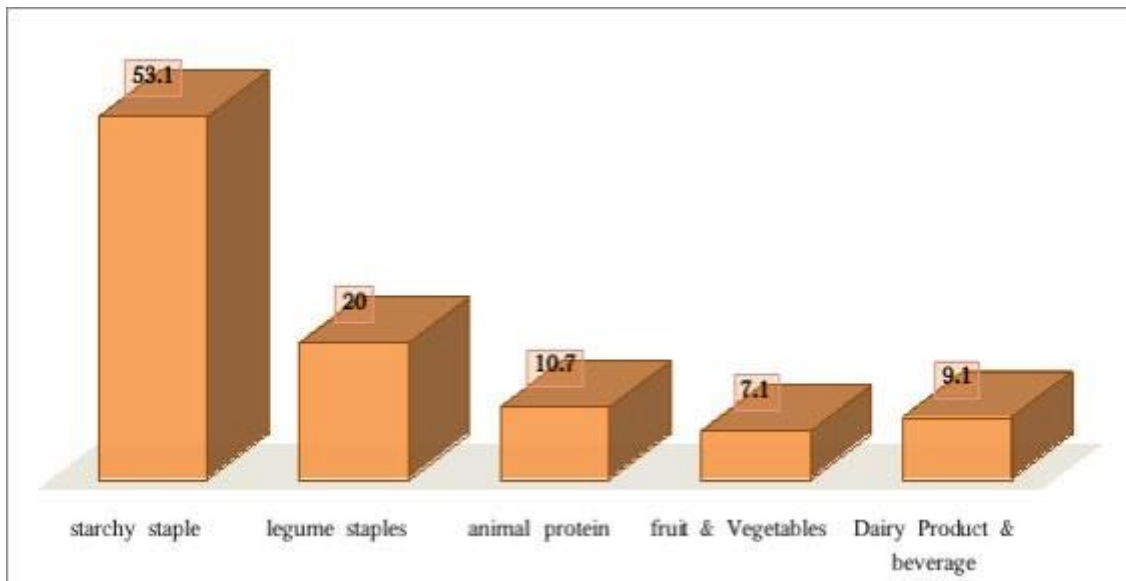


Figure 5.4: The most consumed food group among the mothers

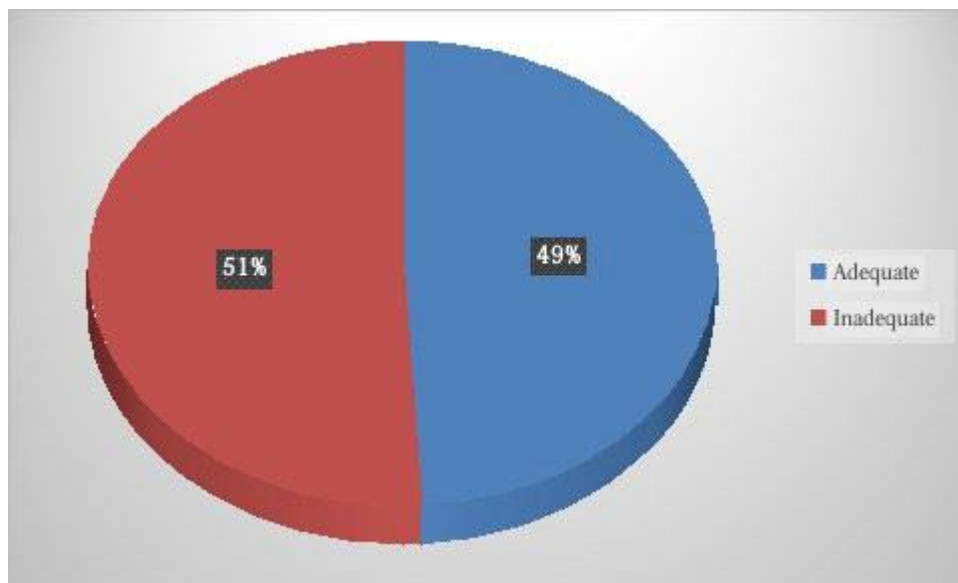


Figure 5.5: The proportion of mothers who met their minimum dietary diversity score

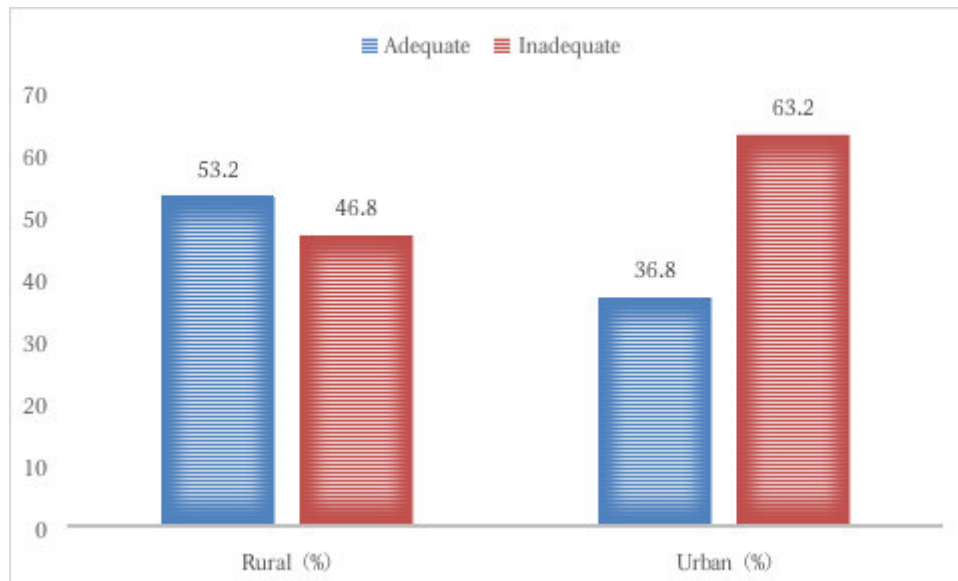


Figure 5.6: Minimum dietary diversity score of the mothers based on their residential area

5.14.2 Impact of Maternal Nutrition Knowledge on Meal Quality

Most (54.0%) of mothers indicated that nutrition knowledge never positively impacted their feeding pattern (Figure 5.7).



Figure 5.7: The proportion of mothers whose nutrition knowledge impacted their meal quality

5.15 Anthropometric Status of Mothers of the Preschool Children

The anthropometric indicator of the mothers is presented in Figure 5.8 and Table 5.3. More than half (57.6%) of the mothers were within the normal range (18.5kg/m^2 to 24.5kg/m^2). The mean maternal BMI and waist-hip ratios were $24.52 \pm 5.31 \text{ kg/m}^2$ and 0.82 ± 0.08 , respectively.

However, their waist-hip ratio showed that the majority (58.9%) had a value less than 0.80, at low risk of developing cardiovascular diseases.

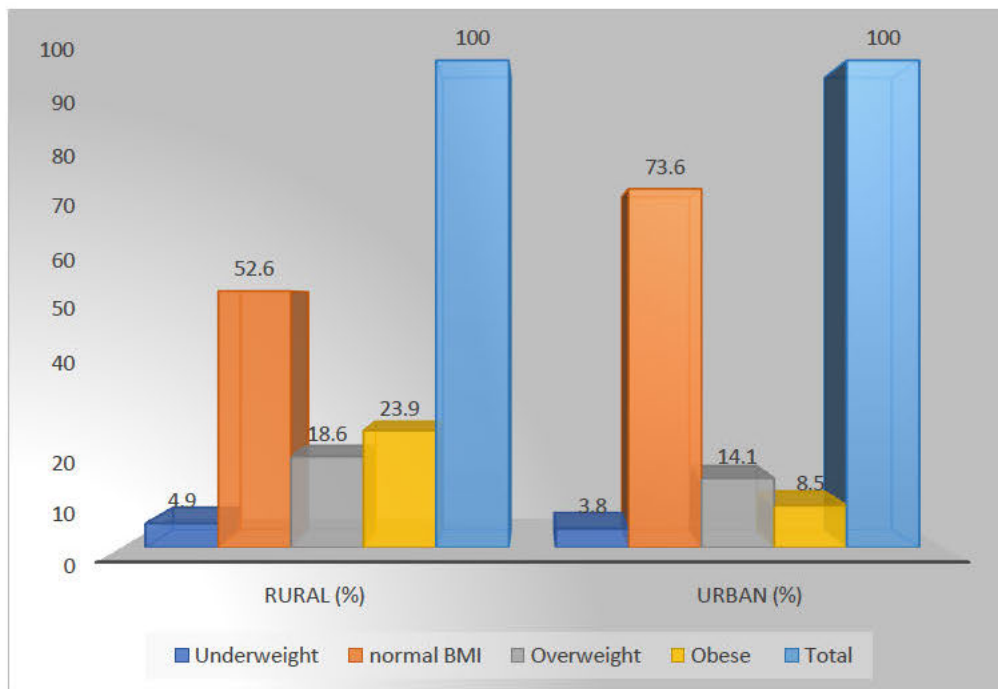


Figure 5.8: Body Mass Index of the mothers based on the residential area

Table 5.3: Risk of Developing Coronary Heart Disease among the Mothers

Waist-hip ratio range	Risk of CHD	Frequency (N= 450)	Percentage (%)
≥ 0.86	High health risk	135	30
0.81- 0.85	Moderate health risk	54	12
≤ 0.80	Low health risk	261	58

5.16 Association between Sociodemographic Characteristics and Minimum Dietary Diversity of the Mothers

The linear regression model showed that ethnic group, occupation, residential area, and method of waste disposal were risk factors for inadequacy in the minimum dietary diversity among the mothers (Table 5.4). The body mass index (BMI) of the mothers was significantly associated with and a predictor of the adequacy of their minimum dietary diversity ($p = 0.000$, unstandardized $\beta = 24.358$, F value = 0.064, 95% CI = 23.011- 25.706). However, there was no association between maternal nutrition knowledge and their minimum dietary diversity ($p = 0.09$, $\chi^2 = 13.682$).

Table 5.4: The Association between Sociodemographic Characteristics and Adequacy of Minimum Dietary Diversity Score Using a Regression Model

Variables	χ^2	P-value	
Ethnic group	10.214	0.037*	
Residential area	8.725	0.003*	
Occupation	20.439	0.005*	
Source of potable water	7.685	0.053	
Method of waste disposal	9.228	0.026*	
Maternal nutrition knowledge	13.682	0.090	
F-value	R	Unstandardised β	95% CI
1.666	0.136	4.212	3.163-5.260

The asterisk values were statistically significant at $p < 0.05$.

This study assessed the sociodemographic and economic status, nutrition knowledge and nutritional status of mothers in selected LGAs of Niger State, North Central Nigeria. More than two-thirds of the mothers were 26–35 years old. It is consistent with a study conducted among lactating mothers by Tessema *et al.* (2020) and Kibre *et al.* (2022), where the majority (71.0% and 49.0%, respectively) of the mothers were more than 25 years of age. It is, however in contrast to the findings of Hundera *et al.* (2015) and Ajisha *et al.* (2022) where the majority (81.3% and 57.5%) of the mothers from a study conducted in Ethiopia and India, respectively, were below 25 years. Studies have reported a positive association between maternal age and nutrition knowledge, maternal educational status, and healthy eating habits (Jemide *et al.* 2016; Fadare *et al.* 2019; Appiah *et al.* 2021).

The study also shows a positive association between maternal age and nutrition knowledge ($p < 0.05$) (Table 5.1). More than two-thirds of the mothers were Nupes. This could be because Nupe is the major tribe in the study area. Ethnicity was significantly associated with maternal nutrition knowledge in the current study ($p = 0.004$). Most of the mothers were married. The high proportion of married participants could be attributed to Islamic practices encouraging early marriages. Also, poor disposition to female education and poverty predisposes the girl-child to be married off early. This practice is common among poor-income and uneducated households in the northern regions of Nigeria (Bolarinwa *et al.* 2022). The finding agrees with an Ethiopia study by Kibre *et al.* (2022) who reported a similar trend of a high proportion of married women. In contrast, a study in Ghana showed that almost all (91.0%) of the mothers were not legally married (Appiah *et al.* 2021).

Less than half (45.8%) of mothers in this study were petty traders which is consistent with the findings of Appiah *et al.* (2021) where 45.2% of the mothers were petty traders. It could be because most of the mothers were from rural communities where farming is the main occupation of their husbands. However, it contrasts with the findings of Kibre *et al.* (2022) and Smith *et al.* (2022) where about 70% and 49.0% of the mothers were farmers, respectively. Also, Ajisha *et al.* (2022) reported that most mothers in their study area were full housewives. Maternal occupational status was strongly associated with nutrition knowledge ($p = < 0.001$; $\chi^2 = 47.259$). However, poor maternal occupational status contributes significantly to the low income among mothers, thus, affecting their ability to afford nutritious food or meet their minimum dietary diversity for healthier living and productivity (Jemide *et al.* 2016; Fadare *et al.* 2019).

Above half of the mothers had no formal education besides Islamic education. This high proportion of non-formal education may be due to poor enrolment of females in schools, also, early marriage, pregnancy, and childbirth which are predominant in northern Nigeria might have led to the termination of education earlier than expected (Jemide *et al.* 2016; Fadare *et al.* 2019). This finding contrasts with the report of Kibre *et al.* (2022) and Ajisha *et al.* (2022) where most of the mothers had primary education. It is also in contrast to the study by Smith *et al.* (2022) who reported that a higher proportion of mothers had secondary education. Educational status is reported to influence maternal nutrition knowledge, food acquisition and maternal dietary quality (Jemide *et al.* 2016; Fadare *et al.* 2019; Walker *et al.* 2022). However, poor educational status in this study may have contributed to the low maternal nutrition knowledge and poor dietary diversity seen. Maternal illiteracy, therefore, is a potential risk factor for poor dietary quality, morbidity and mortality among mothers and the nation at large (Jemide *et al.* 2016; Tessema *et al.* 2020).

Most mothers in the study area were rural dwellers which may be because Niger state has more rural settlements than urban settlements. This finding is similar to the report of Kibre *et al.* (2022) where most mothers resided in rural areas; however, it is in contrast with the findings of Karcz *et al.* (2021) and Ajisha *et al.* (2022) where most of the mothers resided in the city. Most (53.2%) of the mothers from rural communities could meet their minimum dietary diversity cut-off than mothers (36.8%) from urban communities, hence, residential areas played a vital role in meal quality among the mothers (Fig. 5.7). This could be because mothers in rural communities tend to have more access to varieties of food at lower prices, many also acquire

food items from their farm produce or as a transfer/gift from fellow farming households than the urban community dwellers who patronize malls and shop at a higher cost. Secondly, rural dwellers are more likely to consume more varieties of indigenous staples, fruits and vegetables from vast harvests and less processed foods than urban dwellers due to proximity to local produce markets, ownership of home gardens, farmlands, affordability of such food items and cheaper cost of living than people in the city centers.

Above half of mothers could not define what a balanced diet/healthy eating is, and they also showed poor nutrition knowledge. It, however, contrasts with the findings of Hundera *et al.* (2015) where more than two-thirds of the mothers could define what a balanced diet is, also, less than half of the mothers had good basic nutrition knowledge. This finding could be due to the poor formal educational status among the mothers since basic nutrition information is taught in formal schools. A similar study among young mothers in Ghana by Appiah *et al.* (2021) also showed that less than half (44.9%) of the women had good nutrition knowledge. The current study, contrasts with that of Hundera *et al.* (2015), who reported that more than half (58.3%) of nursing mothers in Ethiopia had good nutrition knowledge. Maternal nutrition knowledge has been reported to influence the level of feeding pattern, nutritional status, and healthy lifestyle practices among women in previous studies (Jemide *et al.* 2016; Fadare *et al.* 2019). However, the majority (54%) of the mothers indicated that nutrition knowledge never improved their meal quality. Also, there was no statistical association between maternal nutrition knowledge and dietary quality ($p = 0.09$; $\chi^2 = 13.682$) despite Vaitkeviciute *et al.* (2014) and Jemide *et al.* (2016) reported a positive impact of nutrition knowledge on meal quality. The reason for this could be the influence of other underlying factors on meal quality, such as the high cost of healthy, nutritious foods as compared to the affordability of convenient and ultra-processed foods and, most recently, the negative impact of insurgency and Covid-19 pandemic across the nation (Adelaja *et al.* 2019).

Among the sources of nutrition information available to the mothers, online/social media was the most patronized for information on nutrition issues (36.4%). In a similar study by Quaidoo *et al.* (2018) in Accra, Ghana, most (78.1%) of the participants also employed online/social media as their source of nutrition information. However, in contrast, Tessema *et al.* (2020) reported that 63.6% of mothers in their study acquired nutrition information from health workers. The wide use of online/social media platforms for nutrition information in this study

could be due to the increase in telecommunication technology coverage in many rural communities in Nigeria.

Also, more people are increasingly accessing internet services via several portable digital devices like mobile phones. More so, online sources are relatively cheap and more convenient than consulting with a few available health workers, professional nutritionists, and dietitians in the various healthcare facilities across the State. Although most mothers explored social media for nutrition information, many did not understand what a balanced diet entails, nor did they have basic nutrition knowledge of the six food groups, their health benefits, and deficiency symptoms of lack of essential nutrients. Many do not know how to prepare and lack indigenous knowledge on the sources and the right proportion to consume from each food group for a healthy life. This could be because most of the information on the online platforms need to contain local content or indigenous food system for middle- and low-class citizens. Secondly, most of the information in the media promotes Westernised food above indigenous nutrient-dense diets. Many of these foreign foods are not pocket-friendly, hence not easily and readily accessible to adopt as healthy meals (FAO *et al.* 2020). Similarly, the credibility of social medial sources of nutrition information could be more specific and beneficial, especially when they are not from a professional and scientific standpoint. Although, Quaidoo *et al.* (2018) in a similar study conducted among young adults in Accra, Ghana, reported that the participants ascertained the credibility and reliability of online sources of nutrition information above other sources. In contrast, Lee *et al.* (2018) reported that nutrition information obtained from professionals (clinicians and midwives) is more dependable and reliable. It is imperative to note that adequate nutritional knowledge and appropriate healthy practices play a significant role in determining optimal health outcomes for mothers. Therefore, providing quality nutritional information via an indigenous knowledge system (IKS) to all mothers is a prerequisite for reducing diet-related maternal morbidity and mortality in many developing countries (Jemide *et al.* 2016; Tessema *et al.* 2020). Traditional media such as television, radio, billboards, and poster advertisements were the second most used source of nutrition information, while few (19.6%) of mothers sought nutrition information from either community health workers or community women's gatherings, respectively. Families/relatives and academic forums were the most petite medium of nutrition information among the mothers.

Starchy staples were the most consumed food among the mothers, and these usually consisted of staples like rice and fermented beverages (such as pap and 'Kunu') from millet. Fruits,

vegetables, and dairy products were the least consumed food groups (7.1% and 9.1% respectively). It is similar to the finding of Appiah *et al.* (2021) who reported that the starchy/cereal group was the most consumed food group per day while fruits and vegetables were the least consumed among their participants. The high consumption of starchy staples among the mothers in the current study could be because Niger State is one of Nigeria's primary producers of cereal crops. The low consumption of fruits and vegetables may be due to the lack of or poor knowledge of its benefits, poor availability due to seasonality or lack of financial means to purchase them. Animal proteins (such as offal, beef, and poultry products) and dairy products were also among the least consumed food groups. This complements the findings of Appiah *et al.* (2021). However, animal protein consumption could be low due to costs and financial constraints, while food taboos, cultural beliefs, myths regarding their consumption among nursing mothers could be a factor.

About half (50.7%) of the mothers did not meet up with the minimum dietary diversity for women (MDDS_W) as recommended by the Food and Agriculture Organization (FAO and FHI, 2016). The low proportion of mothers who met their dietary diversity in this study could be attributed to poor financial and empowerment, poor educational status, occupational status and over-dependence on monotonous available starchy staples. Other factors reported by Katenga-Kaunda *et al.* (2022) were the lack of possession of a home garden, small-scale livestock and animal husbandry, food myths based on cultural and religious beliefs, food illiteracy and poor nutrition knowledge of the health benefits of essential food groups.

BMI is an indicator of body size and composition; it helps predict nutritional status. However, the waist-hip ratio was additionally used because it is superior to BMI in predicting cardiovascular disease (CVD) risk (WHO 2011; Cao *et al.* 2018). Waist-hip ratio measures abdominal adiposity and risk of coronary heart disease (CHD). This is because increased visceral adipose tissue is associated with metabolic abnormalities and myocardial infarction (MI), including decreased glucose tolerance, reduced insulin sensitivity and adverse lipid profiles which are risk factors for type 2 diabetes and deaths (Cao *et al.* 2018). The recommended range for women is 0.85 or below; the higher the value, the higher the risk of CHD in women (WHO 2011).

The BMI of the mothers in this study indicated that more than half (57.6%) of the mothers were within the normal range of 18.5kg/m²-24.5kg/m², few (17.6%, 4.7%) of the mothers were obese

or underweight respectively. It contrasts with a study conducted among women of reproductive age in Cameroon by M'bobda *et al.* (2020) where most mothers were either overweight or obese (30.8%, 38.5%), respectively. A study in Lesotho by Rothman *et al.* (2019) also reported a higher proportion of obesity among women.

The mean maternal BMI and waist to hip ratio were 24.52 ± 5.31 kg/m² and 0.82 ± 0.08 , respectively. However, their waist to hip ratio showed that the majority (58.0%) had a value less than 0.8 (Table 5.3) which indicates lower risk of developing coronary heart disease (CHD). The proportion of obesity was higher among rural women (23.9%) than urban women (8.5%). It is similar with the findings of Trivedi *et al.* (2015) who reported high level of obesity among rural women than urban women; however, this finding contrasts with the findings of Rothman *et al.* (2019) where obesity was higher among urban women than the rural women. The high Proportion of obesity among rural women could be attributed to their occupational status and sedentary lifestyles, as most were petty traders who sold their goods within their residential area.

5.17 Limitation of the Study

The study did not assess the sufficiency of each nutrient consumed by the mothers compared with the recommended nutrient intake (RNI). Therefore, the prevalence of micronutrient deficiency among mothers could not be investigated.

5.18 Conclusions and Recommendations

This study explored the impact of maternal nutrition knowledge on the health vulnerability of mothers of preschool children in Niger state, North Central, Nigeria and thus contributes to scanty literature in this area. Findings from the study revealed that about half of the mothers had poor nutrition education. Among the few mothers with good nutrition knowledge, there was no significant impact on their meal quality, because of several underlying factors like poverty, cultural preference, and poor accessibility (security threats) to healthy foods across the nation. The poor literacy level and nutrition knowledge among the mothers, could also be attributed to high level of informal education in the study area. The socioeconomic status of the mothers played a significant role in their nutrition knowledge. Although social media was the most explored source of nutrition information by the mothers, there was no correlation between nutrition knowledge and the meal quality of the mothers. The dietary diversity of the mothers

varied across their residential settings. Mothers from rural communities appeared to be more diverse in their dietary intake compared to mothers from urban centres; however, the quantity consumed was below the recommended minimum dietary diversity score for most mothers. Although, the variation in consumption patterns could be due to the cheaper cost of living in rural environments and proximity to produce (local/armers) markets than in urban settlements. The anthropometric indicators showed that most mothers were within the normal BMI range, while the waist-hip ratio showed a lower risk of CHDs among the mothers. However, the risk of micronutrient deficiency could not be ascertained in the study.

This study implies that efforts towards optimizing maternal dietary quality and health outcomes in Africa and other low-and middle-income countries like Nigeria must address wholistically the underlying and intermediate determinants of maternal nutrition as spelt out by the 2020 UNICEF conceptual framework of maternal and child nutrition if the Sustainable development goals 2030 and Africa agenda 2063 is to be realized.

Further studies should therefore investigate and quantify each nutrient component of meals that mothers of preschool children consume in Niger state vis-a-vis the recommended daily intake (RDI) and determine the risk of hidden hunger and its associated complications among the mothers.

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CHAPTER 6: FOOD INSECURITY AND VULNERABILITY OF FOOD ENVIRONMENT AMONG NIGERIAN MOTHERS IN THE POST-PANDEMIC ERA

This chapter has been prepared by Bosede A. Omachi*, Annette Van Onselen, & Unathi Kolanisi to be submitted for publication with the title: Food Insecurity and Vulnerability of Food Environment among Nigerian Mothers in the Post-Pandemic Era - A Review. The manuscript is presented in the following pages.

6.1 Abstract

Food acquisition and utilisation are essential for mothers' food and nutrition security. Consumption of nutrient-poor meals and poor eating habits create a high risk of the triple burden of malnutrition (TBM), disability-adjusted life years, and mortality among mothers in Nigeria. The impact of climate change, conflicts, and the COVID-19 pandemic is predicted to aggravate these challenges across Nigeria and other developing countries. The interconnectedness of the food environment with food acquisition and utilisation in addressing food insecurity and malnutrition as an innovative concept is yet to be well understood and conceptualised in Nigeria. Therefore, this study explored the literature using a qualitative approach and an overview of online sources, peer-reviewed articles, books, and other publications to investigate the concept of the food environment, food acquisition, and utilisation among Nigerian mothers, and to explore the interconnectedness and complexities of the phenomenon as it relates to maternal health outcomes in resource-limited societies. The current study found that factors that affected mothers' food acquisition and nutrient utilisation were inflation, trade policies, poor food systems, food waste, poor nutrition-sensitive agriculture intervention, compromised dietary quality, wealth disparity, poverty, insurgency, economic downturn, nutrition transitioning, urbanisation, and COVID-19 restrictions. More Nigerians, especially women, have experienced food insecurity, severe hunger, and poor health outcomes due to poverty and poor dietary intake, thus developing unhealthy coping strategies. To mitigate the consequences of a poor food environment on the food and nutrition security and health outcomes of women, it is recommended that policies and interventions should be geared towards improving the affordability, accessibility, and utilisation of healthy foods among mothers in food-insecure communities in Nigeria.

Keywords: Food, Insecurity, Environment, Mothers, Nigeria.

6.2 Introduction

Hunger, food shortages, and nutritional insecurity have continued to be a global public health concern affecting over three billion people globally (FAO *et al.* 2020). The highest burden is in sub-Saharan Africa and Asia. Mothers are often the most vulnerable because of the gross impact on their health and that of their households; hence, the nutritional status of mothers contributes significantly to any country's food and nutrition security status (Clover 2003; FAO, ECA, *et al.* 2021). In 2016, approximately 650 million adults were obese globally (Bhatti *et al.* 2022; GBD 2015 & Obesity Collaborators 2017), and by 2030, more than 2 billion adults will be overweight (Ataey *et al.* 2020; Lin & Li 2021). Recently, there has been a surge in the prevalence of overweight and obesity in developing countries, especially in sub-Saharan Africa, and it is higher among women in urban centres than among men (Amugsi *et al.* 2017; Global Nutrition Report 2020). The World Health Organization (WHO) estimates that more than 2 billion people suffer from various micronutrient insufficiencies worldwide, accounting for approximately 7% of the global disease burden (Demaio & Branca 2017; Fisher *et al.* 2019).

The TBM refers to the coexistence of undernourishment, over nourishment, and hidden hunger within the same household. It has continued to increase globally and in sub-Saharan Africa (West *et al.* 2020; FAO, IFAD 2021). One of every five deaths is attributed to TBM and other eating habit-related non-communicable diseases such as obesity, hypertension, cancer, diabetes, stroke, and arteriosclerosis. Aside from food insecurity, over 255 million people worldwide are affected annually (Bhurosy & Jeewon 2014; GBD 2015 & Obesity Collaborators 2017; West *et al.* 2020). The concept of food and nutrition insecurity in recent times has transcended the mere lack of physical and economic access to food and is now linked to food consumption inadequacy and nutrient insufficiency. The adequacy and sufficiency of nutrient intake among mothers, especially those with a low wealth index, depend primarily on their food environment (Widener *et al.* 2011; Herforth & Ahmed 2015; FAO 2016b; Parker *et al.* 2018; Bai *et al.* 2021).

Recently, concerns have been raised about the pattern of food consumption among mothers in relation to unhealthy eating habits that have resulted in high-calorie meals (the full but empty plate concept). The nexus between food environment, food acquisition, dietary patterns, and health outcomes among Nigerian mothers is yet to be explored, especially among the less privileged. Therefore, this study investigated the impact of the food environment on food

acquisition and nutrient utilisation vis-à-vis health outcomes among Nigerian mothers (Widener *et al.* 2011; Dubowitz *et al.* 2012; Black *et al.* 2014; Trapp *et al.* 2015; FAO 2016b; Díez *et al.* 2017; Adams *et al.* 2020).

6.3 Factors Influencing Food Environment among Nigerian Mothers

Food security exists when all people have physical, social, and economic access to sufficient, safe, and nutritious food that meet their dietary needs and food preferences for an active and healthy life (Ivers & Cullen 2011). This is crucial to achieving a healthy food environment and is closely related to human health, nutrition, sustainable food systems, and economic growth. Food security includes the physical availability of food, economic and physical access to food, sustainability, adequate consumption, and utilisation for healthy living (FAO, 2017, 2018, 2019; Oderinde *et al.* 2022). It is paramount to note that food insecurity is associated with poverty and low incomes. Food insecurity has grave implications for the health and nutrition of women because of their contribution to food production, preparation, and their role in society as child bearers and caregivers (Ivers & Cullen 2011; Dubowitz *et al.* 2012; Asabe & Kumar 2014; EWEC 2015).

The increasing number of female-headed households globally and their disproportionately poor economic status make it essential to consider the impact of food insecurity, poor food environment, and compromised food habits on women's health and overall outcomes (Ivers & Cullen 2011; Dubowitz *et al.* 2012; Ibnouf 2012; Ware *et al.* 2021). A proper understanding of the food environment concept, as it relates to food choices, acquisition, planning, processing, preparation, preservation, handling, accessibility, affordability, intake, and utilisation, is paramount to addressing the complexities of food insecurity, malnutrition, and disease burden among mothers in developing countries such as Nigeria. Therefore, it is expedient to consider the various categories of the food environment and their contribution to various health outcomes in women of childbearing age (Franco *et al.* 2015; Herforth & Ahmed 2015). According to Swinburn *et al.* (2013) the food environment is the collective physical, economic, policy, and socio-cultural environment, opportunities, and conditions that influence people's food, beverage choices, and nutritional status (Parker *et al.* 2018). The Global Panel on Agriculture and Food Systems for Nutrition (2016b). and Food Agricultural Organization (FAO) (FAO 2016b) also described the food environment as food available to people in their

surroundings as they go about their everyday lives and the nutritional quality, safety, price, convenience, labelling, and promotion of these foods (Sawyer *et al.* 2021; Acciai *et al.* 2022).

The food environment is categorised into community (market-driven) and local (non-market-driven) (Caspi *et al.* 2012; Franco *et al.* 2015; Menezes *et al.* 2017; Turner *et al.* 2018, 2020). The community food environment, also known as the local neighbourhood, entails the type and location of food outlets (stores, restaurants, supermarkets, and grocery stores), accessibility, and proximity to consumers (Caspi *et al.* 2012; Menezes *et al.* 2017; Parker *et al.* 2018). Government policies, industrial policies, media and advertising agencies, and environmental factors such as climate change, seasonality, and geographical location influence a community's food environment. Other factors include conflict, insecurity, nutrition transitions, and urbanisation. These are market-driven because availability depends mainly on demand (Duran *et al.* 2015; Turner *et al.* 2018, 2020). Consumer or local (in-store) food environments consider the availability of healthy foods, affordability regarding price, nutrition literacy, culture, individual food preference, palatability, food labelling and information, advertisement, seasonality, economic shock, socioeconomic status, conflicts, and insecurity (Caspi *et al.* 2012; Abizari *et al.* 2017; Menezes *et al.* 2017; Baye *et al.* 2021). In most cases, the local food environment is non-market driven (Duran *et al.* 2015).

Globally, the food environment and its determinants influence human eating habits and health outcomes among food-insecure populations, especially mothers (Sawyer *et al.* 2021; Acciai *et al.* 2022). However, these determinants are categorised into two broad groups: external or personal factors that vary significantly from country to country, most notably among individuals living in urban slums and food-insecure households (Paul *et al.* 2019; Pradeilles *et al.* 2021; Downs *et al.* 2022; Iyassu *et al.* 2023).

External factors influencing the food environment are available opportunities and constraints to accessing healthy food, such as prices, seasonality, vendor (retail outlets), product properties, marketing, and government regulation and policies (Menezes *et al.* 2017; Turner *et al.* 2018). These external factors significantly impair mothers' consumption patterns and health outcomes because of the mall effect on food preferences, packaging, advertising, palatability, and convenience (Mielmann 2019). Personal factors refer to food accessibility (proximity to the market, fresh produce stores for perishable food such as fruits and vegetables), social class and income status, affordability (price), convenience (time and energy saving), and desirability of

food sources and products. Culture, palatability, and food preference often influence personal factors (Herforth & Ahmed, 2015; Turner *et al.* 2018, 2020; Steiner & Kralovec, 2020). The interconnectedness of these factors are summarised in Figure 6.1.

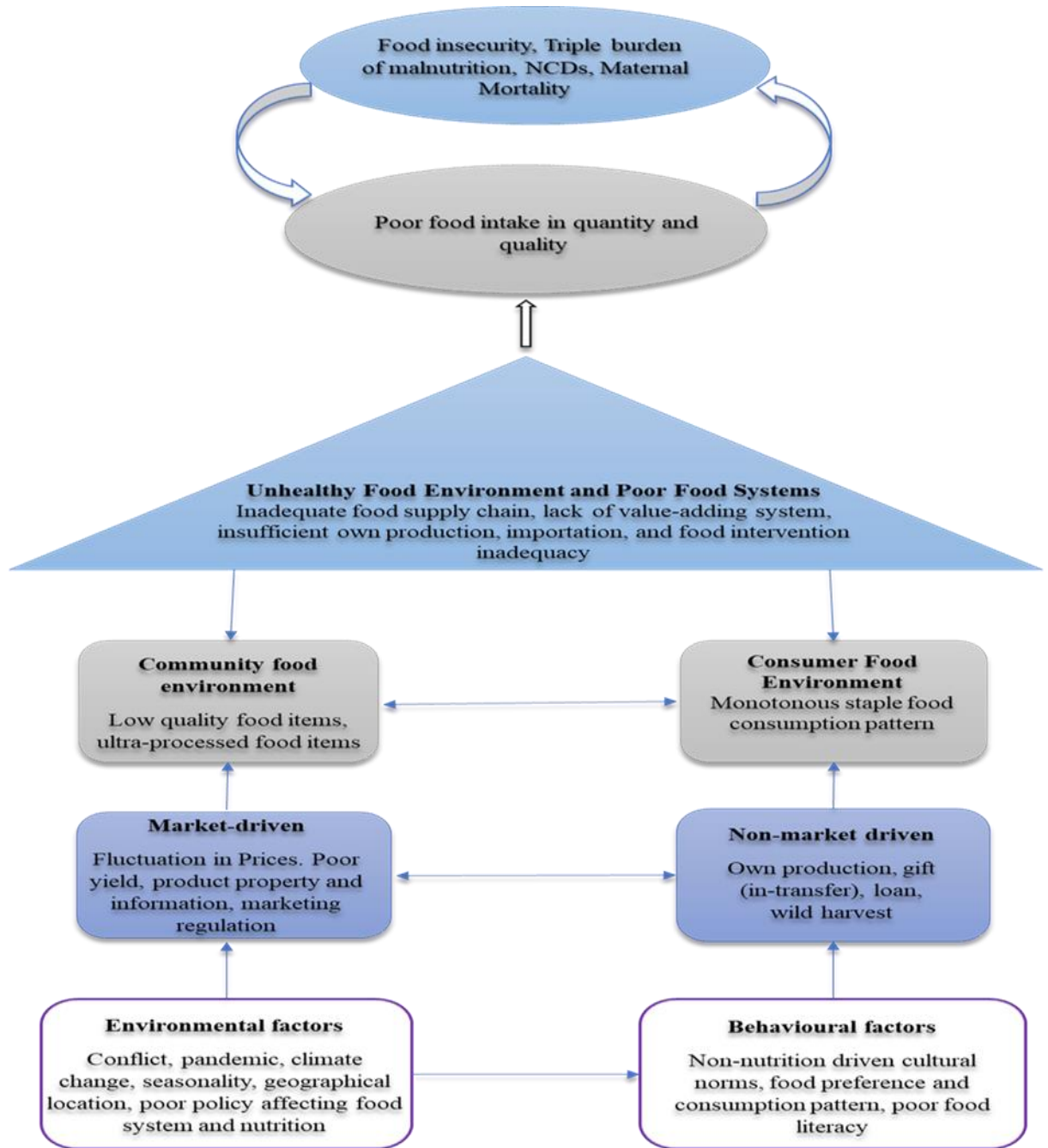


Figure 6.1: The conceptual framework of the food environment and health outcomes
 Source: Modified and adapted from Parker *et al.* (2018)

The above figure shows how environmental and behavioural factors form the underlying determinants of the food system and environment and how they ultimately influence mothers' food intake and health outcomes.

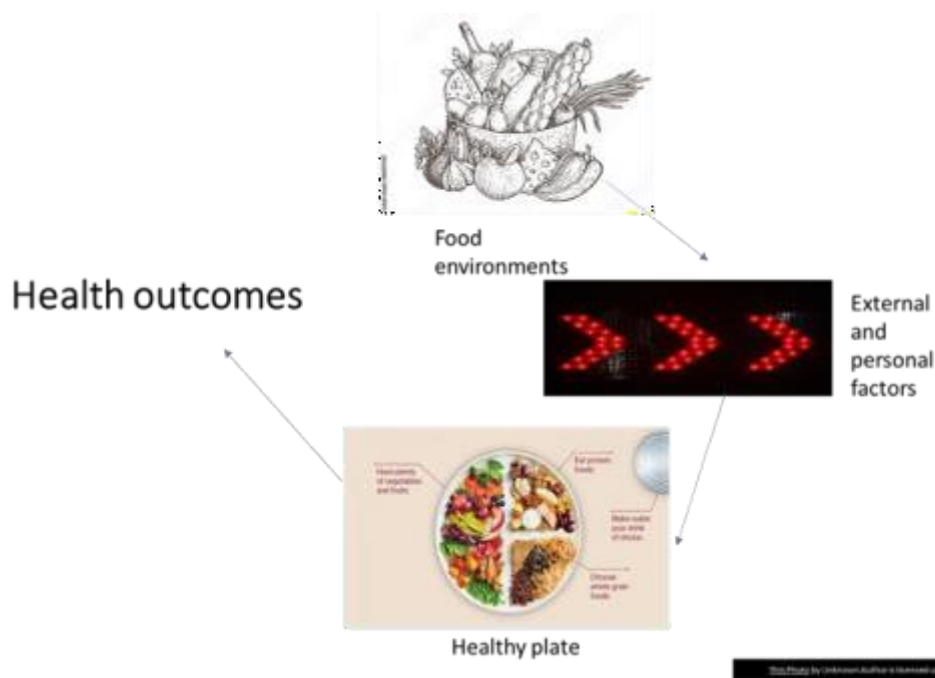
Food choices among food-insecure mothers in Nigeria and many other low- and middle-income countries depend primarily on their wealth index, purchasing power, proximity to the produce market, cost, availability, cultural food preference of household head, and the number of dependence ratios in the family (Clover 2003; FAO, 2020; FAO, ECA, 2021).

6.4 Drivers of Food Environment, Food Acquisition and Utilisation among Nigerian Mothers

There are structural drivers of food acquisition, consumption, and nutritional status among households, especially among mothers in Nigeria. The availability, affordability, convenience, and desirability of various foods are major components of the food environment that affect food intake and the health status of mothers (Sawyer *et al.* 2021; Acciai *et al.* 2022). These components ultimately describe the food environment as the interface where mothers interact with the available food systems to acquire and consume food (Gravina *et al.* 2020). Food is usually acquired from four primary sources: the market, own production, wild harvest, and transfer (gift) (Widener *et al.* 2011; Turner *et al.* 2018). In a healthy food environment, foods, beverages, and meals that contribute to an individual's diet and meet the recommended national dietary guidelines are widely available, affordable, and promoted for easy access by the vulnerable in rural and urban settings (Swinburn *et al.* 2013)

In rural settings, where more Nigerians reside, the local food environment plays a significant role in food acquisition, consumption, nutrient utilisation, and nutritional status of mothers and their households (Caspi *et al.* 2012; Turner *et al.* 2020; Chang *et al.* 2022; Atanasova *et al.* 2022). In this setting, most household food systems are non-market driven and influenced by culture and identity (Reddy & Anitha, 2015; Gravina *et al.* 2020; Reddy & van Dam, 2020). Food items are obtained from their own production, wild harvest, or transfer of a similar or different crop from a fellow farmer; hence, the desirability of safe, healthy, and nutritious food outside the locality is relatively low, especially if they are not readily accessible and affordable (Herforth & Ahmed 2015; HLPE 2020; Abubakar *et al.* 2022; Downs *et al.* 2022).

In recent times, the challenge of nutrition insecurity among mothers in Nigeria is the inability to transform the existing food environment into healthy eating habits “from farm to plate” to



optimise their health outcomes in an era of economic shock and post- COVID 19 pandemic (Sawyer *et al.* 2021; Acciai *et al.* 2022) as illustrated in Figure 6.2. Hence, there is a high prevalence of maternal malnutrition, eating-habit-related chronic diseases, and mortality. However, this varies across the six geopolitical zones in the nation, with mothers from the northeastern region most affected by high poverty, poor educational level, poor eating habits, poor health-seeking behaviour, and an inability to make informed choices on health-related issues (Muhammad & Sidique 2019; Abubakar *et al.* 2022).

Figure 6.2: Challenge of navigating food environments to produce a healthy plate for positive health outcomes among mothers

Figure 6.2 illustrates how external and internal factors in the food environment determine food choices and acquisition and how personal choices determine nutrient quality to optimise health outcomes among women and their households. Some of the factors mitigating the transformation of the food environment among rural mothers in Nigeria regarding healthy meals include lack of food literacy (the knowledge, skills, and attitudes that enable mothers to make informed decisions about their food choices and to understand the broader food system), high dependency ratio, poor income, cultural beliefs, religious bigotry, food taboos, conflicts and insecurity, seasonality of common fruits and vegetables, constant hike in food price, lack of portion control, and poor eating habits diversity across geopolitical zones (east, west, south,

and north) (Adelaja & George 2019; Obayelu & Osho 2020; Steiner & Kralovec 2020; Chigozirim *et al.* 2021; Mekonnen *et al.* 2021; Obayelu & Akpan 2021).

The determinants of health outcomes among mothers relates to the inability to appropriately navigate the community, and consumers' food environment in Nigeria which includes poverty, poor food systems, poor food chain supply, inadequate nutrition-sensitive agricultural practices, cattle rustling, insurgency, and COVID-19 fallout in its various forms (Adelaja & George 2019; FAO, USAID *et al.* 2021; Emejo 2022; Mukaila *et al.* 2022). These factors contribute immensely to food shortages at the community and household levels because they cripple food production and interstate transportation, leading to poor food choices and poor access to quality healthcare (Rother *et al.* 2016; FAO 2017; Owoo 2018; FAO *et al.* 2020a, 2020b; FAO & WFP 2020).

The overall impact of a poor food environment on food acquisition and utilisation of mothers in Nigeria is evident in the increased prevalence of overweight or obesity, micronutrient deficiency diseases, and deaths. For instance, the prevalence of overweight and obesity is higher among mothers from the southern region of Nigeria, especially in the eastern and south-south states, because of the mall effect (proximity to supermarkets), leading to the consumption of Westernised diets (refined food products) and access to social amenities for convenient lifestyles (Kandala & Stranges 2014; Adeloje *et al.* 2021; Chang *et al.* 2022).

On the other hand, mothers from the northern region experience more undernourishment and hidden hunger due to overdependence on starchy staples that are caloric-dense and nutrient-poor (Longhurst *et al.* 2013; Benson *et al.* 2017; Amare *et al.* 2018; Meh *et al.* 2019; Owoo 2020; Ezeh *et al.* 2021). Improving the food environment of mothers can be achieved by addressing the intrinsic factors that influence and mitigate good food acquisition and nutrient utilisation among mothers in Nigeria. This will significantly reduce the TBM and other eating habits related to non-communicable diseases and food and nutrition insecurity, which is ravaging the health of women from low- and middle-income households across Nigeria.

6.5 Food Insecurity, Poor Food Environment and Maternal Coping Skills amidst Economic Shock

Food insecurity is usually associated with low incomes; it denotes a lack of regular access to sufficient food and the consumption of poor nutrients, which may contribute to the

development of non-communicable diseases such as obesity, heart disease, hypertension, and diabetes (FAO, IFAD *et al.* 2021). The disparity in wealth distribution is prominent among poor- and middle-income households across Nigeria, which consequently favours the acquisition of inexpensive, nutrient-poor fast-food high in fat, added sugar and/or salt, and sugar-sweetened beverages (FAO 2018; Kupka *et al.* 2020; Kennedy *et al.* 2021). For women, children, and adolescents from resource-poor settings, this situation predisposes them to increased reliance on nutrient-poor foods (full but empty plates) and poorer eating habits (Monteiro *et al.* 2013; Willett *et al.* 2019; Kupka *et al.* 2020). Consequently, this has contributed to the rising incidence of nutritional transition and the TBM across the nation and sub-Saharan African countries (Global Nutrition Report 2020)

Nigeria's food insecurity status is alarming (Adelaja & George 2019; Oderinde *et al.* 2022). The country's emerging rates of food insecurity, diet quality decline, micronutrient deficiencies, and other forms of malnutrition are attributed to dynamic changes in agricultural activity and poor food environment (Willett *et al.* 2019; FAO *et al.* 2020; Global Nutrition Report 2020). Therefore, ensuring food and nutrition security is important not only at the national level, but also at the household and individual levels. However, food and nutrition security at the individual or family level can be determined by food production or purchases that require sufficient and adequate intake for optimal health (Samuel *et al.* 2020).

Household food insecurity (HFI) is a useful proxy for understanding public health nutrition situations at national and community levels. Therefore, it is crucial to meet international nutrition targets and is a suitable index for monitoring and achieving Sustainable Development Goals (SDG) 2 and 3. It is imperative to note that economic growth is the core of the fight against hunger and poverty, especially among nations experiencing erratic population growth, like Nigeria (FAO 2015; McGuire 2015; Samuel *et al.* 2020). However, developing survival mechanisms or coping strategies, especially among mothers from LMICs, helps to tackle HFI and economic shock. Coping strategies are all actions adopted by individuals and households to limit their expenses or gain extra income to pay for necessities and not be relegated too far behind society's level of welfare (Snel & Staring 2001; Samuel *et al.* 2020). Understanding household-level coping strategies is vital for discerning adaptive strategies among food-insecure members in resource-poor and informal settings (Dil Farzana *et al.* 2017). Coping strategies adopted by poor income-earning households to reduce food expenses in most regions across Nigeria include skipping meals, reducing meal quantity, reducing the number of meals

per day, snacking, consumption of monotonous starchy staples, reduction in portion size at mealtime, restricting consumption in favour of young children, getting food on loan, or from wild harvests of fruits and vegetables (Snel & Staring 2001; Aurino & Morrow 2018).

6.6 Factors that Influence Food Systems in Nigeria

6.6.1 Market Dynamics and Food Affordability

In Nigeria, there is an increasing dependence on market purchases for procuring food because of reduced agricultural practices (deagrarianisation); hence, most household livelihoods are increasingly delinked from agriculture (from farm to plate) due to migration to urban centers for high-paying jobs, incessant communal clashes between herdsman and farmers, and Boko haram attacks in farming communities, leading to the destruction of lives and farm produce (Adelaja & George 2019). This, in turn, alters the market dynamics, affects the cost of healthy foods, increases the poverty level and food insecurity, and eventually compromises food availability and consumption patterns not only in the affected areas but across the nation. Consequently, these factors increase the prevalence of food-related noncommunicable diseases, malnutrition, and mortality among women (Nackers & Appelhans 2013; Bai *et al.* 2021; Chigozirim *et al.* 2021).

6.6.2 Consumer Choices for Safe, Nutritious and Healthy Foods

Nutrition transition is a significant driver of food choices among most Nigerian women, because it is a function of convenience and affordability, as they are of preference and marketing. Pereira (2014) reported an increased consumption of “fast food” which is convenience food obtained from take-away street vendors. These foods are usually characterised as energy-dense and low in micronutrients and fibre but high in added sugars and salt, highlighting the concept of full but empty plates (Kirk *et al.* 2019; Willett *et al.* 2019). Such foods include pastries, bread, fried chips, roasted corn, carbonated (fizzy) drinks, and fermented local cereal-based beverages (kunu). This lifestyle is cheaper, resulting in less consumption of homemade nutritious meals and leading to acute or severe cases of malnutrition (Igumbor *et al.* 2012; Monteiro *et al.* 2013; Pereira 2014; Duran *et al.* 2015; Samuel *et al.* 2020).

The nutrition transition has involved the industrial food system replacing indigenous or traditional yet nutritious foods with highly refined food which is usually low in fibre and high

in fats (including trans fatty acids), refined sugar, and salt, making many women prone to obesity, hypertension, constipation, stroke, arteriosclerosis, cancer, and many other digestive and degenerative disorders that have continued to increase in recent times across Africa and other LMICs (Swinburn *et al.* 2013; Pipe 2018; Demétrio *et al.* 2020; Bjelland *et al.* 2021). Marketing and advertising have a huge impact on women's food choices. It is evident in recent times that individuals in rural and urban settings buy more and grow less food, especially cruciferous herbs and vegetables. Hence, it is critical to understand how business practices influence consumer food preferences, and therefore, the food and nutrition security of women and their households (Global Nutrition Report 2020; Samuel *et al.* 2020).

6.6.3 Business Practices Influence and Consumer Food Preferences

The effects of rapid migration to city centres, globalisation of the food trade, and the subsequent concentration of agribusiness in urban areas have radically altered the Nigerian food system which is the case with every other developing country suffering food and nutrition insecurity (FAO 2018; Kupka *et al.* 2020; Kennedy *et al.* 2021). The major proportion of food consumed by Nigerians comes from rural communities and subsistence farming, which are intercepted by middlemen who play an intermediary role in the distribution or transaction chain by purchasing farm produce at cheaper rates (wholesale prices) and then inflating the prices before it gets to the consumers. The intermediary involvement of middlemen negatively impacts the purchasing power of healthy foods and drastically affects the consumption pattern and adequacy of diversified nutritious healthy meals among poor households (Menezes *et al.* 2017; Abay *et al.* 2021). Hence, there is a need for a regulatory body that controls the prices and retail of food and farm produce.

6.6.4 Urbanisation

Studies have shown that more than half of the world's population (54%) lives in urban areas; however, the trends and rates of urbanisation vary widely according to regional and national income levels (United Nations, 2019). Like several African countries, many Nigerians migrate to cities with minimal agricultural activities; thus, there is a high dependence on food purchases. Ironically, rural dwellers rely more on purchasing food (Westernised products) from neighbouring cities due to nutrition transitioning, neglecting home-grown, indigenous underutilised nutrient-rich crops (Cobb *et al.* 2015; Trivedi *et al.* 2015; Abayomi & Cleopatra 2021). There is an urgent need to find a way to deal with the consequences of rapid urbanisation

that has distanced people from accessing nutrient-rich foods, fresh fruits, and vegetables, while simultaneously providing relatively cheap and easy access to highly processed foods (Monteiro *et al.* 2013; Ruel *et al.* 2017; Samuel *et al.* 2020).

6.6.5 Water Depletion and Climate Change

Water is a valuable resource for improving agricultural activities and food systems (Ringler *et al.* 2022). However, its scarcity has been a challenge in recent times. Water scarcity exacerbates the direct and long-term effects of desertification on land, soil quality, soil structure, organic matter, soil moisture, and agricultural productivity (FAO 2016a; Mabhaudhi *et al.* 2016; Ofori *et al.* 2021). This is a major concern for the sustainable future of humanity and the conservation of important ecosystem functions. Recently, agricultural regions worldwide have been subjected to extensive and increasing water shortages. Adverse climatic conditions, such as droughts, have affected agricultural production while diminishing surface and groundwater reserves, especially in Chile, the United States, and many African countries such as Nigeria (Ringler *et al.* 2010; Swinburn *et al.* 2019; Ofori *et al.* 2021). These and other extreme weather events, such as floods or tropical storms, have been predicted to deplete water availability in most farming regions owing to the adverse effects of climate change.

Climate change, as defined by the Intergovernmental Panel on Climate Change (IPCC), is a change in the state of the weather that can be identified (e.g., using statistical tests) by changes in the mean and/or variability of its properties and persists for an extended period, typically decades or longer (Intergovernmental Panel on Climate Change [IPCC] 2014). These changes include rise in atmospheric and ocean temperatures, sea level, increase and decrease in precipitation, changes in the natural habitats of terrestrial and marine ecosystems, ocean acidification, and decrease in snow and ice extent (FAO 2016a; Oderinde *et al.* 2022). These changes can be attributed to natural variability or human activity (Ofori *et al.* 2021). Climate change threatens agricultural production due to higher and more inconsistent temperatures, as well as variations in rainfall patterns and extreme events such as droughts and floods occurring more often, affecting food production and supply chains (Adebayo & Ojo 2012; Ogbo *et al.* 2013).

Water shortages often have a strong impact on agricultural and food systems. Highly water-dependent sectors are worst affected such as the productivity of irrigated crops and livestock activities, further impacting the market value of agricultural produce, trade, food, and nutrition

security of individuals and the nation (Branca *et al.* 2019). Climate change can also affect food quality as extreme weather events such as droughts, extreme temperatures, and floods contamination of water, soil, and agricultural land with hazardous substances during crop production. Thus, climate change can restrict access to healthy foods (Steiner & Kralovec 2020). The impact of climate change is more severe among low-income households in developing countries. This effect is increasing and may adversely affect global health in the future, especially in LMICs (Wossen *et al.* 2018; Oderinde *et al.* 2022).

The implications of climate change on nutrition security and human health are undernutrition, inadequate and unsafe water supply, poor crop yield, poor dietary quality, burning low-quality fossil fuels for household energy consumption, increased disability-adjusted life years (DALYs), and low life expectancy among women (St. Louis & Hess 2008; Ogbo *et al.* 2013; Springmann *et al.* 2016). Others are increasing food insecurity among disadvantaged populations in informal settings due to crop failures, reduced food production, extreme weather that produces droughts and flooding, increased foodborne and other infectious diseases, and civil unrest (Adebayo & Ojo 2012; Ogbo *et al.* 2013).

Climate change, declining water precipitation, warmer temperatures, and higher CO₂ emissions negatively impact crop yield, nutrient profiles, and sustainable food and nutrition security (Ogbo *et al.* 2013; Wossen *et al.* 2018; Oderinde *et al.* 2022). The economic effects of climate change include the costs of environmental disasters (e.g., drought and wildfires), biosecurity, sea level rise, hunger, and infections. Climate change is predicted to cost 5-10% of global GDP.

6.6.6 Inadequate Nutrition-Sensitive Agricultural Practices

Agriculture is the major source of food, employment, and income among the larger population in Nigeria, especially the poor who are directly or indirectly involved in agricultural activities, although at a subsistence level (Swinburn *et al.* 2019). Nutrition-sensitive agriculture ensures year-round availability and accessibility of a variety of diverse foods and prevents nutrient losses; thus, when consumed, these foods improve nutrient intake through dietary diversification, improve levels of nutrition, and prevent macro- and micronutrient deficiencies (Ruel *et al.* 2018). Nutrition-sensitive agriculture is an approach that seeks to maximise the contribution of agriculture to nutrition. It can improve food availability and access, enhancing household food security, dietary quality, income, and women's empowerment both nationally and globally (Balz *et al.* 2015; Ruel *et al.* 2018). Nigeria recently inaugurated a nutrition-

sensitive agricultural initiative programme to increase crop production, promote nutrient-dense biofortified crops, improve nutrition, and address opportunities and potential constraints for achieving food and nutrition security among its citizens (IFAD 2015).

Food-based approaches to nutrition security can be achieved through nutrition-specific interventions which address the immediate causes of neonatal and child malnutrition and developmental issues such as inadequate food and nutrient intake, poor feeding, caregiving and parenting practices, and burden of infectious diseases. Another approach to nutrition security is through nutrition-sensitive programmes that address the underlying factors of foetal and under-five children's nutrition and development, such as food security, adequate caregiving resources, access to quality health services, and a safe and hygienic environment (Keding *et al.* 2013; Maluf *et al.* 2015; Singh & Fernandes 2018). At the household level, dietary diversification, adequate intake, and improved nutrition via nutrition-sensitive agriculture can be achieved among women and other vulnerable groups by promoting the production of nutrient-dense crops through home-grown farming, a common practice in most rural and semi-urban communities nationwide (IFAD 2015, 2019). This practice will ultimately improve the consumption of more nutritious non-staple crops and indigenous prioritized crops such as legumes and dark, green leafy vegetables, and thus ameliorate micronutrient deficiencies that are of public health importance, such as vitamin A and iron (IFAD 2019).

6.6.7 Food Waste and Nutrient Loss

Nutrient loss is the decline in the quantity or quality of food nutrients because of the decisions and actions of suppliers along the food distribution value chain, and food waste is the decrease in the quantity or quality of food resulting from decisions and actions by retailers, food service establishments, and consumers (FAO 2019; Gorzeń-Mitka *et al.* 2020). The Food and Agriculture Organization (FAO) estimates state that about 1.3 billion tons of food that are edible for human consumption is lost annually, and between 40% and 60% of this food waste is from consumers, while up to 10% of food is wasted by food retailers (supply chain); hence, only half of the food produced is consumed (Gorzeń-Mitka *et al.* 2020). Food waste is a public health issue, mainly because over 12.9% of the population is undernourished and 9.1 million people die annually from hunger worldwide; a higher proportion of these people are found in Africa and Asia (FAO 2019).

Several factors contribute to food waste and nutrient loss in Nigeria, such as suboptimal foods, misinformation amongst consumers surrounding food labels and nutrient composition, poor food handling and storage practices, inadequate appropriate storage facilities, poor road networks, erratic electricity, and poorly designed packaging materials, which accumulate to about 3-10% of the total product lost to waste, thereby increasing the number of food insecure and hungry people, especially women and children from both rural and urban centres, and poor income households across the nation (FAO 2019; Flanagan & Priyadarshini 2021).

Similarly, inefficient handling and preservation of raw materials and food products renders most food inedible for human consumption and thus results in a gross waste of manpower, resources, and economic cost valued at approximately USD \$936 billion (Gorzeń-Mitka *et al.* 2020; Flanagan & Priyadarshini 2021). Therefore, reducing food waste along the food value chain (from production, retail, food service, and household level) can benefit both aquatic and terrestrial lives and the planet at large by providing sustainable food systems, a healthy food environment, and a healthier planet for healthier living (FAO 2019).

6.6.8 Naira Devaluation and Trade Policies

Over the years, the Nigerian economy has been monoculture and oil driven. With oil funding 95% of foreign earnings, 80% of GDP, and more than 90% of total export valued at \$47.8 billion and import at \$39.5 billion, thus making Nigeria the 49th largest exporter and 53rd most significant importer of petroleum products globally (Abubakar *et al.* 2022; World Bank Group 2022). Despite this position, the country is not immune from the global economic downturn and is thus affected by exchange rate volatility, which necessitates naira devaluation as a way out of financial and economic distress (Anagun & Michael 2021; Samuel *et al.* 2018; World Bank Group 2019). After the global COVID-19 pandemic, Nigeria was forced to reduce its oil price by half thus increasing pressure on the currencies and inflation rate (20.8%), increasing wealth disparity, and raising prices of food and other essentials of life (PIND & MADE 2017; Eko Ewa *et al.* 2018; Central Bank of Nigeria 2022; Oyekanmi 2022).

Devaluation also led to a significant increase in the costs of principal agricultural inputs, which influence costs across the value chains, such as the cost of energy, fertilisers, hybrid crops, and drought-resistant varieties. This has put more constraints on actors in the agricultural sector, thus making food products more expensive and less accessible to the common person on the

street with limited income, especially for women who bear the brunt of this hardship (Onwuka *et al.* 2019; Anagun & Michael 2021; Onwuka 2022).

Trade policies such as border closures influence the prices of food commodities differently, producing distinct effects on purchasing power among women and their households (World Bank Group 2022). For example, the border closure in 2019 grossly affected the price of imported rice, thereby exposing women to the risk of poverty owing to a reduction in purchasing power. It is noteworthy that international and domestic markets are interlinked; hence, domestic markets are not insulated from the knock-on effects of trade policies (World Bank Group 2022).

6.7 Health and Economic Cost of Food Insecurity and Unhealthy Food Environment among Women

Food insecurity (FI), hunger and compromised household food baskets are on the rise in many African countries where economic growth has declined, especially among the low- and middle-income countries, which rely heavily on international trade for primary commodities. The outcome is evident in women's nutritional and health status manifesting as mental, social, and physical disorders or instabilities, chronic diseases and eventually death (Tacoli, 2017; Arena *et al.* 2017; Hu *et al.* 2020; Popkin *et al.* 2020; Sawyer *et al.* 2021). Maternal undernutrition has been attributed to increased maternal mortality, and FI and poor dietary intake increase the risk of various forms of malnutrition (hidden hunger, protein-calorie malnutrition, obesity and overweight (Akerele *et al.* 2017; Alamu *et al.* 2020). Undernutrition and over nutrition are risk factors for non-communicable diseases (NCDs) among women. These poor health conditions increase healthcare cost, which has been projected to hit USD 1.3 trillion by 2030 if not tackled early. This cost includes the cost of treatment of different food-related diseases, loss in labour productivity and informal care for sick women (Idris *et al.* 2020; FAO *et al.* 2020, 2023). The cumulative effect of hunger and food insecurity among mothers is the triple burden of malnutrition (TBM), which is a significant contributor to the global disease burden and more than one-third of maternal mortality worldwide (UNICEF 2013; Adewusi & Nwokocha 2018; Abate *et al.* 2019; Meh *et al.* 2019).

Diet-related non-communicable diseases also increase among women due to globalization, urbanization, lifestyle transition, socio-cultural factors, poor maternal nutrition, and foetal outcomes (Kimani-Murage *et al.* 2014, 2015; Keates *et al.* 2017; Ruel *et al.* 2017; Branca *et*

al. 2019; Hu *et al.* 2020; Osendarp *et al.* 2021; Pradeilles *et al.* 2021). The National Demographic Health Survey (NDHS) 2018 reported that 6.9% and 3.8% of Nigerian mothers were acutely and severely malnourished, respectively (NPC & ICF 2019). In 2020, about 21 million and 12 million mothers were overweight and obese, accounting for an age-adjusted prevalence of 20.3% (overweight) and 11.6% (obese) respectively. Also, the prevalence of overweight and obesity was consistently higher among urban dwellers (27.2% and 14.4%) compared to rural dwellers (16.4% and 12.1%); similarly, a study conducted in Nsukka, Enugu State among adolescents by Ayogu *et al.* (2016), showed that the prevalence of micronutrient malnutrition (anaemia) was 64%, and vitamin A deficiency 44% (Ayogu *et al.* 2016; Morakinyo *et al.* 2020; Adeloye *et al.* 2021).

The maternal mortality rate (MMR) in Nigeria is 814/100 000 live births, which accounts for about 20% of global maternal deaths, this prevalence is higher in the northern region than in the southern region, and maternal undernutrition attributed to inadequate dietary intake remains a leading cause of morbidity and mortality in the nation. Aside from mortality, food insecurity, compromised food environment, and malnutrition (stunting) contribute about 11% to economic loss in the nation's gross domestic product (GDP) (Global Panel on Agriculture and Food Systems for Nutrition 2016a; Morakinyo *et al.* 2020; Ope 2020; Onyeiwu 2021; Akseer *et al.* 2022).

6.8 Conclusion

Food and nutrition insecurity is a complex phenomenon challenging sub-Saharan African countries like Nigeria, resulting in various adverse health outcomes owing to a poor understanding of the inter-relationship between food environment, food acquisition and consumption among mothers, especially after the COVID-19 pandemic.

Most households lost their source of livelihood and breadwinners to the emergence of the COVID-19 pandemic, which consequently further strained their income generation potential and ability to acquire adequate, safe, and nutritious food for healthy living. Several women and households are yet to recover from these massive losses, thus, struggling to live a healthy everyday life. Most women adopted coping strategies that compromised their dietary patterns and health to cushion this effect. Some of the coping strategies adopted were meal skipping, snacking, eating limited meals, and consuming convenient caloric-dense, non-nutritious meals,

resulting in a recent phenomenon called “Full but empty plate”, aimed at quenching hunger pangs but not nourishing the body.

Climate change, economic shock and conflicts have negatively impacted the household and community food environments, thus compromising the quality of food mothers consume due to the monotony of what is available in the market. The seasonality of perishable foods, geographical location, religion and culture are core determinants of the household food basket in Nigeria and most sub-Saharan African countries experiencing food insecurity. Consumption of healthy food by rightly acquiring and using nutrient-dense food from both the community and consumer food environment rather than feeding on nutrient-poor, convenient, and ultra-processed food is essential to curbing the menace of TBM, food insecurity and other eating habits-related non-communicable diseases, life expectancy and obstetric outcomes among Nigerian mothers.

Poor household income impairs maternal purchasing power along with poor maternal occupation, education, and nutrition knowledge. These factors restrict mothers’ ability to make informed decisions on adequately purchasing diversified, safe, nutritious, and healthy foods and attaining the minimum meal frequency and recommended eating habits for mothers, children, and households. Similarly, nutrition transitioning and 200rioritized200 presenting as the mall effect is where well-packaged ultra-processed, convenient retail foods play a significant role in maternal food choices and acquisition because they are attractive, cheaper, and popular due to advertisement strategy. This has led to a “full but empty plate” concept. Disasters and conflicts also mitigated food production and food storage among households and the nation. Households’ readiness, especially mothers, to withstand such vulnerabilities has led to several coping strategies such as reduced meal frequency and quality to cater for the nutritional need of the dependent members of the households.

Implementing gender-sensitive policies and programmes that address determinants of food acquisition, consumption, and food insecurity at the grassroots is a potential tool in ameliorating TBM and mortality in many developing countries like Nigeria. Funding nutrition-sensitive or specific agriculture interventions will help mothers adopt a healthy food system and environment to curb TBM, disability-adjusted life years (DALYs), diet-related chronic diseases, and maternal mortality. Minimising food waste and nutrient loss along the value chain will drastically reduce poor dietary quality, improve consumption patterns, and consequently

reduce poor health outcomes among women, children, and households across all strata of society, especially among prioritized and low-income earners in Nigeria, Africa and globally. Efforts should be geared towards improving the existing food environment of the citizens that has been strained by the impact of COVID-19 pandemic on the economy. Creating awareness programmes via nutrition information on the utilisation and health benefits of underutilized, nutrient-dense food via an indigenous knowledge system is a proven dietary approach tool. This will also enlighten women on local sources of pocket-friendly healthy foods, thereby drastically reducing the disease burden of poor nutrition among women across Nigeria, Africa, and the globe.

Authors' contribution: OBA conceptualized and wrote the original draft, AVO and KU reviewed, edited, and gave the final approval for the manuscript to be published. All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest: The authors have no conflict of interest to report for this study.

Funding: This research received no specific grant from public, commercial, or not-for-profit funding agencies.

Institutional Review Board Statement : The study was conducted in accordance with the declaration of Helsinki and the protocol was approved by the National Health Research Ethics Committee (NHREC) in Nigeria (NHREC/01/01/2007-11/01/2022) and the Biomedical Research Ethics Committee (BREC), University of KwaZulu-Natal, South Africa (protocol number BREC/00003392/2021).

Acknowledgements: This study was self-funded with no support from external agencies. The authors thank Sanusi Adeyemi, Omachi Paul A, Olusanya R.N and Oyeyinka Adewumi for initial manuscript editing.

Conflicts of Interest: The authors have no conflict of interest to report for this study entitled 'Food Insecurity and Vulnerability of Food Environment among Nigerian Mothers – A Review'.

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CHAPTER 7: SUMMARY, CONCLUSION AND RECOMMENDATION

Globally, Africa and Asia account for the highest proportion of undernourishment, especially among under-five children and women; for instance, UNICEF/ WHO/WB-JME 2019 reported that more than one-third of under-five children are stunted, about one-quarter are overweight, and more than one-quarter is wasted in Africa compared to Europe and Oceania.

Food, an essential component of human existence for proper growth, development, and prevention of nutrition-related disorders and diseases, especially among growing children and women of reproductive age, has over time been inadequately consumed across many households in many developed countries due to poor access in terms of availability and affordability all year round, hence, the high prevalence of food and nutrition insecurity in these regions. Therefore, access to adequate intake of safe, nutritious food by the vulnerable members of society is a vital indicator of the food and nutrition security status of any nation.

The optimal nutrient intake of pre-school children and their mothers impacts significantly on their overall health outcomes and food security status; hence, the state of food and nutrition status of children and vulnerable mothers in any nation determines the national preparedness towards achieving no poverty, zero hunger, and good health and well-being which are important indicators of sustainable development goals (SDGs) 2030 and Africa agenda 2063. To achieve these goals, it is important to address the determinants of maternal and child nutrition as summarized in the modified 2020 UNICEF conceptual framework, and also to address the complexity and interconnectedness of the components of food and nutrition insecurity beyond mere food production by improving food system and food environment to address malnutrition and other nutrition-related health issues, especially among the marginalized and those experiencing security threats across Africa and beyond.

The high prevalence of food insecurity and TBM among preschoolers and mothers across many developing countries like Nigeria has been attributed to several underlying factors such as poverty, security threats/communal clashes, climate change, post-pandemic effect, and economic downturn, among others. This has further strained the ability of many households to acquire adequately safe and nutritious food for optimal health outcomes and thus has become a great public health issue. Therefore, this study assessed the maternal and pre-school

children's food and nutrition security status: a cross-sectional case study of North Central zone, Nigeria, under the following objectives; (i) To describe the food and nutrition security status of pre-school children in Nigeria towards achieving sustainable development goals, (ii) To describe the household food security, food adequacy, nutrient intake pattern among mothers of preschool children in Niger State, North Central zone of Nigeria, (iii) To assess the dynamics of nutrition knowledge on the food security and nutritional status of mothers of pre-school children in North-central, Nigeria and, (iv) To assess the impact of food environment on Food Acquisition, Utilisation, and Health Outcomes of Nigerian Mothers

7.1 Evaluation of Food and Nutrition Security Status of Preschool Children in Nigeria

Child nutrition is an essential predictor of any country's food and nutrition security status. It goes beyond food security to encompass all the components of child well-being and cognitive development. The complexity and interconnectedness of the components of child nutrition remain grey in developing countries and are yet to be well conceptualized. Africa has the highest child malnutrition and mortality prevalence, mainly due to a high poverty rate, economic shock, and conflicts in many sub-Saharan regions like Nigeria.

Nigeria, the most populated country in this region, records a high prevalence of child malnutrition, morbidity, and mortality. A review and experimental study was carried out to explore the food and nutrition security status of preschool children in Nigeria with a special focus on Niger States, North Central geopolitical zone, using a mixed method approach, the main findings from both qualitative and quantitative data obtained showed that the high prevalence of food and nutrition insecurity was high among preschool children from rural and poor households in this region, which was attributed to poor maternal educational status, high parity, high poverty, variation in seasonal availability of functional foods like fruits and vegetables, security threats, post-pandemic fall out on household income, unemployment rates, inflation and poor policies, monotonous consumption of starchy staples, and poor care practices such as poor sanitation and hygiene practices for the preschoolers, especially as the country navigates towards achieving sustainable development goals (SDGs) 2030 and the Africa Agenda 2063.

Many of the preschool children did not meet up with their minimum dietary diversity (MDD) and minimum meal frequency (MMF) as recommended for their age. This research also brings home the contributions of the multidimensional drivers of child malnutrition and poor overall health outcomes among the study participants. In addition, it proffers possible solutions to these

challenges to ensure the attainment of both the SDGs and Africa Agenda indicators that address hunger, poverty, and the overall well-being of children. For the review part, the study explored available online resources, peer-reviewed articles, books, and relevant reports from official websites to identify the problems and solutions from Nigeria's perspective.

Summarily, the nutritional status of preschool children is significantly influenced by household food (in)security status, dietary intake, care and hygiene practices, maternal occupation, and socioeconomic status. Other factors that stood out as influencing dietary diversity among the preschoolers from this study were poor food environment or food system, household food basket, cultural food preference, maternal nutrition information, and household income. Low household income restricts the power to adequately purchase diversified safe, nutritious and healthy foods, attain the minimum meal frequency and acceptable dietary intake recommended for this age group. Likewise, poor maternal occupation due to poor educational status also impairs mothers' financial empowerment to conveniently afford healthy meals and quality healthcare services for preschool children, thus impacting their food and nutrition security status. These are key areas to be invested in to alleviate hunger, reduce poverty and thus improve quality of life, which are the core indicators of SDGs 2030 for Nigerians and other LMICs experiencing food and nutrition insecurity.

7.2 Household Food Security, Food Adequacy, Nutrient Intake Pattern among Mothers of Preschool Children in Niger State, North Central Zone, Nigeria

The conundrum of food adequacy and nutrient sufficiency remains a challenge. Hence the world is now dealing with a triple malnutrition burden. The dynamics of adequacy and nutrient sufficiency are yet to be focused on, as the distinction between food security and nutrition security is often not well understood and valued. Nigeria is no exception, as the nutrition security aspect is a challenge, even more than food security. Subsequently, the well-being of women in Nigeria with food and nutrition security is of great public health concern. This review explored literature using a qualitative approach and an overview of online sources, peer-reviewed articles, books, and other publications to investigate the concept of food adequacy and nutrient sufficiency complexities amongst women. The review distinguishes food and nutrition security as a global multi-faceted challenge focusing on women. This study sought to understand the concept of food adequacy and nutrient sufficiency contextualized to Nigerian women, deliberating on the previously reported prevalence of food and nutrition insecurity

amongst women. The risk factors contributing to food insecurity across the geopolitical zones and how nutrient sufficiency influences overall consequences on women, households, and the nation, were explored. The prevalence and effects varied significantly across the six geopolitical zones and the socio-economic class of women in Nigeria. The Northern region has a higher prevalence than the Southern region. Prime factors found to negatively impact nutrient sufficiency amongst the women included poor dietary diversity, poor nutrition knowledge, poor socioeconomic status, conflict (communal clashes) and insurgency, lack of support system, climate change and seasonality, inflation in prices of food commodities, and unmet need for family planning.

Finally, this review concludes by proffering possible solutions that could address these determinants. In summary, this section buttresses the fact that attaining the SDGs that address hunger, poverty, and the well-being of mothers and children will continue to be undermined in many LMICs like Nigeria if the intrinsic factors or determinants of maternal and child nutrition as stipulated in the modified 2020 UNICEF conceptual framework are not consciously addressed by all stakeholders. To achieve the SDGs and reduce maternal morbidity and mortality in Nigeria, policies and laws that empower, ensure, and protect women's right to adequate food and grant autonomous access to quality healthcare services need to be implemented and enforced, especially among the uneducated rural women who bear the brunt of social injustice.

7.3 The Dynamics of Nutrition Knowledge on the Food Security and Nutritional Status of Mothers of Preschool Children in Niger State, North Central, Nigeria

Poor nutrition knowledge and nutrient intake among women of reproductive age contribute significantly to poor nutritional status and mortality among mothers in most developing countries like Nigeria. The high prevalence of malnutrition and diet-related non-communicable diseases accounts for the high maternal morbidity and mortality rates, especially in many rural and poor households across the nation, thus becoming a significant public health concern. This study, therefore, explored the contribution of maternal nutrition literacy to the nutritional status of mothers in Niger State, North Central Nigeria. A multi-stage sampling technique was used to recruit four hundred and fifty mothers across the twenty-five local government areas in Niger State. Information on the mothers' socioeconomic, demographic characteristics and anthropometric indices were obtained using a semi-structured questionnaire. The mothers'

feeding patterns were assessed using the qualitative 7-day dietary recall, while body mass index and waist to hip ratio were calculated. The results showed that the majority (63.8%) of the mothers were within 26-35 years. More than half (51.6%) of the mothers did not know a balanced diet. Social media or online was the most (36.4%) explored source of nutrition information among the mothers. Fifty-four per cent of the mothers indicated that their nutrition literacy had no positive impact on their dietary quality. The food consumption pattern showed that fruits/vegetables, and dairy products were the least consumed food group among the mothers (7.1% and 9.1%, respectively). More than half (57.6%) of the mothers were within the normal BMI range, and the mean waist to hip ratio was 0.82 ± 0.08 . the regression model showed that ethnicity, place of residence, occupation, source of potable water, and method of waste disposal were significantly associated with maternal minimum dietary diversity adequacy. Although nutrition knowledge has been reported to influence dietary quality among mothers, this study shows that intrinsic factors impact dietary quality and the nutritional status of mothers in Niger State.

This section highlights that intrinsic factors of food and nutrition security such as local food environment, unverified sources of nutrition information, wealth index, affordability, a threat to life, and climate vulnerability affecting food system stability played significant roles in dietary quality and the nutritional status of mothers in Niger state because most mothers were not financially empowered to acquire safe, nutritious and healthy food for themselves and household members despite their awareness of the potential benefits of consuming adequate nutritious diets to health and longevity. The majority of the mothers were in the middle age group (26-35 years). Most (36.4%) of the mothers explored unverified online sources and social media platforms for nutrition information. This shows that the younger generation assesses online resources for information on various subject matter, including nutrition, more than the older generation due to numerous pocket-friendly services and mobile facilities made available by the various service providers.

Several factors mitigated mothers' dietary quality and quantity. However, the most striking determinant was the nutrition information received and the reliability and adaptation of the information to the local context (indigenous knowledge). Most recommended healthy diets were not culturally acceptable and readily accessible to indigenous natives. There is scanty information on the utilisation of indigenous underutilised foods that are healthier and culturally acceptable, and affordable within the local context. Since information and research outputs on

indigenous knowledge systems (IKS) focusing on the utilisation of neglected nutrient-dense staples and vegetables are still very scarce and not readily available in the public domain for Nigerians and other food-insecure African countries.

7.4 Impact of Food Environment on Food Acquisition, Utilisation, and Health Outcomes of Nigerian Mothers

In conclusion, the study explored the impact of the food environment on maternal food acquisition, utilisation, and health outcomes, since mothers are often the custodian of household food store, and preparation. This was necessary because, in recent times, it has been found that environment and food systems play a vital role in addressing nutrition security status and its associated problems of TBM, especially in food secure households across developed nations. Therefore, a review study was conducted by exploring literature using a qualitative approach and an overview of online sources, peer-reviewed articles, books, and other publications to investigate the concept of the food environment, food acquisition and utilisation amongst Nigerian mothers and to explore the interconnectedness and complexities of the phenomenon as it relates to maternal health outcomes in resource-limited societies.

Food acquisition and utilisation are important determinants of the food and nutrition security status of women. Poor nutrient intake accounts for the high risk of maternal morbidity and mortality in Nigeria and has become a public health issue. The prevalence of the TBM globally is alarming, especially among developing nations, affecting more women than men. The interconnectedness of the food environment to food acquisition and utilisation in addressing food insecurity and malnutrition as an innovative concept is yet to be well understood and conceptualized in Nigeria.

This review study identified the drivers of food environments, food acquisition, and nutrient utilisation. It also investigated the prevalence of TBM among mothers or caregivers across the six geopolitical zones in the country. Some of the factors found to impact food acquisition and utilisation among mothers were poor food environment or food systems, suboptimal food intake, food illiteracy, poverty, insurgence, lack of support system, seasonality, climate vulnerability, and family size or high dependency ratio, and consequently, increase the proportion of preschool children who are surviving but not thriving (healthy). This section revealed that the major challenge faced by many developing countries like Nigeria, is poor food system and food environment due to urbanization and nutrition transitioning. Other

significant factors were economic meltdown, steady inflation rate, poverty, communal clashes, insurgency, and under-employments. There is also continuous mass migration to urban centres for a better source of livelihood and a loss of passion for agricultural investments attributed to climate change and natural disasters, drastically reducing food production. These factors have led to food deficit in many homes and rural communities and thus, nations at large, thereby, aggravating food and nutrition insecurity challenges currently experienced globally.

This current situation undermines the concerted efforts implored by various governments across nations towards achieving the SDGs 2030, which is about seven years away. The nutrition transition-mall effect, where well-packaged ultra-processed, convenient foods are retailed, plays a significant role in maternal food choices and acquisition because they are cheaper and more popular due to advertisement strategy. This has led to the new phenomenon of ‘full but empty plate’.

Disasters and conflicts effects also mitigated food production and food store among households and the nation. The readiness of the households, especially mothers, to withstand such vulnerabilities has led to several coping strategies like reduced meal frequency and quality to cater for the nutritional need of the dependent members of the households. The relationship between food environment and food quality is poorly understood in how they affect food baskets and plates at the household level. There is a high prevalence of overweight and obesity among dwellers in city centres, while in rural communities, there is underweight and hidden hunger – all these indicators suggest food and nutrition insecurity. The food and nutrition (in) security nexus remains dynamic and poorly understood.

7.5 Implications of Findings and Recommendations

This study only focused on assessing dietary quality. Dietary intakes were not quantified as energy and nutrient intakes due to a lack of a Nigerian food composition database; hence, the study could not ascertain the adequacy of each nutrient consumed, nor evaluate the prevalence of people at risk of hidden hunger (micronutrient deficiency), nor the adequacy of macronutrients consumed per participants. Therefore, further studies should explore the possibility of assessing these components using the new International Dietary Data Expansion Project (INDDEX 24) proposed by Friedman School of Nutrition Science and Policy, Tufts University, Massachusetts, USA.

1. To mitigate the challenges of food and nutrition insecurity among preschool children and their mothers, it is recommended that efforts be aimed at improving the food environment, food accessibility and nutrient 228rioritized among mothers in food insecure and marginalized communities.
2. To optimize food security status and health outcomes among mothers and preschool children, stakeholders at all levels and relevant agencies and organisations must prioritise improving food systems to focus on the affordability and availability of healthy foods through the implementation of programmes and policies that address issues like insurgence, inflation, climate change, the disparity in wealth distribution and seasonal vulnerability which are intrinsic drivers of nutrition security among low income earners and rural dwellers across Nigeria and other African countries. Adopt a workable food system approach via policies that are all inclusive (social and environmental determinants of health) that addresses root causes, complexity, and unintended consequences of nutrition insecurity among these vulnerable groups across every socioeconomic class and geographical settlement

7.6 Study Critique

1. The study only focused on a few Local Government Areas (municipalities) in Niger State because these were the safe zones not under the attack by Boko Haram. Hence a larger coverage can be explored when the country's security situation improves.
2. Investment in and delivery of high-quality, healthy and sustainable diets or foods by moving food systems from food production as a goal towards food production as a tool for ensuring nutrition security will ensure that human health and nutrition are 228rioritized, thereby supporting nourishment rather than mere feeding. In this way the food system will be a solution and not a problem.
3. Consequently, the number of children living and not just surviving across Africa and other LMICs will increase drastically.
4. Creating a nutritious food innovation hub for SMEs via a functional partnership with the private sector, development partners and tertiary institutions for sustainability.
5. Scaling up investments in and promoting the production and consumption of biofortified crops and underutilised nutritious crops that are nutrient-dense and indigenous to each locality via incorporation of indigenous knowledge system (IKS) research outputs to enhance food systems.

6. Gender-sensitive social protection programmes and policies should be more nutrition-sensitive and prioritized among low-income earning women, single mothers, and widows with preschool children

7.7 Lines of Future Research

1. The absence of a national food composition database for Nigerians did not allow the research to evaluate the recommended nutrient intake (RNI), estimated energy requirement (EER), the estimated average requirement (EAR), recommended dietary allowance (RDA), adequate intake (AI), reference intake range for macronutrients (Ris), and tolerable upper intake level (UL) appropriate for the mothers and their preschool children in the study area which future researchers can explore.
2. The complexity and interconnectedness of the food environment, food literacy (nutrition knowledge) and food and nutrition security status in the nation, especially among mothers and their households, is a grey area yet to be explored in many developing countries like Nigeria. This new concept should be investigated in future studies.

APPENDICES

APPENDIX A



03 March 2022

Mrs Alice Bosede Omachi (220108101)
School of Agriculture Earth & Environmental Sciences
Pietermaritzburg

Dear Mrs Omachi,

Protocol reference number: BREC/00003392/2021
Project title: Assessment of Maternal and Preschool Children's food and Nutrition Security Status: A Cross-Sectional Case Study of North-Central Zone, Nigeria.
Degree Purposes: PhD

EXPEDITED APPLICATION: APPROVAL LETTER

A sub-committee of the Biomedical Research Ethics Committee has considered and noted your application.

The conditions have been met and the study is given full ethics approval and may begin as from 03 March 2022. Please ensure that any outstanding site permissions are obtained and forwarded to BREC for approval before commencing research at a site.

This approval is subject to national and UKZN lockdown regulations, see (http://research.ukzn.ac.za/Libraries/BREC/BREC_Amended_Lockdown_Level_1_Guidelines.sflb.ashx). Based on feedback from some sites, we urge PIs to show sensitivity and exercise appropriate consideration at sites where personnel and service users appear stressed or overloaded.

This approval is valid for one year from 03 March 2022. To ensure uninterrupted approval of this study beyond the approval expiry date, an application for recertification must be submitted to BREC on the appropriate BREC form 2-3 months before the expiry date.

Any amendments to this study, unless urgently required to ensure safety of participants, must be approved by BREC prior to implementation.

Your acceptance of this approval denotes your compliance with South African National Research Ethics Guidelines (2015), South African National Good Clinical Practice Guidelines (2020) (if applicable) and with UKZN BREC ethics requirements as contained in the UKZN BREC Terms of Reference and Standard Operating Procedures, all available at <http://research.ukzn.ac.za/Research-Ethics/Biomedical-Research-Ethics.aspx>.

BREC is registered with the South African National Health Research Ethics Council (REC-290408-009). BREC has US Office for Human Research Protections (OHRP) Federal-wide Assurance (FWA 678).

The sub-committee's decision will be noted by a full Committee at its next meeting taking place on 12 April 2022.

Yours sincerely,



Prof D Wassenaar
Chair: Biomedical Research Ethics Committee

Biomedical Research Ethics Committee
Chair: Professor D R Wassenaar
UKZN Research Ethics Office Westville Campus, Govan Mbeki Building
Postal Address: Private Bag X54001, Durban 4000
Email: PREC@ukzn.ac.za
Website: <http://research.ukzn.ac.za/Research-Ethics/Biomedical-Research-Ethics.aspx>

Founding Campuses: Edgewood Howard College Medical School Pietermaritzburg Westville

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Appendix A 1APPENDIX A

APPENDIX B



NHREC Protocol Number NHREC/01/01/2007- 28/11/2021
NHREC Approval Number NHREC/01/01/2007-11/01/2022
Date: 12th January, 2022

Re: Assessment of Maternal and Preschool Children's Food and Nutrition Security Status: A Cross-Sectional Case Study of North-Central, Nigeria.

Health Research Committee assigned number: NHREC/01/01/2007

Name of Student Principal Investigator: Alice Bosede Omachi

Address of Student Principal Investigator: Department of Dietetics and Human Nutrition
University of Kwazulu-Natal, Pietermaritzburg Campus
South Africa.

Email: omalice80@gmail.com

Tel: ; +27 644185336; +234 80 30939624

Date of receipt of valid application: 28/11/2021

Date when final determination of research was made: 12-01-2022

Notice of Full Committee Review and Approval

This is to inform you that the research described in the submitted protocol, the consent forms and other participant information materials have been reviewed and given full committee approval by the National Health Research Ethics Committee.

This approval dates from 12/01/2022 to 11/01/2023. If there is delay in starting the research, please inform the HREC so that the dates of approval can be adjusted accordingly. Note that no participant accrual or activity related to this research may be conducted outside of these dates. *All informed consent forms used in this study must carry the HREC assigned number and duration of HREC approval of the study. If this is a multi-year research, endeavour to submit your annual report to the HREC early in order to obtain renewal of your approval and avoid disruption of your research.*

The National Code for Health Research Ethics requires you to comply with all institutional guidelines, rules and regulations and with the tenets of the Code including ensuring that all adverse events are reported promptly to the HREC. No changes are permitted in the research without prior approval by the HREC except in circumstances outlined in the Code. The HREC reserves the right to conduct compliance visit to your research site without previous notification.

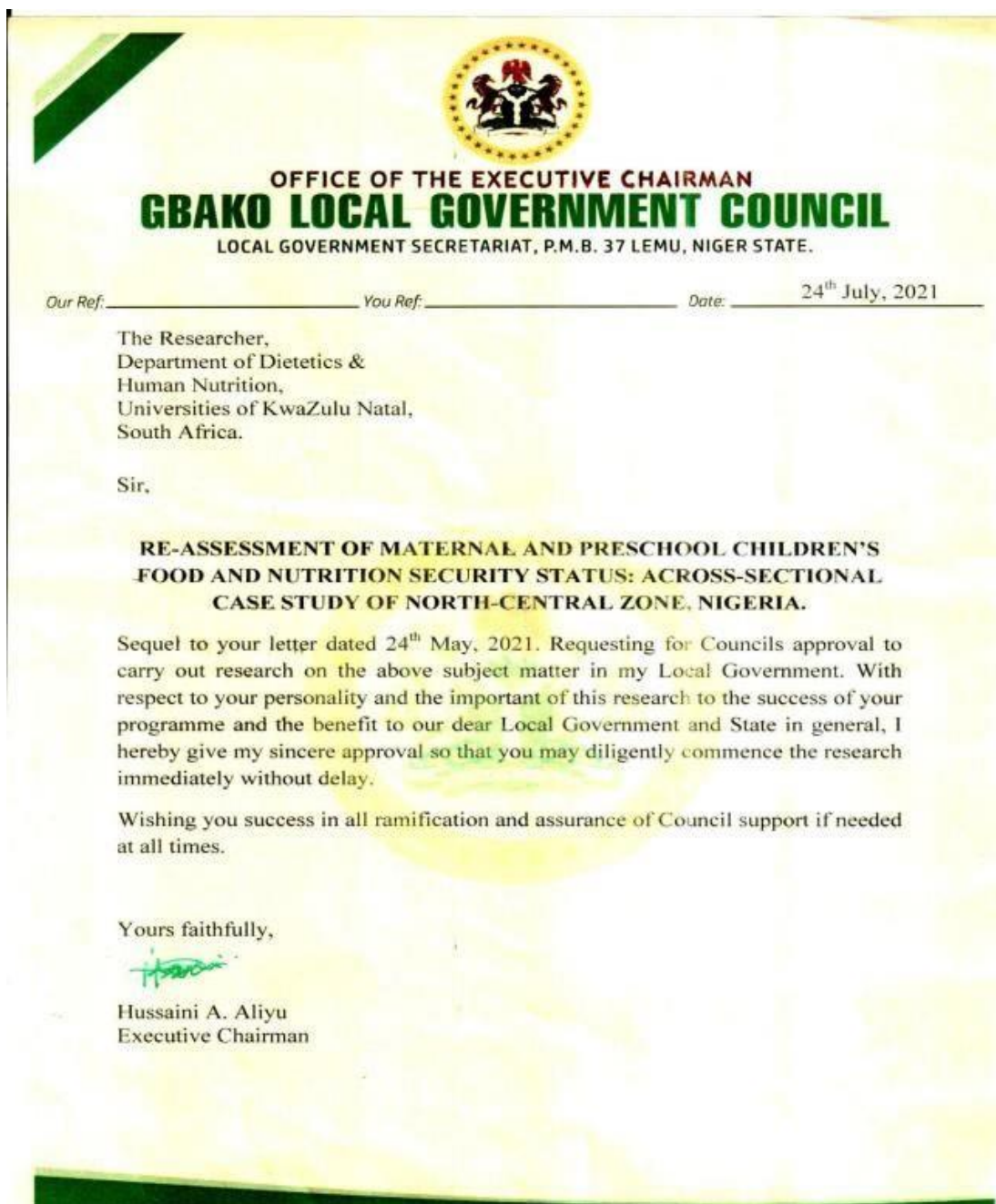
Signed

**Professor Zubairu Iliyasu MBBS (UniMaid), MPH (Glasg.), PhD (Shef.), FWACP, FMCPH
Chairman, National Health Research Ethics Committee of Nigeria (NHREC)**

Department of Health Planning, Research & Statistics Federal Ministry of Health 11 th Floor, Federal Secretariat Complex Phase III Ahmadu Bello Way, Abuja	Tel: +234-09-523-8367 E-mail: chairman@nhrec.net , secretary@nhrec.net , deskofficer@nhrec.net , URL: http://www.nhrec.net
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Appendix A 2APPENDIX B

APPENDIX C



Appendix A 3APPENDIX C

APPENDIX D



Zertifikat
Certificat

Certificado
Certificate

Promouvoir les plus hauts standards éthiques dans la protection des participants à la recherche biomédicale
Promoting the highest ethical standards in the protection of biomedical research participants



Certificat de formation - Training Certificate

Ce document atteste que - this document certifies that

Alice O machi

a complété avec succès - has successfully completed

Informé Consent

du programme de formation TRREE en évaluation éthique de la recherche
of the TRREE training program in research ethics evaluation

Release Date: 2021/09/23
CID : 1348040400

Professeur Dominique Sprumont
Coordinateur TRREE Coordinator



Ce programme est soutenu par - This program is supported by:

European and Developing Countries Clinical Trials Partnership (EDCTP) (www.edctp.org) - Swiss National Science Foundation (www.snf.ch) - Canadian Institutes of Health Research (http://www.cihr-inrc.gc.ca/2014.html) - Swiss Academy of Medical Sciences (SAM SM / SA MW) (www.sam.ch) - Commission for Research Partnerships with Developing Countries (www.dpech)

APPENDIX E



CONSENT DOCUMENT FOR ADULT SUBJECTS IN ENGLISH

AN ASSESSMENT OF MOTHERS, PRESCHOOL-AGE CHILDREN'S FOOD AND NUTRITION SECURITY STATUS: A CROSS-SECTIONAL CASE STUDY OF NORTH- CENTRAL ZONE, NIGERIA

Participant's code: _____

My name is Alice Bosedede. Omachi, a full-time PhD student registered at the University of KwaZulu Natal, School of Agriculture, Earth and Environmental Sciences, Department of Dietetics and Human Nutrition, Pietermaritzburg campus, South Africa. I would like you to participate in this study. Contact no: +234 80 309939624; +27 64 418 5336; email: omalice80@gmail.com, for enquiry, you may contact Prof. Unathi Kolanisi; kolanisiU@unizulu.ac.za; +27730548481 and Dr. Annette Van onselen annette.vanonselen@smu.ac.za; +27 83 468 2862 who are the project supervisors.

Therefore, you will be required to participate in this survey by filling a questionnaire using the codes assigned to the options provided in the various sections as appropriate, this will take about 15minutes of your time. It is essential you know that:

- ✓ Participants identified for the project are women of reproductive age (and their pre-school children), who are the caregivers in their household and also in charge of meal planning and preparation.
- ✓ Participation in this study is voluntary, you can stop participating at any time during the study
- ✓ There will be no form of payment or reimbursement of financial expenses for participating in this study, however, counselling will be offered to women whose children are at risk of severe or acute malnutrition.
- ✓ There will be audio recording of focus group discussions. These recordings will be kept confidential and will only be used for the purpose of this study.
- ✓ All information will be kept confidential and stored at the department of Dietetics and Human Nutrition, which will be destroyed when it is no longer required.
- ✓ Over time the information provided will be destroyed when deemed necessary
- ✓ Guidelines of COVID-19 such as social distancing, nose mask and hand sanitizers will be made available during the period of data collection.
- ✓ For further information about the study, please contact Research Ethics Office as follows:

APPENDIX F



Appendix A 6APPENDIX F

STRUCTURED INTERVIEW QUESTIONNAIRE FOR PhD RESEARCH PROJECT

TITLE:

AN ASSESSMENT OF MOTHERS, PRESCHOOL-AGE CHILDREN'S FOOD AND NUTRITION SECURITY STATUS: A CROSS-SECTIONAL CASE STUDY OF NORTH- CENTRAL ZONE, NIGERIA

Interviewer: _____ **Date of interview:** _____

Interviewee _____ **identification number:** _____

Local Government Area Name: _____ **Ward number:** _____

INSTRUCTION TO THE INTERVIEWER: Please put a circle around an appropriate response, represented by a number on the right or kindly record the answer provided

by the respondent where necessary

Section A: Socio-Demographic Information of Respondent		CODE
Ethnic Group	Nupe	1

	Gwari	2
	Hausa	3
	Yoruba	4
	Ibo	5
	Others (specify)	6
Age	Specify in years-----	
Resident area	Urban	1
	Rural	2

Educational status	Never attended formal school or Islamic school	1
	Primary school incomplete	2
	Primary school completed	3
	Secondary school incomplete	4
	Secondary school completed	5
	Tertiary education	6
	Others (specify)	7
Marital status	Single	1
	Married	2
	Divorced or separated	3
	Others (specify) _____	4
Parity	Primiparous (1)	1
	Multiparous (2-4)	2
	Grand multiparous (≥ 5)	3
Religion	Christianity	1
	Islam	2
	Traditional	3
	Others	4
Employment status	Employed (full-time service)	1
	Retired	2
	Unemployed	3
	Part-time employment	4

Occupation	Civil servant	1
	Artisan or (unskilled worker)	2
	Apprentice	3
	Full time house wife	4
	Petty trader	5
	Farming	6
	Self-employed or business woman Others (specify)	7
		8
Source of household income	Wages/salary	1
	Sales of farm produce	2
	Casual non-farm labour	3
	Family business or petty trading	4
	Casual farm labour	5
	Remittance or loan	6
	Others	7
		8
Income range	≤N18,000	1
	N18,000-N50,000	2
	N51,000-N100,000	3
	N101,000-N150,000	4
	≥#151,000	5
		6
Amount spent on meal per day	≤ N1000 per day	1
	≥ N1000 per day	2
Bread winner	Father only	1
	Mother only	2

	Both parents (joint effort)	3
	Grand parents	4
	Siblings	5
	Children	6
Source of food items for home use	Own Produce from previous harvest	1
	Bulk purchase	2
	Daily purchase	3
	Borrowing	4
	Food aid or in kind sources(gift)	5
Source of portable water	Public borehole	1
	Deep well	2
	Waterboard	3
	River or stream	4
Toilet facilities	Water closet	1
	Pit toilet	2
	Bush	3
Source of healthcare facilities	Primary healthcare center	1
	Secondary healthcare (general hospitals)	2
	Tertiary healthcare center(FMC)	3
	Traditional homes	4
	Midwives (family nurse)	5
Method of waste disposal	Community incinerator	1
	Water ways(drainage)	2
	Running water (during rain fall)	3
	Nearby bush	4

Method of water treatment for children	Boiling	1
	Addition of water guard (allum, commercially sold chemicals)	2
	Sedimentation and decantation	3
	None	4
method of family planning		
	Natural method	1
	Scientific methods	2
	None	3

Which food group do you often purchase? Tick as appropriate

Food	Frequency			
	Daily (D)	Weekly (W)	Monthly (M)	Fortnightly (F)
Grains (maize, millet, rice)				
Legumes (cow pea, soybeans)				
Vegetables				
Fruits				
Dairy products				
Fish or meat or eggs				

Section B1i: Questionnaire for Dietary Diversity in a Household (family members) within the last 24HRS

Sor N	Food groups	Response Yes=1 No=2
1	Consumed Cereals yesterday? e.g. Rice, pap, Corn pudding(tuwomasara), Masa, spaghetti, couscous Millet pudding (tuwo)	
2	Consumed White tubers and roots yesterday? e.g. Boiled yam, fried yam, Sweet potatoes, Cassava flakes (ebaor garri), Cassava starch (bambara)	

- 3 **Consumed Vegetables yesterday?**
e.g. Spinach (alefo), okro, Pumpkin leaves (ugwu),
Mia kuka,
- 4 **Consumed Fruits yesterday:**
e.g. Orange (lemu), Date (dabino), Water melon, mango,
Tamarind (samia), Tiger nuts (aaya)
- 5 **Consumed Meats yesterday?**
e.g. Beef tissue, Organs, Skin (pomo), chicken, Goat, busy meat, Birds, barbecue (suya)
- 6 **Consumed Eggs yesterday?**
- 7 **Consumed Fish and other seafoods yesterday?**
e.g. Dry catfish, Tilapia, Fresh catfish, Iced fish (sawa)
- 8 **Consumed Legumes, nut and seeds yesterday?**
e.g. Beans pudding (moimoi), Beans cake (koseorakara),
Beans porridge, Soy cheese, groundnut cake (kuli), roasted ground nut (jeda)
- 9 **Consumed Milk and milk products yesterday?**
e.g. Soy milk, commercially sold milk products (milk drinks)
- 10 **Consumed Oils and fats yesterday?**
e.g. Palm oil, Groundnut oil, Melon (egusi), Bambara
- 11 **Consumed Sweetsor snacks yesterday?**
e.g. Carbonated drinks, Non-carbonated drinks (kunuaaya, jeda, masara) Fruit juices, Fermented beverages,
Pastries (buns, pies, sausage, cakes, biscuits)

- 12 **Consumed Spices and condiments yesterday?**
 e.g. Locust bean(dawadawa), Commercially sold condiments
 (bouillon cubes),
-

B1ii: Does anyone eat outside the home? (A.) yes----- (B.) no-
 ----- If yes, why? ----- and how often? -----

**Section B2i: Questionnaire for Dietary Diversity (For Individual mother or caregivers)
 previous day**

Sor N	Food groups	Response Yes=1 No=2
1	Consumed Starchy staples yesterday? e.g. Rice, pap, Corn pudding (tuwomasara), Masa, spaghetti, Millet pudding (tuwo), couscous, Boiled yam, fried yam, Sweet potatoes, Cassava flakes (ebaor garri), Cassava starch (bambara)	
2	Consumed Dark green leafy vegetables yesterday? e.g. Spinach(alefo), Okro, Pumpkin leaves(ugwu), Mia kuka,	
3	Consumed Other Vitamin A rich fruits and vegetables yesterday?	
4	Consumed Other fruits and vegetables yesterday? e.g. (lemu), Date (dabino), Water melon, Mango, Tamarind(samia), tiger nuts(aaya), banana	
5	Consumed Organ meats or offal yesterday?	
6	Consumed Meat and/or fish yesterday? e.g. dry catfish, tilapia, fresh catfish, iced fish(sawa),	

- beef, chicken, lean meat (busy meat), birds(pigeon)
- 7 **Consumed Eggs yesterday?**
- 8 **Consumed Legumes, nut and seeds yesterday?**
e.g. Beans pudding (moimoi), Beans cake (koseorakara), Beans porridge, Soy cheese, Ground nut cake (kuli). soymilk, dawadawa
- 9 **Consumed Milk and milk products yesterday?**
e.g. Yoghurt, Cheese (wara), Fura de nunu (raw cow milk)

consumed Sweetersnack yesterday?

- Sugar-sweetened commercially produced drinks (fruit juice or sodas)
- 10 Sugar- sweetened home-made drinks (zobo, kunu, fura, etc)
 Pastry (buns, cakes, bread, etc)

Section B2ii: Food Frequency Questionnaire for Qualitative Dietary intake of Mothers or caregivers LAST WEEK

How often do you consume the following food items last week?

Sor N	Food Groups	Never	1-2 times or week	3-6 times or week
1	How many times did you eat Starchy staples last week? e.g. Rice, Fermented gruel (pap), Corn pudding (tuwomasara) Masa (rice pudding), Spaghetti, Millet pudding (tuwo) Cuscus (broken pasta), Yam (boiled or fried), sweet potatoes (boiled or fried), Cassava flakes (eba or garri), Cassava starch (bambara), Fermented cereal drinks (kunu)			
2	How many times did you eat Dark green leafy vegetables last week? e.g., Spinach (aleefo), Okro, Pumpkin leaves (ugwu), Mia kuka			
3	How many times did you eat Other Vitamin A rich fruits and vegetables last week? e.g. Carrots, Oranges (lemu) Mangoes, Pawpaw, Garden eggs			

- 4 **How many times did you eat Other fruits and vegetables last week? e.g.** Date (dabino), Water melon, Tamarind(samia)
Tiger nuts(aaya), Coconut, Cucumber, Banana, Kunu aaya
- 5 **How many times did you eat Organ meats or offal last week?**
- 6 **How many times did you eat Meat or fish last week? e.g.:**
Catfish (fresh or oven dried), Tilapia (fresh or smoked) Iced fish(sawa), Beef (red meat, barbeque), Mutton
Chicken, Lean meat (busy meat, birds(pigeon))
- 7 **How many times did you eat Eggs last week? e.g. From Hybrid fowl, From Local fowl**
- 8 How many times did you eat Legumes, nut and seeds last week?
e.g. Beans pudding(moimoi), Beans cake (koseorakara), Beans porridge, Soy cheese (fried or boiled), Ground nut cake (kuli). Locust bean (dawadawa)
- 9 **How many times did you drink Milk and milk products last week:**
e.g. Yoghurt, Cheese (awara), Fura de nunu (raw cow milk), Commercially packaged milk products (economy pack)
- 10 **How many times did you take Sweets or Snacks last week? e.g.**
Sugar sweetened Carbonated drinks (commercially produced (coca-cola) beverages), Pastry (cakes, buns, biscuits, pies, sausages)
Sugar sweetened Non- carbonated drinks (fermented beverages)
Sugar sweetened Fruit juices(canned or bottled) home- made, commercially sold e.g. Zobo.

Section Ci: Dietary Diversity Scale for Preschooler (previous day 24Hr recall)

Sor	Food groups	Response
N		Yes=1 No=2
1	Did your child eat Cereal or root and tubers yesterday? e.g. Rice, pap, Corn pudding (tuwomasara), Masa, Spaghetti, indomie, Millet pudding (tuwo), Couscous, Boiled yam, fried yam, Sweet potatoes, Cassava flakes (ebaor garri), Cassava starch (bambara), Custard,	
2	Did your child eat Legumes and/or nuts yesterday? e.g.: Beans pudding (moimoi), Beans cake (koseorakara), Beans porridge, Soy cheese, Ground nut cake (kuli).	
3	Did your child drink Milk (Dairy) and its derivatives yesterday? e.g.: Sugar-sweetened Commercially produced Beverages from milk and cocoa products, Powdered milk, Sugar-sweetened Commercially packaged flavoured milk products (bobo, nutrimilk)	
4	Did your child eat animal (Flesh) products; yesterday? e.g. Beef, Poultry, Offal, Fish	
5	Did your child eat Eggs yesterday?	
6	Did your child eat Vitamin A-rich fruits and vegetables yesterday? e.g.; Leafy green vegetables, Spinach (alefo), Pumpkin leaves (ugwu), Mia kuka, Yellow fruits and vegetables, Carrots, Tomatoes, Okro,	
7	Did your child eat Other fruits and vegetables yesterday? e.g.: Orange (lemu), Date (dabino)Water melon, Mango, Tamarind (samia), Tiger nuts(aaya), Pawpaw, Pineapple, Banana	
8	Did your child eat Sweets/snacks yesterday? Sugar-sweetened beverages (commercially-produced) Sugar-sweetened beverages (home-made) Pastry (buns, biscuits, cakes, doughnut, bread)	

Section Cii: Food Frequency Questionnaire for qualitative dietary intake of Preschoolers

How often does your child consume the following food items last week?

Sor N	Food groups	Never or week	1- 2 times or week	3- 6 times or week
1	How many times does your child eat Cereals every week? e.g.: Rice, Pap, Corn pudding (tuwomasara), Masa, Spaghetti or noodles Soya cheese Millet pudding (tuwo) Cuscus (broken pasta) Custard			
2	How many times does your child eat Root and Tuber every week? e.g. Yam (boiled or fried) Sweet potatoes (boiled or fried) Cassava flakes (eba or garri)			
3	How many times does your child drink Milk and its derivatives every week? Sugar-sweetened Beverages from milk and cocoa products, powdered milk Sugar-sweetened Commercially packaged milk flavoured drinks (bobo, nutrimilk) Fura de nunu (fresh cow milk drink)			
4	How many times does your child eat Meat products and or Fish every week? Red meat Poultry Offal Fish (fresh or dry)			
5	How many times does your child eat Eggs every week?			
6	How many times does your child eat Snacks every week? Biscuit, Pastry (chin chin, buns, cakes, dough nuts), Cheese balls			

7	<p>How many times does your child eat Vitamin A-rich fruits and vegetables every week?</p> <p>Leafy green vegetables, Spinach(alefo), P umpkin leaves(ugwu)) Mia kukaorokro Yellow fruits and vegetables (carrots, tomatoes), orange (lemu)</p>		
8	<p>How many times your child does eats Other fruits and vegetables every week?</p> <p>Date (dabino) Water melon Mango Tamarind (samia) Tiger nuts (aaya) Pawpaw Pineapple Coconut Banana</p>		
9	<p>How many times does your child eats Sweets every week?</p> <p>Sugar-sweetened fruit juices (Bobo, Coca-Cola, lolly) Sugar-sweetened home-made drinks or beverages (kunu, Zobo)</p>		

SECTION Di: Household Food Insecurity Access Scale (HFIAS)

SorN	Question	Response Option	Code
0			
1	In the past four weeks, did you worry that your household would not have enough food?	0 = No (skip to Q2) 1=Yes	

- 1b How often did this happen? 1 = Rarely (once or twice in the past four weeks)
2 = Sometimes (three to ten times in the past four weeks)
3 = Often (more than ten times in the past four weeks)
- 2 In the past four weeks, were you or any household member not able to eat the kinds of foods you preferred because of a lack of resources? 0 = No (skip to Q3) 1=Yes
- 2b How often did this happen? 1 = Rarely (once or twice in the past four weeks)
2 = Sometimes (three to ten times in the past four weeks)
3 = Often (more than ten times in the past four weeks)
- 3 In the past four weeks, did you or any household member have to eat a limited variety of foods due to a lack of resources? 0 = No (skip to Q4)
1 = Yes
- 3b How often did this happen? 1 = Rarely (once or twice in the past four weeks)
2 = Sometimes (three to ten times in the past four weeks)
3 = Often (more than ten times in the past four weeks)
- 4 In the past four weeks, did you or any household member have to eat some foods that you really did not want to eat because of a lack of resources to obtain other types of food? 0 = No (skip to Q5)
1 = Yes

- 4a How often did this happen?
- 1 = Rarely (once or twice in the past four weeks)
 2 = Sometimes (three to ten times in the past four weeks)
 3 = Often (more than ten times in the past four weeks)
- 5 In the past four weeks, did you or any household member have to eat a smaller meal than you felt you needed because there was not enough food?
- 0 = No (skip to Q6)
 1 = Yes
- 5a How often did this happen?
- 1 = Rarely (once or twice in the past four weeks)
 2 = Sometimes (three to ten times in the past four weeks)
 3 = Often (more than ten times in the past four weeks)
- 6 In the past four weeks, did you or any other household member have to eat fewer meals in a day because there was not enough food?
- 0 = No (skip to Q7)
 1 = Yes
- 6a How often did this happen?
- 1 = Rarely (once or twice in the past four weeks)
 2 = Sometimes (three to ten times in the past four weeks)
 3 = Often (more than ten times in the past four weeks)
- 7 In the past four weeks, was there ever no food to eat of any kind in your household because of lack of resources to get food?
- 0 = No (skip to Q8)
 1 = Yes

- 7a How often did this happen?
- 1 = Rarely (once or twice in the past four weeks)
 2 = Sometimes (three to ten times in the past four weeks)
 3 = Often (more than ten times in the past four weeks)
- 8 In the past four weeks, did you or any household member go to sleep at night hungry because there was not enough food?
- 0 = No (skip to Q9)
 1 = Yes
- 8a How often did this happen?
- 1 = Rarely (once or twice in the past four weeks)
 2 = Sometimes (three to ten times in the past four weeks)
 3 = Often (more than ten times in the past four weeks)
- 9 In the past four weeks, did you or any household member go a whole day and night without eating anything because there was not enough food?
- 0 = No (questionnaire is finished)
 1 = Yes
- 9a How often did this happen?
- 1 = Rarely (once or twice in the past four weeks)
 2 = Sometimes (three to ten times in the past four weeks)
 3 = Often (more than ten times in the past four weeks)

Section Diii; Nutritional Knowledge of Mothers

1. What is healthy eating?
 - a) Eating meals in a day consisting of all the basic food groups
 - b) Don't know
2. List foods that make a proper (balanced) diet?.....
 - a) Balanced (Carbohydrates, Proteins, fat & oil, Vitamins, Minerals, Water)
 - b) Not balanced
3. What is the importance of the following food in the body?
(Maize, Rice, Sweet potatoes, Cassava, Sorghum, Millet, yam, pap, kunu, masa, bambara)
 - a) Provision of energy or strength
 - b) Don't know
4. What is the importance of the following food in the body?
(Beans, Meat, Fish, Eggs, Soya milk, nunu Milk, dawadawa, awara (soy cheese),)
 - a) Body building
 - b) Don't know
5. What is the importance of the following food in the body? (cashew, oranges, dabino, tomatoes, Onion, Bananas, Mangoes, Pawpaw, watermelon)
 - a) Disease prevention or Recovery from illness or Healing of wounds
 - b) Don't Know
6. Which local foods are rich in:
 - a) Carbohydrates (Energy giving)
 - b) Proteins (Body building)
 - c) Vitamins (Fruits and vegetables)
7. Which vegetables or fruits help the body to recover from illness?
 - a) Vitamin C Rich foods (Oranges, Lemons, Green leafy vegetables)
 - b) Don't know
8. What are the signs of having little or insufficient blood in the body?
 - a) Fainting, Dizziness, Paleness
 - b) Don't know
9. Which foods help to build or add blood in the body?
 - a) Iron Rich Foods (Liver, Beef, Green Leafy Vegetables, Beans)
 - b) Don't know

10. Which foods are rich in Vitamin A?
- Yellow fruits, Green leafy vegetables, Carrots
 - Don't know
11. What is your most reliable source of nutrition information?
- Media
 - Community Health Worker
 - Women meeting
 - School
 - Religious gatherings
 - others (please specify)
- 12 How has this affected the number of times you cook meals daily? a) Increased b) decreased c) no difference

Likert Scale to assess the quality of maternal Nutrition Knowledge

1. Healthy eating is eating meals that contains all the classes of food in their right proportion every day (a) strongly agreed (b) agreed (c) undecided (d) disagreed (e) strongly disagreed
2. Carbohydrates are energy giving foods (a) strongly agreed (b) agreed (c) undecided (d) disagreed (e) strongly disagreed
3. Proteins are body building foods (a) strongly agreed (b) agreed (c) undecided (d) disagreed (e) strongly disagreed
4. Fruits and vegetables help us to fight against diseases and illnesses (a) strongly agreed (b) agreed (c) undecided (d) disagreed (e) strongly disagreed
5. Eating healthy foods will not make my child fall sick (a) strongly agreed (b) agreed (c) undecided (d) disagreed (e) strongly disagreed
6. I know what to eat or give my child but I cannot afford it (a) strongly agreed (b) agreed (c) undecided (d) disagreed (e) strongly disagreed
7. There are foods that mothers should not give their growing children so that they don't steal (a) strongly agreed (b) agreed (c) undecided (d) disagreed (e) strongly disagreed
8. There are foods that are forbidden to pregnant/nursing mothers (a) strongly agreed (b) agreed (c) undecided (d) disagreed (e) strongly disagreed
9. I can get reliable nutrition information only from medical professional or health workers (a) strongly agreed (b) agreed (c) undecided (d) disagreed (e) strongly disagreed
10. Culture, and religion plays significant role on food preference no matter how healthy or unhealthy the food is (a) strongly agreed (b) agreed (c) undecided (d) disagreed (e) strongly disagreed.

Section E: Infant Information and Anthropometric Indices

Age (months)-----Sex: (a) Male (b) Female

Birth weight (kg) (optional)--- Height (cm): -----Position of child in the family: -----

Present weight (kg): -----MUAC reading: ----- BMI or Age-----

Section F: Anthropometric Indices of Mothers

Weight(kg): ----- Height(m): -----Hip Circumference(cm): -----

Waist circumference (cm): ----- BMI (kgorm²): -----

WaistorHeight ratio: -----

Medical History of the Mother

Maternal age (years)----- Maternal BMI (kgorm²) -----

Do you have any non-communicable disease(s)? a) Yes b) No

a) Tuberculosis b) Diabetes c) Hypertension d) Organ dysfunction e) specify

Section G: impact of insecurity and pandemic on household food security

a. Is your family affected in anyway by the current insecurity and pandemic situation in the state? A) Yes B) No, if yes how? (specify)

b. Which has the most devastating impact on your family? A) Insecurity b) Covid-19
c) both

bii How? Pls. specify ----- (**reduced farming activity, loss of job or loss of bread winner**)

biii How did it affect your income? A) increased B) decreased c) no difference

c. How did it affect your family feeding habit in quantity and quality? A) increased b)
decreased c) no difference

d. How did it affect your child's feeding? A) increased b) decreased c) no difference

- e. How did this affect the number of times you eat daily? A) increase b) decreased c) no difference
- f. How did this affect the number of times you feed your child daily? A) increased b) decreased c) no difference
- g. How has this affected the number of times you cook meals daily? A) increased b) decreased c) no difference

APPENDIX G



Focused Group Interviews Guide using the Projective Technique Biodata Information of Children

- a) Sex----- b) Age(month) ----- c) Position of child in the family-----

d) Parity----- e) Weight(kg)----- f) Height(m)----- g)
Educational profile----

Using pictures of common food items from the nine (9) food groups to retrieve salient information on consumption pattern of the preschoolers

1. Can you identify the food items in these visual aids?
2. Why do we have to eat these foods?
3. Which of these food items do you like eating? (Food from animal and plant sources, commonly consumed fruits and vegetables) and give reasons for these?
4. How many times do you eat them in a day or week? If occasionally, why?
5. How much of this do you eat daily (amount and size)? And why?
6. How often will you like to be eating these food items?
7. What is the importance of this(ese) food to your health and growth?
8. What do you think could happen to you if you don't eat this regularly?



FIG. A

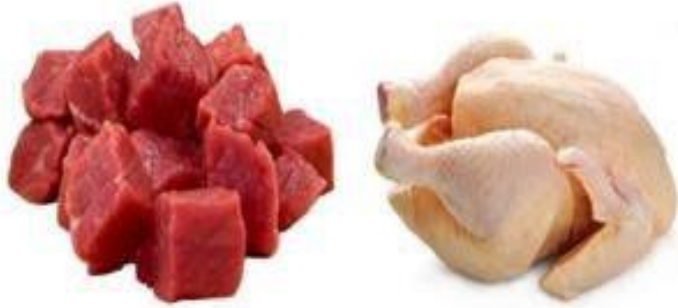


FIG. B



FIG. C
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Banana
(*Musa paradisiaca*)



Carrot
(*Daucus carota*)



Avocado pear
(*Persea americana*)



Pineapple
(*Ananas comosus*)



Pawpaw
(*Carica papaya*)



Guava
(*Psidium Guajava*)



Tomato
(*Lycopersicon esculentum*)



African star apple
(*Chrysophyllum albidum*)



Watermelon
(*Citrullis lanatus*)



Orange
(*Citrus sinensis*)



Cashew
(*Anacardium occidentale*)



Soursop
(*Annona muricata*)



Breadfruit
(*Artocarpus altilis*)

Fig. D

APPENDIX H



MAKANTA LEGEN LEGE NYA KWAZULU NATAL CINTARAGI 1

EGANGBINZHI KAKANYI ETI DUDUGIWAZA NYA KATUN DIGIRI LEGEN LEGE O
EGA 'TI: Ekpo nya tsutswa nya Enyangicizhi to enya 'milozhi nya Nnazhi to egi nazhi dan zunma
eya gutsun o na: Dudugiwa eti egan nana o dagan kin nya arewa nya tacin nya Naijeriya o.

Eza na a gbin 'ganzhi na _____ Etswafo nya Egangbin _____

Eza na a ya ezhezhi na _____ Nomba Nya Ezheyaci _____

Eka Muliki Tetengi _____ Eka ganfi nya siyasajin _____

EBAWUZHI YA EZA NA A GBINGA NANAZHI NA: Jin hankuri a lanyi kurugi la ma ezhe
na we ga li na kezhe. Ezhe nazhi we a li na dan gwalo nya egangbinzhi o. Ko ma wo ka ezhe na
eza na we e gbin 'gan na dan 'bandoci o wo kemina u ga gonyi na.

KASAN MAFARI: Labari nya etitacin nya eza na a ya ezhezhi nya egangbin nanazhi na Namba
Ezhe

Ezhi Misun We	Nupe	1
	Gwari	2
	Kenchi	3
	Eyagi	4
	Egbo	5
	Ndocizhi (Tun a ye)	6
Eya We	Egi ya gunkin we yi o _____	
Ezhi nya we	Ezhiko	1
	Ezhi tetengi	2
Bana wo jin	Mi la jin makanta nya nasaraorIslamiya ndondo le a	1
katun kan na	Mi jin Makanta nya eciaba (Pramari) zo a	2

	Mi a Makanta nya eciaba (Pramari) jin gunmi	3
	Mi jin Makanta nya ekpo baci (Sekondari) zo a	4
	Mi a Makanta nya Sekondari (Pramari) jin gunmi	5
	Mi jin Makanta na dan yegboro nya sekondari o na jin	6
	Ndocizhi (Tun a ye)	7
Ekpo nya iyali	Mi la loorjin yawo a	1
	Mi da yawo a ni	2
	Mi a yawo laor a kegan be zabaci mi nyi	3
	Ndocizhi (Tun a ye)	4
Ekpa ma	Egima nini kete (1)	1
	Egima guba o lo guni (2 – 4)	2
	Egima na dokun gan guni na (5 – lo finti)	3
Adinni we	Kristen	1
	Musulumi	2
	Alada nya Ndako yizhi	3
	Ndocizhi (Tun a ye)	4
Ekpo nya etun na we e lo na	Wo dan etun o shisheci	1
	Wo a etun lugwa a ni	2
	Wo la de etun ndondo a	3
	Wo e lo etun kobagi ndoci	4
Yiri etun na we e lo na	Etun gominanti	1
	Etun ‘gwa loci (nya etitacin wotso)	2
	We e kpin ‘tun be ‘zandoci nyi	3
	Etun nya eyeladan emi ke nyimi na wo e lo o	4
	Wocece wawagizhi ga wo e ce o	5
	Enunu	6
	KodagbaorWocececi woncinko	7
	Ndocizhi (Tun a ye)	8
Yeko na iyali we e de aziki na	Ewotswa	1
	Kunkun nya enyangici latizhi	2
	Etunlo kobagizhi na jin nya lati a na	3
	Wocece nya Iyalizhior Woce kobagizhi	4
	Etun kobagizhi nya lati	5
	Gbatawozhi to Ewo mimacizhi	6
	Ndocizhi (Tun a ye)	7
Kotonkoci ewo na e lo ‘gwa we na	Wun a gba ewo jika shini be guwo e (#18,000)	1
	Tsakani jika shini be guwo e lo jika kpako be arata nyi (#18,000 – #50,000)	2
	Ewo Jika kpako be arata tu nini nyi lo jika shitsun shitsun eda gutsun	

	(# 51,000 - #100,000)	3
	Ewo Jika kpauba be shirtsun tu nini lo jika kpa guni din arata (#101,000 – #150,000)	4
	Ewo na gan jika kpa'guni tu arata be nini nyi na	5
Ewo nya'nyangici		
'fo eni ndondo na	Wun a gba ewo jika gutsun 'fo ndondo (#1,000)	1
	Wun gan ewo jika gutsun 'fo ndondo (#1,000)	2
Eza na e da wa ewo		
zhin be ya iyali na	Nda gbaugi	1
	Nna gbaugi	2
	Nda be Nna e (A e fin 'gwa keba)	3
	Ndako be Nnako e	4
	Yegizhi (Nugunci to 'gwazunmazhi)	5
	Egizhi	6
Ba na ye de 'nyangici	Daga na ye nu lati o yabaci na	
1		
na ye e gi 'mbo na	Ye shi shi dundu dzuko o	2
	Ye e da shishi 'fo ndondo	3
	Ye e da jin yaro jin	4
	Ezazhi e jin ye tamako jin	5
Ba na ye e de nuwon	Goga kpakpaci (bo hol)	1
finfinci na	Goga kwakwara	2
	Nuwon pompu nya 'zandondo	3
	Nuwonjeci	4
Babo ye e jin	Emi nin bo (shekpatajinba nya zaman)	1
shekpata o	Saliga nya gushe na a gba na	2
	'Gonta o	3
Asibiti yiri kici	Asibiti wawagizhi	1
Ye e lo o?	Asibiti woncinko nya gominati (general)	2
	Asibiti woncinko nya gominati tacin (FMC)	3
	Asibiti nya aladazhi (Gargajiya)	4
	Zezhi e lotun asibiti 'Mbo na (zezhi e sun nyizagizhi 'gwa ya egima na)	5
Babo ye e da Che	Tutunti nya ezhi kpata o	1
Shikanzhi ya fi o?	Hannya ruwa o	2
	Elenje o (kamina ele ga du na)	3
	Zhekpata o (Ego o)	4

Ke ye e ta nuwon dzu	Ye e du nuwon du	1
ta ya egizhi na o?	Yi e la alom to cigbe nazhi e la nuwon shi na dan u	2
	Yi e la nuwon san be ede yisangi nyi	3
	Yi e jin enya ndondo a	4
Yeko nya egima Kan	Kemina wuntso ga be etitacin u nyi Na	1
	Yeko nya kpikpe nya zaman	2
	Yi e jin ndondo a	3

Enyangici yiri kiczhi ye e shi kamizhi dokun o? La eri dan bo kemina u ga gonyi na.

Enyangici ndondo)	Zungukin o ('Fondondo, 'fo gutota tota, etswa ndondo, 'fo guwegi Nyangici sunsunzhi (kaba,mayi, shinkafa)'Nyangici kosunzhi (guzhia, soya sunsun) Nyangici finnizhi Enyan Mumucizhi Enyangici dagan dabazhio (nyikan, nakan, ezhi bishe)
--------------------------	--

KASAN B1i: Egangbinzhi eti yeko nya nyangici gi yiri yiri nimi 'mbo o nimi efo nini na gogan na o

nambaekpo nya enyangicizhi	ezheya (acinga=1, ah ah=2)
-----------------------------------	-----------------------------------

1. "Nyangici Warazhi:

shinkafa, kunu, eje kaba,
masa, spageti, eje kpayi, kuskus

2. **Nyangici nazhi de gbera bokun na:**

Eci na a du na, eci kinkanci, duku, gariorte'ba, bambaraorefan

3. **Nyangici finnizhi:**

Aleyefa, kpamin, finni ugwu
Kuka, nimbolo, emagi

4. **Sunsun mumucizhi:**

Lemu, donbina, paragi mumuci (wata milo)
mungoro, lemu bakagi, aya

5. Nakan:

Nakan nanko, kayan ciki,
kpakuma, nakan bishe,

nakan ‘nangi, ena ‘gonta
elugizhi, nakan soya.

6. Lemu bakagi, Mungoro, Aya, Konkeni, Gbiadiayibo Yaba.Ezhi:

7. **Nyikan to nyangicizhi dagan nuwon o:** Zhengi kansana, tsokungi, ‘zhengi funfuru, nyikan yeko

8. Sunsunzhi, kosunzhi to edzozhi:

Ezo (lialia), kose (akara), ezo na a lu na,
Bambara nya Soya bin, kuli, shiaruwa

9. Mandara to enya nazhi a jin be mandara e na:

mandara nya soya bin, yogot, to enya ndoci nazhi a jin daga mandara o na

10. Emi to enya nazhi de emi na:

Emi dzuru, emi kuli, epingi (paragi)
Edin, edzu

11. Enya managizhi to enyangici kobagizhi:

Enya finfinci ke koke, Fanta na
Kudo, kunu aya, kunu nya guzhia, zobo
kunu kaba
Egban nya cigban sunsunzhi,
Enya finfinci nazhi a san a (munge, ege dzuru to ndocizhi)
Enya nazhi a sa fi emi o na, (keki, bisikiti, kpof-kpofu)

12. Ninyazhi:

Kula tsaka, kula magi nor, to ndoci nazhi yi nya zaman na

B1ii: A de ‘za eni ndondo na e gi enyangici dembo na? (A) Eba (B) A de a
Wun ga yi acinga o, ke la o? to ke zun gukin na o?

KASAN B2i: Egangbinzhi eti yeko nya nyangici gi yiri o (ya egi mayiwo ‘za eni ‘za eni)

NAMBA EKPO NYA ‘NYANGICI

EZHEYA

**EBA =1,
AH = 2**

1. Nyangici nazhi de yikuru na:

Shinkafa, kunu, eje kaba,
masa, spageti, eje kpayi, kuskus
Eci na a du na, eci kinkanci, duku,
gariorte’ba, bambaraorefan.

2. Finni gigici zhikozhi: Aleyefa,
kpamin, finni ugwu Kuka, nimbolo,
emagi

3. Enya mumuci nazhi de vitamin A na:

4. Sunsun to enya mumuci nazhi ke na: Lemu,
donbina, paragi mumuci (wata milo) mungoro, lemu
bakagi, aya, yaba.

5. Kayan chikizhi:

6. Nakan to nyikan:

Zhengi kansana, tsokungi, ‘zhengi funfuru,
nyikan yeko, nakan nanko, nakan bishe, nakan
‘go, nakan elugizhi, (‘lukuku)

7. Ezhi:

8. Sunsunzhi, kosunzhi to edzozhi:

Ezo (lialia), kose (akara), ezo na a lu na, Bambara
nya Soya bin, kuli, shiaruwa, kula tsaka

9. Mandara to enya nazhi a jin daga mandara o na:

Yogot, wankashi, .fura be nwuanwua e, mandara nya nanko.

KASAN b2ii: Egangbinzhi eti zun gunkin na nna e gi enyangici gi na Zun gukin we gi enyangici nanazhi gbako sati na go gan na bo o?

Namba Ekpo nya enyangicizhi

Mi kara gi wun a

1 – 2

3 -6

o

Sati nini o

Sati nini

1. Enyangici na de yikuru na:

Shinkafa,
kunu, eje kaba,
masa,
spageti,
soya,
eje kpayi,
kuskus
Eci (duduciorkinkanci),
duku,
(duduciorkinkanci),
gariorte'ba,
bambaraorefan,
Kudo.

2. Finni gigici zhikozhi:

Aleyefa,
kpamin,
finni ugwu
Kuka,
nimbolo,
emagi

3. Enya mumuci nazhi de vitamin A na:

Karot,
Lemu,
Mungoro,
Konkeni,
Yengi

4. Sunsun to enya mumuci nazhi ke na: Donbina,

paragi mumuci (wata milo)
lemu bakagi,
aya,
yikunnu kpauta,
Ebe,
yaba,
kunu aya.

5. Kayan chikizhi:

6. Nakan to nyikan:

Zhengi (funfuru to kansana),
tsokungi (funfuru to kansana),
nyikan yeko,nakan nanko,
nakan bishe,
nakan 'go, {nakan elugizhi, ('lukuku)}

7. Ezhi:

Nya bishe nasara,
Nya bishe nya emi.

8. Sunsunzhi, kosunzhi to edzozhi:

Ezo (lialia),
kose (akara),
ezo na a lu na,
Bambara nya Soya bin (duduci to kinkanci),
kuli,
mandara nya soya bin,
kula tsaka

9. Mandara to enya nazhi a jin daga mandara o na:

Yogot,
wankashi,
fura be nwua-nwua e,
mandara na a la fi gongoni o na.

10. Enya managizhi to enyangici kobagizhi:

Enya finfinci ke koke, Fanta na
Enya nazhi a sa fi emi o na,
(keki, bisikiti, kpof-kpofu)
Enya finfinci nazhi a sa na
(munge, ege dzuru to ndocizhi)
Egban nya cigban sunsunzhi,
(nazhi a la fi gongoni ko bambo o na) Kudo ko zobo

KASAN Ci: Tsuwon nya yiri enyangici na a e la ya egi na la lo makanta a na gi (cin nya ke efo nini na gogan a ni na le)

Namba Ekpo nya enyangicizhi

Ezheya Eba = 1

Ah = 2

- 1 **Ebe nuwon:**
- 2 **Enyangici na de yikuru na:**
Shinkafa,
kunu,
eje kaba,
masa, spageti,eje kpayi,
kuskus
Eci (duduciorkinkanci),
duku,
gariorte'ba,
bambaraorefan,
Kunu nya nasara, biskiti, kpof - kpof.
- 3 **Sunsunzhi, kosunzhi to edzozhi:**
Ezo (lialia),
kose (akara),
ezo na a lu na,
Bambara nya Soya bin,
kuli.
- 4 **Mandara to enya nazhi a jin daga mandara o na:**
Enya finfincizhi nya mandara to koko
Mandara ruku,
Mandara na e kun fi babo o na (bobo, to ndocizhi)
- 5 **Enya nazhi a jin be nakan e na:**
Nakan nanko
Nakan bishe
Kayan cikizhi
Nyika.
- 6 **Ezhi:**
- 7 **Enya mumuci nazhi de vitamin A na:**
(Finni nazhi shi zhiko na)
Aleyefa,
finni ugwu
Kuka,
Karot,
tomato,
kpamin.
- 8 **Finni to enya mumuci ndocizhi:**
Lemu managi,
Donbina,

Paragi mumuci (wata milo)
Lemu bakagi,
Mungoro,
Aya,
Konkeni,
Gbiadiayibo
Yaba.

KASAN Cii: egangbinzhi eti nyangici wangi na egi na la lo makanta a na e gi na o

Ke zun gukin na egi we egi enyangici nanazhi ‘fo eni ndondo o?

Namba Ekpo nya ‘nyangicizhi gbako sati nini bo a	Mi kara la ya u gi	1 – 2 Sati nini o	3 -6 Sati nini
<p>1. Enyangici na de yikuru na:</p> <p>Shinkafa, kunu, eje kaba, masa, spageti, eje kpayi, kuskus, Kunu nya nasara,</p> <p>2. Gbere to ‘nyangici nazhi e sa fi kin bo na</p> <p>Eci (duduciorkinkanci), duku, (duduciorkinkanci), gariorte’ba, bambaraorefan.</p> <p>3. Mandara to enya nazhi</p> <p>a jin daga mandara o na: Enya finfincizhi nya mandara to koko Mandara ruku, Mandara na e kun fi babo o na (bobo, to ndocizhi).</p> <p>4. Enya nazhi a jin be Nakan e na to bishe:</p> <p>Nakan nanko (dzuru) Nakan bishe Kayan cikizhi Nyika (funfuru ko kansana).</p> <p>5. Ezhi:</p> <p>6. Enya managizhi to enyangici kobagizhi:</p>			

Bisikiti,
 Enya nazhi a sa fi emi o na,
 (chinchin, keki, , kprof-kprofu)
 To ndocizhi.

7. Enya mumuci to finni nazhi de vitamin A na:

Aleyefa
 Finni Ugwu,
 Eni Kuka,
 Kpanmi,
 karot,
 tomato,
 Lemu

8. Finni to enya mumuci ndocizhi:

Lemu managi,
 Donbina,
 Paragi mumuci (wata milo)
 Lemu bakagi,
 Mungoro,
 Aya,
 Konkeni,
 Gbiadiayibo
 Yaba

KASAN Di: Tsuwon dan nya cincinbo nya enyangici nimi iyali o

Namba	Egangbinzhi	Ezhezhi	Enya Eri
1	Gbako etswa nini na gogan na o,	Ah ah (janfuru dawo de wanikosa ke 'za 'mi we a de	
	egangbin 2) 'nyangici gi a na?	1 = Acinga o	
1a	Ke zun gukin na nana jin o?	1 = U gan kpwua a (Zunni ko zun guba etswa nini)	
		2 = Kandocizhi (Ke zun guwo na nimi etswa nini)	
		3 = Kandondo (U gan zun guwo gbako)	
	o)		
	etswa nini o)		
1	Nimi gbako etswa na gogan o na, 0 = Ah ah (Janfuru da Egangbin 3) a de eza ndondo nimi iyali ye bo na	1 = Acinga ode 'nyangici na wo wa gan wo j gi a na,	
	ebo cinbo nya aziki o?		
2a	Ke zun gukin na nana jin o?	1 = U gan kpwua a (Zunni ko zun guba etswa nini)	
		2 = Kandocizhi (Ke zun guwo na nimi etswa nini o)	
		3 = Kandondo (U gan zun guwo gbako etswa nini o)	

- 2 Nimi gbako etswa na gogan o na, 0 = Ah (Janfuru da Egangbin 4)
a de eza ndondo nimi iyali ye bo na 1 = Acinga ode ‘nyangici yiri na u wa gan wun
a gi na gi a, ebo cinbo nya
aziki bo o?
- 3b Ke zun gukin na nana jin o? 1 = U gan kpwua a (Zunni ko zun guba etswa nini)
2 = Kandocizhi (Ke zun guwo na nimi etswa nini o)
3 = Kandondo (U gan zun guwo gbako etswa nini o)
- 3 Nimi gbako etswa na gogan o na, 0 = Ah (Janfuru da Egangbin 5)
a de eza ndondo nimi iyali ye bo na 1 = Acinga ogi ‘nyangici yiri na u wa gan wun
a gi kponyi a na, ebo cinbo nya aziki na ye
ga a shi yiri ‘nyangici na ye wa na bo o?
- 4a Ke zun gukin na nana jin o? 1 = U gan kpwua a (Zunni ko zun guba etswa nini)
2 = Kandocizhi (Ke zun guwo na nimi etswa nini o)
3 = Kandondo (U gan zun guwo gbako etswa nini o)
- o)
- 4 Nimi gbako etswa na gogan o na, 0 = Ah (Janfuru da Egangbin 6)
a de eza ndondo nimi iyali ye bo na 1 = Acinga ogi ‘nyangici na a gba tsuwon na u
wa gan wun a gi na, ebo cinbo nya aziki na yega a shi ‘nyangici na a kun ye nyi
gi na bo o?
- 5a Ke zun gukin na nana jin o? 1 = U gan kpwua a (Zunni ko zun guba etswa nini)
2 = Kandocizhi (Ke zun guta lo guwo na etswa nini o)
3 = Kandondo (U gan zun guwo gbako etswa nini o)
- o)
- 5 Nimi gbako etswa na gogan o na, 0 = Ah (Janfuru da Egangbin 7) a de eza ndondo
nimi iyali ye bo na 1 = Acinga gi ‘nyangici na a gba zun gukin
na ye da ye e gi nyangici
na, ebo cinbo nya
aziki na ye ga a shi ‘nyangici na
a kun ye nyi gi na bo o?
- 6a Ke zun gukin na nana jin o? 1 = U gan kpwua a (Zunni ko zun guba etswa nini)
2 = Kandocizhi (Ke zun guta lo guwo na etswa nini o)
3 = Kandondo (U gan zun guwo gbako etswa nini o)
- o)
- = Kandondo (U gan zun guwo gbako etswa nini o)
- 6 Nimi gbako etswa na gogan na o, 0 = Ah ah (Janfuru da Egangbin 8) a de kami na ‘nyangici
ndondo danbo 1 = Acinga o na ye a gi emi ye bo na a, ebo cinbonya
aziki na ye ga a shi ‘nyangici na a na o?
- 7a Ke zun gukin na nana jin o? 1 = U gan kpwua a (Zunni ko zun guba etswa nini)
2 = Kandocizhi (Ke zun guta lo guwo na etswa nini o)
3 = Kandondo (U gan zun guwo gbako etswa nini o)

- 8 Nimi gbako etswa na gogan na o, ndondo nimi iyali ye bo 0 = Ah ah (Janfuru da Egangbin 9)a de ‘za eni
1 = Acinga o na lele be madan nyi ebo na ye de
nyangici na kun ye nyi gi na a na?
- 8a Ke zun gukin na nana jin o? 1 = U gan kpwua a (Zunni ko zun guba etswa nini)
2 = Kandocizhi (Ke zun guta lo guwo na etswa nini)
3 = Kandondo (U gan zun guwo gbako
o) etswa nini o)
- 9 Nimi gbako etswa na gogan na o, nimi iyali ye bo 0 = Ah ah (Egangbizhi a zo babo) a de ‘za eni ndondo
1 = Acinga o na de ‘nyangici gi dagan lazhin hari
da yeshi nyi a na?
- 9a Ke zun gukin na nana jin o? 1 = U gan kpwua a (Zunni ko zun guba etswa nini)
2 = Kandocizhi (Ke zun guta lo guwo na etswa nini)
3 = Kandondo (U gan
o) zun guwo gbako etswa nini o)

KASAN Diii: Kpikpe nya Nna eti’nyangici wangi na gonyi a gin a o.

- 1 Ke yi enyangici gi lafiyaci o?
a) Gigi nya enyangici nazhi a jin be ekpo ekpozhi nya ‘nyangici na yi gunguru na nyi.
b) Mi tso kpe a.
- 2 Tun ekpo ekpozhi nya ‘nyangici na e la nyangici na a jin na fe gunguru na
a) ‘Nyangici gunguru (Nyangici na e ya ‘za kagbo na, na e ya ‘za lafiya na, na de emi na,
nazhi de anfani wanginya nakan na, nazhi de esan na nakan e wan a, nuwon)
b) Nyangici na jin gunguru a na.
- 3 Ke yi kpatakibo nya ‘nyangici nanazhi nakan bo o? (Kaba, shinkafa, duku, rogo, eyi
ekpan, kpayi, eci, kunu, masa, bambara)
a) Na wun a ya ‘za kagbo na
b) Mi tso kpe a.
- 4 Ke yi kpatakibo nya ‘nyangici nanazhi nakan bo o? (Ezo, Nakan, Nyikan, Ezhi, Mandara
soya bin, Mandara nya nanko, Kula tsaka, wankashi nya soya bins.)
a) Na wun a la nakan ‘za sa na
b) Mi tso kpe a.
- 5 Ke yi kpatakibo nya ‘nyangici nanazhi nakan bo o? (Kashiu, lemuzhi, donbina, tomato,
lubasa, yaba, mungoro, konkeni, paragi mumuco {water milo})

- a) Na wun a ya ‘za kagbo na
 b) Mi tso kpe a.
- 6 ‘Nyangici gobagi nya yitso kiczhi e:
 a) ya ‘za Kagbo o?

 b) la nakan ‘za sa o?

- c) yi finnizhi tu egban nya cigban sunsun o?
- 7 Finni to egban nya cigban sunsun kiczhi e la nakan ‘za sagun dagan batan bo
 o?.....
 a) Enyangici nazhi yi ke Lemu, Lemu bakagi, Finni nazhi yi dofa na)
 b) Mitso kpe a
- 8 Kezhi yi eri na la wu ke egia dokun fi nakan bo a na o?
 a) Eyiku, eza ga a to bokun
 b) Mitso kpe a.
- 9 Nyangici kiczhi e be egia nya nakan cigban nya eza o?
 a) Nyangici ke (Hanta na, nakan nanko, finni dofa dofazhi to ezo)
 b) Mitso kpe a.
- 10 Nyangici kiczhi de Vitamin A nyi o?
 a) Sunsun nazhi de etsa ke dzuru na, finni nazhi de etsa zhikozhi na, karot.
 b) Mitso kpe a.
- 11 Babo we e de kpikpe eti nya enyangici gungunci nazhi u gonyi ezazhi a gi na o?
 a) Emi redio, kpati foto nyalabarizhi b) Man nya asibitizhi c) Ekanyeba nya
 nyizagizhi
 d) Makanta o e) Ekanyeba nya adinizhi o f) Dana ndocizhi o (tun a
 ye)

KASAN E: kemina cinbo nya etswazhi (eza yi won, ewunsunzhi to batan korona) be la ‘gwa la to nyangici de gi gboro nya iyalizhi na

- 1 Mgba cincinbo nya etswa na dan eka yi bo na to batan korona na be lo kin nya yi na a egwa la
 to iyali we yeko ndondo o? a) Acinga b) Ah ah (Wun a yi
 acinga o)(U kpe ye)
2. Nimi nanazhi o, kici la ‘gwa to iyali we saranyi kemina ye e gi ‘nyangici gi na o?
 a) Cincinbo nya etswazhi (masibazhi nya rayi)
 b) Kandan nya Korona c) Gubaba
- 3 Ke a la ‘gwa la to iyali we na o? a) Jinjizhi nya iyali ye a ba ke b) Etun a fan ye ‘gwa
 c) Cincinbo nya eza na yi ke ekpo woncinko ya ye na d) eloma nya nyangicizhi
- 4 Ke ewotswa nya we yiyi ebo enya nanazhi o na o? Wun a: a) Be da ‘ye b) din
 ke c) ‘Rikpe dan bo a
- 5 Ke u la ‘gwa la to enyangici gi nya iyali ye eba ekundo o, to nyangici wangi gi o na o?
 a) wun a be da ye b) wun a ke c) ‘rikpe dan bo a
- 6 Ke u la ‘gwa la to enyangici gi nya egi we eba ekundo o na o?

- 8 a) wun a be da ye b) wun a ke c) 'rikpe dan bo a7 Ke u la 'gwa lato
 zun gukin na wo gi enyangici nimi efo nini o na o? a) wun a ke b) 'rikpe dan bo a
- 8 Ke u la 'gwa la to zun gukin na wo ya egi we enyangici gi nimi efo nini o na o?
 a) wun a ke b) wun a ke c) 'rikpe dan bo a
- 9 Ke nana la 'gwa la to zun gukin na wo jin enyangici nimi efo nini o na o?
 a) wun a ke b) wun a ke c) 'rikpe dan bo a

KASAN F: Kpikpe ndocizhi eti nya egi o, to tsuwon dan nya nakancigban u zhi

Eya (Etswa) Bagi ko Nyizagi a) Bagi b) Nyizagi Ekpinlu nya u
 gbani (Kg) (U jin tile a) Ekpawun (cm)..... 'za gukinci egi nana yi iyali
 bo o? Ekpinlu nya u gbani (Kg)..... Tsuwon nya
 MUAC..... BMIorEya u.....

KASAN G: Tsuwon dan nya nakancigban nya Nnazhi

Ekpinlu (Kg)..... Ekpawun (m).....Gbugbo nya gboko (cm)
Gbugbo nya eshin BMI (kgorm²)
 Gbugbo nya eshinor ekpawun nyi.....

APPENDIX I



Appendix A 8APPENDIX I

MAKANTA LEGEN LEGE NYA KWAZULZ NATAL CINTARAGI II

EGANGBINZHI KAKANYI YA ENA ENAZHI, ANFANIJIN BE
DUDUGIWAZA NIMI YEKO NYA EGANGBIN NDOCIZHI O
Dede nya enya ndocizhi eti nya Egi o

- a) BagiorNyizagi b) Eyac) Egi
gukinci na u yi iyali o
na..... d) Egi rayideci gukin we ma a ni o?
e) Ekpindu
(kg) f) Ekpawun g) Babo u jin
makanta kan o?

.....
Etan eti lafiya nya Nna o

Eya nya Nna.....Tsuwondan nya ekinlu
be lisafi ndoci nya ekinlu (BMI).....
Wo de batan ndondo na e ku ka eza a na? a) Acinga b) Ah ah
a) Ekpa - heniagi b) Batan suga c) Batan Egiagun d)
Batan bagun bagun ndoci nazhi e lotun a na e)
Ndocizhi (Tun a ye)

**Jin anfani be foto nya ekpo ekpo gutwani nya nyangicizhi o, ebo we o la kpikpe
susoci o tin o ya eti yeko nya enyangicigi nya egi na la ya makanta nyi lo a na**

1. Mgba wo la enyangici nazhi dan foto nana o na kpeye wo?
2. Ke la u ci gonyi yi gi enyangici dozhin nanazhi o?
3. Enyangici yiri kicizhi wo yebo we o gi o? ('nyangici daga dabazhi to enya dzudzocizhi o, Finni to sunsun nya cigbanzhi na ezazhi yebo a gi na) La wujia tu la na la wo ci yebo 'o gi a na.

4. Zun gukin we e gi a 'fo eni ko sati nini o? Wun a yi wure nini o (u jin kami kpata a), ke la o?
5. Ke ekundo to ecinwon nya na we e gi 'fondondo na yiyi na o? To ke la o?

6. Ke zun gunkin na we a wag an we o fe o gi enyangici nanazhi o?
7. Ke yi kpatakibo nya enyangici nana(zhi) ya lafiya to sisaloye nya we o?
8. Ke wo kpaye gan wun a be jin we o, kaga wo de ‘nyangici nanazhi gi kemi na u gonyi na a na o?

Ebawu kpataki ya ezheyaci (Eza kpataki na de dede enyangici gboro dan ezhi o na)

1. Mgba eba kpikpe wo bo, ke wo kpeye gan e ye “nyangici gi mai lafiya o”?
2. ‘Nyangici nya gobagi yetsozhi kiczhi wo kpeye ke a yi nyangicizhi nya lafiya na yetso e dzo ci e gi kin mi ye bo na o?
3. Ke zun gukin na ye e la labarizhi eti nyangici gi gboro o lo ba nyizagizhi nya ezhi ye o?
4. Yeko kiczhi bo ye e la la labari nanazhi lo ba nyizagi nanazhi o?
5. Kew o gan wo eti lila dan jinjin o nya labari nanazhi nimi ezhi ye bo o?
6. Ke yi eny kpataki na e de ‘gwa dan yiri enyangici na iyalizhi to ezazhi e gi kin babo nana bo o?
7. Batan wawagi nazhi e fe daga eba cincinbo nya nyangicigi wangi o be na kiczhi wo le ye be eza nazhi e be eba we na o?
8. Ke we e ko cigbe nya batan nanazhi ko, na eza nazhi e be eba we na e la be na o?
9. Ekopawu kiczhi wo e de eba nya labari la lo eba ezazhiorezhi gobagi yizhi eti enyangicigi gboro bo o?

Ekpinlu (Kg)..... Ekpawun (m)..... Gbugbo nya gboko (cm)

.....Gbugbo nya eshin BMI (kgorm²)

..... Gbugbo nya eshinor ekpawun nyi.....

APPENDIX J



A cross section of focused group discussion using pictorial charts of food groups on mobile app with some children

APPENDIX K



Anthropometry equipment for mother/child pairs: A- Digital body composition weighing scale (Omron), B- MUAC strip, C- Stadiometer

APPENDIX L



Picture A Shows height measurement of a child, while Picture B shows MUAC strip in use

APPENDIX M



Pictures A, B, C and D shows weight and height measurements of the mothers

APPENDIX N

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EDITING CERTIFICATE

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UKZN doctoral thesis: ASSESSMENT OF MOTHERS AND PRESCHOOL-AGE CHILDREN'S FOOD AND NUTRITION SECURITY STATUS: A CROSS-SECTIONAL CASE STUDY OF NORTH CENTRAL ZONE, NIGERIA

I confirm that I edited this thesis and the references (except for Chapters 4 and 5) for clarity, language and layout. I returned the document to the author with track changes so correct implementation of the changes and clarifications requested in the text and references is the responsibility of the author. The intellectual content of the document is the responsibility of the author. I am a freelance editor specialising in proofreading and editing academic documents. My original tertiary degree which I obtained at the University of Cape Town was a B.A. with English as a major and I went on to complete an H.D.E. (P.G.) Sec. with English as my teaching subject. I was a part-time lecturer in the Department of Homoeopathy at the Durban University of Technology for 13 years and supervised many master's degree dissertations during that period.

Dr Richard Steele

05 September 2023

per email