To Explore the Emotion of Fear as a Barrier to Physical Activity in Younger Adults Who Are Obese

By

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November 2020

Edge Hill University

A thesis submitted in partial fulfilment for the requirements for the award of Doctor of Philosophy at Edge Hill University.

Declaration

This thesis is entirely my own work. The material in this thesis has not been submitted, in full, or in part, for any other degree or qualification at any other institution.

Signed

Oliver Hamer

Acknowledgements

I would like to take the opportunity to express my deepest thanks to my supervisory team for all the support they have provided. I greatly appreciate the patience and expertise I received from Prof Paola Dey that enabled me to grow as a researcher. I thank Dr Derek Larkin for sharing his insightful thoughts and guidance, whilst brightening our meetings with his humour. I am grateful to Dr Nicola Relph who gave me confidence in my ability throughout my time at Edge Hill University. Without each member of my supervisory team I would not have developed into the researcher I have become.

I owe a special thanks to staff members of Edge Hill University, namely, Phillip Gichuru, Steve Clayton, Anthony Bardsley, Claire Blennerhassett, Martin Stott, Simon Nielson, Beth Gibson, Michael Owen and Alexandra Bradshaw who assisted me in various phases of my PhD research. I also want to thank Clare Austin, Leon Culbertson and my supervisory team for giving me the fantastic opportunity of a funded PhD, which I would not have otherwise been able to undertake.

I sincerely thank all the participants who voluntarily gave up their time to contribute to the research in this thesis. Without their participation, the completion of this thesis would not have been possible.

I am grateful for the support I received from my family, friends and partner during my PhD. It was difficult to spend so much time away from them, but the experience was invaluable. It proved that with a strong work ethic and desire, almost anyone can achieve their goals.

I want to dedicate the thesis to my grandma who tragically passed away in May 2020 with the coronavirus, she would have been pleased with the effort I gave. I also want to dedicate this thesis to my father who fought off pneumonia twice to see it finished. He struggled tremendously with his health throughout my time at EHU but worked hard to improve his condition to see it through.

Abstract

Title: To Explore the Emotion of Fear as a Barrier to Physical Activity in Younger Adults Who Are Obese

Background: Physical activity helps weight maintenance and has health benefits, but adults with obesity report activity barriers. Although psychological concerns are important barriers, interventions underpinned by psychological theory have had limited success. This may be because of the limited focus on fear, particularly in younger adults.

Aim: To explore the emotion of fear as a barrier to physical activity in younger adults (aged 18-45 years) with obesity

Method: This PhD consisted of three phases: i) a scoping literature review on activity related fears; ii) a semi-structured interview study in 10 younger adults to explore activity-related fear experiences and iii) a cross-sectional survey to develop and validate a new tool on pain-related fear for younger adults and explore differences across body mass index groups.

Results: The scoping review identified 38 relevant papers. It confirmed fear as an important physical activity barrier but with limited information on younger adults with obesity. The semi-structured interviews suggested fear was an important activity related barrier in this group, particularly pain-related fear. These findings were used to develop a conceptual map of pain-related fear. Current measures of pain-related fear (PASS-20, PDI and NRS) only mapped onto the conceptual map when combined, but with considerable overlap. In total, 236 participants completed the three instruments. Factor analysis of their item scores resulted in a four-factor model with 12 items, with good construct and criterion validity. Participant scores on this new instrument confirmed those classified as obese had significantly higher pain-related fears compared to healthy weight adults (mean scores 29.8 vs 22.3; P= 0.000).

Conclusion: Fear, particularly pain-related fear, may be an important barrier to activity in younger adults with obesity. A conceptually underpinned new instrument, named the Pain-Related Fear Scale, will allow large-scale investigation of pain-related fear, and inform interventions to increase activity, within this under-researched group.

Keywords: Obesity; physical activity; exercise; health behaviour; fear; barriers

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List of Abbreviations

PhD	Doctor of Philosophy
WHO	World Health Organisation
BMI	Body Mass Index
KG/M^2	Kilograms per Metre Squared
PPI	Patient and Public Involvement
PIS	Participant Information Sheet
ID	Interpretative Description
TA	Thematic Analysis
IPA	Interpretative Phenomenological Analysis
FA	Fear Avoidance
FAM	Fear Avoidance Model
MEDLINE	Medical Literature Analysis and Retrieval System Online
CINAHL	Cumulative Index Nursing and Allied Health Literature
PEDro	Physiotherapy Evidence Database
TSK	Tampa Scale of Kinesiophobia
PASS-20	Pain Anxiety Symptoms Scale -20
PDI	Pain Disability Index
IPAQ-L7S	International Physical Activity Questionnaire- Short form 7 items
NRS	Numeric Rating Scale (of Pain)
VAS	Visual Analogue Scale (Pain)
FABQ	Fear Avoidance Beliefs Questionnaire
FAPS	Fear Avoidance of Pain Scale
MPQ	McGill Pain Questionnaire
FPQ	Fear of Pain Questionnaire
EHU	Edge Hill University
REC	Research Ethics Committee
QOL	Quality of Life
UK	United Kingdom
GDPR	General Data Protection Regulations
SPSS	Statistical Package for the Social Sciences
AMOS	Analysis Of a Moment Structures
PRISMA	Preferred Reporting Items for Systematic Review and Meta-Analysis
PROSPERO	International Prospective Register Of Systematic Reviews
SD	Standard Deviation
P-Value	Probability Value
NHS	National Health Service
SEM	Standard Error of Measurement
DF	Degrees of Freedom
STD	Standard
N	Frequency
COSMIN	COnsensus based Standards for the selection of health status Measurement INstruments

EFA	Exploratory Factor Analysis
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
GFI	Goodness of Fit Index
AGFI	Adjusted Goodness of Fit Index
RMSEA	Root Mean Square Error of Approximation
CI	Confidence Interval
ANOVA	Analysis of Variance
MNAR	Missing Not At Random
MAR	Missing At Random
MET	Metabolic Equivalent of Task
BMR	Basal Metabolic Rate
TDF	Theoretical Domains Framework

Chapter 1

Introduction

1.1 Background

Obesity is a complex multifaceted condition that develops from the interaction of genetic, cultural, socioeconomic, behavioural, physiologic, metabolic, cellular, and molecular factors (Montague and Broadnax, 2004). Obesity is defined by the World Health Organisation as a Body Mass Index (BMI) greater than or equal to 30kg/m^2. Other classifications such as overweight, healthy weight and underweight are defined by a BMI lower than 30kg/m^2 (underweight, below 18.5kg/m^2; healthy weight, 18.5-24.9kg/m^2; overweigh, 25-29.9kg/m^2) (WHO, 2018). BMI is calculated as weight in kilograms divided by the square of height in metres (kg/m^2) (De Bourdeaudhuij, 2003). There is some research that suggests the reliance of worldwide health statistics on BMI is problematic in defining obesity as it is a measure of both fat and lean mass (Sowers et al, 2007). Sowers et al, (2007) stated that muscle mass contributing to muscular strength, cannot be disaggregated in BMI calculations. Despite this, BMI has become a universally accepted individual and population-level measure of overweight and obese persons because of its simplicity and ease of measurement, and hence will be used in this study (Mahadevan and Ali, 2016).

Obesity is nearly always a result of prolonged positive energy balance whereby energy intake exceeds energy expenditure (Chooi, Ding and Makos, 2018). Obesity is associated with an increased risk of developing co-morbidities such as cancer, diabetes mellitus, osteoarthritis, cardiovascular disease, liver disease, stress and psychiatric concerns (Dixon, 2010; Wang et al, 2011; Hruby and Hu, 2015; Larkin et al, 2017). It is estimated that the annual economic costs of obesity on the National Health Service in the United Kingdom are close to £6.3 billion (Carl Baker, 2018). This cost places obesity as the third highest global burden of disease in the United Kingdom (Newton et al, 2015). This is concerning given that the prevalence of obesity in the UK continues to rise year upon year, reflecting the growing trend among other countries (NHS Digital, 2018). Globally, the World Health Organisation have deemed the increasing prevalence of obesity a crisis, in need of national and international intervention (WHO, 2016). However, as yet, despite widespread efforts, no country has successfully reversed the increase in prevalence (Roberto et al, 2015).

There are a range of factors that can contribute to this rise, however the concept of obesity resulting from energy intake exceeding energy expenditure is frequently cited (Chooi, Ding and Magkos, 2018; Wiklund, 2011). While some of the factors leading to obesity cannot be easily modified, restriction in energy intake in the form of dietary control and energy expenditure in the form of physical activity, can be effective methods for weight maintenance and weight loss (Wiklund, 2016). Alongside weight maintenance, participation in physical activity also has advantages in that it is associated with improvements in cardiorespiratory fitness, reducing the risk of diabetes and cardiovascular disease (Jakicic and Davis, 2011). However, despite the potential benefits of physical activity, adults with obesity often report high levels of inactivity (Cassidy et al, 2017). The reasons for this are complex and need further exploration to identify the key barriers to activity among adults who are obese (Macintosh et al, 2016).

This introduction summarises the factors that contribute to increases in the prevalence of obesity and its association with physical activity. The chapter will outline the important developments in the management of obesity and highlight the current gaps in research that need further exploration.

1.2 Epidemiology of obesity

Over the last three decades, the prevalence of obesity has increased worldwide (Chooi, Ding and Magkos, 2018). The international prevalence of obesity is a growing public health concern that affects over 650 million individuals (Roberto et al, 2015). Currently, the global prevalence of adult obesity is approximately 13% with a further 39% of adults overweight (WHO, 2020). It is forecast that obesity prevalence could rise to 25% of the world's population within the next 10 years (Wang et al, 2008; Hruby and Hu, 2015). The United States of America leads the international prevalence of obesity at approximately 35% (Odgen, Carroll and Flegal, 2014). The average population prevalence across most European countries is estimated to be 20% to 30% (Von Ruesten et al, 2011; World Health Organisation, 2018).

The latest figures in England suggest that obesity prevalence is approximately 27% (NHS Digital, 2017). These figures do not fully capture the wider concern of excessive BMI given that national statistics indicated that 58% of women and 68% of men were considered overweight or obese (NHS Digital, 2017). However, the prevalence of adults who are overweight is generally declining, whereas obesity has been on a steady increase since statistics in England were first recorded in 1993 (NHS Digital, 2017). Prevalence rates of obesity vary across different age groups with the highest rates among 55 to 64 year olds. However, there has been a notable rise in obesity prevalence among younger adults aged 18 to 44 years (NHS Digital, 2017). Statistics show that prevalence tends to be higher in females, but that male prevalence has begun to increase within the last decade. These rising trends have challenged researchers to identify the factors that may be contributing to the epidemic (Roberto et al, 2015).

1.3 Factors contributing to increases in the prevalence of obesity

Research has identified many factors involved in the rise of prevalence in obesity (Kadouh and Acosta, 2017). The most comprehensive review to date was conducted by the Foresight team and identified 109 factors that may contribute to obesity (Vandenbroeck et al, 2007). The review clustered these factors into seven main themes; physiology, food consumption, physical activity, individual psychology, social psychology, food production and physical activity environments (Vandenbroeck et al, 2007). The obesity system map highlights how these themes, their independencies and how they interact, determine the condition of obesity for an individual or a group (Vandenbroeck et al, 2007). The interactions between the factors demonstrates the complex systemic structure of obesity. The chapter will now introduce several of these themes and highlight the key factors that contribute to obesity.

1.3.1 Physiology

1.3.1.1 Genetics, pharmaceutical medicine, medical conditions, pre-birth determinants, gastrointestinal systems and hormones.

To date, there is some evidence that there is a genetic factor to obesity (Choquet and Meyre, 2011). Several studies have detected a genetic hereditability for body fat, food intake and physical activity (Chaput et al, 2014; Perusse et al, 2004). Research has identified 97 genotype loci that have been associated with BMI (Locke et al, 2015). However, variants in genes have only accounted for a 1.45% to 2.7% variation in BMI (Kadouh and Acosta, 2017; Speliotes et al, 2010). Further research is needed to identify variant combinations of multiple genes that may predispose individuals to early onset obesity (Huvenne et al, 2016). Mono-genetic research has produced more substantial results that show associations with the regulation of food intake (Rao et al, 2014). Research has identified genes that have mutated to cause an elevated BMI (because of ineffective regulation of food intake), the most notable of which is leptin (LEP that encodes the OB gene; controls satiety and satiation) (Choquet and Meyre, 2011). Identification of these gene mutations in early life could assist in the diagnosis of mono-genic obesity, and the administration of appropriate medication to delay its onset (Melchior et al, 2009). Research is limited; however, literature does suggest that obesity may not just be a result of poor energy balance but could be influenced by genetic factors. Further research is needed to identify those who may be at risk of obesity because of mutated or defective genes (Rao et al, 2014).

Recent evidence suggests that the use of prescription drugs (to treat a variety of medical conditions) may also be a factor in weight gain leading to a higher prevalence of obesity (Kadouh and Acosta, 2017). Several medications, such as, antidepressants, antihistamines, anti-hypertensives, antipsychotics, antidiabetics, antiepileptic's and some contraceptives are known to be positively associated with weight gain (Apovian et al, 2015). Research has highlighted that weight gain can occur (from 2.4kg to 12.8kg) with drug usage because of factors that influence energy balance (Leslie et al, 2007; Kadouh and Acosta, 2017). Drug related therapies are an important factor given that they treat conditions that hold strong relationships with obesity (such as depression and negative affectivity) (Hruby and Hu, 2015).

In the last decade research has identified several medical conditions such as hypothyroidism and hypothalamic obesity that have been associated with excessive weight gain and a BMI greater than 30kg/m^2 (Roth, 2015). A common condition is hypothyroidism whereby the body's thyroid glands becomes unproductive (Sanyal and Raychaudhuri, 2016). Studies have shown that energy expenditure is lower and that small reductions in thyroid productivity are associated with BMI increases of 2kg/m^2 (Knudsen et al, 2005). Another condition that has been associated with an elevated BMI is hypothalamic obesity (Steele et al, 2013). This condition is a result of injury or damage to the hypothalamus which plays a part in the regulation of energy intake and expenditure (Kadouh and Acosta, 2017). Findings have shown an association between this condition and higher BMI classifications of obesity, often exceeding 40kg/m^2 (Roth, 2015). Other conditions such as diabetes, heart disease, cancer and hypertension have all been associated with obesity (Jarolimova, Tagoni and Stern, 2013). Most of these conditions are positively correlated with increasing BMI and have been found among all ethnic groups, nationalities, and genders (Nguyen et al, 2008; Dam et al, 2006; Jarolimova, Tagoni and Stern, 2013).

Alongside these other factors, there is a growing body of literature that states that obesity can be influenced by nutritional and environmental factors in the prenatal periods prior to birth (Mannan et al, 2013). The most influential factor is that of pre-pregnancy BMI, which can predict future occurrences of obesity in children and adolescents (Baptiste-Roberts et al, 2012). Previous research highlights that children born with obese parents are approximately two times more likely to have a BMI that classifies them as overweight or obese (Dev et al, 2014). Maternal obesity can also double the risk of infant mortality in preterm and interim births (Johansson et al, 2014). Excessive alcohol consumption and smoking during pregnancy can also predispose children to obesity later in life (Lifschitz, 2015). Exposure to these factors is stated to likely change the structure of organs, causing alterations in the brain gut axis that regulates hunger, satiety and satiation (Ozanne, 2015). However, more research is needed to clarify the effects of prenatal influences and to understand the mechanisms for these determinants (Kadouh and Acosta, 2017).

There is some evidence that obesity can result from individual variations in gastric functions and abnormalities in the brain gut axis (Kadouh and Acosta, 2017). Research has found that excess weight in some adults, can alter communication signals (among the brain and gastrointestinal system) that are primarily responsible for the control of food consumption (Hussain and Bloom, 2013). These altercations in gastric function have resulted in decreased satiation, increased gastric motor function, and accelerated gastric emptying (Acosta et al, 2015). As a result, individuals often over consume calories and are unable to energy match their intake to their expenditure (Church et al, 2011). At present, research remains unclear as to how the brain-gut altercations occur, and whether they are a cause or effect of obesity (Acosta and Camilleri, 2014). However, it is thought that alterations in several hormones involved in the regulation of gastric function and satiety may be a contributing factor in the growing prevalence of obesity (Acosta et al, 2015). Several studies have shown that imbalances among hormones are a contributing factor towards obesity (Wynne et al, 2005). These hormones are mainly those that control appetite, energy intake and satiety signals (Hardman and Stensel, 2009). One such hormone called leptin, acts to supress appetite and increase energy expenditure. When this hormone is not produced, appetite becomes uncontrolled and rapid weight gains occur (Licinio et al, 2004). Some studies have shown that lower leptin levels can also slow down rates of metabolism which promote weight gain, especially following a period of calorie restriction (Troke, Tan and Bloom, 2014). Although research is still in stages of infancy, defects in hormone production that contribute to obesity are rare, and at most, only impact on 5% of obese individuals worldwide (Korner and Aronne, 2003).

1.3.2 Psychological factors

1.3.2.1 Stress and mental health disorders

The mechanisms by which stress is associated with obesity are not yet fully understood, but studies have identified that prolonged stress is related to an increased BMI (Block et al, 2009; Holmes et al, 2009). The stress response and its impact on the body is often measured by amplitude (e.g. heart rate, cortisol release or blood pressure measurements), but these methods often overlook the gradual dysregulation of endocrine systems that regulate the bodies return to baseline (Holmes et al, 2009). The hypothalamic-pituitary adrenocortical (HPA) axis is an endocrine system responsible for the production of corticotrophin, the adrenocorticotropic hormone and cortisol (Charmandari et al, 2005). These systems regulate negative stress responses and have some involvement in food intake and fat deposition (Holmes et al, 2009). It is thought that extended periods of chronic stress may result in adaptations to the HPA axis that disrupt the regulation of fat deposition (Dallman et al, 2006). Disruption results in the formation of fatty streaks, weight gain and visceral obesity (Beisiegel and Clair, 1996; Alvarez et al, 2002). Some research has suggested that stress can also cause disruptions in regulation of gut function which promotes obesity (Tschop, Hosoda and Heiman, 2000). In two studies, periods of chronic stress were associated with a rise in ghrelin secretion into the gut (hormone) that stimulates energy intake (Kojima et al, 1999; Wang et al, 2013). Further to this, several studies have shown associations between high levels of stress and weight gain. For example, Van Jaarsveld et al, (2009) found that high-stress groups of adolescents had significantly greater waist circumference and BMI compared to low-stress groups. Similarly, Block et al. (2009), concluded that increases in BMI (in adults from the US) are related to heighted stress caused by work, relationship, or family life. From this evidence, prolonged stress and depressive cognitions may be a factor in weight gain and the increased prevalence of obesity.

An important factor in the relationship between obesity and stress is experiences of weight stigma and weight bias that have negative consequences for weight and wellbeing (British Psychological Society, 2019). Obese individuals encounter weight stigma from several sources such as the media, society, politics, policy, health promotion and healthcare (O'Hara and Taylor, 2018). Research suggests that enacted weight stigma has harmful emotional consequences for obese adults, frequently provoking stress and depression (Kadouh and Acosta, 2017). Experiences of stigma also has physiological effects such as the heightening of blood pressure, dysregulation of the metabolic system and increased cortisol reactivity (Unger et al, 2017; O'Hara and Taylor, 2018). Weight stigma has detrimental consequences for health promoting behaviour in that victims avoid physical activity (often resulting in additional weight gain) (Puhl, Brownell and DePierre, 2014; Giel et al, 2012). Research now suggests that weight stigma is a contributing factor in the growing prevalence of obesity and needs to be dispelled in order to successfully reverse these trends.

Alongside stress, there is a growing body of literature suggesting that mental disorders such as anxiety and depression can also increase the risk of obesity (Kyrou et al, 2018). Research by Vogelzangs et al, (2008) established strong associations between baseline depression and increases in body fat, contributing to a heightened BMI. Other research has found associations between anxiety disorders and increased risk of weight gain (Atlantis and Baker, 2008). Notably, these associations are stronger in females and those who are morbidly obese (BMI >40g/m^2) (Muhlig et al, 2016). At present, obesity is understood to have a bi-directional relationship with mental health and psychological wellbeing (Kyrou et al, 2018; Mulhig et al, 2016). Though the mechanisms for these associations are not yet fully understood, they are likely linked to the gradual dysregulation of the endocrine system and hormone imbalances in a similar manner to the bodies stress response (Kyrou et al, 2018; Holmes et al, 2009). However, they may also be linked to declines in motivation, self-esteem and confidence which can negatively impact upon energy balance (i.e. reductions in physical activity levels) (Chang et al, 2008).

1.3.3 Physical activity and the environment

Physical activity is defined by the World Health Organisation (2014) as any bodily movement produced by skeletal muscles that requires energy expenditure and can be categorised into occupational, sports, conditioning, household or other activities. This definition unlike others, includes low intensity incidental activities that are especially significant for obese adults that often cannot engage in moderate to higher intensity activities (Wingo et al, 2011). Since the definition was developed in 1985, it has been a foundation by which epidemiological studies could contextualise an understanding of energy expenditure by way of body movement (Caspersen et al, 1985). To continue the contextual foundations of epidemiological studies, this PhD study will adopt the WHO definition.

The World Health Organization (2011) highlights that physical activity can have important benefits for health. Adults aged 18- 64 years doing at least 150 minutes of moderate intensity exercise per week have lower rates of all-cause mortality, coronary heart disease, high blood pressure, stroke, type 2 diabetes, metabolic syndrome, colon and breast cancer, depression, hip or vertebral fractures, higher level of cardiorespiratory health, muscular fitness and are more likely to maintain a healthy weight (WHO, 2011). Physical activity has been identified by some as the principal management strategy to obesity in young adults (Watts et al 2005). This is based on evidence that the global direction of food quality, portion sizes, and point-of-choice nutrition all points to an increase in average energy intake (Chan and Woo, 2010). Adherence to physical activity serves to counteract the increased calorific content and promote health benefits beyond weight loss (Swift et al, 2014). Despite this, data from 2016 suggests that 39% of the English population were still failing to meet the recommended activity guidance (NHS, 2017).

Although general physical activity recommendations exist, recommendations for obese adults has yet to be determined by the UK government (Street, Wells and Hills, 2015). Research has suggested that physical activity for the obese should incorporate an increase in aerobic activity, such as, walking for >150 minutes per week and include two 30-minute sessions of resistance training to preserve lean body mass (Ryan and

Heaner, 2014). To maintain lost weight, greater amounts of physical activity exceeding 200-300 minutes per week are recommended (Valencia et al, 2014). To achieve noteworthy weight loss, recent evidence has suggested that obese individuals should gradually accumulate up to 420 minutes of activity per week (Raynor and Champagne, 2016). However, these guidelines have received some criticism because they require obese adults to perform approximately 60 minutes of activity per day which is often unachievable given employment, family and social commitments (Samir et al, 2011; Flannery et al, 2018). Similarly, these activity guidelines lack detail regarding appropriate exercises and intensities that are necessary for minimising barriers and ensuring activity is sustainable (McIntosh, Hunter and Royce, 2016). Some research has stated that universal guidelines may not be appropriate for obese adults given the range of comorbidities and need for a person-centred approach (Wiklund, 2016; Swift et al, 2014).

1.3.3.1 Inactivity and sedentary lifestyles

Inactivity and sedentary behaviours have been consistently associated with an increased body mass (Romieu et al, 2017). Research has stated that this is due to an inability among individuals to predict a suitable energy intake when appetite is not being driven by energy expenditure (physical activity) (González et al, 2017). Inactivity is problematic in that increases the risks of several non-communicable diseases such as diabetes, hypertension, osteoporosis, CVD, cancer and depression (Kumar, 2017). These diseases have all been associated with disability that presents a barrier to physical activity and increases the risk of obesity (Cicognani et al, 2014). There is growing evidence that physical inactivity has increased over the last 18 years, rising annually to an estimated 37% of western country populations in 2016 (Guthold et al, 2018). The rise in inactivity amongst these countries is comparable to the rise in levels of obesity, strengthening the premise that inactivity is a contributing factor to the growing prevalence of obesity (WHO, 2016; Guthold et al, 2018). It is thought that urbanisation and industrialisation over the past several decades have caused individuals to become less active (Chooi et al, 2019). The increasing reliance on energy sparing equipment and prolonged screen time in employment settings has also contributed to reductions in activity (Kadouh and Acosta, 2017). These environmental changes have been described as ‘obesogenic’ because they support unhealthy behaviour as a default choice for many adults (O’Hara and Taylor, 2018).

Evidence shows that worldwide efforts to reduce physical inactivity have been slow in its progress and are failing to meet annual targets (Guthold et al, 2018). This is concerning for obesity given that weight maintenance and achievement in weight loss are significantly greater when physical activity is sustained (Johns et al, 2014; Gonzalez et al, 2017).

1.3.4 Energy balance

Arguably the biggest factor in the growing prevalence of obesity is that of energy imbalance (Romieu et al, 2017; Kadou and Acosta, 2017). Both reductions in physical activity and the increase in dietary intake, contribute to the imbalance between energy intake and expenditure. This imbalance is important because energy consumed in excess of energy expended is generally stored as fat (Elia, 1992). Restricting dietary intake and increasing physical activity can contribute to more energy being used than taken in (Manore et al, 2017). This is called a calorie deficit, and by achieving daily calorie deficits individuals can consistently lose weight (Hall, 2008).

The reduction of dietary calorie intake has been the focus of many intervention strategies for weight loss and has had more success than physical activity alone in achievements of weight loss (Johns et al, 2014). However, weight loss achieved through dietary intervention is rarely maintained after two years of follow up, and weight is often regained within one year (Van Baak and Mariman, 2019). International statistics suggest that neither diet nor physical activity interventions have been wholly successful in reducing the increasing prevalence of obesity (Foster-Schubert, 2012). This lack of success has been attributed to a combination of internal and external factors such as psychological concerns, poor socioeconomic status and accessibility (Hill et al, 2012). These factors present a barrier physical activity and the ability to sustain healthy eating (Thomas et al, 2010). Because of the influences of these factors, recent literature has stated the need for an alternative approach to tackling obesity (Romieu et al, 2017). Research suggests that it could be beneficial to focus less on weight loss and concentrate on other health benefits (Ayotte et al, 2010). This is because research suggests that weight loss is difficult to achieve, whilst improvements in health, cardiorespiratory fitness and strength are often easier to attain, particularly for adults with weight concerns (Kumar, 2017). Arguably, physical activity can contribute more benefits outside of weight loss. For example cardiorespiratory, strength and functional improvements promote a greater quality of life (WHO, 2011). The effects of physical activity have also been found to impact on long-term energy balance through an increase of resting energy expenditure (burning more calories) (Hall et al, 2012). This is a result of an increase in metabolic energy expenditure that continues long after activity has concluded (Hall et al, 2012). Body composition changes as a result of physical activity, can also affect energy balance. For example, increases in muscle mass and density require more energy (calories) to function, adding to an individual's basal metabolic rate (Hall et al, 2012). These benefits provide a rationale to focus more upon physical activity to tackle the growing concerns around excess weight (Kumar, 2017)

1.4 Interventions to tackle obesity

Over the past 20 years, interventions to tackle obesity levels have largely been ineffective, therefore have failed to reduce treatment costs of associated conditions (Thomas et al, 2010). This is because there has been very little improvement that has led to universal success in lifestyle interventions that promote physical activity, diet and behaviour change as a way to tackle obesity (Baillot et al, 2015).

Community based interventions that target multiple health behaviours have had greater success with weight loss by encouraging social support, tailored activity programmes and self-regulation techniques (British Psychological Society, 2019). However, most community intervention have yet to develop clear protocols and are not based upon up to date scientific evidence or with insight from behavioural science (British Psychological Society, 2019). These interventions also lack suitably trained staff who understand the complex components of behaviour change, and can provide psychological support to adults who have weight concerns (Nelson, 2013). Because of this, community-based interventions show weak evidence of weight loss being maintained at 12 month follow up, and show little evidence that health promoting behaviour change continues post intervention (National Institute for Clinical Excellence, 2019). This provides a strong rationale to suggest that there is a need for reform within the strategies of interventions (Mitchie, Atkins and West, 2015). One of the key criticisms is that current strategies do not do enough to tackle psychological barriers of behaviour change (Kelly et al, 2016). This may be because existing strategies are often focused on education which has had little success in reducing psychological worries and concerns (Wansink and Pope, 2015). Some research suggests that health promoting interventions may actually be exacerbating psychological concerns, because they have utilised stigmatisation and fear-based communications in an attempt to alter behaviour (Baranowski et al, 2003; Cooper et al, 2010). These communication strategies have found to be counterproductive and demotivating, particularly for obese adults (Wansink and Pope, 2015).

Evidence is also weak for individual interventions which are designed to tackle obesity (Schaefer and Magnuson, 2014). Research suggests that at most, obese individuals are able to achieve modest weight loss (>5% body mass) (Agha, Agha and Sandwell, 2014). However, a large proportion of literature states that weight loss is often regained at 12 months follow up (Agha, Agha and Sandwell, 2014; Dobbs et al, 2014; Lee et al, 2010). This is likely because interventions have yet to adopt a person centred approach and target the complex web of psychological concerns (such as fear) that have been found to contribute to the problem of energy balance in the obese (Foster-Schubert et al, 2011; Ayotte, Margrett and Hicks, 2010).

At present, interventions have largely focused on dietary intervention as the primary approach to weight loss, with less emphasis on promoting physical activity (Sweet and Fortier, 2010). This is problematic because research has shown that the addition of physical activity promotes a greater reduction in waist circumference, hepatic fat content and BMI (Goodpaster et al, 2010). That being said, there is little evidence to support the effectiveness of any intervention in slowing the growing trend of obesity, and so targeting the development of physical activity interventions for health benefits (beyond weight loss) may be another way forward (Johns et al, 2014). Research shows that achieving 150 to 300 minutes per week of moderate to vigorous intensity physical activity can reduce bone fractures, depression, type II diabetes, incidences of cancer and cardiovascular disease (Kumar, 2017; Chalder et al, 2012; Frietas et al, 2014; DiPietro and Stachenfield, 2017). For sedentary individuals, achieving an initial

120 minutes of moderate intensity walking per week has been shown to reduce all-cause mortality by up to 54% (Kumar, 2017; Penedo and Dahn, 2005). As obese adults have been found to be largely sedentary, they could benefit most from physical activity and improvements in cardiorespiratory fitness because of the likely reduction in chronic disease prevalence that is independent of body mass (Romieu et al, 2017). This is important because many obese adults experience a decline in quality of life as a consequence of co-morbid chronic conditions, rather than the obesity itself (Cooper et al, 2018). This provides a rationale to shift the focus of interventions toward developing and promoting physical activity within a more balanced approach, rather than focusing heavily on diet (Swift et al, 2014).

1.5 Physical inactivity levels among obese adults

Large international studies estimate that 1 in 5 individuals are physical inactive, failing to meet minimum activity guidelines (Dumith et al, 2011). Inactivity statistics are significantly higher in individuals with a BMI above 30kg/m^2 (Gonzalez et al, 2017; WHO, 2001). One study highlighted that physical inactivity among obese adults could be as high as 70% (Samir et al, 2011). Sallinen et al (2009), stated that severely obese adults (BMI of 35kg/m^2 or more) were at four times higher risk of being physically inactive than those who were moderately obese (BMI of 30 to 34.9kg/m^2). This has ramifications for further weight gain, increasing the risk of suffering chronic disease and early mortality (Haapanen et al, 1997). The increase in physical inactivity among obese adults is likely due to a higher prevalence of chronic diseases, pain, functional limitations, and fear (Sallinen et al, 2009; Cooper et al, 2016). Some research suggests that older obese adults may be at a greater risk of inactivity because they have increasingly poor health and greater fears that restrict activity (Toft and Uhrenfeldt, 2015; McIntosh, Hunter and Royce, 2016). However, other studies suggest that most obese adults irrespective of age, experience similar barriers that increase the risk of inactivity (MacLellan et al, 2017).

1.6 Barriers to physical activity for obese adults

Individuals with weight concerns have described several physical barriers that prevent physical activity. Central to these physical barriers is excess weight, making basic movement difficult, uncomfortable and often painful (Piana et al, 2013). Individuals experiencing discomfort and pain often enter a cycle of reduced activity leading to further weight gain (Egan et al, 2013). This is because pain often manifests into pain-related fear(s), shifting barriers from physical to psychological (Matter et al, 2012). Other physical barriers such as ill health also increase the likelihood that overweight and obese adults avoid activity (Cheng et al, 2010; Matter et al, 2012).

Alongside physical barriers, external barriers (such as lack of time, and lack of facilities) have been found to impact on activity levels (Rech et al, 2016; Stankov et al, 2012). Several studies have concluded that the issue of time is significant to obese adults (Peacock et al, 2014; Bond et al, 2013; Rech et al, 2016; Napolitano et al, 2011). Two explanations for the perceived lack of time have been suggested: One points to personal commitments/responsibilities, and the second to a lack of motivation (Dias et al, 2015; Bowles et al, 2002). Some authors have suggested that a lack of time is often expressed by obese adults to conceal other psychological barriers (Bowles et al, 2002). This was evident by the findings of Egan et al (2013), who found that obese adults who reported a lack of time also spent several hours per day watching television. This strengthens views that reports of a lack of time may be consistent with other psychological barriers such as a lack of motivation. The reporting of external barriers as an alternate to the admittance of psychological barriers could explain why government initiatives (building physical activity facilities, lowering costings of facilities and free education) to reduce external barriers, does not appear to have had any substantial impact on levels of inactivity (NHS, 2016; McIntosh et al, 2016).

As stated above, there is some evidence that the reporting of both physical and external barriers could be used to mask psychological reasons why obese adults do not meet the national guidelines for physical activity (Wiklund et al, 2011). Evidence suggests that interventions targeting physical and external barriers are unlikely to be effective if psychological barriers are not addressed together with them (Wiklund et al, 2011). There is a consensus among research that psychological concerns appear to be the primary activity related barriers for overweight and obese adults (Aibar-Almazána et al, 2017). Psychological barriers to activity include negative perpetuations of weight, low mood, lack of enjoyment, lack of motivation, lack of confidence and activity related fears (Napolitano et al, 2011). Stankov et al (2016), highlighted that the most common psychological barriers are a lack of confidence and negative body image. However, there is some recent literature that suggests a growing concern regarding activity related fears because they are likely to impact upon and intensify other psychological barriers (Rosic et al, 2019; Wingo et al, 2011). Arguably, fear related barriers are the most difficult to overcome because they are often a consequence of poor mental health (Gatineau and Dent, 2011). This is important because evidence shows a strong association between obesity and poor mental health in both children and adults (Gatineau and Dent, 2011). This association is not unidirectional as mental health can be both a consequence and antecedent of increasing BMI (Russell-Mayhew et al, 2012; Goldfield et al, 2010). Fuller et al (2017), identified that the incidence of depression in obese persons is double that compared to healthy weight individuals. This research suggests that there is a need to reduce psychological barriers to increase the success of activity interventions for the obese (Carels et al, 2009; King et al, 2012).

1.6.1 Developments in fear as a barrier to physical activity

Recently there has been some exploratory focus on the emotion of fear as a barrier to activity in middle to older aged adults (Aibar-Almazána et al, 2017; Forbes, 2014; Wingo et al, 2011; Rosic, 2019; Jeon, 2013). This research suggests that fear beliefs contribute to activity avoidance and inactivity (Vlaeyen et al, 2012). Fears relating to injury, falling, movement, pain, stigma, and embarrassment are of particularly importance for overweight and obese adults because they have been associated with lower levels of activity participation (Fjeldstad et al, 2008; Finkelstein et al, 2007; Baillot et al, 2013; Rosic, 2019). Fear related barriers are also important because experiences of fear often result in a series of maladaptive psychological responses that provoke negative cognitions, depression, and increased perceptions of disability (Vlaeyen, Crombez, and Linton, 2016; Vincent et al, 2014; Cooper et al, 2017). These consequences are likely to increase the risk of inactivity among obese adults (Zelle et al, 2016). That being said, there are several limitations with the current literature in that very few studies have explored fear related barriers in younger adults or with non-clinical populations (Vincent et al, 2014; Rosic et al, 2019). These limitations are exacerbated by the fact that there has been no known review of the literature relating to fear as a barrier to physical activity. The following chapter, a review of the literature, will identify what is currently known about fear related barriers and confirm any gaps in knowledge for future research.

1.7 Defining and conceptualising fear

There are several definitions of fear dependant on the disciplinary context, for example neuroscientists use fear to describe the empirical relation between a threat stimulus and the behavioural response (LeDoux, 2012). In biology, fear is associated with the release of adrenaline from the amygdala with the purpose of providing energy to flee or fight a threat (Adolphs, 2014). However, with the focus of this research on psychological phenomena, fear will be understood within the context of psychology. In psychology, fear is thought to arise with a threat of harm, either psychologically, physically, or emotionally (imagined or real) (LeDoux, 2014). The psychological construct of fear suggests that its purpose is to protect an individual against an immediate, real and subjective threat (Asmundson, Vlaeyen and Crombez, 2004; Adolphs, 2014). For example, a fear of reptiles (herpetophobia) may serve (in evolutionary contexts) to provoke an increase in awareness that helped humans to survive the species (LeDoux, 2014). In this sense, fear is typically directed toward a distinguishable stimulus, situation, or activity (Asmundson, Vlaeyen and Crombez, 2004). However, the intensity of fear is thought to be multifaceted and largely dependent on the stimulus (ranging from experiences of being afraid to extremely terrified) (Frijda et al. 1992). The severity of the threat is likely to dictate the intensity of the fear related experience and determine how the individual responds to reduce or eliminate the threat (LeDoux, 2014).

Literature proposes that fear can exist prior to, and following three key dimensions along which fear is expressed: cognitive, behavioural and physiological (Asmundson, Vlaeyen and Crombez, 2004). Each of the three dimensions and how they are expressed is important to the understanding of fears that relate to activity (being the focus of this research) (Vlaeyens et al, 2012). The cognitive emotional dimension is characterised by cognitions relating to threatening stimulus or danger (Asmundson, Vlaeyen and Crombez, 2004). This dimension can increase negative cognitions which directs attention away from motivating action such as health promoting behaviour (Asmundson, Norton and Norton, 1999). The behavioural dimension can be characterised by the defensive behaviour that occurs as a direct response to a perceived threat (Asmundson, Vlaeyen and Crombez, 2004). Defensive behaviours are typically those that include fight or flight responses (Asmundson, Vlaeyen and Crombez, 2004). A flight response to activity related fears may include a partial or complete avoidance, whilst a fight response may include partaking in health promoting behaviours to combat a perceived threat (such as ill health or mortality). The physiological dimension is characterised by a stimulation of the sympathetic nervous to prepare the body to respond to threats (Asmundson, Vlaeyen and Crombez, 2004). This dimension may provoke an increase in heart rate and muscle tension to better facilitate fight response (Adolphs, 2014; Vlaeyen and Linton, 2000). It may also increase respiratory rate allowing more oxygen to be transported to the musculature to prepare the body for flight responses (Asmundson, Vlaeyen and Crombez, 2004). These three dimensions along which fear is expressed are thought to be loosely coupled but differ systematically between individuals (Adolphs, 2014). This means that dependant on the context and stimuli, behaviour responses may play a greater role over another (e.g. cognitive) dimension or vice versa (Asmundson, Vlaeyen and Crombez, 2004).

These concepts provide a basis for a definition of fear in that it is a perceived 'real' or 'objective' threat that causes cognitive, physiological, and behavioural responses, often resulting in actual or intended flight or fight (Adolphs, 2014). This definition will shape the researcher's perception and interpretation of participant fears throughout the PhD. This definition separates perceptions of generalised anxiety and worry in that anxiety is typically a response to anticipated threats (future orientated) that are vague, lack clarity or are largely unknown to the individual, whereas fear is directed towards a concrete stimulus (Asmundson, Vlaeyen and Crombez, 2004; Barlow, 2000; Adolphs, 2014).

1.8 Chapter summary

In summary, obesity is a growing public health concern that affects over 650 million adults worldwide (Roberto et al, 2015; Kyrou et al, 2018). Obesity is widely considered a chronic disease that exacerbates and increases the risks of a wide spectrum of co-morbidities, including cardiovascular disease, type 2 diabetes mellitus, cancer, hypertension, various mental health conditions and several types of musculoskeletal disorders (Kyrou et al, 2018). Its multifaceted aetiology means that there are several factors that can cause excessive weight gain (Kadouh and Acosta, 2016). Factors such as genetics, medical conditions, stress and environmental exposures contribute to the prevalence of obesity but are not determined by conscious or voluntary behavioural choices (Benton and Young, 2017). Other factors such as energy balance (energy input from food consumption and energy expenditure from physical activity) are believed to be influences that can be manipulated and controlled by behaviour (O'Hara and Taylor, 2018). Because the focus on energy intake within interventions (dietary) has not been wholly successful in reducing national obesity levels, energy output in the form of regular physical activity has been proposed as a primary component to tackling obesity (Hruby and Hu, 2015). Physical activity may be superior to dietary intervention alone because of the additional physical and psychological health benefits that are gained irrespective of weight reduction. However, regular physical activity is difficult to achieve because obese adults experience several barriers to participation. These barriers are multifactorial and can include physical, psychological and environmental components. Evidence suggest that psychological barriers are the primary obstacles preventing obese adults from contemplating and partaking in physical activity (Aiber-Almazan et al, 2017). However, even though there is a much greater understanding of the role played by psychological barriers, such as, motivation and depressive symptoms, there are still high levels of inactivity among obese adults. This suggests that interventions that do not target ,or only target a limited spectrum of psychological barriers are failing to recognise that there may be several other factors to the problem of inactivity in the obese (Foster-Schubert et al, 2011; Ayotte, Margrett, and Hicks, 2010).

To tackle this failure, it is necessary to re-examine the barriers that an obese population may face that could prevent an increase in their levels of activity. An area of research that has received little attention within this field is that of fear. Fear is an emotion that protects an individual against an immediate, real and subjective threat (Asmundson, Vlaeyen and Crombez, 2004; Adolphs, 2014). Some research has highlighted that elevated levels of fear are associated with reduced activity participation in middle to older aged adults (Vincent et al, 2010; Rosic et al, 2019). This has led to several conceptual components of fears such as a fear of falling, pain-related fear and a fear of injury (kinesiophobia) being categorised as psychological barriers to physical activity (Ramírez-Vélez et al, 2015). However, research encapsulating fear as a psychological barrier is limited and has only been explored in older adults and those with chronic diseases (aged over 45 years), with a dearth of literature in younger adults who are obese (Vincent et al, 2014).

The next chapter will review the current literature to summarise the existing research that has focused on activity related fears in adults with weight concerns. The review will identify gaps in the existing literature that form the basis of further research in this PhD.

Chapter 2

A Scoping Review of Fear as a Barrier to Physical Activity

2.1 Background

Physical activity can effectively promote weight loss and reduce body fat (WHO, 2014). However, overweight and obese adults experience several barriers to partaking in physical activity that result in sedentary lifestyles (WHO, 2014; Ashmore et al, 2012). Findings suggest that psychological barriers are the primary concerns for overweight and obese adults at the point of activity engagement (McIntosh, Hunter, and Royce, 2016; Aiber-Almazan et al, 2017). This appears to be because of increased perceptions of weight related disability, concerns around weight stigmatisation, depressive cognitions, and a lack of motivation (Napolitano et al, 2011; McIntosh, Hunter, & Royce, 2016). Psychological barriers in this context, are conceptualised as an attitude, belief, thought pattern or perception that prevents an individual from participating in physical activity (Rankin, 2012). Intervention studies that fail to acknowledge psychological barriers or include psychological components have been shown to be less effective at increasingly activity in the obese (Wiklund, Olsen, & Willen, 2010). Even though there is a much greater understanding of the role played by some psychological barriers (such as motivation and depressive symptoms), there are still high levels of inactivity among adults who are obese (Napolitano et al, 2011). This would indicate that there may be other psychological factors contributing to the problem of inactivity in the obese (Foster-Schubert et al, 2011).

2.2 Aim and objectives of the Review

Aims

- The purpose of this review is to summarise research findings relating to fear as a barrier to physical activity and to identify research gaps in the existing literature.

Objective

- To identify the fears that impact on physical activity in overweight and obese adults

2.3 Methodology, methods and analysis

2.3.1 Study design

A scoping review of literature represents a methodology that allows a rapid assessment of emerging evidence, as well as a first step in identifying research gaps (Peterson et al, 2017). At present, there is no universal guide or definition for a scoping review (Whittlemore et al, 2014). However, the main characteristics of this review will follow the framework set out by Arksey and O'Malley (2005).

To fulfil the aims of this review, this study will adopt 5 of the 6 stage framework of a scoping review methodology outlined by Arksey and O'Malley (2005), and later adapted by Levac et al, (2010):

Stage 1. Identifying the research question
Stage 2. Identifying relevant studies
Stage 3. Study selection
Stage 4. Charting the data
Stage 5. Collating, summarising and reporting the results
Stage 6. Consultation of knowledge users (Optional)

The sixth stage will not be implemented because the first five stages are sufficient to satisfy the aim of the review in summarising research findings relating to fear as a barrier to physical activity. This review also forms part of a larger PhD that intends to explore the gaps in knowledge identified by the first five stages.

2.3.2 Justification for this study design

The justification to conduct a scoping review was because of the need to account for a diverse, complex range of literature that uses several methodologies. A scoping review provides a preliminary exploratory assessment of the scope of available literature, maps the key concepts underpinning the research area and evaluates the types of evidence available (Grant and Booth, 2009). With no available reviews within the area of interest, it was appropriate to employ a methodology that could synthesise and contextualize a broad research topic (Grant and Booth, 2009). Literature suggests that the strengths of a scoping review are that they can provide a comprehensive overview of a phenomenon, identify what types of studies have been conducted and establish gaps in knowledge (Lockwood and Tricco, 2020). Scoping reviews are also beneficial in that the findings serve to determine the value of undertaking a systematic review (Grant and Booth, 2009). These strengths aligned with the study aims and objectives, providing a strong rationale for the decision to adopt a scoping review methodology (Arksey and O'Malley, 2005).

It was felt that a full systematic review was not necessary because a scoping review was capable of drawing out existing research that could meet the aims and highlight gaps in knowledge for the further studies of this PhD. Equally, a systematic review would not have been feasible given the resource limitations of the PhD program of studies. The flexibility of a review of this design allows a rapid assessment of all narrative reviews, theoretical papers, qualitative and quantitative research within a reasonable timeframe (Peterson et al, 2017). The data from this review will provide an informed starting point for further research, a key aim of this study (Peterson et al, 2017; Arksey and O'Malley, 2005).

2.4 The 6 Stages of the scoping review (Arksey and O'Malley, 2005)

2.4.1 Framework stage 1: Identifying the research question

A preliminary literature search refined the research aim and the areas of interest within this review. The following research will aim to summarise research findings relating to fear as a barrier to physical activity and to identify research gaps in the existing literature.

2.4.2 Framework stage 2: Identifying relevant studies, selection criteria and definitions

2.4.2.1 Defining physical activity

For the purpose of this review, physical activity was defined as any bodily movement produced by skeletal muscles that requires energy expenditure and can be categorised into occupational, sports, conditioning, household or other activities (World Health Organisation, 2014). This definition includes low intensity routine activities (such as housework or shopping) that are important for obese adults who may be unable to partake in higher intensity activities (Wingo et al, 2011).

2.4.2.2 Defining fear

For the purpose of this review, fear was interpreted by the researcher to be that which is outlined in chapter one (section 1.7).

2.4.2.3 Selection criteria

The characteristics of the participants of this review included adults aged 18 years and over, of any gender, and who were classified as overweight or obese (BMI greater than 25kg/m^2). The review did not discriminate on how participant BMI was attained, including those participants whom self-report or have been measured in respect of being overweight or obese. Studies were also included if a mean BMI range within the overall population was greater than 25kg/m^2. Overweight and obese populations were included regardless of percentage to overall sample size as long as the overweight, obese participant data has been, or can be apportioned from other BMI classifications. Participants with diabetes, osteoarthritis, joint pain, lower back pain, high cholesterol, heart disease, liver or kidney disease and asthma were considered for inclusion as these conditions have a strong causation with obesity (Katzmarzyk and Lear, 2012). Other conditions and illnesses were also considered for inclusion if they were secondary and randomly included based on a targeted overweight and obesity population.

The phenomenon of interest was that of fear and so all studies that explored psychological and physiological behaviours based on the phenomena of fear as a barrier/ facilitator in the context of activity were included. This included all substrates of barriers/ facilitators, which included an enacted avoidance behaviour from fearful emotions (in the context of physical activity).

The study was included irrespective of the setting and the geographical location. For example, studies based in primary or secondary healthcare, community dwellings, community or private leisure facilities, weight management settings and/or not exclusive to health promotion centres, were included. All study designs, qualitative or quantitative, were included if they addressed an aspect of fear as a barrier or facilitator to physical activity in overweight and obese adults.

2.4.3 Exclusion criteria

Any articles that were not peer reviewed (or in the form of magazines, letters, editorials, and newspaper and commentary articles) were excluded. Any studies that were not available in full text or could not be retrieved in full text where also excluded. Any studies that were not available in English were not included in this review. Any studies that reflect on the emotion of fear specifically relating to someone under the age of 18 years were excluded because this study had a focus on adults. Research whereby part of the sample population is overweight/ obese, and part is of a healthy weight, but the overweight/ obese finding cannot be apportioned, were excluded.

2.4.4 Outcomes

The primary measure was how fears impacted on physical activity, as either a barrier or facilitator.

2.4.5 Databases

MEDLINE, Cumulative Index to Nursing and Allied Health Literature (CINAHL Complete, excluding MEDLINE), Sports Discus, Psych Info and PEDro were searched. MEDLINE, CINAHL Complete and Sport Discus were searched through EBSCOhost; Psych Info was searched through Ovid and PEDro was searched through its own webpage search bars. Key journal reference lists were scoped to identify further studies.

2.4.5.1 Search terms

The search strategy conducted in each database consisted of key three categories relating to overweight and obesity, physical activity and fear(s). Within the categories, the search terms were combined using the Boolean Operator ‘OR’. The Boolean Operator ‘AND’ was used to combine across the categories. Truncation and wildcards symbols expanded on the key word searches to assure that papers would not be missed.

The search terms relating to each category were identified using subject headings within electronic databases and existing literature relevant to the areas of interest. Subject headings were exploded to include all other relevant terms. Thesaurus searches within the databases provided additional terms that were used for keyword searches. Relevant systematic reviews, academic papers and the International Prospective Register Of Systematic Reviews (PROSPERO) protocols were reviewed to identify additional terms. Table 2.1 and appendix A through E displays examples of searches that have been run in each database.

Table 2.1. Example search strategy using MEDLINE (EBSCO Host).

Search	Term (mesh/ keyword)
S1	Explode_ (MH "Obesity+")
S2	Explode_ (MH "Overweight+")
S3	Explode_ (MH "Body Weight+")
S4	Explode_ (MH "Waist Circumference+")
S5	MH_ ("Body Mass Index")
S6	MH_ ("adiposity")
S7	("Obese*")
S8	("Fatness")
S9	S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8
S10	Explode_ (MH "Exercise Therapy+")
S11	Explode_ (MH "Exercise Movement Techniques+")
S12	Explode_ (MH "Exercise+")
S13	Explode_ (MH "Activities of Daily Living+")
S14	Explode_ (MH "Movement+")
S15	MH_ ("Physical Exertion") OR MH_ ("Physical Fitness")
S16	("Activity*")
S17	("Fitness")
S18	S11 OR S12 OR S13 OR S14 OR S15 OR S16 OR S17
S19	Explode_ (MH "Fear+")
S20	Explode_ (MH "Phobic Disorders+")
S21	MH_ ("Panic Disorders")
S22	MH_ ("Phobia, Social")
S23	("Afraid")

S24	(“Fright*”)
S25	(“Concern*”)
S26	(“Avoidance”)
S27	(“Negative evaluation”)
S28	(“Threat”)
S29	S20 OR S21 OR S22 OR S23 OR S24 OR S25 OR S26 OR S27 OR S28 OR S29
S30	S9 AND S18 AND S29
S31	S30 (Limiters - English Language; Human; Age Related: All Adult) (1278)

2.4.6 Framework stage 3: Study selection

The first part of the selection involved screening both the titles and abstracts of the different database searches to broadly identify studies based on the inclusion and exclusion criteria. For those studies that met the inclusion criteria, the full articles were retrieved and saved into a database folder. Following the initial selection of relevant studies, full texts were exported from electronic databases into RefWorks to exclude duplicates. Once duplicates were deleted, full text articles were screened and included or excluded based on their content. The reference lists of all eligible studies were screened to identify any additional studies not identified by the electronic search.

2.4.7 Framework stage 4: Charting the data (Extraction)

Full text articles that met the inclusion criteria were charted to summarise the findings. While the methodology adopted in this review (outlined by Arksey and O’Malley, 2005) does not specifically seek to assess the quality of the studies, the review did document enough information to make a narrative analysis about the quality.

Those studies that met the inclusion criteria were summarised using the ‘charting’ framework described by Arksey and O’Malley (2005). For each extracted article, contextual information on the emotion of fear and physical activity were reported within the limits of the individual articles. This detailed fear either as a facilitator or barrier to physical activity, recording on any contextual details provided by the articles. Similarly, BMI or mean BMI was reported to identify overweight or obese participants providing it had been reported within the article. Age was extracted so the researcher could identify the distribution of fear related studies in younger adults (18 to 45 years), middle aged adults (46 to 64 years) and older adults (65 years and over). The charting framework was piloted to ensure that it can be consistently applied to qualitative, quantitative and mixed method studies without the possibility that data could be missed. The charting framework included the content seen in table 2.2. Once charted, the PhD supervisory team analysed a 10% sample (N= 4) of the extracted studies to ensure the studies conformed to the inclusion criteria and contained the relevant data for the review (Bussiek et al, 2018). Discrepancies in the extraction process were discussed between the team until an agreement was reached about the data.

Table 2.2. Charting framework.

Charting framework components		
Main Category	Subcategory	Description
Author, year, study location	Author	Specify the author of the publication
	Year	Specify the year of publication
	Country	Determine the country in which the study was carried out
Study population	➢ Target population	Determine the target population, subpopulation groups or the broad populations
	➢ Participant numbers	Specify the number of participants at the point of data analysis.
	➢ Age	Specify the age/ mean age of the population.
	➢ Sex	Specify the gender of the population, either with percentage split or participant numbers
	➢ Disabilities/ Comorbidities	Specify if the study targeted individuals based on disability, comorbidities or other conditions.
BMI	➢ BMI, weight status i.e. over-weight or obese. Class-ification	Detail the BMI status of participants, mean BMI and separated BMI's per population groups.

Study title/ aims	Aims	Specify the studies aims if not apparent from the title.
Method	Quantitative Qualitative Mixed Method	Specify the methodological approach and the data collection method, detailing a survey, focus group or/and interview approach.
Key findings	Physical activity	Describe the context of the physical activity in reference to the fear (running, gym, swimming etc.).
	Fear Facilitators	Describe the context in which fear may facilitate physical activity and what fears may support this premise.
	Fear as a Barrier	Describe the context in which fear may be a barrier to physical activity and what fears may support this premise.
	Impact	Describe if the emotion of fear has been reported to have any impact on weight status, health, quality of life or physical activity levels.

2.4.8 Framework stage 5: Collating, summarizing and the approach to analysis

From the information, it was not appropriate to perform a statistical pooling analysis because of the diversity range of data that included qualitative methods. A narrative synthesis was chosen to summarise the data because it allowed the diversity of data to be analysed with ease (Arai et al, 2007). Initially the data was numerically charted according to fear, BMI, type and age. This revealed an early indication of activity related fears that were summarised in the review. This also indicated gaps in the research. In summarising the findings on fear and its impact on activity, the template set out by Arksey and O'Malley (2005) was employed to improve the consistency of comparison across the findings.

2.5 Results

The search of the five electronic databases produced 2367 hits. Following the screening of titles and abstracts, 2245 texts were discarded. 122 full texts were reviewed, 21 were immediately discarded as they were duplications. From the remaining 101 full texts, 65 were discarded as they did not meet the review inclusion criteria. Two additional studies were identified from the reference lists of the full text articles. This process identified 38 studies that were analysed within the review. This can be seen in the flow diagram in figure 2.1. The characteristics and key findings of the 38 papers (or studies see comment) are outlined in Appendix F.

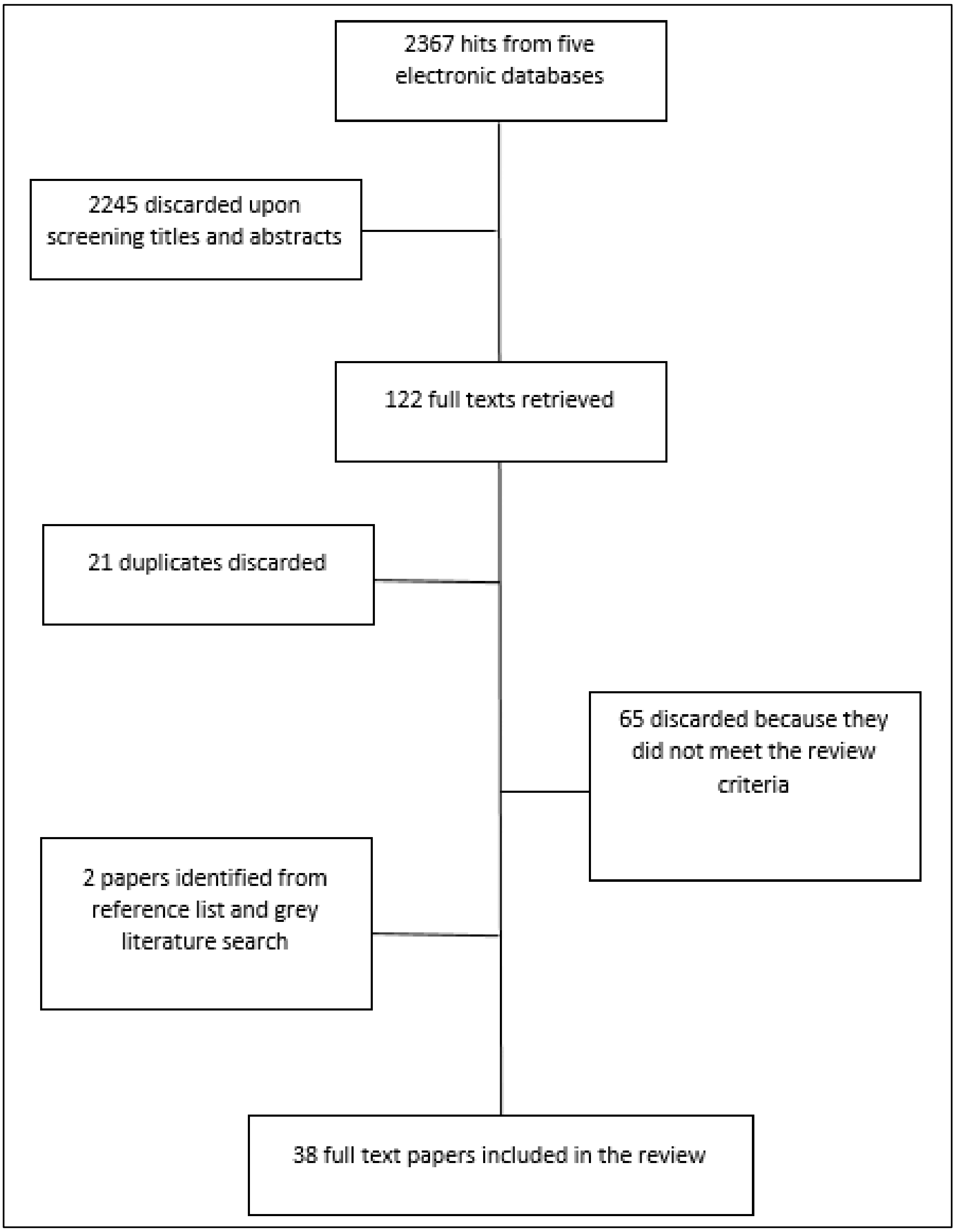


Figure 2.1. Flow diagram showing the study selection process

2.5.1 Excluded studies

Of the 65 papers excluded because they did not meet the inclusion criteria: 27 papers were not Informative to the research aim because they reported validation of measurement instruments; 15 papers did not report on overweight and obese groups data; seven included children; six included participants with chronic conditions not ordinarily associated with obesity; five papers reported on biomechanical and injury and five papers reported on fears in other contexts (such as dental practices).

2.5.2 Description of included studies

The studies included in this review had several research designs. All of the studies were cross sectional and used either a survey design (N= 21) (Larsson and Mattsson, 2001; Neri et al, 2017. Etc.), interviews (Cooper et al, 2017. Etc.) (N= 13) or focus groups (N= 4) (Wingo et al, 2011) as their method of data collection. The number of participants ranged from seven to 5663, and the ages ranged from 18 to 85 years old. The majority of studies included middle to older overweight and obese adults (N=23). Notably, only a small number of studies (N= 5) explicitly intended to explore fears, but it was broader investigations around barriers to activity that highlighted activity related fears (Neri et al, 2017; Rosic et al, 2019; Vincent et al, 2011; Vincent et al, 2013; Vincent et al, 2014).

2.6 Fear related barriers to physical activity in overweight and obese adults

From the 38 texts, the review identified 13 explicit fears that either acted as a barrier or facilitator for physical activity. Overweight and obese adults reported 10 fear related barriers and four fear related facilitators. The fear of embarrassment had been reported as both a fear related barrier and facilitator to physical activity. A summary of fears can be seen in figure 2.2.

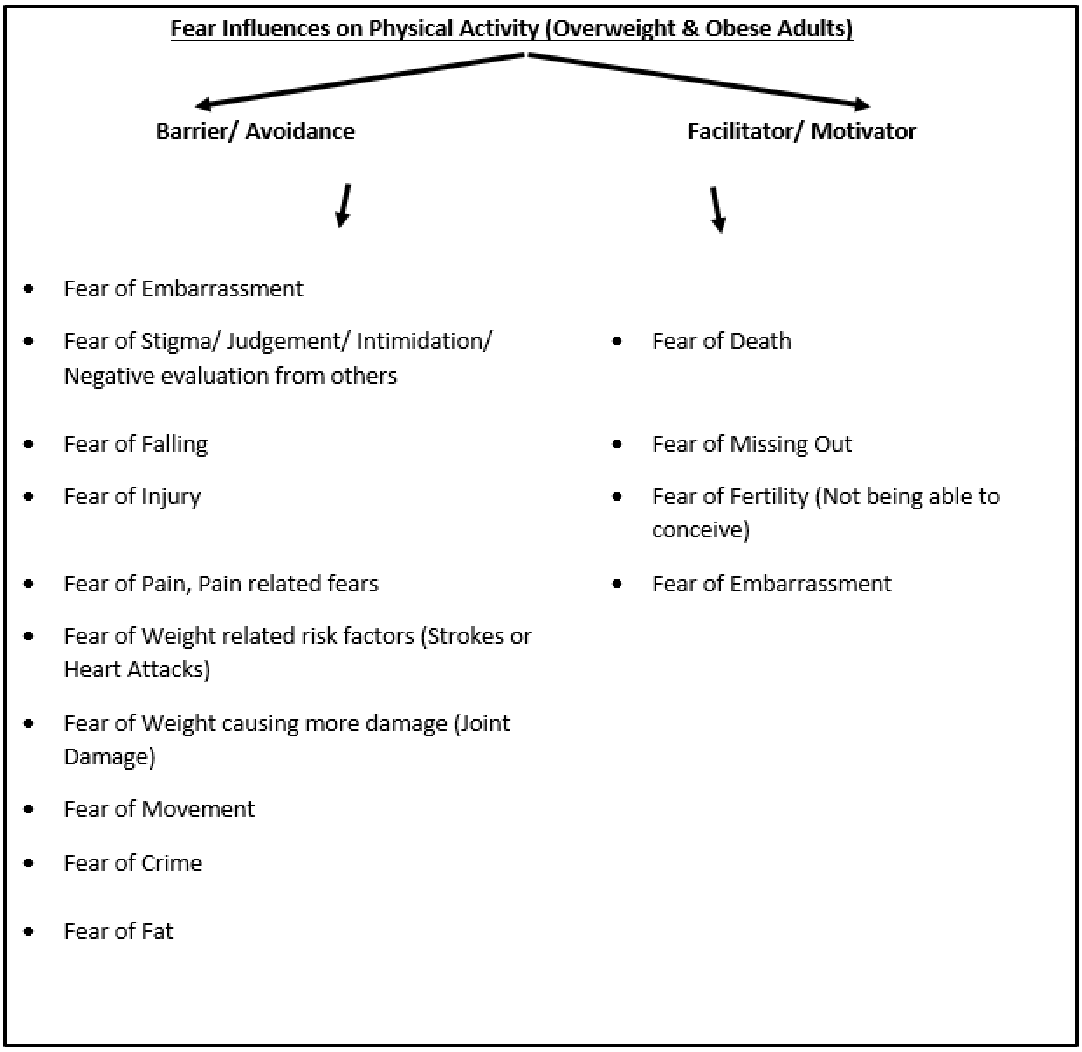


Figure 2.2. Identified areas in review of literature,
Fear influences on activity (barriers and motivators).

The review highlighted substantially more papers that reported on fear related barriers than fear related facilitators. The review identified research gaps for fear related barriers in younger overweight and obese adults. The findings highlighted that the fears of falling, pain, movement, weight related risk factors and crime have not been explored in younger overweight and obese adults. The review also highlighted that there is a dearth of literature that has explored fear as a facilitator or enabler for physical activity in overweight and obese adults (seen in table 2.3).

Table 2.3. Identified areas relating to explicit activity related fears.

Area of Interest/ Theme(s)	N	Papers/ Authors	Type of study	Population Frequency an age (years)
Fear of Stigma/ Judgement/ Negative evaluation from others	13	Sand, Emaus & Lian, (2017).	Qualitative	N= 12, aged 18 to 21
		O'Brien et al, (2017).	Qualitative	N= 22, aged 18 to 45
		Lewis et al, (2011).	Qualitative	N= 36, aged 18 to 75
		Denison et al, (2015).	Qualitative	N= 13, aged 25 to 34
		Zabatiero et al, (2015).	Survey design	N= 19, mean age 41.6
		Ashton et al, (2015).	Qualitative	N= 61, aged 18 to 25
		Baruth et al, (2014).	Qualitative	N=28, mean age 34.3
		Alqout & Reynolds, (2014).	Qualitative	N=7, aged 26 to 43
		Chang et al, (2008).	Qualitative	N= 22, aged 18 to 35
		Farhangi et al, (2016).	Survey design	N= 170, aged 18 to 45
		Thomas et al, (2008).	Qualitative	N= 76, mean age 47
		Dikareva et al, (2016).	Qualitative	N=12, mean age 47
		Wiklund et al, (2011).	Qualitative	N=19, aged 29 to 62
Fear of Embarrassment and Humiliation	12	Ashton et al, (2015).	Qualitative	N= 61, aged 18 to 25
		Ball et al, (2000).	Survey design	N= 2,298, aged 18 to 75
		Baruth et al, (2014).	Qualitative	N= 28, mean age 34.3
		Capodaglio et al, (2010).	Review	Narrative review
		Denison et al, (2015).	Qualitative	N= 13, aged 25 to 34
		Lewis et al, (2011).	Qualitative	N= 36, aged 18 to 75
		Rosic et al, (2019).	Survey design	N= 63, aged 18 to 49
		Sand, Emaus & Lian, (2017).	Qualitative	N= 12, aged 18 to 21
		Thomas et al, (2008).	Qualitative	N= 76, mean age 47
		Wiklund et al, (2011).	Qualitative	N= 19, aged 29 to 62
		Wouters et al, (2011).	Survey design	N= 42, mean age 38
		Zabatiero et al, (2015).	Survey design	N= 19, mean age 41.6
Fear of Falling	7	Sallinen et al, (2009).	Survey design	N= 619, aged 75 to 81
		Byoung-Jin Jeon (2013).	Survey design	N= 351, aged 60 plus
		Rosic et al, (2019).	Survey design	N= 63, aged 18 to 49
		Bruce et al, (2002).	Survey design	N= 1500, aged 70 to 85
		Deshpande et al, (2008).	Survey design	N= 848, mean age 75.9
		Larsson and Mattsson, (2001).	Survey design	N= 57, mean age 44
		Neri et al, (2017).	Survey design	N= 226, mean age 68
Fear of Injury	6	Ramírez-Vélez et al (2014).	Survey design	N= 5663, mean age 20
		Guess, (2012).	Qualitative	N= 30, mean age 40.7
		Napolitano et al, (2011).	Survey design	N= 280, aged 18 to 65
		Wouters et al, (2011).	Survey design	N= 42, mean age 38
		Sallinen et al, (2009).	Survey design	N= 619, aged 75 to 81
		Vincent et al, (2013).	Survey design	N= 55, aged 60 to 85
Fear of Pain/ Pain-related fears	5	McPhail et al, (2014).	Survey design	N= 217, mean age 53
		Vincent et al, (2014).	Survey design	N= 49, aged 60 to 85
		Somers et al, (2009).	Survey design	N= 106, mean age 58.7
		Capodaglio et al, (2010).	Review	Narrative review
		Wingo et al, (2011).	Qualitative	N= 21, mean age 48.5
Fear of Movement	4	Vincent et al, (2010).	Survey design	N= 278, aged 60 plus
		Vincent et al, (2011).	Survey design	N= 198, mean age 48.2
		Vincent et al, (2013).	Survey design	N= 55, aged 60 to 85
		Vincent et al, (2014).	Survey design	N= 49, aged 60 to 85
Fear of Weight related risk to health (Strokes or Heart Attacks)	1	Wingo et al, (2011).	Qualitative	N= 21, mean age 48.5

Fear of Weight causing more damage (Joint Damage)	1	Cooper et al, (2017).	Qualitative	N= 18, aged 29 to 71
Fear of Crime	1	Kodjebacheva et al, (2015).	Survey design	N= 1427, mean age 55
Fear of Fat	1	Phelan et al, (2015).	Survey design	N= 4687, mean age 23.9
Fear of Death	2	Dikareva et al, (2016). Tod and Lacey, (2004).	Qualitative Qualitative	N= 12, mean age 47 N= 16, aged 33 to 68
Fear of Missing Out	1	Alvarado et al, (2015).		N= 17, mean age 30
Fear of infertility	1	Alquot and Reynolds, (2014).	Qualitative	N=7, aged 26 to 43
Fear of Embarrassment and Humiliation	1	Tod and Lacey (2004).	Qualitative	N= 16, aged 33 to 68

2.6.1 Fears with negative consequences for physical activity

The fears of embarrassment, stigma, falling, injury, pain, movement, fears of weight related health risks, fears of weight causing damage and fears of crime were described by overweight and obese adults as having negative consequences (barrier) for physical activity.

2.6.1.1 Fear of embarrassment

A fear of embarrassment within the context of physical activity has been described as a belief that there is a self-presentational cost to failing, beyond the absence of a reward (Conroy et al, 2001). A fear of embarrassment has been identified as a significant barrier to physical activity in several populations (Lascar et al, 2014). This review charted 12 studies that highlighted a fear of embarrassment as a barrier to physical activity for overweight and obese adults. Of these, seven were qualitative studies and four were quantitative studies.

A qualitative study by Ball et al (2000) suggested that embarrassment and a fear of being embarrassed (whilst performing physical activity) is more pronounced in adults with a BMI over 25 than those with a BMI under 25kg/m^2 (adults aged between 18 to 78) (Ball et al, 2000). Since then, a number of studies both quantitative and qualitative have confirmed these findings. Wouters et al (2011) found fear of embarrassment in over 75% of middle-aged obese adults in their study. The findings also highlighted that fears, alongside a lack of perceived benefits of physical activity, were associated with lower levels of physical activity in obese adults (Wouters et al, 2011).

The study by Ball et al, (2000) also found that a fear of embarrassment can lead to activity avoidance and can be experienced in several contexts of activity such as swimming and jogging (Ball et al, 2000). Lewis et al (2011) highlighted that older obese men were fearful explicitly within gyms and group fitness classes. In this study, It was thought that body image concerns manifested into fears relating to embarrassment in this context (Lewis et al, 2011). Similar themes have been identified in younger obese adults who described feelings of humiliation and embarrassment when they attempted to engage in gym-based activity (Thomas et al, 2008). In this study, participant fears were found to intensify when they had to walk or swim in the presence of other people because of body image perceptions. These fears were also present in participants in the qualitative study conducted by Wiklund et al, (2011). Wiklund et al (2011) concluded that middle aged obese participants experienced the feeling of embarrassment when wearing tightfitting exercise attire. They described feelings of discomfort and fear at the thought of being observed in bathing suits or tight clothes. Importantly, these fears were given as the main reason for physical activity avoidance.

Research by Baruth et al, (2014), revealed that fear experiences often resulted in the avoidance of activity. These finding may not be exclusive to obese adults as similar findings have been reported by young overweight adults. Ashton et al, (2015) highlighted that young overweight men described gyms or exercise facility as places they actively avoid because gym staff and personal trainers may embarrass them about their exercise efficacy (Ashton et al, 2015; Denison et al, 2015). Zabatiero et al, (2014) found that the primary issue with fears relating to embarrassment lies within a self-presentational concern, fearing what others may think. The findings highlighted that that obese adults regularly feel distressed with their physical appearance and this is a primary factor in the manifestation of embarrassment related fears. This rationale is supported in a recent study by Sand et al (2017) who stated that overweight and obese adults repeatedly place a greater importance on avoiding embarrassment than the health-related benefits of physical activity (Sand et al, 2017). The data from these studies suggests that a fear of embarrassment is a substantial barrier to physical activity for overweight and obese adults. These findings concern overweight and obese adults from all ages and genders.

2.6.2 Fear of stigma and negative evaluation from others

Weight stigma has been defined as an attitude that leads people to maltreat, reject or stereotype those who have a body size outside of a perceived healthy weight (Schvey, Puhl and Brownell, 2014). This review has identified 13 studies that identify a fear of stigma and negative evaluation as barriers to physical activity in the overweight or obese adults. Of these, ten were qualitative studies and two were quantitative studies.

Thomas et al (2008), in a qualitative study, identified that middle-aged obese adults avoid physical activity when there is an increased risk of weight stigmatisation. Even with strong advice from medical professionals (for weight loss purposes), this research suggested that obese adults are deterred from participating in physical activity because of weight stigmatisation (Thomas et al, 2008). A qualitative study by Chang et al, (2008) revealed that the sense of stigma intensified when obese adults participated in group fitness sessions. The younger obese adult sample aged between 18 to 35 years, stated that weight stigmatisation led to an avoidance of activity, and deterred them from partaking in other social activities. It was concluded that fears of weight stigma had a substantial impact on quality of life because of the increased risk of social isolation. These stigma concerns have also been documented in middle to older aged obese adults (Wiklund et al, 2011).

The stigma associated with obesity has been described as an important factor of fear avoidance. Several studies conducted with obese adults have suggested that fears of stigma play an important part in decisions to avoid physical activity, especially within group activity sessions (Lewis et al, 2011; Alquot and Reynolds, 2014). These studies highlight that obese adults who experience fears of stigma often report high levels of inactivity (Alquot and Reynolds, 2014). Importantly, the research suggests that obese adults with a BMI greater than 40kg/m^2, experience intensified fears compared to overweight adults (Alqout and Reynolds, 2014). This is important because intense stigma related fears could lead to a worsening of social isolation and depression in populations already at risk of mental health concerns (Baruth et al, 2014). Notably, these studies have identified that stigma related fears are particularly important for middle-aged overweight and obese women, specifically in contexts of gym-based exercise (Baruth et al, 2014; Ashton et al, 2015). This is because overweight women have often reported being victims of stigma, discrimination and torment in environments where they are inappropriately compared to their leaner counterparts or are blamed for their obesity.

Instances of weight stigma are also known to be experienced by obese adults in healthcare settings (Denison et al, 2015). In the qualitative study conducted by Denison et al. (2015), younger morbidly obese women (age between 25 to 34 years) were deterred from activity because they perceived that professionals such as general practitioners and exercise specialists stigmatised them. Participants described feeling fearful and demotivated to engage with activity because of unhelpful advice from doctors who lacked compassion for weight concerns. Alongside a decrease in motivation, several studies have shown that stigma related fears exacerbate poor self-efficacy, confidence issues, feelings of laziness, and activity avoidance beliefs (O'Brien et al, 2017; Dikareva et al, 2016; Sand et al, 2017). Findings from Farhangi et al, (2016) also indicate that higher stigma related fears are also associated with higher psychological distress and lower quality of life scores in overweight and obese adults (across all ages). These findings appear to suggest that fears relating to weight stigma and enacted stigma, may exacerbate depressive cognitions and increase inactivity, especially amongst young to middle aged obese adults.

2.6.3 Fear of falling

Fear of falling can compromise quality of life by limiting mobility, diminishing sense of well-being and reducing social interactions (Mane et al, 2014). At present, a fear of falling is recognised as a cautious concern with falling which may ultimately result in the restriction of activities associated with daily life (Lavedan et al, 2018; Tinetti and Powell, 1993). A frequently reported association with fear of falling is that it can contribute to actual falls, leading to inactivity and poor health (Powell and Myers, 1995). This review found seven studies that identified fall related fears as an important barrier to physical activity in obese and overweight adults (Sallinen et al, 2009;

Byoung-Jin Jeon, 2013; Rosic et al, 2019; Bruce et al, 2002; Deshpande et al, 2008; Larsson and Mattsson, 2001; Neri et al, 2017). Of these, all seven were quantitative studies.

Several studies have highlighted that the risk of inactivity from fear of falling is substantially more common among obese adults than healthy weight adults (Bruce et al, 2002; Sallinen et al, 2009). Studies have highlighted that a fear of falling could increase the risk of inactivity by up to four times in obese adults and that they are associated with reduced physical function that can limit intensity of activity (Sallinen et al, 2009; Deshpande et al, 2008). Bruce et al, (2002) concluded that obese adult's manifestations of fear are the subjective lack of safety when partaking in activity, and thus future activity is generally avoided because of this manifestation. Several studies suggest that fall related fears may only be a risk factor for inactivity in older adults and in those with a BMI above 40kg/m^2 (Byoung-Jin Jeon, 2013; Sallinen et al, 2009). However, recent findings have established that younger obese adults with higher BMI report low fall efficacy, reduced activity levels and an increased fear of falling compared to those of lower BMI (Rosic et al, 2019). These associations were partially explained by lower limb stability concerns associated with excess weight away from the bodies' central axis, and because of the possibility others may ridicule or mock them in the event of a fall (Neri et al, 2017; Larsson and Mattson, 2001). Notably, lower limb stability appears to be the primary concern of older obese adults whilst younger to middle aged obese adults desire to avoid humiliation and derogatory remarks they may receive following a fall (Neri et al, 2017). The consequences of fall related fears can be severe in that they have been associated with an increased perception of disability and functional limitations (Neri et al, 2017). These findings reinforce the premise that a fear of falling may be a risk factor for inactivity in obese adults of all age groups (Rosic et al, 2019; Bruce et al, 2002). However, the evidence is limited for those under the age of 50 years, and overweight adults with a BMI under 30kg/m^2 (Neri et al, 2017; Byoung-Jin Jeon, 2013). Fear of falling appears to have the most detrimental consequences for physical activity in older obese adults above 60 years of age and adults with a BMI greater than 40kg/m^2, because it leads to greater levels of inactivity (Neri et al, 2017).

2.6.4 Fear of injury

According to Million et al, (1999) a fear of injury is the abnormal or excessive desire to avoid injury or hurt. A fear of injury has been established as an important barrier to physical activity, but literature has largely focused upon sporting athletes undergoing rehabilitation (Vincent et al, 2013). This review has identified six studies that have reported on a fear of injury in overweight and obese adults (Ramírez-Vélez et al, 2014; Guess, 2012; Napolitano et al, 2011; Wouters et al, 2011; Sallinen et al, 2009; Vincent et al, 2013). Of these studies, the review identified five that were quantitative and one study that was qualitative.

In several studies, a fear of injury has been identified as one of the most important barriers to activity in overweight and obese adults (Ramírez-Vélez et al, 2014; Wouters et al, 2011; Guess, 2012). The study by Ramírez-Vélez et al, (2014) highlighted that injury related fears were the number one barrier to activity for young overweight adults. The findings identified fear as a more important barrier than a lack of skill, knowledge, resources or motivation. These findings have been corroborated in obese adults. In the study by Wouters et al, (2011) a fear of injury was associated with reduced physical activity participation in middle aged morbidly obese adults. Other research has suggested that resistance activity (such as weightlifting) is most concerning for overweight and obese adults because of the increase in the risk of injury. Findings from one study suggests that injury related fears largely manifest from a lack of knowledge in how to perform resistance movements (Guess, 2012). Guess (2012) concluded that a fear of injury could be made up of two factors relating to the acquisition of skills and knowledge. However, Napolitano et al, (2011) suggested an alternative explanation that these fears could be the result of heightened concerns over their health and low self-efficacy for exercising. Considering both explanations, the literature suggests that a fear of injury, (among other things, comorbidities, pain and tiredness) is likely associated with an increased risk of inactivity in obese adults (Sallinen et al, 2009). Notably, these fears are seemingly intensified in elderly obese adults and those who suffer with pain. Equally, fears are intensified by activity that is located outdoors because of the exposure to slippery and uneven surfaces (Vincent et al, 2014).

2.6.5 Fears related to pain (pain-related fears)

Fear of pain is referred to as a debilitating and disproportionate fear of physical movement or activity resulting from emotions of vulnerability to pain (Keefe et al, 2000). With chronic pain complaints, a fear of pain has been associated with psychological disability and activity avoidance (Somers et al, 2009). This review identified five studies that have explored pain-related fears in overweight and obese adults (McPhail et al, 2014; Vincent et al, 2014; Somers et al, 2009; Capodaglio et al, 2010; Wingo et al, 2011). Of these studies, three were quantitative, one study was qualitative, and one paper was a literature review.

Early findings by Somers et al, (2009) suggested that pain-related fears contributed to activity avoidance and increasing levels of inactivity. These findings are consistent with the finding a more up to date study that identified pain-related fears in overweight adults (McPhail et al, 2014). McPhail et al, (2014) found that middle to older aged overweight adults expressed a desire to distance themselves from feelings of pain and discomfort caused by physical activity. The anticipation and subsequent fear of pain caused many participants to cease participation of all physical activity. Vincent et al (2014) confirmed that fear avoidance beliefs related to pain are elevated in the obese compared with nonobese individuals of similar age, and that these result in activity avoidance. However, pain-related fear findings were limited to middle and older aged adults (age between 50 to 85 years), with a dearth of literature in younger adults.

2.6.6 Fear of movement

Obesity itself is associated with reduced functional movement, musculoskeletal pain and perceived disability (Vincent et al, 2011). These associations may be contributing factors to the findings that a fear of movement is higher in obese adults than non-obese adults (Vincent et al, 2011). A fear of movement has been described as physical activity that is wrongfully assumed to cause long lasting harm to the body (Vlaeyen, 1995). This review identified four studies that have explored fears of movement in overweight and obese adults (Vincent et al, 2010; Vincent et al, 2011; Vincent et al, 2013; Vincent et al, 2014). Of these, all four were quantitative studies. It is also notable that the studies were from the same research group.

Research surrounding fear of movement has largely been collected using self-reported measurement instrument based on various items of pain, injury, disability and functional limitations (Vincent et al, 2011) The research suggests that a fear of movement is closely associated with lower body joint pain and a deterioration in quality of life (Vincent et al, 2010). Findings from middle aged obese adults indicate that a fear of movement is closely related to perceived difficulty with walking and psychological disability (Vincent et al, 2011). These factors have been shown to reduce level of physical activity in obese adults (Vincent et al, 2014). Further research has identified that older obese adults avoid physical activity because of heightened fears of movement (Vincent et al, 2014; Vincent et al, 2013). This was consistent with findings of Capodaglio et al, (2010) who identified a cycle of pain, fear of movement/ activity avoidance, and functional disability in middle to older obese adults.

2.6.7 Fear of weight related risks to health (strokes or heart attacks)

A fear of weight related risks to health has been conceptualised as the increased awareness of physical responses during or after physical activity which are perceived as risk factors for a serious health event (Wingo et al, 2011). This review identified one qualitative study that explored fears relating to heart attacks and strokes in obese adults (Wingo et al, 2011).

This fear explicitly describes a concern about an incidence of heart attack or stroke whilst participating in physical activity. In the study identified by this review, obese adults described fears that provoked an avoidance of physical activity (Wingo et al, 2011). These fears compromised the duration and intensity of physical activity because participants did not want to exert too much stress upon their bodies (Wingo et al, 2011). Participants believed that higher intensity workouts and resistance exercise were unsafe due to their weight and found that they would talk themselves out of activity (Wingo et al, 2011). This may not be surprising considering a high BMI is a risk factor for various subtypes of cardiovascular disease (Ndumele et al, 2016).

2.6.8 Fear of weight causing more damage (specifically related to joint damage)

A fear of weight causing more damage to the body refers to concerns about strains, tears, trapped nerves and wear on the joints (Cooper et al, 2017). This review identified one study that explored fears of weight related damage with overweight and obese adults (Cooper et al, 2017).

A study by Cooper et al (2017) revealed that obese and overweight adults reported fears that physical activity may cause more damage to the lower extremity joints (due to the mechanical loading). This fear was considered a barrier to physical activity by overweight and obese adults and a reason for activity avoidance. Notably, fears were exacerbated by perceptions of heavy load bearing exercises such as jumping. This concern may be justified considering that obesity is associated with the incidence and progression of osteoarthritis through excessive joint loading (King et al, 2013). The study found that chronic musculoskeletal pain may be a factor in the development of fear related barriers to activity, but these needs to be explored further (Cooper et al, 2017).

2.6.9 Fear of crime

A fear of crime has been defined as a reactive emotional response to potential victimization (Wyant, 2008). This review identified one study that highlights a fear of crime as a barrier to physical activity in older overweight adults (Kodjebacheva et al, 2015). The quantitative study by Kodjebacheva et al, (2015) reported that a fear of crime was associated with lower participation in activity among overweight older adults. The findings showed that a fear of crime was associated with depressive symptoms, which in turn was associated with reduced activity and higher BMI. Given that a common physical activity modality for older adults is neighbourhood walking, this study suggests that a fear of crime within the community is likely to reduce opportunities for activity (Vlaeyans et al, 2012).

2.6.10 Fear of fat

A fear of fat has been defined as a fear of losing control, leading to excessive weight (becoming overweight or obese) (Goldfarb, Dykens, and Gerrard, 1985). This review identified one study that explored fears relating to fat in younger overweight and obese adults (Phelan et al, 2015). The quantitative study found that overweight and obese adults reported a ‘fear of fat’ as a barrier to activity (Phelan et al, 2015). The findings indicated that participants who feared fat reported worse overall health and lower activity levels. This is consistent with other literature that has highlighted strong associations between low self-esteem, poor overall health and activity avoidance (Sand, Emaus and Lian, 2017; O'Brien et al, 2017).

2.7 Fear related facilitators/ motivators to physical activity

Fear is a powerful emotional state that can sometimes motivate behaviour change (Witte, 1993). Substantial threats to health can trigger protective behaviour (i.e. increases in activity) that intend to prevent unwanted outcomes (Lewis, Watson, Tay, and White, 2007). Literature identified by this review has proposed that fears may prompt adults with weight concerns to engage in physical activity because of perceptions that it may benefit health and reduce threats of early mortality (Dikareva et al, 2016). The review identified four explicit fears which were described as factors which may motivate, facilitate or enable physical activity. Notably, fears that facilitated or motivated participants to engage with activity were expressed largely by obese adults. An overall observation was that there are fewer studies about fear related motivators to activity than fear related barriers to activity.

2.7.1 Fear of death as a motivator to activity

Individuals with obesity have a reduced life expectancy of approximately eight years, and this could be a cause of fear among the population (Grover et al, 2014). A fear of death has been defined as a feeling of dread, apprehension or anxiety when on individual thinks of the process of dying, or ceasing to be (Peters et al, 2013). A fear of death has been reported in several studies as a motivator for increased engagement with physical activity (Dikareva et al, 2016; Tod and Lacey, 2004). This review identified two studies which highlighted that fear may motivate younger to middle aged obese adults to engage with regular activity (to prevent early mortality) (Dikareva et al, 2016; Tod and Lacey, 2004). Of these, both used qualitative methods. The findings in both studies showed that participants were fearful of death from a catastrophic disease or incident and this prompted them to increase their activity levels (Dikareva et al, 2016; Tod and Lacey, 2004). The primary reason for this behaviour change was a desire to improve their overall health and lose weight to observe their children and grandchildren grow-up.

2.7.2 Fear of embarrassment as a motivator to activity

In this review, fears related to embarrassment were also found to be a motivator to physical activity (Tod and Lacey, 2004). Embarrassment related fears were largely termed by most studies, which examined this, as a barrier to activity (Denison et al, 2015; Lewis et al, 2011; Sand et al, 2017; Thomas et al, 2008; Wiklund et al, 2011). However, one qualitative study highlighted that these fears could motivate increased participation in physical activity (Tod and Lacey, 2004). The participants (overweight and obese adults) stated that weight related comments that could embarrass them provoked them to increase physical activity. Participants expressed that comments from family members were particularly motivating for positive behaviour change in that they felt their weight was a reflection of their character. To combat fears and lessen weight related stigma, physical activity was used as a method to promote weight loss and attain a better aesthetic appearance (Tod and Lacey, 2004).

2.7.3 Fear of missing out as a facilitator to activity

A fear of missing out has been described as a pervasive apprehension that others might be having rewarding experiences from which one is absent (Przybylski et al, 2013). This review identified one study that established a fear of missing out as a motivator for an increase in physical activity (Alvarado et al, 2015). The findings of the study identified that some younger obese adults feared missing out on the social interactions that took place within group physical activity sessions (Alvarado et al, 2015). The findings highlighted that this fear was reported to be a strong motivator for participants in maintaining regular physical activity, especially engaging with group activity sessions. Participants described a need to preserve their status as a member of the group by being present for the sessions. They expressed depressive and fearful cognitions when they did not attend. The findings suggested that a strong community cohesion, accountability and social interaction were important in the development of this fear and for sustaining physical activity (Alvarado et al, 2015).

2.7.4 Fear of infertility (not being able to conceive) as a motivator

A fear of infertility has been defined as an overwhelming concern that one might be infertile and unable to conceive (Feldman-Savelsberg, 1994). This review identified one study with two participants describing fears that related to fertility in female obese adults (Alqout and Reynolds, 2014). This fear motivated younger obese females to participate in physical activity because they perceived it to bring health benefits that would increase their chances of conception. The study stated that younger obese females were concerned that being obese could be a barrier to conception. These concerns were a result of advice given by health professionals who had warned the participants about the risks their weight could have on fertility. Participants acknowledged that poor dietary habits and sedentary lifestyles increased their risk of infertility and sought to distance themselves from fears through health promoting behaviours (such as physical activity and healthy eating).

2.8 Discussion

The findings of this review highlight fear as an important factor in overweight and obese adult's decisions to participate in physical activity (Cooper et al, 2017). This is despite other reviews that did not report fear related barriers or facilitators to activity among the important factors for overweight and obese adults (McIntosh et al, 2016). This review demonstrates that fear is a substantial barrier that often leads to the avoidance of physical activity (Dikareva et al, 2016). Fears have also been reported as a facilitator for overweight and obese adults in increasing levels of physical activity (Alvarado et al, 2015). However, these findings highlight that fear facilitators are less frequent and have yet to be directly associated with increased levels of activity. This is because fear related facilitators to activity have only been explored in smaller samples using qualitative methods (Alvarado et al, 2015; Tod and Lacey, 2004). A limitation of the current literature is that studies need to be confirm and quantify these fears in larger samples of overweight and obese adults. Critically, the review established that the emotion of fear is generally regarded as a barrier to activity, substantially outweighing reports that fears can facilitate activity. However, there is a limitation in that the studies identified by this review often focus solely on fear related barriers and because of this are biased toward investigations that rarely include questions on fear related motivators to activity. This is problematic because the review suggests that several fear(s) may be both a barrier and motivator to activity dependant on the age of the participant, BMI or context of physical activity. Further research is needed to explore fear, and how it contributes to levels of physical activity as both a barrier and motivator.

The findings advocate that fear related barriers are more prevalent and have greater avoidance consequences in obese adults when compared to overweight adults (Wingo et al, 2011). The literature suggests that age may play a role in the manifestation of fearful cognitions because of the wider range and frequency of fear related barriers reported by middle to older obese adults (Vincent et al, 2014; Neri et al, 2017). However, the literature revealed a wide spectrum of fears that had negative consequences for activity in all age groups of overweight and obese adults (Cooper et al, 2017). Younger overweight and obese adults reported profound fears relating to embarrassment and stigma, whilst middle to older adult generally report fears of pain, falling, injury, and movement (Denison et al, 2015; Vincent et al, 2014). Younger adult's fears were often the result of depressive cognitions around body image and how other people may perceive their weight (O'Brien et al, 2017). Because of this, they would avoid environments whereby they would be observed in the fear they would be humiliated or stigmatised (Puhl and Heuer, 2010). These fears were associated with activity avoidance which led to an increase in sedentary behaviour and higher levels of inactivity (Ramírez-Vélez et al, 2014; Farhangi et al, 2016). Older overweight and obese adult's fears often related to the desire to avoid pain and functional disability (Wingo et al, 2011). This meant that they would avoid specific modes and higher intensities activities because of fears they may fall an injury themselves (Rosic et al, 2019). Several studies showed that most fears intensified as BMI heightened and that activity avoidance was at its highest in obese adults with a BMI over 40kg/m^2 (Vincent et al, 2014; Wingo et al, 2011).

This review highlighted notable gaps in the literature relating to how pain and movement related fears impact on activity for younger obese adults under 45 years. This is an important gap in knowledge given that pain-related fears in older obese adults intensify perceptions of disability resulting in greater levels of inactivity (Vincent et al, 2014). Notably, there is already a strong rationale to suggest these fears may exist in younger obese adults because of the prevalence of fears relating to injury and experiences of musculoskeletal pain (that impact upon movement) (Okifuji and Hare, 2015; Ramirez-Velez et al, 2015).

Several studies included in this review suggest that by tackling many of these fear related barriers to activity we could reduce the cases of avoidance and encourage overweight and obese adults back into physical activity. The research indicated that without psychological intervention explicitly addressing activity related fears, it is likely that overweight and obese adults will remain inactive (Cooper et al, 2017; Wingo et al, 2011). However, with a dearth of literature in fears that are not related to stigma and embarrassment, there is a need for further research to confirm and quantify fears as a risk factor for inactivity in overweight and obese adults. A primary example of this is that the review could not identify one study that has explored pain-related fears in younger obese adults in the context of physical activity. This research is necessary because chronic pain complaints are common in younger obese adults, and chronic pain often leads to the manifestation pain-related fears which exacerbates activity avoidance (Vlaeyen et al, 2000; Okifuji and Hare, 2014). This is a gap in knowledge in which research is needed to explore the concept and prevalence of pain-related fears in obese adults under 45 years. Equally, there is also a similar gap in existing knowledge regarding fears relating to movement. There is a dearth of literature in how a fear of movement impacts on physical activity for younger overweight and obese adults. These fears need to be explored in younger adult populations to determine if they are a risk factor for inactivity. Arguably, these fears need first exploring in obese adults because of the greater risk of activity avoidance and health consequences as a consequence of inactivity (Vincent et al, 2014).

Contrary to the common concept of fear as a barrier, this review found some studies that proposed fear as a facilitator for increases in physical activity. This review found four explicit fears that may have motivated overweight and obese adults to become more active. The fear of death, infertility, embarrassment and missing out on social interaction prompted some overweight and obese adults to increase their levels of physical activity. The literature is limited in that these fears were explicitly contextual, infrequent and were only reported by a small number of younger to middle aged obese adults. For example, the findings related to fears of fertility are limited because of the small sample size, narrow age range and restricted BMI range. Further research is needed in all age ranges and BMI classifications to quantify these fears with larger populations, as it may be an important health message that encourages overweight and obese adults to partake in increased activity (Alqout and Reynolds, 2014). Further research is also needed to explore the conceptual understanding of fear as a facilitator, and it is not yet clear if fear is a common phenomenon among overweight and obese adults who have changed their behaviours to promote health (Alqout and Reynolds, 2014).

Table 2.4. Research gaps by age group – explicit activity related fear research

Fear	18 to 45 years olds	46-59 years old	60 plus years old
Fear of Embarrassment	9 studies	5 studies	3 studies
Fear of Stigma	10 studies	3 studies	1 study
Fear of Falling	1 study	2 studies	5 studies
Fear of Injury	4 studies	1 study	3 studies
Fear of Pain/ Pain-related fears		3 studies	1 study
Fear of Movement		2 studies	2 studies
Fear of Weight related risk factors		1 study	
Fear of Weight causing more damage (Joint Damage)	1 study	1 study	1 study
Fear of Crime		1 study	
Fear of Fat	1 study		
Fear of Death	2 studies	1 study	
Fear of Infertility	1 study		
Fear of Missing Out	1 study		

2.8.1 Strengths and limitations of the review

A key strength of this scoping review is that the study design allowed for an examination of the broader field of evidence related to fear and physical activity. Because a review relating to the current study aims had not been conducted previously, the scoping review methodology provided benefits in that it allowed flexibility in a more expansive inclusion criteria that ensured all relevant studies were included (Munn et al, 2018). The review provides a unique insight into what is currently known about activity related fears, and how they may be perceived as a barrier or facilitator in overweight and obese adults. The findings identify specific gaps in existing knowledge base that are useful in shaping future research initiatives (Munn et al, 2018). The strength of the study design could also be a limitation in that it did not assess the methodological quality of current evidence. This could have consequences for this review in that it is difficult to identify areas of research that may have gaps in knowledge or need further exploration based on poor quality, lacking sufficient validity, reliability or rigour (Arksey and O'Malley, 2005). Limitations aside, this study achieved its aim to summarise research findings relating to how fear impacts on physical activity in overweight and obese adults.

A further strength of this review is that it highlighted interrelationships (i.e. fear may reduce motivation for physical activity) that may exist between several barriers to activity (Sallinen et al, 2009). These interactions are likely to construct a complex web of barriers that increase the risk of inactivity among overweight and obese adults (Cooper et al, 2017). These findings help to improve understanding of the factors that contribute to the conceptual constructs of fear related barriers (De Vet et al, 2011). However, these are likely to be more complex than previously known and therefore further research is needed to explore these barriers in overweight and obese adults.

A limitation of the study selection process was that the papers were only screened in detail by one researcher. Because of these limitations, there may be a degree of researcher bias or misinterpretation in which relevant studies may have been missed (Arksey and O'Malley, 2005). Similarly, the researcher screening the documents limited the search to English language papers because of the lack of resources available to translate studies from other languages. Because of this, several studies that met the inclusion criteria but may have been published in languages other than English could have been missed.

A further limitation of this review is that the interpretation about importance of different fears (as identified by number of studies) was limited by the focus of other researchers. Most of the studies conducted research employing specific aims that focused on barriers to activity or explored explicit fears (Vincent et al, 2014; Rosic et al, 2019; Neri et al, 2017). Because of this, the data relating to fears lacked sufficient depth to outline a conceptual framework (Cooper et al, 2017). From these findings, it is evident that further research is needed to develop an improved understanding of the constructs relating to activity related fears in populations of overweight and obese adults.

2.9 Conclusion

This review accomplished its primary aim of identifying how fear impact upon physical activity for overweight and obese adults. The review highlights a plethora of literature relating to fear as a barrier to physical activity in overweight and obese adults. However, the range and strength of the research varies dependant on which explicit fear has been reported. The fears of embarrassment, stigma, judgement, intimidation, negative evaluation, falling, Injury, pain and movement have been explored in several age groups and with overweight and obese adults. However, there are some limitations in generalisability because of a dearth of literature within the younger obese population. Notably, there is a rationale to suggest that theoretically these fears may exist in younger obese populations and that fear related barriers could pose a threat to activity engagement. This is because the evidence has shown that beliefs of fear have some relationship with the avoidance of physical activity. Fear related activity avoidance has previously been conceptualised by Vlaeyen et al, (2000) within the theoretical factors of the Fear Avoidance Model. These fear avoidance beliefs have detrimental consequences to all populations, but a case may be made that obese persons are in danger of more serious health detriments as an outcome of these beliefs. This is because these fears are greater or the consequences of fear-related lack of activity are greater (NHLBI, 2013).

2.10 PhD research questions, aims and objectives

The findings from this review have provided evidence that explicit fears could be categorised as a psychological barrier to physical activity in overweight and obese adults. The review has highlighted gaps in existing knowledge relating to fears and how they contribute to the lack of physical activity engagement. Of these gaps, the most notable is a dearth of literature in younger adults aged 18 to 45 years that has explored fears of pain, movement and falling. These fears are particularly important given that they have been associated with inactivity, and been identified as a barrier to activity in middle to older aged adults (Vincent et al, 2011; Rosic et al, 2019; Cooper et al, 2017).

The focus of this PhD will be on the exploration of psychological barriers to physical activity (with a focus on fear) in obese young adults, which are defined, for the purposes of this PhD, as those aged 18 to 45 years. The research aims, and objectives are as follows:

Research Aims

- To investigate psychological barriers to physical activity in young obese adults with a focus on fear avoidance

Research Objectives

1. To explore whether and how fears contribute to the lack of physical activity engagement in young obese adults.
2. To identify existing measures of fear that relate to activity.
3. To use existing tools and if necessary, develop a new tool to estimate levels of fear related to activity in young obese adults and to compare these across body mass index (BMI) classifications.

Through this it is hoped to provide novel insights, which will help policymakers, weight management specialists and lifestyle professionals to develop more relevant interventions to promote sustained changes in activity levels for obese adults.

2.11 Chapter Summary

This chapter has identified that fear is an important barrier to physical activity for overweight and obese adults. The review highlighted that there is a range of literature identifying several explicit activity related fears that may be a risk factor for inactivity. However, there are important gaps in knowledge relating to how several fears impact on physical activity for younger obese adults under 45 years. Notably, there is a dearth of literature that has explored fears of pain, movement and falling. These fear related barriers need further research to identify if they could pose a threat to activity engagement. This PhD seeks to address these gaps through an exploration of activity related fears to identify how they contribute to sedentary behaviours in younger obese adults.

The following PhD consists of two studies which are outlined in chapters three and four. Chapter three employs qualitative methods to explore whether, and how, fears contribute to physical activity engagement in younger adults aged 18 to 45 years who are obese. Chapter four employs quantitative methods to explore fear related barriers using existing instruments to measure them in a larger sample of adults aged 18 to 45 years.

Chapter 3

Exploring the Emotion of Fear as a Barrier to Physical Activity in Adults Aged 18- 45 Years Who Are Obese – A Qualitative Study

3.0 Background

The literature review in chapter two suggests that activity related fears exist in obese populations. When these fears are perceived as barriers to activity, they could pose a threat to adherence to physical activity recommendations because they provoke fear avoidance beliefs (McIntosh et al, 2016). These fear avoidance beliefs have detrimental consequences in all populations (Vlaeyen et al, 2012). The avoidance of physical activity increases the risk of several conditions such as cardiovascular disease, type two diabetes and some cancers (Lee et al, 2009). A case may be made that obese individuals are in danger of more serious health detriments as an outcome of these fear avoidance beliefs (Cooper et al, 2017). This may be because these fears are greater, the consequences of fear-related lack of activity are greater or they may lead to greater avoidance of activity (NHLBI, 2013).

As seen from the findings of the previous chapter, much of the literature on fear related barriers (in the context of physical activity) has focused on middle to older aged obese adults, with limited information (outside of weight stigma) relating to younger obese adults under 45 years (Wiklund et al, 2011; Vincent et al, 2013). With obesity increasing among young adults, it is now necessary to explore the prevalent barriers to activity that prevent engagement. Literature over the past decade has reported on the barriers to activity in young healthy weight adults but has not yet adequately investigate obese adults ranging from 18 to 45 years of age (McIntosh et al, 2016; Pooblalan et al, 2012; Sallinen et al, 2009). Additionally, the barriers to physical activity that have been discovered in healthy weight adults may not fully represent the barriers in obese adults. This is because literature directly correlates pain, movement, negative affectivity and issues of fear with increased body mass index (Lee et al, 2013; Pooblalan et al, 2012; Vincent et al, 2013). A gap currently exists within the understanding of how particular fear(s) influence young obese adults within the contexts of physical activity (Sola et al, 2011).

3.0.1 Fear, and fear related barriers to physical activity

As previously discussed in the introduction chapter, the emotion of fear is a contextual experience that can vary from one person to another (Adolphs, 2014). It can encompass psychological, physiological and behavioural changes (Steimer, 2002).

Primarily, fear begins as a psychological state that leads to physiological and behavioural changes (Schachter, 1975). Fear is caused by a perceived trigger, often contextual and explicit to an individual. This trigger is commonly characterized as a 'threat' (Bates, 2014). The scale of the 'threat' usually determines the level of fear someone may experience (Larosiliere, 2015). A 'threat' is nearly always external to an individual, and the fear is the internal response to it (Bates, 2014). Fear reactions resulting from threats, elicits two main action responses: flight (a distancing or avoidance from the judgement of threat) or fight (a defensive battling or confrontation of the threat to save one's self) (English and Stengel, 2010). This is known as the fight-or-flight response to fear, originally characterised by Walter Cannon (1915).

An individual's behavioural response (either fight or flight) depends entirely on contextual clues, a risk assessment of the given situation and their coping strategy (Steimer, 2002). It is possible through consistent behavioural and neuroendocrine patterns that an individual may respond similarly, (by either flight or fight) when perceiving threat (Koolhaas et al, 1999). Dewey (1922) states that when a fear response results in avoidance (flight) then the next time a similar situation occurs, the response induces the same reaction. A conceptual model named the 'fear avoidance cycle' has been developed to demonstrate this process in the context of physical activity (Vlaeyen et al, 1995, 2000, 2012). The cycle outlines injury or negative cognitions around wellbeing as its entry points. From these points, pain becomes the construct factor that leads to fears and the avoidance of physical activity (fear avoidance). The theory then proposes that mental health, deconditioning of the body and functional disability worsen as a result of fear avoidance. This increases the probability that individuals may experience pain and so the cycle of fear avoidance begins again (Vlaeyen et al, 2000). The fear avoidance cycle is displayed in figure 3.1.

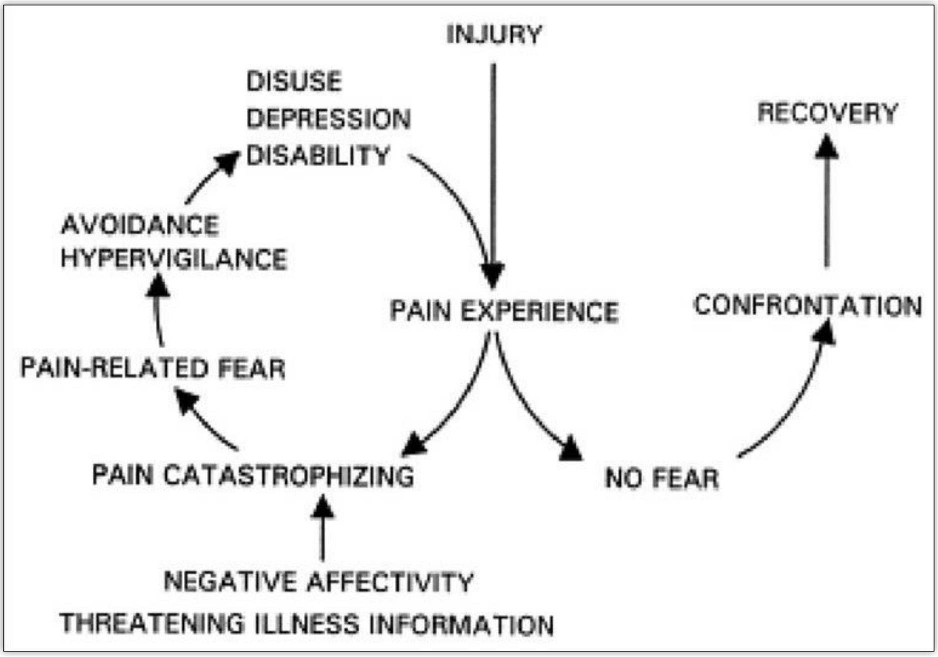


Figure 3.1. Graphic display of the fear-avoidance cycle, (Vlaeyen and Linton, 2000 and 2012)

Similarly, when a fear response results in protective action (fight; providing the individual has adequate self-efficacy), the response will induce the same reaction (Witte, 1992). The Extended Parallel Process Model (EPPM) conceptualises the fight responses of fear in the context of health promotion behaviours (Rogers, 1983; Witte, 1992). The model's entry point outlines how a threat is perceived by an individual. The model shows that if a threat is perceived as severe and imminent, then the emotion of fear can be aroused. Following the arousal of fear, the individual can alter their behaviour to the threat through two pathways. One pathway states that the individual becomes defensive in their behaviour (non-active) and is motivated to reject the threat. In second pathway, the individual is motivated to protect their wellbeing which stimulates health promoting behaviour (e.g. physical activity), to distance themselves from the threat. In this sense, fears could motivate an increase in activity if the threats associated with inactivity are perceived as severe and the individual has adequate self-efficacy (Witte, 1992). The Extended Parallel Process Model is displayed in figure 3.2.

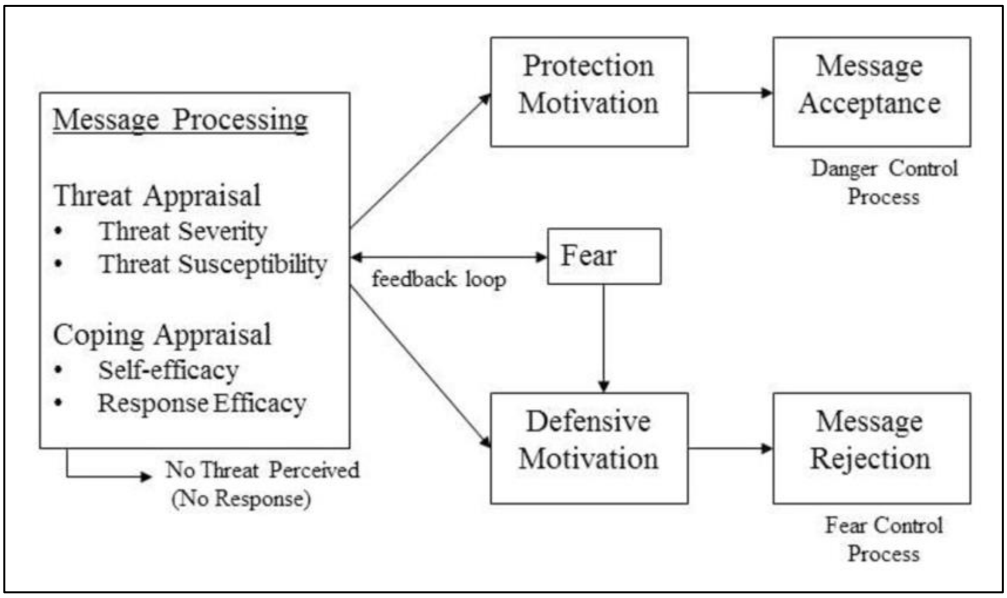


Figure 3.2. Expanded Parallel Process Model (Witte, 1992).

Literature suggests that by tackling fear related barriers to activity we could reduce the cases of avoidance and encourage obese adults to become active (Denison et al, 2015). However, research that has focused on fear (in the context of physical activity) has not fully explored its concepts as a barrier and/ or facilitator. This is largely because there is a dearth of literature and that existing studies have failed to investigate a range of fears in younger obese adults. An exploratory study is needed to understand what fears, concerns and worries obese adults have about undertaking physical activity.

This chapter will explore exiting gaps in knowledge using qualitative methods to increase understanding of whether, and how, fears impact on physical activity. This will highlight how younger adults who are obese experience and perceive fear(s) within the contexts of physical activity (Thorne, 2016).

3.1 Research question

To explore whether, and how, fears contribute to physical activity engagement in younger adults aged 18 to 45 years who are obese.

3.2 Study design

The study design chosen for this phase was qualitative, employing an Interpretive Description approach. This approach focuses on psychological phenomena and how it is understood through the experiences of individuals (Giorgi, 2009). The justification for a qualitative design was that it allowed the researcher flexibility to probe iteratively into individual experiences (Smith et al, 2009). In a qualitative exploration, participants have a greater opportunity (as opposed to quantitative designs) to detail experiences from their own perspective and describe phenomena in several contexts (Smith et al, 2009). This is particularly important given that fear and physical activity varies contextually in its frequency, intensity, duration and type.

3.3 Methodology

The objectives of this study were to understand whether, and how, fears had an impact on physical activity from the experiential perceptions of obese adults. With these in mind, a qualitative approach was chosen because of the need to obtain contextual and experiential meanings that have not been explored in research on this topic (Wiklund et al., 2011). From the limitations stated in other research, it is believed that a quantitative method would have failed to capture deep contextual understandings of fear, and how this translates to physical activity or inactivity (Bond et al, 2013; Egan et al, 2013). A quantitative design may also have failed to address contextual understandings of participant fears regarding emotions and activity avoidance (Peacock et al, 2014).

The methodology chosen for this phase was an Interpretive Description approach (Thorne, Kirkham, and MacDonald- Emes, 1997; Thorne, 2016). The concept of fear in the context of physical activity may be perceived in numerous ways, and so this approach was chosen to fully explore this phenomenon (Smith et al, 2009). Interpretative Description is an approach to health research that has been informed by methodological traditions of social science research and has roots within Phenomenology, Ethnography and Data-Based Theory (Thorne, 2013; Smith et al, 2009). It is located within non-dualistic philosophical tradition that capitalises on the perspective that phenomena do not exist ‘out there’ as objective entities but rather are understood through subjective experience of each individual (Thorne, 2016). Interpretative Description utilises several methodological tools associated with phenomenology and ethnography but is not concerned or committed to the theoretical traditions used to analyse data (Thorne et al, 1997). Instead, the data is used to generate new knowledge that can offer practical solutions to the problems faced by health practitioners (Teodoro et al, 2018). This approach is unique to others in that it utilises the general ideas of theoretical methods (such as phenomenology) to assist with research but is flexible in that it will abandon methodological traditions if they become obstacles to the generation of useful knowledge (Thorne, Stephens and Truant, 2016). It remains a pragmatic approach that fits with a wide range of epistemological views and align with the researcher's pragmatism paradigm (Teodoro et al, 2018). Fundamentally, an Interpretative Description approach remains firmly focused on answering practical research questions that arise from real world problems (Thorne, 2016; Teodoro et al, 2018). That being said, research adopting this approach must be systematic, contextually aware, represent different perceptions and detail the intricacies of participant experience (Thorne, 2016).

Interpretative Description in process involves several key phases; entering the field, constructing data, and working data (Thorne, 2016). The first phase of entering the field involves the researcher being able to situate themselves within the role and setting. This is accomplished by reflecting, disclosing insider and outsider perspectives, containing their influences, navigating participant access, and honouring confidentiality. The second phase involves the process of engaging with data collection through interviews or focus groups and tracking constructions of knowledge. The third phase is the process of sorting and organising data and making sense of the data to inform further data collection (Thorne, 2016). Although these phases appear sequential, they are typically recursive whereby the researcher moves back and forth between them (Thorne, 2016).

To put into the context the choice of methodology, it is useful to understand the researcher's positionality, ontology and epistemology (Starks and Trinidad, 2007). The researcher's positionality is shaped from lived experiences and how these experiences are reflected upon (reflexivity).

3.3.1 Reflexivity

Throughout the last five years, the lead researcher had been heavily invested in the health industry, working within the culture of obesity and physical activity as a health promoter. The researcher has worked alongside obese adults and is knowledgeable about the prevailing cultures but is somewhat of an outsider with a lack of experience being obese (Sanghera and Thapar-Bjorkert, 2008). However, the researcher holds some à priori knowledge of the barriers to physical activity and can relate these to the population. The researcher's knowledge surrounding obesity management allowed him to understand non-verbal cues prominent within obese adults (Weiner- levy and Queder, 2012). To this extent, the researcher considered himself an 'insider-researcher' which undoubtable influenced the interpretation of data (Rabe, 2003). Although this perspective may have had benefits within data collection, it may have exposed the study to bias and misrepresentation of findings (Herod, 1999; Mercer, 2007). This is because interpretations within the data collection could have been made that did not truly represent the views of the participants. The interpretation of data may have also been influenced by the researcher's academic background in sports performance psychology and coaching.

The researcher has come to accept through the undertaking of research that there can be little or no position-free knowledge that relies upon social perception. Researchers have been moulded by culture, institutions, social influences, and knowledge, and even if we believe to have not been influenced by any of the above, that position maintains a value of its own. The researcher acknowledges that his own values or subjective experience may have impacted on data collection and analysis throughout the study. An example of this could be seen during the stages of analysis whereby the researcher was influenced and employed his pre-existing knowledge and experience in sports coaching and performance (e.g. the interpretations of intrinsic, extrinsic motivations, self-confidence, fear of failure and several personality characteristics). The researcher acknowledges that the interpretations may only be subjective assessments at the time of analysis (Savin-Baden and Major, 2013).

From these experiences and beliefs, the researcher has begun to shape a positionality. His positionality can be closely aligned with a pragmatist (Pierce, 1878). Pragmatism is a key philosophical concept that is the fundamentals of his ontological and epistemological stance that guided the research approach. In understanding the researcher's qualitative approach to this study, it is beneficial to outline the lenses in which he views the world that undoubtedly had an impact on the research.

3.3.2 Ontology

In understanding the researcher's concept of pragmatism and research paradigm, it is necessary for the reader to have an understanding of the work of Peirce (1878). The researchers pragmatic thought processes are to investigate a concept, critically deliberate, and be able to action the results through practical clarification. In this sense, the researcher's philosophy is guided by the desire for impact. The researcher's approach to investigation is led by an attitude that truth is simply irrelevant unless it holds usefulness. It is the principles of what may best resolve any given problem, and a drive towards practical outcomes. His own philosophical truths are built on collective observations about what he knows about the world, rather than what others see (Agarwal, Bansal and Maheshwari, 2010). Peirce's (1905) later literatures aligns with his academic development, as his perceptions dictate that if something holds no practical meaning, it is immaterial to his understanding of the world. His philosophy guides him to analogies such as: 'If a tree fell in a forest and no one is around to hear it, does it make a sound' (Berkeley, 1710). Rather than consider the concept in philosophy, it is simply discarded with the consideration whether it would, in fact, enhance his or others knowledge for the better (Bernstein, 2010). In this regard the researcher always reflects upon the outcomes of his actions, will they create growth, or stunt knowledge. This is something Dewey (1999) identifies as a key concept of pragmatism.

The researcher's academic paradigm dictates that any investigation must be carried out rigorously. This is something which James (1907) had reiterated in his progressive pragmatism work of Pierce (1878). James (1907) nor the researcher hold any purist views about a particular methodological approach. Rather, the research inquiry or questions guide the stance and approach that the researcher uses. In this process, the researcher critically analyses the methodological options, the desired impact and, subsequently, designs the investigation using the rigour applicable to the method. However, the researcher closely resonates with the work of James (1907) who considers the significance of human beings as experiential individualists and this could, at points in time, tilt the researcher towards an interpretivist philosophy (Streb, 2010). In this thinking, the researcher will utilise a relativist ontology to focus on human interpretations of experiences throughout this phase, to assist the future direction of this research approach and deliver impact (Braun and Clarke, 2013).

The researcher's pragmatism paradigm will provide a middle ground for the studies of this PhD in that the modes of inquiry will embrace a paradigm continuum that moves back and forth between post positivism and constructivism (Kaushik and Walsh, 2019). The key advantages of the pragmatist research paradigm are that the researcher is afforded the flexibility to identify and select the most appropriate methodology to address each research question (Kaushik and Walsh, 2019). In this instance, the PhD will employ multiple methodologies based upon their appropriateness to address the research questions that have or may arise from each study.

3.3.3 Epistemology

The researcher's epistemological position portrays the philosophy of truth as the knowledge that improves practice (Grix, 2010). True knowledge is useful and can improve experience through the eyes of the beholder (Dewey, 1921). In practice, this pragmatist epistemology leans towards impactful research that can solve novel challenges. It seeks to benefit populations by understanding phenomena through an experiential lens. This philosophy of truth is derived from the scriptures of James (1907) and Dewey (1921) who centre their philosophy on experience:

> 'The only things that shall be debatable among philosophers shall be things definable in terms drawn from experience' (James, 1909; In Hookway, 2013, Pg. 13).
>
> 'the relations between things, conjunctive as well as disjunctive, are just as much matters of direct experience, neither more nor less so, than the things themselves' (James, 1909; In Hookway, 2013, Pg. 14).

Dewey (1921) states that knowledge is acquired through experiences and those experiences can be immediate or mediated. Immediate experiences are the sense of knowledge acquired through definable undergoing of assignable reasoning. A simple but applicable concept to the researcher. This knowledge can be acquired through any pathway of ontology, as long as there is an attempt to attain it through the most effective method. The researcher embraces this stance and feels a responsibility to exhaust the most effective method to meet the objectives of the study.

3.3.4 Justification of the methodological choice

The Interpretative description approach has become an established method within health research and is fitting for exploratory inquiry relating to weight concerns and physical activity (Throne et al, 1997). This is because it has been effectively employed in previous research to investigate barriers to physical activity in younger overweight adolescents (Clark, Spence and Holt, 2011). This aligns with the study's aim of exploring the experiences of younger obese adults and how they perceive fear related barriers within the context of physical activity (Streb, 2010). Importantly, this method matched with the researcher's pragmatism paradigm (Starks and Trinidad, 2017). After careful consideration, it was determined that an interpretative description would best suit the studies objectives and the researcher's epistemological beliefs (Sokolowski, 2000). The researcher considered Interpretative Phenomenological Analysis, discourse analysis and grounded theory approaches because of their frequent use within health, psychology, and sports literature (Smith, Flowers and Larkin, 2009; Gee, 2005). Each approach had advantages that may have been valuable in the interpretation of data during analysis, however these approaches were rejected based on epistemological and conceptual reasoning.

Interpretative Phenomenological Analysis (IPA) is another qualitative methodology concerned with the interpretation of participant lived experiences (Smith, Flowers and Larkin, 2009). IPA seeks to understand the meaning of experience through the eyes of the participants through the concepts of phenomenology, hermeneutics and idiography (Smith et al, 2009). The interpretative theory of hermeneutics describes a need for detailed accounts of lived experiences (Husserl, 1927). This theory portrays our experiences as perceptual, temporal, and always meaningful in relation to some other experience (Satre, 1956). The theory of phenomenology portrays that the very make up of someone's psychology, has been created from their experience of the world and that we as researchers must represent and attempt to understand it (Merleua- Ponty, 1952: 106). Finally, the theory of ideography states a commitment to in depth contextual analysis which is achieved through a systematic approach to research (Harre, 1979). Combining these theories gives IPA its unique approach to research inquiry that represents, contextualises and probes deeper into the experiences and interpretations of participants (Harre, 1979). The exploratory nature meant that it was not appropriate to adopt the theories and traditions of IPA. This is because IPA often lends itself to a narrative and unstructured style of data collection with the need to understand how the participants view their experiences from a wider set of beliefs (Smith et al, 2019). The additional phases of analysis and lengthy data collection process of IPA were not necessary for this study given that the data obtained in this phase was intended to inform a further study to address the aims and objectives of the PhD thesis.

Discourse analysis is a qualitative approach that is concerned with the use of language and how it shapes our understanding of reality (Gee, 2005). The approach dissects the use of terminology to conceptualise experiences of participants (Gee, 2005). It is particularly beneficial in understanding social norms, social interaction and the construction of group identities (Gee, 2005). This may have been useful for this study in the interpretation of terminology relating to fear, activity and weight concerns. However, this study did not aim to reconceptualise fear, obesity or physical activity through linguistics and so the process of discourse analysis did not align as a methodology. The researcher used existing theory to form a research interest and so the discourse surrounding that theory was already established. Discourse analysis also did not align with the researcher's positionality that the concept of fear is a phenomenon that provides an origin for the expression of language. It was rejected as an approach because discourse analysis does not seek to make claim about the reality of people's experience, something which contradicted this study's objective (Georgaca and Avdi, 2009). Conceptually, discourse analysis did not align with the aim as the researcher did not seek to construct the fear related experiences of others, but merely wanted to represent their views through a hermeneutic approach. The researcher's pragmatist ontology also did not align with the concepts of discourse analysis described by Potter and Wetherell (1987). The researcher disagreed with the ontological construction and mediation of reality solely through language, and so the approach was rejected.

Grounded theory is a qualitative methodology that seeks to understand the basic social processes of interaction (Glaser and Strauss, 1967). This is explicitly achieved through the development of explanatory theory. This approach states that social processes can be understood through structures, codes of conduct and procedures of everyday interactions, and that there are regular patterns among these (Jeon, 2004).

This approach did not align with the aims of the study because an established theory surrounding fear avoidance had already been used to conceptualise the social process of younger obese adults. Moreover, grounded theory has a realist orientation that views reality as independent of the mind (Scotland, 2012). This epistemology did not align with that of the researcher as he believes more within a pragmatist reality, created by human experience and interpretation (Creswell, 1994). As an 'insider researcher' with some à priori familiarity with the population and topic, the researcher deemed his interpretative positionality as unavoidable. Therefore, he could not adopt the epistemological principles of grounded theory that seek to remove all conceptual preconceptions from the interpretation of data (Charmaz, 2008). A grounded theory approach was rejected based on epistemological and conceptual mismatches between the objectives, method and the researcher.

3.4 Methods

3.4.1 Participants

The participants were eligible if they were adults, aged between 18- 45 years old, with a Body Mass Index (BMI) greater than 30 kg/m^2. This included class one obese (BMI, 30- 34.9kg/m^2), class two obese (BMI, 35- 39.9kg/m^2) and class three morbidly obese (BMI >40kg/m^2). BMI was self-reported by the participants through a screening document. The age range of 18 to 45 years was employed because of a plethora of existing literature that has explored fears in adults over 45 years but not yet explored them in younger adults (Vincent et al, 2014; Thomas et al, 2008; Dikareva et al, 2016; McPhail et al, 2014).

Participants were excluded if they suffered any physical condition unrelated to weight that affected movement, such as, degenerative muscle conditions, artificial joints, amputations, neurological conditions and fatal diseases. This was because the range of barriers experienced by sufferers of these conditions, may not accurately represent the barriers experienced by younger obese adults (aged 18 to 45 years). The study also excluded anyone who could not consent for themselves, such as vulnerable adults and those who could not speak English. This was because of the limited resources available within the PhD programme of studies.

3.4.2 Sampling

A purposive sampling strategy was employed with the aim of generating 'insight and in depth understanding' of psychological barriers to physical activity in obese adults aged 18 to 45 years (Patton, 2002, Pg. 230). Purposive sampling was used to identify those who hold rich accounts of psychological concerns in the context of activity avoidance (Al-Busaidi, 2008). Because of the dearth of data and the exploratory nature of the study, a theoretical or quota sampling strategy was not necessary for the population (Patton, 2002). Marshall (1996) rationalised that quota and theoretical samples are strategies that emerge from the need to target gaps in previous studies' sample characteristics. As there was limited literature outlining previous sample characteristics, recruitment was based on rich contextual experiences and not on previous sample characteristics (Cleary et al, 2014). Following participation, snowball sampling was also employed to recruit further participants (Braun and Clarke, 2013). This sampling strategy involved asking participants if they would be happy to recommend the study to people they knew, and to pass on the participant information sheet (PIS). These nominations made contact with the researcher who after meeting eligibility criteria were included in the sample (Denscombe, 2012).

3.4.3 Recruitment

Participants were recruited from one university and private leisure facilities within the North West of England and Cornwall. Recruitment leaflets and posters were used to advertise the study. These gave a brief outline of the research project and the details of the lead researcher.

3.4.4 Informed consent

Individuals who made contact were given written detailed information about the study and at least 48 hours to consider participation. Individuals who agreed to participate completed a screening document to confirm eligibility and signed a consent form.

3.4.5 Screening for eligibility

The screening document included information on age, height, weight, sex, medical conditions, and any use of assistive devices. Self-reported weight and height were used to calculate BMI. Participants who did not meet the eligibility criteria were thanked and their data destroyed.

3.4.6 Sample size

The intention of this exploratory study was to recruit a sample of between eight to 12 obese adults aged between 18 to 45 years. 10 participants were recruited. This is considered adequate by Braun and Clarke (2009) for a medium size study as part of a PhD project, and meets the recommendations for an exploratory Interpretive Description study (Burmeister and Aitken, 2012). The final sample size was dictated by data saturation (Bowen, 2008). Data saturation was understood by the researcher to be when the research has a full understanding of the population's perspective of a particular phenomenon (Legard et al, 2003). The researcher's perception of data saturation was reached following interview with participant nine. Interview data from participants nine and 10 repeated and reinforced the themes that had emerged from previous data but were redundant of any new themes (Middlemiss et al, 2015). However, their data was useful in affirming the frequency of established themes across the sample.

3.4.7 Data collection process

Telephone or face to face semi structured interviews were conducted from a private office space by the lead researcher. Interviews ranged from 25 to 60 minutes, but typically lasted ~35 minutes and were digitally recorded. Interviews began with a confirmation of consent and some rapport building with participants. Participants were then asked questions around the topic areas of physical activity, barriers, facilitators and fears. The interviews adopted a funnel approach beginning with broader questioning about the topics, followed by more specific questioning once a rapport was established. The opening question specifically asked participants if and what physical activity they currently participate in. This included prompts about the modes, intensity and duration. It was noted that fewer questions and prompts were employed when interviews were via telephone. This was because participants discussed activity related fears and revealed psychological concerns openly at earlier points in the interviews. Participants interviewed face to face required additional rapport building in the initial stages of interview before revealing activity related fears. Although the questions within the interview were largely dictated by participant responses, an interview schedule was employed as a framework (this can be viewed in appendix G). The interview schedule was inspired by the findings of the literature review in chapter two (Vlaeyen et al, 2000).

Brief field notes were made during the interview, followed by a comprehensive reflection of the contextual and linguistic comments. These notes documented facial expressions, changes in voice tones and periods of silence that could contextualised segments of the transcripts. These field notes made a significant contribution to the process of reflexivity.

3.4.8 Justification for the data collection process

Semi structured Interviews were chosen because of the desire to probe deeper into the emotional beliefs of participants (Adams and Cox, 2008). Literature suggests that a semi structured approach (opposed to an unstructured approach) allows for a clear list of topics to be addressed and research questions to be answered (Denscombe, 2012). The semi structured approach (opposed to a structured approach) also has additional benefits of allowing the participant to develop ideas and speak more widely on the issues raised in the interview (Denscombe, 2012). An advantage of the semi structured approach is that it gives the researcher control of the discussion, whilst probing deeper into the experiences of participants (Denscombe, 2012). This allows for efficient data collection that meet the aims of a research project.

One to one interviews are generally cited as the best method for attaining data based on emotions and experiences (Denscombe, 2012; Stokes and Bergin, 2006). Comparisons of one to one interviews and focus groups has revealed that interviews produced more original, diverse and a wider range of themes (Heary and Hennesey, 2006; Guest et al, 2017). Focus groups have been deemed more time consuming, more costly and difficult to manage (Lama et al, 2012). The primary reasoning and justification behind the interview method was the need to adopt a ‘no harm’ principle to the research (Senjari et al, 2014). The research held a responsibility to minimise harm that might affect the participants as a result of participation. Research has stated that the verbal communication of fear experience, either, implicitly or explicitly, from one person to another can be significant in the development of fears that lead to avoidance behaviours (Rachman, 1977; Olsson and Phelps, 2007; Percy et al, 2016);

> 'Fears can be acquired indirectly from others via nonverbal and verbal transmission pathways.' (Aktar et al, 2017. Pg. 1).

With this in mind, focus group discussion could have exposed participants to the development of new fears. Ethically, this could be harmful in that the development of fear beliefs could provoke further activity avoidance.

3.5 Data analysis

Thematic analysis, as described by Braun and Clarke (2006), was employed as the method of analysis. Thematic analysis seeks to identify, analyse and describe in rich detail the patterns within a data set (Braun and Clarke, 2006). Thematic analysis is not aligned to a particular theoretical or epistemological approach, but rather is a more accessible form of analysis. This is because thematic analysis is a flexible approach in that it allows research to utilise other analytic methods (such as IPA and grounded theory) without being bound to their theoretical traditions (Maguire and Delahunt, 2017). In practice, this means that researchers can identify and report patterns of data that is useful to their enquiry in the most pragmatic and efficient way (Braun and Clarke, 2013). This fit the Interpretative Description methodology as they both share key objectives in remaining firmly focused on answering research questions through pragmatic approaches, without being bound by theoretical traditions (Thorne, 2016, Braun and Clarke, 2006).

Identifying patterns within data can be approached through thematic analysis in two distinct ways. The first is a theoretical analysis that is driven by the researcher's interests into specific theory. The coding of data tends to be formed from a theoretical framework and data patterns that do not fit with the framework are discarded (Boyatzis, 1998; Braun and Clarke, 2006). The second is an inductive analysis where patterns and themes are data driven, not specific to any topic, and are formed without a pre-existing coding framework that can influence the analysis (Braun and Clarke, 2006). This study used an inductive approach because the purpose of the study was to generate a greater understanding of fear in the context of activity. Once completed, and having identified potential conceptual frameworks and theories, the researcher then re-analysed the data with a theoretical approach, focusing on the fear avoidance model (Vlaeyen and Linton, 2000; 2012; Witte, 1992).

The exploratory nature of the study meant that themes were established at a semantic level (Braun and Clarke, 2006). Interpretation of the themes remained close to the data and did not look to assert meaning beyond what a participant had said in the interviews (Boyatzis, 1998). However, in the final stages of analysis the interpretation progressed from traditional description and attempted to theorize how the themes mapped onto existing conceptual models of fear.

In the first phase, each interview was transcribed verbatim by the lead researcher within 48 hours of the data collection. The transcripts were then checked for accuracy and the format affirmed by another member of the supervisory team. The lead researcher became immersed in the data through repeated reading whilst listening to the participant voice (on audio) in the context of the interviews. Initial thoughts and themes were noted in a reflective journal.

Phase two involved an active engagement with the data, making semantic notes in one margin of the transcripts. These notes explored contextual meanings and interesting patterns within the transcripts. Effort was made to code as many potential patterns as possible. Each transcript and data item received equal attention and were highlighted using coloured markers to collate similar codes together. Microsoft Word assisted with the tagging of codes. At a later stage, phase two was repeated and conceptual comments were made about psychological theories and critical perceptions of participant experiences. Phase two concluded with a deconstruction of important codes and a reflective summary of each participant interview.

Phase three began with the transcripts being separated into sections and each code being organised with similar ones across the dataset. The codes were then collated together in a Microsoft Excel spreadsheet. The Excel spreadsheet formed a mind map of the initial codes. From this, themes began to emerge and were revised as the analysis progressed. At the conclusion of phase three, all the potential themes were lifted from the transcripts into a Microsoft Word table with the corresponding quotes from the transcripts. This assisted with a fast and efficient comparison of initial themes across the sample.

Phase four clustered all the candidate themes from the participants together in an excel spreadsheet. Several candidate themes were collapsed together because of the distinct similarities they shared. Other candidate themes were separated into several themes because they contained data important for the objectives of the study. This process eventually identified 16 candidate themes that were represented in a thematic map. Numeration analysis was conducted on the 16 candidate themes. The process of numeration highlighted the frequency of each theme and patterns across the whole sample. Although numeration is not an indicator of importance, it did indicate which themes were central to most of the sample and how the data could be accurately represented in the write up phase. At the conclusion of this phase the thematic map was affirmed by another member of the supervisory team.

Phase five gathered the relevant data extracts that corroborated the themes and assisted with the naming of them. Once they had been named, a detailed summary was written to identify the story and narrative of each theme. Several sub themes emerged as part of this phase. The sub themes were formed because it provided a hierarchal structure for one of the more complex themes within the dataset. Each theme was refined by revisiting the transcripts, re-reading data extracts and redrafting the summary until the themes had a concise analytic narrative. At the conclusion of phase five, the thematic map was updated to represent the refined themes and the sub themes. Phase six embedded vivid data extracts with analytical narrative to provide a coherent argument that addressed the objectives of the study (Braun and Clarke, 2006).

Throughout the phases of analysis, the research team regularly discussed the transcripts and were in agreement about the refined themes and sub themes. This process aided in developing the robustness of the findings (Houghton et al, 2013). This method aligns with other research on barriers and facilitators to physical activity (Cooper et al, 2017). A reflexive journal captured the thoughts of the lead researcher throughout the analysis and assisted with bracketing beliefs to minimise bias (Smith et al, 2009).

3.5.1 The process of generating themes to meet the objectives of the study

As shown in figure 3.3, the process of analysis followed the six stages of thematic analysis until the themes had been established. 16 refined themes and 16 sub themes were documented. These themes were then analysed through the lens of two concepts: the barriers and facilitators to physical activity. This met the requirements of the study’s objectives. Aligning with the traditions of thematic analysis, the themes were written up in their entirety. However, effort was made to illuminate the two distinct concepts (barriers and facilitators) within each theme.

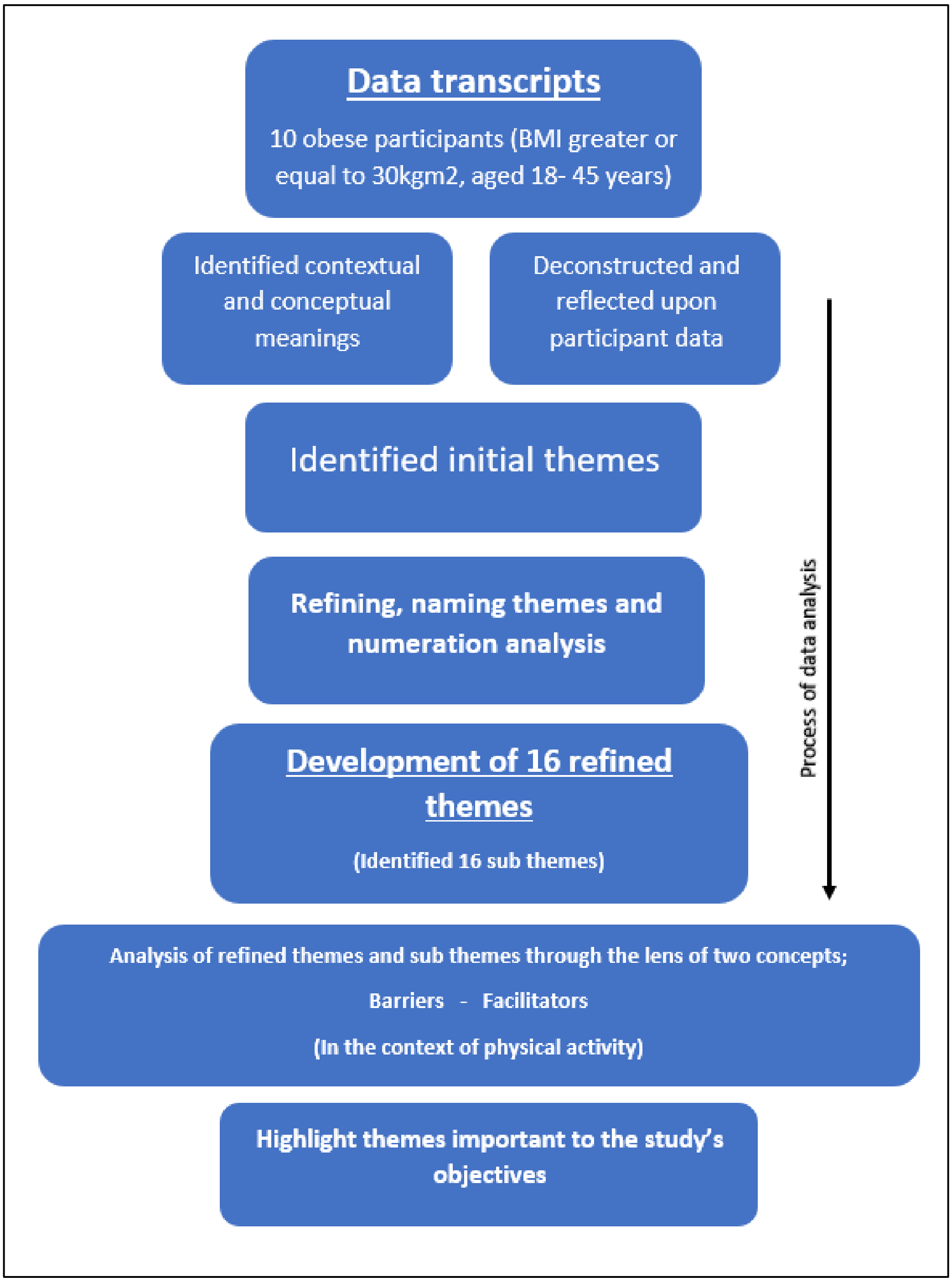


Figure 3.3. Process of data analysis – establishing qualitative themes.

3.6 Ethical approval and permissions

Ethical approval to conduct the research was obtained from Edge Hill University Faculty of Health and Social Care Ethics Committee. Approval was granted on the 19th April 2018 with the reference code: FOHS 202 (Appendix H). Permission to access staff and students was granted by the University. Private leisure facility managers also gave verbal permission to place posters and distribute leaflets around their facilities to assist with recruitment. Participants were given a participant information sheet which outlined the intensions of the research and provided consent prior to their involvement (seen in appendix I).

3.6.1 Main ethical and governance Issues

There were four main ethical and governance issues to consider in the design and implementation of this study: Breach of confidentiality, Participant distress and harm, researcher isolation through lone working and issues relating to research conducted with students. The issues and processes adopted to minimise the issues are outlined below.

3.6.2 Breach of confidentiality

A data management plan was implemented prior to, and throughout the data collection to mitigate risk. Following each interview, the audio voice recordings were transcribed, anonymised and a unique study pseudonym assigned to protect the identity of each participant. Following transcription, the researcher stored the audio recording files of each interview in a secure OneDrive (encrypted and password protected). Consent forms and all documentation that held demographic and personal data were kept in a separate locked cabinet in the lead researcher office at Edge Hill University. Anonymised transcript data was kept on the OneDrive (encrypted and password protected) data storage system. Audio files, anonymised transcript data and participant documents were kept separate (at all times) throughout the research project to mitigate a breach of confidentiality. Only the lead researcher had access to raw data that had not been anonymised. In accordance with Edge Hill University guidelines, participant data stored via audio will be stored until the research has been published, at which time it will be destroyed. The anonymised data in the form of transcripts will be stored for ten years in accordance with Edge Hill University guidelines.

3.6.3 Distress or harm

Although it was a possibility that distress may have occurred from discussing barriers to physical activity, participants in this study did not appear to experience any. The researcher considered that if a participant was anxious, distressed or upset during the data collection, the researcher would stop the interview process and ask if they would like to pause the audio recording. The researcher considered the option of terminating the interview or rescheduling at a later date if upset or distress had occurred. Following the interviews, a de-briefing sheet with relevant agencies (such as the Samaritans) was given out in case participants developed negative cognitions at a later time.

Once data collection had taken place, the selected member of the supervisory team was contacted for de-briefing. There was no instance in which the lead researcher felt a need to consult professional support as a result of the data collection.

3.6.4 Lone working

All data collection took place within the lead researcher's office either face to face or by telephone. If the lead researcher was lone working steps to ensure the safeguarding of the lead researcher were put in place using a buddy system. The study adhered to Edge Hill University's Safe Fieldwork and the Health and Safety policy.

3.6.5 Conducting research with EHU students

The lead researcher followed the ethical guidance for undertaking research with university students. When data collecting with students, the lead researcher highlighted on more than one occasion that participation or non-participation would have no detrimental effect on relations with the researcher or other academic staff, or on grades or other academic achievements. The researcher did not recruit participants that were or would be taught by himself. No financial, academic, grade or other incentives/ rewards were offered or given for participation within the study. The researcher avoided coercive acts to persuade participant involvement. Data collection was strictly organised outside of academic commitments and under no circumstances affected teaching or learning activities. Participation was entirely on a voluntary basis.

3.7 Results

3.7.1 Participants

The 10 obese participants were made up of six males and four females, with BMI ranging from 30.4 kg/m^2 to 36.6 kg/m^2: including eight class one, and two class two obese participants (WHO, 2018). Participants described their current activity levels as low and irregular. Six participants were employed, three were full time students and one was unemployed. Table 3.1 displays participant profiles.

Table 3.1 Participant profiles.

Participant	**Gender** **(Self-reported)**	**Activity levels** **(Self-reported)**	**Employment/ Student** **(self-reported)**	**BMI** **(Self-reported height & weight)**
1	Male	Low	Student	31.4 – Class 1
2	Female	Moderate- Low	Student	31.6 – Class 1
3	Male	Moderate- Low	Employed & Student	30.4 – Class 1
4	Female	Low	Employed	30.4 – Class 1
5	Male	Moderate- Low	Student	36.6 – Class 2
6	Female	Low	Employed & Student	36.2 -- Class 2
7	Female	Low	Unemployed	30.7 – Class 1
8	Male	Low	Employed	32.3 – Class 1
9	Male	Low	Employed	34.1 – Class 1
10	Male	Low	Employed	32.2 – Class 1

3.7.2 Thematic analysis– generating the themes

There were 16 refined themes relating to physical activity of which 14 were barriers and eight were facilitators. Two directly related to fear: fear as barrier to physical activity and fear as a facilitator/ motivator for physical activity. Table 3.2 shows how these themes were generated.

Table 3.2. The process of establishing themes through coding

Codes	**initial themes**	**Refined theme**
• Concerns about slipping • Fears about sciatic pain • Fears around gym staff and everyone looking if did something wrong • Fears around strangers, weirdos in the dark, being attacked • Fears the embarrassment of wearing tight clothes • Fears of not being able to breath	○ Fears prompt avoidance behaviours ○ Fears prompt a cautious attitude towards physical activity, a reduction in intensity ○ Fears prevent any engagement with physical activity	Fear as a barrier to physical activity
• Fearing failure drives motivation • Scared of diabetes, affected family • Fearful of still birth • Fright of gaining weight •	○ Fears motivating an intension for an increase in physical activity ○ Scared of negative health implications- motivating	Fear as a facilitator/ motivator to physical activity
• Walking is like therapy from family arguments • Mental awareness of weight concern, feels down • Feelings of low self-worth and regret • Obesity deteriorates mental health	○ The mental battle with weight is tiring, a barrier to physical activity. ○ Weight & negative self-image reduces QOL	Mental health and negative affectivity
• Doesn't know how equipment works, avoids it • No advice from health professionals about what activity to do • Doesn't know how to do exercises in the fitness class, avoids classes • Leisure facility staff fail to give correct induction on kit	○ Lack of knowledge can be a barrier to physical activity ○ Improved knowledge helped to facilitate more opportunity for physical activity	The impact of knowledge
• Compares self to fitter gym members • Doesn't want to be a cabbage in a wheelchair • Comparisons to larger women • Feels down about others athletic appearance	○ Comparisons can be a barrier to physical activity ○ Comparisons can motivate obese adults	The impact of social comparison
• Work gets in the way of doing exercise • Like to work out mid-morning but working hours prevent it • Lengthy work hours an obstacle to engaging with activity • Employment desk based and largely sedentary • Unsociable hours working means activity cannot be done, tiredness	○ Working hours prevent physical activity ○ Lack of energy and time following employment a barrier ○ Desk based employment the start of a sedentary lifestyle	Employment and the commitment of work
• Doesn't want to run in rain • No running tracks, roads dangerous • Quiet area for physical activity helps • Gyms not a suitable place, unwelcoming for bigger people, negative evaluation • Prevalence of stigma in leisure facilities, PT's • Reduced concerns and anxieties in outdoor environments	○ Gym not a suitable place for obese to partake in physical activity ○ Quiet, uncrowded environments better for obese adults	Physical activity environment, atmospheres and preferences
• Knee pain • Pain contributing to sedentary behaviour • Traumatised by hip pain • Weight a discomfort • Occurrences of an injury prevents physical activity routines • Back pain disables any movement • Pain in joints worsens during activity	○ Pain as a contributing factor to poor physical activity levels ○ Pain suffering leads to extended periods of inactivity	The experience of pain

Table 3.2 continued. The process of establishing themes through coding

• Competing demands prevent time for physical activity • Demanding academic workload is prioritised over time for physical activity • Physical activity not a priority when free time is available, socialising given priority • Sacrificing time so partner can socialise reduces time for physical activity	○ A perceived lack of time in a typical day is a barrier to physical activity ○ Competing demands prioritised before activity ○ Physical activity not a top priority for free time	Time for physical activity
• Poor self-efficacy for high intensity exercises • Pain won't allow different modes of activity • Cannot run, poor self-efficacy • Personal trainer poor instruction style, cannot do exercises • Size perception reduces capability to do specific exercise	○ A poor perception of ability for physical activity acts as a barrier ○ Self-efficacy for physical activity generally low	Perceived self-efficacy
• Family ridicule and don't encourage activity • Family does not engage with health promoting behaviours • Family encouragement motivating • Family making negative comments about weight • Family competitiveness a barrier	○ Behaviours, attitudes and culture of family has an influence on physical activity levels ○ Positive reinforcement by family a facilitator to increased physical activity	The influence of family on physical activity
• Blaming self for lack of physical activity, laziness • Blaming other people and work for lack of physical activity • Doesn't take owners of physical activity levels • Cognitive dissonance about physical activity	○ Self-blame, taking ownership – internals ○ Blaming others and environment for lack of physical activity- externals	Locus of control
• Groups help with feelings of togetherness • Familiar people and groups can overcome worries • Social aspect of group can improve life • Group promoted better mental health • Support of friends facilitated more activity •	○ Group activities instil accountability and social support ○ Group/ partnered activity an advantage for motivation and consistency	Partnered or group physical activity
• Usually very busy with children • Childcare is a problem • Gyms don't offer childcare, council inadequate for support • No support for single parents • Taking care of young child, a priority for time • Childcare responsibilities time consuming	○ A lack of available childcare a barrier to activity ○ Inadequate social and family support for parents ○ Parental responsibilities prioritised over activity	Parental responsibilities and childcare
• Encouraged by others motivation • Partakes because wants to impress others • Enjoys activity, wants to do it more often • Motivating yourself when obese is challenging • No enthusiasm for exercise • Improvement in health and weight loss as a reason to partake in activities • Weight loss a motivator to activity	○ A lack of motivation is a barrier to physical activity ○ Challenging maintaining motivation to stay active ○ Weight loss a recurring motivator ○ Motivated by health benefits	Motivations (that impact on physical activity)
• Weight detrimental for self confidence • No self-confidence to go to gym • Desire to hide from the world and weight • Negative self-body image, confidence concerns about size • No self-confidence, self-confessed quitter • Self-conscious about clothes fitting and weight	○ Low self-esteem regarding weight, negative impact on opportunities to partake in physical activity. ○ Low self-confidence regarding body image prevented physical activity	Self-esteem and confidence

3.7.3 The refined themes

Numeration analysis was conducted on the themes and highlighted those themes which were present in over half the sample (Table 3.3).

Data was extracted from the 16 refined themes and analysed through the lens of two concepts: barriers or facilitators to physical activity. Of the 16 themes, 13 were present in more than half of the sample. Fear as a motivator was not present in more than half the sample but fear of as a barrier was.

Table 3.3 Table of presence of refined themes among participants highlighting themes present in more than half the sample

Refined themes	P 1	P 2	P 3	P 4	P 5	P 6	P 7	P 8	P 9	P 10	Present in over half sample
The experience of pain	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Self-esteem and confidence	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mental health and negative affectivity	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
The impact of knowledge	No	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Motivations (that impact on physical activity)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Employment and the commitment of work	No	No	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes
Physical activity environment, atmospheres and preferences	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Parental responsibilities and childcare	No	Yes	No	No	No	No	Yes	Yes	No	Yes	No
Time for physical activity	No	Yes	Yes	Yes	No	Yes	No	Yes	Yes	No	Yes
Perceived self-efficacy	No	No	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes
The influence of family on physical activity	Yes	No	No	No	Yes	Yes	No	Yes	Yes	No	No
The impact of social comparison	Yes	Yes	Yes	Yes	No	Yes	Yes	yes	Yes	No	Yes

Locus of control (personality characteristics)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Partnered or group physical activity	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Fear as a facilitator/ motivator to activity	Yes	No	Yes	No	No	No	Yes	Yes	Yes	No	No
Fear as a barrier to physical activity	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

*P = participant. Yes = present. No = not present. Green = present in more than half the sample. Red = not present in more than half the sample, Grey= fear related themes.

3.7.4 Barriers to physical activity in obese adults aged 18- 45 years

Fear was one of 14 barriers to activity. Figure 3.4 graphically displays the 14 barriers to physical activity reported within the data. All barriers were initially given equal consideration and reflexion during the data analysis.

Each participant described a varying number of barriers to physical activity. The minimum number of barriers reported in one interview totalled six. The most barriers reported by one participant was 12. Importantly, the most frequently recorded barriers were fear and low self-esteem. Although this does not indicate the importance of themes, the numeration analysis highlighted fear as the only barrier to be expressed by the whole sample.

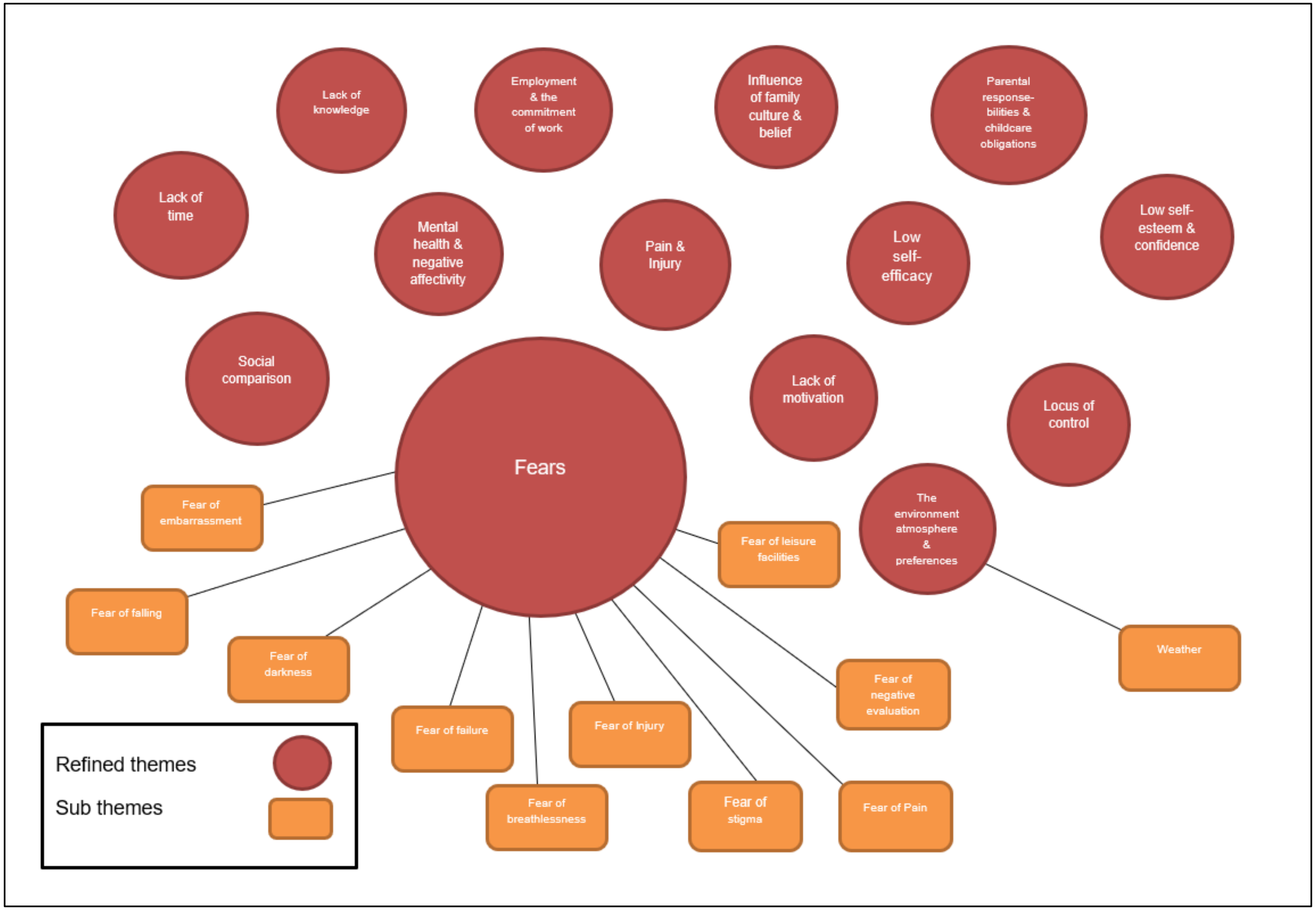


Figure 3.4 Refined themes and sub themes- barriers to physical activity reported by obese adults aged 18- 45 years.

3.7.5 Facilitators/ motivators to physical activity in younger adults who are obese

Fear was one of eight facilitators/ motivators to activity identified within the refined themes. Figure 3.5 displays a simple graphic that represents the facilitators/ motivators to physical activity reported within the data.

Fears were described as a facilitator/ motivator to activity by five of the ten participants. Of the other facilitators/ motivators that were not related to fear, three facilitators/ motivators were reported by more than half the sample: weight loss, emotionally supportive group or partnered activity and group activity that endorsed accountability of attendance.

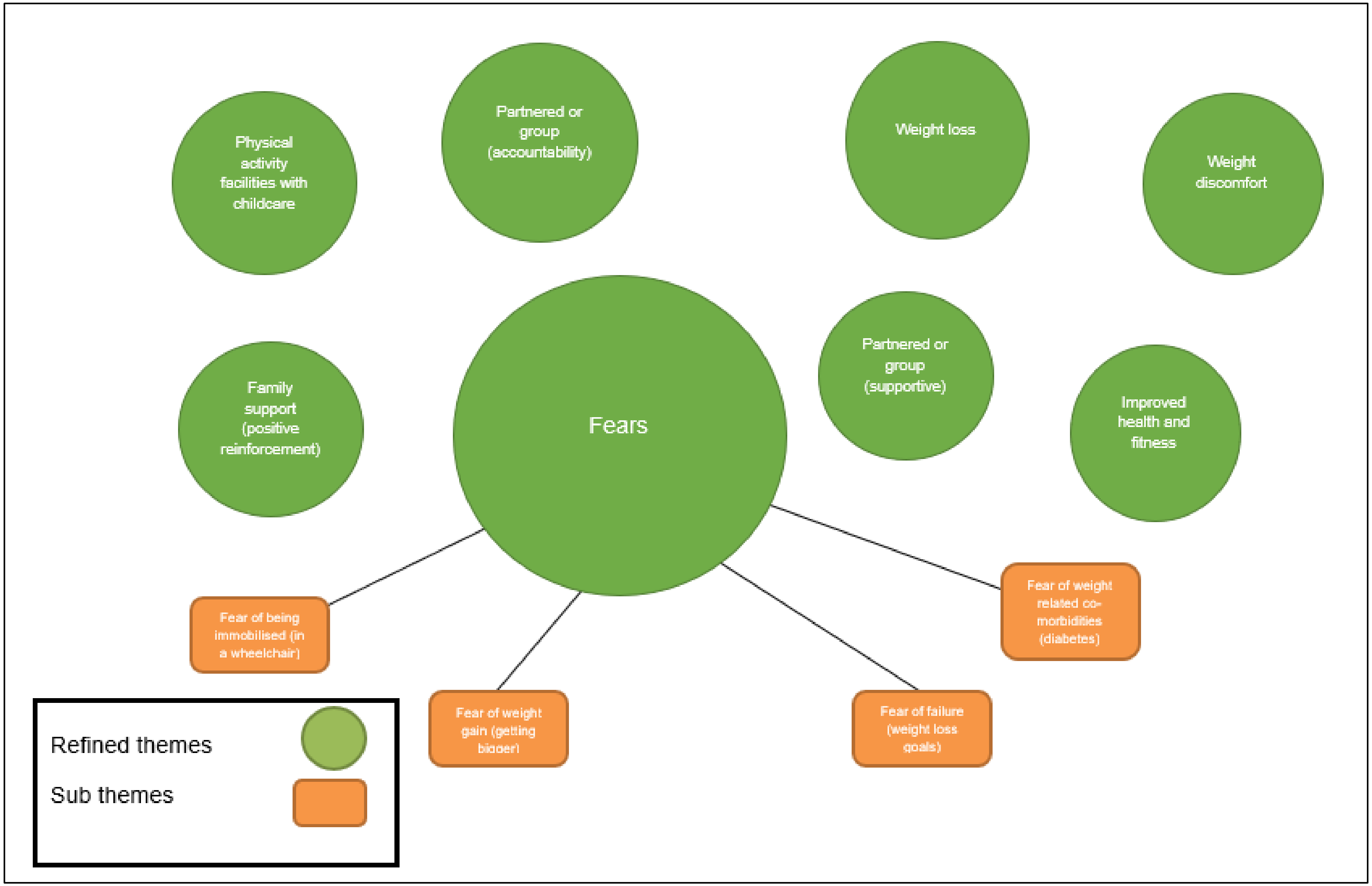


Figure 3.5 Refined themes and sub themes- facilitators/ motivators to physical activity reported by obese adults aged 18- 45 years

3.7.6 Fear related findings

The results will now focus upon the study aims of whether, and how, fears contribute to physical activity engagement in younger adults aged 18 to 45 years who are obese.

Fear related findings had two prominent concepts;

1. Fear as a barrier for physical activity
2. Fear as a facilitator/ motivator for physical activity.

Within these two concepts, a total of fifteen sub themes surrounding fear were identified and analysed. These sub themes highlighted explicit fears that independently contributed to physical activity engagement. Figure 3.6 displays the refined theme of fear and the sub themes that feature within them. The size of the sub theme boxes highlights their prevalence among the participants sample (largest being the most prevalent, smallest being the least prevalent).

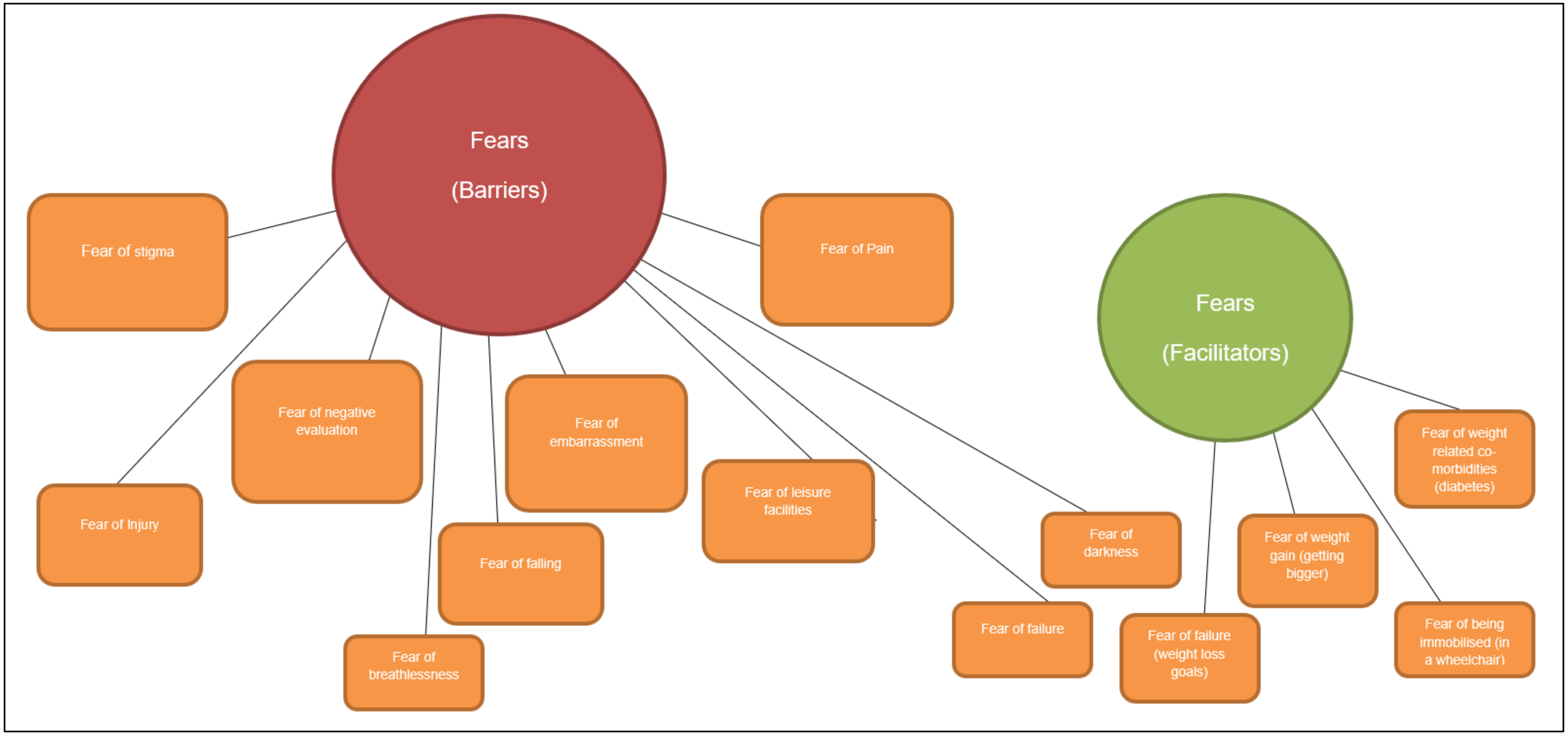


Figure 3.6 Refined themes and sub themes; fears that influence physical activity in obese adults aged 18 to 45 years.

3.7.7 Refined theme- Fear as a barrier to physical activity

Ten participants described fears that were a barrier to partaking in physical activity. Table 3.4 displays the sub themes of fears that describe a barrier to participation in physical activity. These ten sub themes were extracted from the larger refined theme surrounding fear related barriers. These subthemes are expanded on in the next sections.

Table 3.4 Sub themes - fear as a barrier to physical activity

Sub themes - Focus on fear as a barrier to PA	**P1**	**P 2**	**P 3**	**P 4**	**P 5**	**P 6**	**P 7**	**P 8**	**P 9**	**P 10**	**Present in over half sample**
Fear of Stigma	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Fear of Negative Evaluation	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Fear of Embarrassment	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes	No	Yes
Fear of Pain	No	Yes	Yes	Yes	No	No	Yes	No	Yes	Yes	Yes
Fear of Injury	No	Yes	Yes	No	No	No	No	No	No	Yes	No
Fear of Falling	No	Yes	Yes	No	No	Yes	No	No	No	No	No
Fear of Darkness Relating to Crime	No	Yes	No	No	No	Yes	No	No	No	No	No
Fear of Leisure Facilities, Equipment and Fitness Personnel (Staff)	No	No	No	Yes	Yes	Yes	No	No	No	No	No
Fear of Failure	No	No	No	No	No	Yes	No	No	No	No	No
Fear of Breathlessness	No	No	No	No	No	No	Yes	No	No	No	No

*P = participant. Yes = present. No = not present. Green = present in more than half the sample. Red = not present in more than half the sample.

3.7.8 Fear of stigma and negative evaluation as a barrier to physical activity

The fear of weight stigma was described by eight participants as a barrier to physical activity. Participants experienced discomfort about undertaking physical activity because of thoughts that they may be stigmatised. Fears relating stigma were described by five males and four females.

Participants described a worry and concern that others were stigmatising them when they were partaking in physical activity. The worries concerned them even when contemplating physical activity.

> 'I'll go to a gym do something, not do it very well and people are there that have lots of experience … I know no one will think that they're judging but it's just in your head' (Participant 3, female. Pg. 3).

> 'Oh yeah, all the time, if you don't know them, 9/10 times they're discriminating you because of weight and the way you look… even if your trying to make yourself better people still look at you like what are you doing here… like go over there you fat b******' (Participant 9, male. Pg. 7).

These concerns manifested into fear that caused participants to avoid physical activity. Their pre-conceived views shaped their experiences of avoidance.

> 'Well going to the gym on my own is a big no for me, I just couldn't do it… If I walked into a gym on my own I always thought oh, everyone starts looking at me, judging you…' (Participant 5, male Pg. 2)

Both poor self-body image and a low self-esteem accompanied many of the participant's experiences around the fears of stigma. One male participant who did not fear stigma explained that he did not have any body image concerns. He explained that his weight was not a concern and that BMI as an indicator of his obesity was something he disagreed with. He dismissed any concerns regarding self-efficacy or judgement from others in the context of physical activity.

3.7.9 Fear of negative evaluation

The fear of negative evaluation was described by eight participants as a barrier to physical activity. Many participants feared physical activity because of thoughts that they may be negatively evaluated based on their body weight. Fears relating negative evaluation were described by five males and four females.

Participants described cognitions that related to activity avoidance because of fears of negative evaluation.

> ‘Honestly, it just makes me want to go away, if I want to do exercise I do it were there’s no people, I go into the back lanes and exercise there… it’s just that judging makes you feel like why, I know I’m trying to make myself feel better but I don’t need people like them judging me, putting me down’ (Participant 9, male. Pg. 7).

More than half the participants felt that the fear of being negatively evaluated, may be linked to their own psychological perception and not reality.

> ‘They might not be bothered their probably busy doing their own thing, but you tend to just worry in the back of your head… I wouldn’t say that other people have ever expressed that to me so I think I’m kind of putting words into their mouths, it’s probably just self-perception of myself projecting outwards’ (Participant 1, male. Pg. 10).

It is clear from the data that participants were unsure of the reality of whether people would make judgement upon them. However, their negative cognitions acted as a psychological barrier to physical activity irrespective of other people.

However, others had experienced instances of negative evaluation including negative comments about their about their own or others weight or doing physical activity incorrectly. This shaped their cognitions and avoidance of physical activity.

> ‘I think you see so many comments online from various PT’s and fitness people, saying the person at the gym needs to improve their form… the role of social media on me has been massively influential on me not going to a gym to be honest’ (Participant 6, female. Pg. 5 & 8).

> ‘I have had negative comments come my way when I’ve been running outside, not often but it can get to you’ (Participant 8, male. Pg. 3).

Participants described feelings of self-consciousness and low self-efficacy for activity that exacerbated their fears.

3.7.10 Fear of embarrassment

The fear of being embarrassed in the context of physical activity was highlighted by participants as an important barrier to physical activity. Six of the ten participants described fears about being embarrassed: three males and three females. Their BMI ranged from the highest in the sample to the lowest.

Most participants related the embarrassment to how they would be perceived by others. Many described an avoidance of physical activity to prevent situations that could lead to embarrassment. Some participants associated their appearance, either overweight or aesthetics as influential in avoiding embarrassment. Contemplating the feelings of embarrassment provoked avoidance of physical activity, especially when it related to leisure facility settings.

> 'I do know that is a good place to go get fit but it puts me off going in the first place … feeling that I'd embarrass myself' (Participant 1, male. Pg. 5).

> 'If you just walked in the gym… that would be embarrassing, because they might think like why did she come' (Participant 2, female. Pg. 3).

Participants also described the embarrassment of doing physical activity wrong and making a mistake that led to falling. The contemplation of feeling embarrassed led participants to avoid particular activities.

> 'yeah that embarrassment, getting something wrong, doing it the wrong way and people making judgements, judging you I guess … so it's more the feeling about what others would think more than what I would think of myself' (Participant 4, female. Pg. 7).

> 'if you have a fall your down its just done and I'm not getting back up … it's just embarrassing just the reaction I was shocked by it … it still plays on my mind so it obviously had an effect on me… no jumping ever, no star jumps, no jumping on boxes anything like that… my sister always tries to get me to go to the trampoline classes and it is not happening' (Participant 6, female. Pg. 8).

Embarrassing feelings about body image and not appearing aesthetically pleasing was the primary concern for two participants. They described physical activity contexts whereby they could become embarrassed, because of exposure to negative evaluations.

> 'Like oh look she's in a bikini she really shouldn't be in that she should be in a swimsuit' (Participant 4, female. Pg. 7).

The fear of embarrassment and contemplation of being embarrassed was described as a barrier to increasing opportunities for physical activity. Leisure facilities and activities that involved a falling risk were avoided by participants to reduce the chance of embarrassment.

3.7.11 The fear and anticipation of pain

Fear and anticipation of pain emerged from the data as an important theme within younger obese adults. Six out of the ten participants described a fear or anticipation of pain as a barrier to physical activity. Several participants had experienced pain which had manifested into a fear of pain, but others did not. The anticipation of pain was described by most participants as the reasoning for long periods of inactivity.

Participant described a fear of pain as challenging and threatening to the intensity and duration of physical activity. Participant's pain-related fears psychologically affected their ability to partake in physical activity.

> 'I don't want to go back to that pain… I'm secluded I can't do nothing, I feel like a right idiot just sat there doing nothing' (Participant 9, male. Pg. 4)

> 'My knee went at about the 8 mile, so I remember taking it slow not to get past the 8 mile, it's the mental, it took a while go back' (Participant 10, male. Pg. 5)

The data suggested that pain contributed to a cycle of fear avoidance that may have contributed to low physical activity levels among the participants. Many of the participants described caution about future physical activity because of the fear and anticipation of pain.

> 'it made me cautious, nothing long term but like just the pain like the hurt on my legs stops me playing, so it just made me cautious' (Participant 3, male. Pg. 4).

> ‘next time when we go back to doing pure run then I’ll have to put bits in place to combat the pain, I’m just aware all the time that it could happen’ (Participant 4, female. Pg. 5).

Actual pain or an instance of injury were described as the origin of all fears related to pain. A fear of pain was described and experienced by both male and female younger obese adults.

3.7.12 A fear of injury

A fear of sustaining an injury was described by participants as a contributing factor in avoidance and reduction of physical activity. Three out of the ten participants had described a fear for injury. Fear of injury was described by two male participants and one female; all were classified as class one obese. The three participants indicated that they had taken part in higher intensity physical activity, but this was sporadic and irregular. Participants spoke of instances where they had reduced activity intensity as a precaution for the prevention of injury. Those who were concerned with injury showed discomfort within their tones of voice when discussing the topic.

When contemplating physical activity, these participants were reluctant to engage in any higher intensity activity fearing that they could injure themselves.

> ‘Like I said earlier I’ve never been injured, I’ve never like broke a bone, or anything serious so I feel like I try to hold back so I don’t get injured … cos it’s never happened before … so there’s situations were like I’ll be going in and I’ll pull away just trying to avoid injury’ (Participant 3, male. Pg. 4).

Participants spoke of instances whereby they had actively avoided dangerous walking routes, weight equipment and/or making contact with others during periods of physical activity, because of the fear of injury.

> ‘I think about it as soon as I’m approaching it and I’m thinking right, do I, what do I do, do I need to change that route and take another route but then the other routes that are there. Sometimes I’m like do I do it or do I just go on the roads or do I just ignore it all and don’t do it’ (Participant 2, female. Pg. 2).

> ‘yeah yeah, I’m always scared of getting hurt, if I play I’m like not exciting to get hurt, especially on kick off and I’m running full speed to someone, I could run straight into someone, but I always avoid anyone … run round’ (Participant 3, male. Pg. 4).

Fear of injury was not a concern for the other seven participants. When prompted as to if they feared injury, many described no concern, worry or fear.

> ‘Err no, I’ve seen injuries over the few months I’ve been playing but I haven’t stuttered and not committed to something because of I’ve seen others, it’s not crossed my mind’ (Participant 5, male. Pg. 4).

Participant experiences also highlighted that a fear of injury is a barrier to physical activity that does not have to originate from an instance of injury.

3.7.13 A fear of falling

The fear of falling within the context of physical activity prevented some participants from partaking in particular activities. Three out of the ten participants experienced a fear of falling that was a concern for physical activity. A fear of falling in the context of physical activity, was described as a concern for one male and two female younger obese adults. The three participants were classified as class one obese. Participant descriptions linked fear of falling to embarrassment and injury. Some participants described avoidance, whilst others described a cautious attitude because of a fear of falling.

> ‘yeah, yes, I’ve got to be very careful especially when I get to the steps I just have to stop and stutter getting down because there are no rails… there’s high possibility you can easily fall’ (Participant 2, female. Pg. 2).

Participants described the negative impacts of an actual fall as contributing factors to a fear of falling. Concerns ranged from sustaining an injury to the psychological trauma of being embarrassed by falling.

> ‘I fell straight forward… I was really weak on my right side where I broke my leg and he made me jump on that leg and it went completely … It was the most embarrassing thing in my life… if you have a fall your down its just done, it’s just embarrassing just the reaction I was shocked by it … it still plays on my mind, so it obviously had an effect on me’ (Participant 6, female. Pg. 7).

> ‘Falling anyway is quite a concern… I wouldn’t be embarrassed but I wouldn’t want to get injured at all, so if I was to come to work sore from activity and have to carry a table and fall there’s a good chance of injury. High chance I could hurt, miss work’ (Participant 3, male. Pg. 8).

A fear of falling led to the avoidance of particular activities that held an increased risk of falling. One participant described avoiding any activity that included jumping, whilst one described the contemplation of avoiding running.

> ‘I think about it before I go … I think about it as soon as I’m approaching it and I’m thinking right, do I, what do I do… sometimes I’m like do I do it or do I just go on the roads or do I just ignore it all and don’t do it’ (Participant 2, female. Pg. 2).

Importantly, participants highlighted the avoidance of particular activities and environments but did not describe a full avoidance of all physical activity. The origins were not described in depth but actual falls may be a contributing factor in the development of a fear of falling.

3.7.14 The fear of leisure facilities, resistance equipment and staff

The fear of leisure facilities, resistance equipment and staff that work within them, was described by participants as a barrier to physical activity. Three participants described fears that triggered an avoidance from leisure facilities, two females and one male. Alongside these, five other participants described feelings of discomfort and judgement within a context of physical activity, which discouraged them from using local facilities and gyms. Fears centred on weights equipment, doing exercises incorrectly and the dread of being judged and shamed by other members and staff of the facility.

Two participants described gyms as a terrifying environment that is not pleasant for overweight or obese adults.

> ‘It’s so scary, it really is I can’t even describe how daunting bit is … even putting your pin number in the entrance door I got a bit tense’ (Participant 6, female. Pg. 5).

> ‘barriers wise I’d say it is a bit of a fear… it’s really hard to go to a class I have no experience doing … like a new environment a new situation, new people… adding exercise on top of it, going to a class were you’ve got to follow a routine, I’m going look stupid because I have no clue what I’m doing’ (Participant 4, male. Pg. 7).

Participants described the weights section of a gym as scary and intimidating.

> ‘I literally just felt so on edge, he took us into the weights area… I got really scared, especially when you walk in, the first thing you see is all the machinery’ (Participant 6, female. Pg. 5).

Participants described a fear of the gym because of an atmosphere of weight stigma, judgement and embarrassment. Participants avoided leisure facilities and gyms because of the contemplation that they would be made victims of weight stigma or embarrassment.

> ‘Well going to the gym on my own is a big no for me, I just couldn’t do it… If I walked into a gym on my own I always thought oh, everyone starts looking at me, judging you, so I just couldn’t do it’ (Participant 5, male. Pg. 3).

> ‘I think the gym unless I was feeling fitter I probably wouldn’t want to go to a gym, I do know that is a good place to go get fit but it puts me off going in the first place … feeling that id embarrass myself… it’s just the gym really that messes with my mind’ (Participant 1, male. Pg. 5).

For younger obese adults, instructors and staff of leisure facilities and gyms made the atmosphere and experience worse. Participants described being made to feel uncomfortable and humiliated by instructors.

> ‘I had a few personal training sessions but I felt like a dick … (laugh) I couldn’t do anything they asked, they were telling me to push this massive thing, I was,

> my arse is big and they tell me to push it, bums sticking up, I just imagined all the fit people coming in like where did the moon go you know what I mean' (Participant 7, female. Pg. 4).

This data highlights that younger obese adults view leisure facilities and gyms as unwelcoming and intimidating. These views have largely been shaped by unfriendly atmospheres, weight stigma, and negative evaluation from fitter observers and staff members who have failed to recognise the sensitivity of weight concerns.

3.7.15 The fear of darkness linked to crime

The fear of darkness relating to crime was described by participants as an important factor in reducing opportunities to be physically active. Two out of the ten participants described a concern for their safety, when contemplating physical activity that was in natural darkness. Participants did not describe a total avoidance of activity due to these fears, but their concerns of darkness reduced opportunities for physical activity. The fears often related to being alone and vulnerable to attackers.

Participants described a fear of participating in physical activity whilst alone in darkness.

> 'I don't want to be going late, it's not really safe, I'm only 25 so walking into a gym at 2am and having to drive 20 minutes home, it's not ideal situation' (Participant 6, female. Pg. 3).

Participant fear of darkness was associated with an increased chance of being the victim of crime. When prompted about these fears, one participant described being within a deprived area whilst the other participant described the weirdness of people.

> 'I'm concerned about getting attacked, strangers …' (Participant 2, female. Pg. 7).

The origins of these fears were not described by participants and it was not made clear if they had previously experienced crime within a dark environment. Notably, this fear was only described by female participants.

3.7.16 A fear of failure

A fear of failure was described as a reason to avoid physical activity by one female participant who described not wanting the mental anguish of failing to achieve personal goals. The participant highlighted that avoiding any negative mental cognitions was deemed more important than engaging in physical activity. Notably, the female participant had previously described a battle with mental health due to being obese and that mood often dictated physical activity levels. This fear of failure originated from past failures in weight maintenance and the struggle to keep a consistent physical activity regimen.

> ‘So, I think that mentality of failure, then you don’t bother because if you don’t then you can’t really fail can I think people just see you as a failure in that group setting, that sort of thing, you are overweight… probably stems from employment as well that fear of failure constantly, messes with your head’ (Participant 6, female. Pg. 11).

A fear of failure was not reported or acknowledged by any of the other nine participants as a barrier to physical activity.

3.7.17 The fear of breathlessness

The fear of breathlessness and being unable to breathe was described by one female participant as a barrier to partaking in physical activity. Participant seven experienced breathlessness when exercising for longer than 10 minutes and described needing to stop, through fear of not being able to breathe. The fear prevented the participant from partaking in physical activity for extended periods and at moderate to high intensities. They described a low self-efficacy for physical activity and had no previous experiences of regular physical activity.

> ‘You don’t get enough oxygen, so I have found it laborious to breath, which is why I always put down that I can’t run… (Participant 7, female. Pg. 4).

The data suggested that it could be associated with long periods of inactivity. However, these fears were only reported by one female participant.

3.7.18 Refined theme- Fear as a facilitator and motivator to physical activity

The data from this study indicated that fear was not only perceived as a barrier to physical activity, but could also increase the motivation of participants to engage in greater levels of physical activity.

Five participants described fears that motivated or facilitated an increase in physical activity. Notably, these fears were much less frequently articulated than fears that acted as a barrier to physical activity. Four fears emerged as facilitators compared to the ten that were described as a barrier: these were a fear of: diabetes, failure, gaining weight, and being immobile (in a wheelchair). Participants explained that by engaging in physical activity they could distance themselves from that in which they feared. They had an increased sense of motivation because of their determination to avoid their fears becoming reality. Participant's body language and emotion during interview suggested that these were fears and not merely anxiety. One fear (the fear of failure) emerged as both a barrier and facilitator/ motivator to physical activity, but this differed between participants in the explicit context. Table 3.5 displays the sub themes of fears that relate to a facilitation or motivation of physical activity by participants one, three, seven, eight and nine.

Table 3.5 Sub themes - fear as a facilitator/ motivator to physical activity

Sub themes - Focus on fear as a facilitator/ motivator to PA	P 1	P 2	P 3	P 4	P 5	P 6	P 7	P 8	P 9	P 10	Present in over half sample
Fear of Weight Related Co-Morbidities (Diabetes)	Yes	No	No	No	No	No	Yes	No	No	No	No
Fear of Failure (Weight Loss Goals)	Yes	No	No	No	No	No	No	No	No	No	No
Fear of Weight Gain (Getting Bigger)	No	No	Yes	No	No	No	No	Yes	No	No	No
Fear of Being Immobilised (In a Wheelchair)	No	No	No	No	No	No	No	No	Yes	No	No

*P = participant. Yes = present. No = not present. Green = present in more than half the sample. Red = not present in more than half the sample.

3.7.19 Fear of co-morbidities as a motivator

One participant had a concern that being overweight increased her chance of having a stillbirth and suggested that this was a motivator to increase her levels of physical activity.

> 'Well … stillbirths, if I got pregnant now I'm 100% more likely than if I lose weight' (Participant 7, female. Pg. 7).

One participant described a fearful emotion about developing diabetes that had previously plagued his family. This resulted in an increase in motivation to partake in physical activity.

> 'Definitely (long pause) diabetes is something that seems to have affected literally everybody so like my mum, my dad, my grandparents, all the ones that have survived anyway, or at least until they developed it … Umm so that's a

> really big motivation to change kind of from myself looking to do things like the coach to 5k, is something I would like to do' (Participant 1, male. Pg. 8).

This participant showed genuine concern and intense emotion as he described the devastation it would cause him to be affected by diabetes

> 'I'd hate to lose vision because a lot of my entertainment is through my eyes so if I couldn't see a screen or read books id be miserable, yeah' (Participant 1, male. Pg. 8).

The participant did not divulge the origins of the fear.

3.7.20 Fear of failure

One participant was particularly concerned that they would fail in their attempt to stave off diabetes. This thought made him feel so miserable that it further motivated him to partake in more physical activity.

> 'I think it's more to get rid of that feeling of failure, if I don't do something ill it'll just make me feel miserable, I'll just feel I'm letting myself and other people down, trying to avoid that it's easier to do something about it… when it comes to actually getting out the door I think that's the biggest thing that makes me go everyday try to do something' (Participant 1, male. Pg. 3).

The participant stated that the frequency of diabetes in his family was the origin of his fear.

3.7.21 Fear of weight gain

The fear of gaining weight was described by two participants who felt that they needed to increase their activity levels to distance themselves from their fear. When prompted about the concerns they had about gaining weight, both participants described the desire to lower and maintain their weight through activity.

> 'If I get bigger, I know like I'm not skinny but I'm not morbidly obese but if I was to get at that stage, then yeah 1 million percent I would be doing a lot more' (Participant 3, male. Pg. 6).

> 'I am actively watching and looking to sort of watch me food and keep exercising more' (Participant 8, male. Pg. 5).

In both cases, participants had been heavier in the past and wanted to avoid a return to heavier weight.

3.7.22 Fear of being immobile

Finally, it was a fear of being immobile and living from a wheelchair that motivated one participant to continue with regular physical activity.

> 'I don't want to be that person that's just sort of in a wheelchair just sort of unable to move any of the time because I haven't done nothing to help myself' (Participant 9, male. Pg. 5).

His fears stemmed from a desire to be a functioning father who could be active with his daughter.

> 'My daughter, yeah I don't want to be that fat dad lay there 24/7, laying around, I want to be able to at least play and have a laugh, be there even' (Participant 9, male. Pg. 5).

The participant described his weight as a concern for his long-term health and family unit. He experienced chronic back pain as a barrier to physical activity but motivated himself to stay physical active to distance himself from fear of being immobile.

3.7.23 Summary of fear related themes

The data findings suggest that fear could be both a barrier and facilitator to physical activity for younger obese adults. In this sample, fear that was perceived as a barrier, appeared to modify behaviour leading to a partial or complete avoidance of physical activity. Fear that was perceived as a facilitator was found on some occasions to motivate an intention to engage in increased physical activity, but this is less common in younger obese adults. The balance of fear within this section frequently focused on barriers resulting in flight responses from activity. These behavioural responses of fear related to several contexts of physical activity and were explicit to each participant. The data appears to suggest that younger obese adults may adopt flight responses when faced with a threat surrounding the contexts of physical activity. However, these findings need to be confirmed and quantified in a larger sample of obese adults aged 18 to 45 years.

3.7.24 The remaining 14 refined themes

Alongside the refined themes relating to fear, there were several other refined themes that emerged from the data. Each of these refined themes were analysed through two concepts: the barriers to physical activity and the facilitators/ motivators to physical activity. This section will now provide a brief outline of the themes not related to fear. There will be brief sections on themes that do not relate to the studies aims and objectives regarding fear. However, there will be a greater focus on themes of pain, self-esteem, social comparison and mental health because these related to fear.

3.7.25 Motivations

Motivations in the context of physical activity were described by all ten participants during data collection. Participant experiences ranged from a lack of motivation that was described as a barrier, to motivation in which facilitated physical activity. The data suggests that a lack of motivation may reduce overall levels of physical activity in younger obese adults. Intrinsic motivators may be linked to emotional triggers (such as fear) that if identified, and reinforced could increase physical activity levels. However, emotional triggers that increase motivation, appear personal to each young obese adult.

3.7.26 The Impact of knowledge

Seven out of ten participants described a lack of knowledge as a reasoning for physical activity avoidance. This theme highlighted that a lack of knowledge may reduce the opportunities for, or levels of physical activity within younger obese adults. A substantial increase in knowledge about the modes, intensity, duration and equipment used for physical activity may increase motivation and subsequent levels of physical activity in younger obese adults.

3.7.27 Employment and the commitment of work

Employment, hours of labour, and the energy required to fulfil the commitment of work were highlighted by six out of the ten participants. A lack of time and a lack of energy that followed a typical working day was described as a barrier to physical activity. The data suggested that younger obese adult's levels of physical activity may be low when they are employed, committed to long hours and their duties are desk based. A sedentary lifestyle may be exacerbated by a sedentary employment setting, which may not allow for activity when younger obese adults feel most motivated and energetic.

3.7.28 Physical activity environments, atmospheres and preferences

All ten participants described specific atmospheres and environments for physical activity in which they preferred to participate. Most participants favoured outdoor environments away from crowds to partake in physical activity. This is because they did not want to be observed. Leisure facilities and gyms were perceived negatively by younger obese adults and were not considered a welcoming environment for regular physical activity. Perceptions of weight stigma and negative evaluation resulted in avoidance behaviours from gyms and leisure facilities, even when younger obese adults were financially invested. Participants highlighted fears and poor mental health as contributors to the concerns raised in this theme.

3.7.29 Parental responsibilities and childcare barriers

The commitment of being a parent and having to care for young children was described as a barrier to physical activity. Four participants experienced childcare concerns that prevented them from engaging with regular physical activity. This theme highlighted that younger obese adults with children find it increasing difficult to partake in physical activity, because of the parental priorities that underwrite their lives. This is exacerbated by a lack of childcare provisions at leisure facilities. Parental responsibilities were a contributing factor to low levels of physical activity in younger obese adults.

3.7.30 A lack of time for physical activity

A perceived lack of time was often described by participants as a barrier to physical activity. Participant's often prioritised employment and parental responsibility, which did not leave time to partake in physical activity. Participants stated that spending time with their family and partners was a more important use of their free time than partaking in physical activity.

3.7.31 Perceived self-efficacy in the context of physical activity

Self-efficacy (the belief that one has the ability to do something), was a consistent theme among participants in the contexts of physical activity. More than half the sample of younger obese adults were perceived as having low self-efficacy for physical activity. Some participants described avoidance of physical activity because they believed that they were not capable of it. Notably, participants with greater perceptions of self-efficacy did not engage in greater levels of activity. Low self-efficacy in younger obese adults was described as a barrier to physical activity.

3.7.32 The influence of family on physical activity

The attitudes and behaviours of other family members had an impact on motivation and the opportunity to partake in physical activity. Three out of the ten participants described family influence as a barrier to physical activity. Each participant interpreted the influence of their family differently. Participant experiences suggest that when family atmospheres are positive and suitably able to facilitate increased levels of physical activity, younger obese adults may experience an increased motivation. When family culture, attitude and context is not conducive to physical activity, younger obese adults find it difficult to partake.

3.7.33 Locus of control

Participants within this study were labelled externals or internals dependant on the data. Based on the interpretation of transcripts, five participants were labelled externals and five were labelled internals. Irrespective of loci, participant’s overall levels of physical activity were interpreted as low. This indicated that locus of control had no influence on regular physical activity levels in younger obese adults. Further research into the association of these two factors is necessary to exclude it as a barrier to physical activity in younger obese adults.

3.7.34 Partnered or group physical activity

Partnered or group based physical activity arose from the data as an important facilitator to the sustainment of regular activity. Participants stated that physical activity accompanied by individuals with similar weight loss goals and barriers, was as a facilitator to increasing activity levels. The psychological and social support within a group dynamic, helped ease anxieties and worries that may usually cause young obese adults to avoid activity. The data stated that younger obese adult's adherence to physical activity, could be improved by supportive group dynamics that promote accountability to one another.

3.7.35 The experience of pain

The experience of pain in the context surrounding physical activity was present in nine out of a possible ten participants. Experiences of pain ranged from general soreness to chronic back pain. Most experiences of pain caused avoidance or an unintended discontinuation of physical activity. Participants often associated the experience with negative emotions such as fear, trauma or frustration. Pain was described as a key factor in the manifestations of fear related barriers to activity. Avoidance of physical activity due to pain, extended to basic household tasks and walking. The majority of participants described pain that temporarily disabled movement and impeded future physical activity.

A pattern of pain intensity, BMI status and physical activity could not be identified as two participants with the highest BMI experienced little or no pain as a barrier to physical activity. Likewise, one participant who experienced intense pain, described undertaking a sporadic routine of low intensity physical activity. No pattern of gender and pain disablement emerged as a mix of five males and four females described experiences of pain as a barrier to physical activity. However, the most detailed accounts of pain disablement and avoidance experiences, arose from two males. The findings showed that pain has a basis within the decision to partake in physical activity and was described as a barrier by most participants.

3.7.36 Low self-confidence and low self esteem

Feelings of low self-esteem and confidence were described by all 10 participants. Negative self-perceptions of body image dominated their experiences of physical activity. Feelings of weight consciousness nearly always led to the avoidance of activity. Some participants described experiences of distress because of their excess weight, feeling low about the potential that others think negatively of them. Participant experiences led to a desire for weight loss. This was because they wanted to feel more confident and see improvements in their self-esteem. Participants also experienced psychological distress when attempting to partake in physical activity. Many of the participants experienced poor mental health and/or depression relating to their body weight. This theme highlights that low self-confidence could reduce physical activity levels and impede future health promoting behaviour.

3.7.37 The impact of social comparisons

Eight out of the 10 participants described social comparisons that had perceived effects on physical activity. Downward social comparisons were made about others who were less physically fit or were aesthetically lesser than themselves. The data indicated that downward comparisons motivated younger obese adults and facilitated increased physical activity. Upward social comparisons had varying perceived effects on physical activity with some being inspired to do more, whilst others became demotivated by seeing others that were slimmer or looked aesthetically pleasing. For three participants, comparing themselves to others who were higher in social status, and who looked muscular was as a barrier to activity. This was because it worsened motivation, lowered self-esteem and increases perceptions of fear. Social comparisons specifically exacerbated fears of weight stigma and negative evaluation because of how participants felt others would be judging them. This often led to activity avoidance.

3.7.38 Mental health and negative affectivity

Six participants experienced poor mental health and feelings of negative affectivity that had an impact on physical activity. Participants spoke in detail about the negative affect obesity had on their mental health. Participants often referred to themselves through a negative lens, and this presented itself as a barrier to physical activity. Self-consciousness, self-efficacy and low self-esteem were identified as contributing factors to poor mental health. Participants cited difficulty with appearance, clothing, bullying and negative comments that linked poor mental health to their physical activity levels. The negative cognitions relating to their obesity caused mental anguish for many participants. They described a daily battle to overcome depressive thoughts and often spoke of the negative affectivity associated with their lives. Because of this, fearful cognitions were exacerbated because participants though they may be stigmatised or shamed by others for attempting to engage with activity. This often meant that participants would avoid all activity.

3.8 Discussion

This study explored activity related fear within obese adults aged 18 to 45 years of age using a qualitative approach. The aim was to identify if activity related fears were present in participants everyday experience and to understand whether and how, fears contribute to physical activity engagement. In total 16 refined themes were identified relating to the barriers and facilitators of activity. Two of the themes related to fears: fear as barrier to activity and fear as a facilitator to activity. Fear as a barrier to activity was one of the most frequently reported barriers to activity, being reported by all 10 participants; fear as a motivator to activity was less frequently reported.

The following discussion will initially focus upon the general findings relating to the barriers and facilitators of physical activity in obese adults aged 18 to 45 years. Later sections will discuss the key theme of fear related barriers and identify factors such as pain and low self-esteem/low confidence that contributed to the manifestations of fear. This will be followed by a discussion relating to the facilitators/ motivator’s to activity, largely focused on fear(s). The discussion will conclude with the proposal of a conceptual map that identifies the key constructs and factors in how fear contributes to physical activity engagement in younger adults who are obese.

3.8.1 Barriers to physical activity

The five most frequently reported barriers to physical activity were: fears, low self-esteem/ confidence, lack of motivation, unwelcoming and unsuitable environments and pain or injury. A lack of knowledge, time, low self-efficacy and employment commitments were also reported as important barriers to physical activity by more than half the sample. The five most frequently reported facilitators to physical activity were; partnered or group support and accountability, desire for weight loss, improved health, fears and weight discomfort. The data findings suggest that internal psychological barriers were most frequently reported, however this is not to say they held the most importance for participants at the point of physical activity. This finding did not agree with the findings of Sharifi et al, (2013) who stated that external barriers were more important. However, there may be a key difference in that Sharifi et al (2013) collected data from participants in Iran. Iran has fewer leisure facilities, widely thought to be because of cultural norms that do not actively prioritise physical activity (Sharifi et al, 2013). This contrasts with England where the leisure industry and health culture is growing, and leisure facilities are increasing in number, and so it may be the case that participants have less external barriers due to the availability and affordability of facilities (Public Health England, 2017). The current data findings in respect of barriers and facilitators to physical activity are similar to the results of Piana et al (2013). Both this study and Piana et al (2013) found that internal barriers (focused on psychological elements) of motivation, low self-esteem and fear were some of the most frequently reported barriers. Equally, both studies reported that a strong group dynamic (that provides emotional support) can facilitate an increase in physical activity for obese adults.

3.8.2 Activity related fears

Fears was one of the important themes relating to psychological barriers. All 10 participants made references to activity related fears. In this sample, the experiences of fear nearly always led younger obese adults to a partially or completely avoid physical activity. Fear often originated from negative past experiences which reinforced fear avoidance behaviours. The data suggested that fears might predict physical inactivity and have the potential to become a risk factor for inactivity in younger obese adults. This finding is in keeping with the fear avoidance concept developed and validated by Vlaeyens and Linton (2012) which has been discussed in the background section of this chapter.

The refined themes related to fear were analysed through the lens of two concepts (barriers and facilitators), in which 10 sub themes of fear were identified as barriers, and four were identified as facilitators to physical activity. All 10 fear related barriers appeared to provoke avoidance beliefs that held varying importance for each younger obese adult. In this sense, a fear experienced by one or two participants held equal importance as a barrier to physical activity, than a fear experienced by eight participants. The fears of embarrassment, stigma, negative evaluation, and pain were reported by more than half the participants. These are consistent with the fear related findings highlighted in the literature review of chapter two. However, fears related to pain are a novel finding among this age range. The fears of injury, falling, leisure facilities/ staff, darkness, breathlessness and failure were each reported by at least one participant, but by no more than five. Although most of these fears are consistent with previous research, several fears relating to leisure facilities, darkness and breathlessness were not identified by the scoping review in chapter two. These explicit fears are novel findings within younger obese adults aged 18 to 45 years (Vincent et al, 2014; Cooper et al, 2017). Similarly, the four fears that were identified as facilitators to physical activity did not feature in the scoping review in chapter two. This highlights an original contribution to the topics of fear and activity in younger obese adults aged 18 to 45 years, even though the findings are exploratory. However, further research is needed to confirm and quantify these fears in a larger sample.

The discovery of several novel activity related fears in the current study may be attributed to the difference in age range of this sample when compared to the scope of other research (Neri et al, 2017; Vincent et al, 2011; Bruce et al, 2002). The current findings suggest that the increase in fears could be attributed to poor mental health which would go some way to explaining why younger obese adults experience different activity related fears compared to their older counterparts (Okifuji and Hare, 2015). There is some rationale to support this given that there has been significantly greater increases in mental illness among younger adults compared to middle and older aged adults since 2010 (Hubble and Bolton, 2020). Previous research has shown that declines in mental health and increasing rates of mental illness are associated with heightened fear(s), and that fear(s) can reduce physical activity participation (Stafford, Chandola and Marmot, 2007). However, the findings suggest that there may be other factors such as pain, low self-esteem and low self-efficacy that could contribute to the greater frequency of fears among younger adults.

3.8.3 Discussing the themes of fear and the relationships between fear, pain, low self-esteem, low self-efficacy and mental health.

The data indicated three key barriers to physical activity that were reported by the majority of the sample. The themes of pain, fear and low self-esteem/low confidence commanded large segments of participant interviews. This section focuses on the subthemes of fears and the relationship between some of the other themes and fears.

Physical pain was deemed an important barrier to physical activity by younger obese adults. Instances of pain may have led to participants avoiding activity altogether or at least until the pain had lessened. In some cases, pain was so severe that it appeared that it might have the potential to reduce quality of life, bodily movement and provoke depressive symptoms. Participant's attributed much of their pain to their excess weight and stated that weight may have been a factor in developing pain. This theme has been supported by substantial literature and is considered one of the most common barriers for obese adults (Egan et al, 2013; Peacock et al, 2014; Hootman et al, 2011; Flannery et al, 2018; Napolitano et al, 2011). Consistent with the current findings, Piana et al (2013) stated that muscle pain associated with excess weight, has a negative effect on obese adult's desire to partake in physical activity. Although previous studies have indicated that migraine and arthritic pain have been associated with obese adults and physical activity, this study could not corroborate these findings (Hootman et al, 2011; Bond et al, 2014). One explanation for this could be due to the younger age of the sample (18 to 45 years). The overarching research surrounding pain-related barriers suggests that obese adults must build up their physical activity levels in gradual increments and with low impact, as to avoid pain disablement (Matter et al, 2012).

Although the findings are from a small sample, the current study highlighted a potentially important relationship between the reporting of pain and the expression of fears (experiences of pain emerged prior to the expression of fear), which warrants further investigation. Participants who feared pain largely experienced prior incidences of pain in the contexts of physical activity. This finding is consistent with research that has highlighted fear beliefs and negative cognitions associated with pain perception (Turk and Wilson, 2010). The pain-related fears in the current study were often described as disabling and a reason for inactivity. These findings are consistent with those highlighted in middle aged morbidly obese adults (BMI >=40kg/m^2, Vincent et al, 2014). However, these findings differ in that pain-related fears were perceived by younger obese adults as the most disabling (for physical activity) amongst all reported fears. This is important because previous research stated that fears of stigma were the most concerning fear related barrier for younger adults (Stankov et al, 2012). The findings of the scoping review in chapter two highlight that this is a novel finding that has yet to be reported within younger obese adults. There are some similarities with the current findings and those of middle and older aged adults with a BMI over 30kgm^2 (McPhail et al, 2014). For example, Wingo et al (2011) highlighted that middle-aged obese adults perceived a fear of pain that resulted in physical activity avoidance. McPhail et al (2014) reinforced these findings, stating that older overweight and obese adults avoided physical activity because of the desire to distant themselves from fears related to pain. Notably, older obese adults have associated physical activity with actual pain and this could be a factor in fear avoidance beliefs (McPhail et al, 2014). Although the current study cannot generalise the findings to the wider population of younger obese adults, the finding suggest that pain-related fear may be a risk factor for inactivity. However, further research is needed in order to determine its prevalence among the population.

Younger obese adults also described other fears that may have aroused physical activity avoidance. A fear of stigma, negative evaluation and embarrassment accompanied pain as a barrier to activity that was expressed by more than half the sample. These fears were often experienced alongside feelings of low self-esteem, low self-confidence and low self-efficacy. In most cases participants experienced negative cognitions that could be associated with weight related self-body image. Younger obese adults struggled with aspects of their appearance and did not feel comfortable being active in front of others. These findings have been supported by various studies focused on self-esteem, body image and quality of life (Thomas et al, 2008; Sarwer, Thompson, and Cash, 2005; Grey et al 2012). For example, Thomas et al (2008) reported that obese individuals felt emotionally uncomfortable with exercise because of a low self-esteem. In the current study, self-blame and a lack of confidence led to participants feeling isolated and humiliated when they attempted physical activity. This barrier was affirmed in another study by Boscatto et al (2011). Boscatto et al, (2011) deemed negative body image an influential factor in feelings of low self-esteem. Obese adults described aesthetic concerns for clothing and appearance that lowered confidence and reduced opportunities for physical activity. Two studies also highlighted that any unpleasant feelings obese individuals have about themselves, will often be a barrier to physical activity because of a desire to avoid negative evaluation (Yoosin et al, 2016; Sarwer et al, 2005). Previous research shows that obesity is a predictor of low self-esteem, which is an important barrier that may need addressing prior to physical activity interventions (Baccouche et al, 2013).

Self-efficacy is interpreted as the belief in one's abilities to carry out a given task (Buckley, 2017). In the contexts of physical activity, this could refer to the ability to schedule regular exercise sessions, complete physical activities, and/ or overcome concerns about activity (Buckley, 2017). More than half of the sample in the current study appeared to have a low self-efficacy (as judged by their descriptions of perceived ability in the context of physical activity). Younger obese adults largely believed that their capabilities did not extend beyond low intensity activity, explicitly, walking. Descriptions of low self-efficacy were often accompanied by feelings of low self-esteem and confidence which may contribute to a pattern of poor self-belief. These finding have been corroborated by other research (Nascimento et al, 2017; Alharbi et al, 2017). For example, Nascimento et al, (2017) found that obese women with poor self-efficacy were less active than obese women with higher levels of self-efficacy. This shows that the belief of the individual's own success in physical activity, may be a factor in sustaining health promoting behaviour. Similarly, Alharbi et al, (2017) determined that when obese adults have a higher self-efficacy, it can be a strong predictor of retention in short and long-term exercise interventions. These studies affirm the hypothesis of Struber et al, (2004), that a lack of belief in the context of physical activity is an important barrier. The findings from the current study indicate that self-efficacy may be directly associated with other perceived barriers, and the confidence obese adults have in overcoming those perceived barriers. Participants who appeared to have a low self-efficacy (as judged by their descriptions of perceived ability) presented the largest number of self-reported barriers. Although the inter-relatedness of barriers cannot be confirmed, this observation has also been stated in three other studies (Buckley et al, 2016; Alharbi et al, 2017; Allison and Keller, 2004). For example, Buckley, (2016) concluded that overweight and obese adults with a lower self-efficacy perceived more barriers and held a lower expectation of the outcomes of physical activity. These findings suggest that younger obese adults perceived self-efficacy may influence their decision to partake in physical activity. A low self-efficacy could heighten other concerns that may prevent further engagement in physical activity and lead to an increased in avoidance behaviours. For example, the current study indicated that both low self-efficacy and low self-esteem/ confidence may be associated with fears relating to negative evaluation, stigma and embarrassment. However, further research is required to confirm the presence of these barriers and to further investigate the interrelatedness and associations between these barriers.

The findings of the current study how that a fear of weight stigmatisation may have provoked activity avoidance. Younger obese adult's perception of weight stigma centred on thoughts that other people would assume blame upon them for their weight status and discriminate them based on their obesity. This finding is consistent with other qualitative research that sampled younger obese adults (aged between 25 to 43 years) (Alquot and Reynolds, 2014; Denison et al, 2015). For example, Denison et al (2015) found that younger obese adults perceived everyone (including health professionals) to assume they just ate unhealthy foods and were inactive. Zabatiero et al (2015) found that the perception of weight stigma by obese adults, can be a negative self-body image concern that projects into a fear of other people's perceptions. The findings are also consistent with those in older obese adults (50 plus years) who have described total avoidance of physical activity due to a fear of stigma (Lewis et al, 2011). However, there are some limitations in interpretation and generalisation of the current findings given the small sample size.

Similar to fears of stigma, fears of being negatively evaluated and receiving negative commentaries about weight, may have led younger obese adults to avoid physical activity. In the current sample, these fears were particularly prevailing within crowded locations and gyms, whereby physical activity would typically be avoided. The data from this study suggested that previous negative experience played a part in avoidance beliefs of obese adults. These discoveries are consistent with other qualitative findings within younger obese adults (Baruth et al, 2014). Baruth et al, (2014) determined that obese adults held fear avoidance beliefs about being ridiculed in gym settings. Research has highlighted that this is not unique to younger obese adults as this fear has been described by overweight adults (Chang et al, 2008). Data shows fear avoidance beliefs surrounding negative commentaries, is also evidenced in middle aged obese adults (Wiklund et al, 2011). Qualitative findings have indicated that these fears stem from uncomfortable feelings about appearing in public, because of excessive body mass (Wiklund et al, 2011).

The fear of being and feeling embarrassed prevented some younger obese adults from engaging with physical activity. Both weight and aesthetics were found to likely contribute to the contemplation of embarrassment. This finding has been documented in several other research papers (Denison et al, 2015; Wiklund et al, 2011; Zabatiero et al, 2014). For example, Denison et al, (2015) found that obese adult women (aged 25 to 34 years) feared embarrassment and that this prevented them partaking in physical activity. Participants in the study specifically highlighted swimming and contexts whereby tight clothing is required as factors related to fear (Denison et al, 2015). These findings are also consistent in middle aged and older obese adults. In a qualitative research study by Wiklund et al (2011), middle aged obese adults stated that they preferred not to wear sports clothing because of their fear that others would embarrass them. The fear was cited as the main reason for not taking part in physical activity. Likewise, elderly obese adults have also described the fear that someone would highlight their body size and embarrass them as an important barrier (Lewis et al, 2011; Ball et al, 2000). For example, the study by Zabatiero et al, (2014) concluded that the issue with embarrassment lies within a self-presentational concern, and that physical activity holds a risk to that concern. This body of research highlights that a fear of embarrassment (associated with a negative self-body image and self-presentational concerns) may instil avoidance beliefs that prevent physical activity among obese adults. However, further research is needed to confirm and quantify these findings in a larger sample of obese adults aged 18 to 45 years.

The four explicit fears (pain, negative evaluation, stigma and embarrassment) that have been discussed above, appeared to have fear avoidance consequences for all ten participants. This was supported by participant physical activity levels that were reported as being low. These low levels of physical activity may have an association with fear, but limitations with the data mean that this cannot be confirmed. However, there is some rationale to include them (alongside pain) within existing theories of fear avoidance. This is because the consequence of these fears are great, and younger obese adults describe them almost as frequently as pain. Six other explicit fears (that were described as a barrier to physical activity) also had an impact on physical activity. The fear of injury, falling, darkness, leisure facilities, failure and breathlessness aroused a partial or complete avoidance of activity. However, each fear was described by fewer than three participants and some by only one participant.

A fear of injury may have led to a minority of younger obese adults avoiding or limiting their intensity of physical activity. Although the majority of participants declined to have experienced a fear of injury, those who did, stated that it had reduced their levels of physical activity. This finding is consistent with other research that has explored barriers to physical activity in obese adults (Sallinen et al, 2009; Wouters et al, 2011; Guess, 2012). For example, qualitative research has previously highlighted that middle aged obese adults were fearful of injury and this restricted activity (Guess, 2012). This has been affirmed by quantitative data that found this fear as a significant barrier to activity (Wouters et al, 2011). A fear of injury is also consistent with younger and elderly obese adults within the context of physical activity (Sallinen et al, 2009). Although a fear of injury was reported by only three participants within the current study, the data complements the findings of other literature (Napiltano et al, 2011). It may be that these fears were not reported in greater numbers because participants were toward the lower end of obese BMI (BMI<35kgm2). Fear of injury noticeably increases in frequency as BMI rises above 40kg/m^2 (Wouters et al, 2011). However, further research is needed to confirm the association between these fears and inactivity in this population.

Another fear with some link to injury was the fear of falling. In this study sample, a fear of falling may have aroused fear avoidance beliefs for a minority of participants. However, the findings were limited in that they did not explicitly describe it as a barrier to physical activity. These findings have some discrepancies with the findings of another qualitative study (fear of falling in obese adults) that included younger obese adults (Rosic, 2016). Rosic (2016) found that obese adults would actively avoid physical activity because of their concern that they could fall. However, unlike this study, participants in Rosic (2016) labelled a fear of falling as a barrier to engaging in physical activity. Critically, Rosic (2016) noted that concerns and fears were reported by the older participants (40 to 50 years of age) rather than by the younger participants of the sample. The inconsistency is most likely a result of population age in that this study collected data from the younger end of the age range. This assumption is corroborated by research that indicates an increase in fear of falling frequency as obese adult’s age (Larsson and Mattsson, 2001). The BMI status of obese participants could have also been a factor in that a fear of falling is substantially more common among severely obese than among the morbidly obese (Sallinen et al, 2009). With participants in this study on the lower side of obese BMI classifications (largely class one), a conclusion could be made that those of younger age with BMI's close to the overweight/ obese threshold, may not deem falling as a fear for activity. Although firm conclusions cannot be drawn from the current study (due to low participant numbers), the data does suggest that a fear of falling may be a lesser concern for younger obese adults than middle to older aged adults.

In a small number of participants from the current study, a fear of darkness (because of an increased risk of crime) may have led to a reduction in opportunity to be physically active. A small number of the sample described darkness and the risk of being attacked as a barrier to partaking in physical activity. The findings of the scoping review in chapter two highlight that this data is the first to report the fear of darkness as a barrier to physical activity in younger obese adults (aged 18 to 45 years). The novel finding can be corroborated by research in older overweight adults that loosely relates a fear of crime and darkness to inactivity (Kodjebacheva et al, 2015). The findings from Kodjebacheva et al, (2015) showed that a fear of crime in overweight older adults was associated with reduced activity and contributed to increases in BMI. These findings are limited in that they were only reported by a small number of participants, however they provide a rationale for further exploration into the fear of darkness and crime as a risk factor for inactivity in obese adults.

There were other fears such as the fear of leisure facilities, equipment and staff that were described as a barrier to activity. This findings in consistent with other research exploring physical activity with obese adults (Baruth et al, 2014; Ashton et al, 2015). The research by Baruth et al, (2014) highlighted that younger obese women were fearful of being humiliated within a gym, because of the perception that everyone is fitter, more aesthetic and of lower body weight than them. Similarly, Ashton et al (2015) found that overweight and obese young men identified gyms as scary, uncomfortable and were often avoided as a resource for physical activity. These findings are notable given that leisure facilities are promoted in health promotion campaigns, but may be inappropriate for obese young adults if they fear them. This warrants further investigation in order to support the development of more sensitive and relevant approaches within the leisure industry.

The fear of failure and the fear of breathlessness were also described as a barrier to physical activity. The findings of the scoping review in chapter two highlight that these fears may be a novel finding as a barrier to physical activity in younger obese adults. Previous research has highlighted that a fear of failure can lead to avoidance behaviours in sporting athletes, but this has yet to be explored in inactive obese populations (McIlveen, 2006). Research has yet to explore breathlessness as a construct of fear. Although these fears could be important barriers, it is notable that these fears arose in just one participant. Research needs to explore this further as it could be a potential risk factor for inactivity in younger obese populations.

In addition to fear related barriers, mental health may have also played a part in restricting physical activity and contributing to fear. Poor mental health and depressive symptoms have previously been associated with low levels of motivation for physical activity (Hemmis et al, 2015). The data in the current study indicated that all participants who experienced depressive symptoms described a difficulty with motivating themselves. Several participants also highlighted that mental health concerns contributed to fears of stigma and negative evaluation which in turn reduced motivation. Younger obese adults described a lack of motivation as one of the main barriers, stating that they could not push themselves to regularly engage in physical activity. This finding is supported by several papers that have included obese adults (Samir et al, 2011; Egan et al, 2013; Piana et al, 2013; Peacock et al, 2014; Napolitano et al, 2011). Of these, Piana et al, (2013) found a trend of negative attitude towards physical activity that led to low motivation. Consistent with the current study, Piana et al, (2013) described how obese adults acknowledged an internal laziness that had a negative impact on physical activity levels. Similarly, low motivation has also been highlighted as an important internal barrier in overweight and obese adolescents (Jodkowska et al, 2017). The study by Jodkowska et al, (2017) found low willpower and energy as contributing factors to low motivations. A lack of motivation seems to be a common theme that arises when research explores barriers to physical activity in obese and overweight populations. This study’s findings suggest that other factors can contribute to a lack of motivation and that it likely cannot be attributed to laziness alone. Both the influence of family members and making social comparisons were also capable of demotivating participants.

Existing family cultures that were grounded in poor health traditions, appeared to impact negatively on participants levels of physical activity. In the current study, families in which had a history of weight concerns and a culture of inactivity, may have contributed to the demotivation of younger obese adults (which contributed to their sedentary lifestyles). Three participants indicated that existing family cultures did not promote good health and weight, which restricted physical activity. This theme could not be directly supported by other research, as papers did not elaborate on their findings relating to a lack of family support (Egan et al, 2015; Osorio et al, 2013). Notably, Samir et al, (2011) attempted to explain that obese family members create an obesogenic household environment and promote behaviours that lead to a sedentary lifestyle. Similarly, Osorio et al, (2013) highlighted that a lack of family support was a barrier to physical activity in elderly adults (BMI ranges- healthy weight, overweight and obese), but the paper did not describe elements of family culture nor beliefs. Although the depth of this theme could not be corroborated in other studies, it could be associated with a lack of family support. The findings suggest that experiences of family culture that are not harmonious with health promoting behaviours, may be an important consideration for physical activity involving younger obese adults. However, the interrelatedness of these factors that may restrict activity need to be explored further, and with a larger population of obese adults.

The social comparison theory outlines how individuals look upward or downward to others in society (Festinger, 1954). Upward social comparisons describe looking up to those with a higher social status or who are perceived to be a model for the community. Downward social comparisons are when comparisons are made toward individuals that are perceived to be of lower social status, or less of a social ideal (Festinger, 1954). Younger obese adults in this study made upward and downward comparisons in various contexts of physical activity, but only upward social comparisons were described as a barrier. When upward social comparisons were made about individuals of higher social status (who had muscular and toned body shapes), participants became demotivated and this may have contributed to activity avoidance. In previous studies conducted on overweight and obese samples, upward social comparisons have had a positive influence on engagement with physical activity (Rancourt et al, 2015; Arigo et al, 2015). For example, Rancourt et al (2015) concluded that upward social comparisons were associated with an increased likelihood of engaging in exercise (within a sample of overweight women). Likewise, Arigo et al (2015) found that obese women who made upward social comparisons engaged in more minutes of physical activity per week. These findings have been also been confirmed within high school adolescents within a range of BMI's, whereby upward comparisons motivated an increase in physical activity (Barnes, 2013). The current study data indicates that upward social comparisons may have a detrimental effect on physical activity and motivations in some younger obese adults. This finding does not reflect the current literature and is a novel finding within younger obese adults. However, it must be noted that not all younger obese adults in the sample viewed their upward social comparisons as a barrier to physical activity. These findings must be reflected on with caution as there are limitations around the sample size and analysis.

Literature states that perceived locus of control may be linked to motivation (Sonntag et al, 2010). Locus of control describes an aspect of someone's personality that identifies the underlying causes of events in his or her life. It is a unidimensional continuum that ranges from external to internal (Rotter, 1954). Those who believe that behaviour is guided by fate, luck or external circumstances outside of our control, are labelled externals. Opposite to this, is those who believe that their behaviour is guided by personal efforts. These people are labelled internals (Neymotin and Nemzar, 2014). This study identified five younger obese adults as externals, based on their projection of blame in regard to their low activity levels. The externals often blamed their partners, employers and family for their low physical activity levels. Younger obese adults whose took responsibility of their own physical activity levels and acknowledged that they were to blame, were labelled internals. Internals described themselves as lazy, demotivated and holding no enthusiasm for physical activity. Externals described a higher number of barriers to increasing their physical activity levels, than did internals. External and internal loci held no pattern with actual physical activity levels, as overall levels among the sample were low. These findings do not corroborate the assumptions that obese adults are typically externals (Sonntag et al, 2010; Neymotin and Nemzar, 2014). This data also highlights that research stating internals may be more likely to exercise to improve health, may not be accurate for younger obese adults (Strickland, 1978). The data could not confirm the permanency of the sample's locus, but it is notable that each participant's perceptions of control were consistent throughout the interviews. This finding supports the claims made by Holt et al (2000) that locus of control is “mostly” considered a stable trait, and cannot easily be influenced. Younger obese adults who described internal loci traits did express a strong desire for increased physical activity, but this did not reflect in their actual activity levels (at the point of interview). These interpretations do hold some comparison to Saltzer (1978) in that internals ate mpting weight loss reported significantly more behavioural intentions than their external counterparts. Overall though, no association could be made between levels of physical activity and locus of control within the sample of younger obese adults. Locus of control traits and health promoting behaviours in younger obese adults were mixed, similar to the findings of Tobias and MacDonald (1977). The interpretations of data in this study are limited in that they relied upon the application of Festinger’s (1954) and Rotter’s (1954) theories of social comparison (that includes locus of control). This study found no evidence that would support a personalised locus of control based physical activity intervention for younger obese adults. The findings also suggest that personality traits alone may not be solely attributed to low levels of physical activity in younger obese adults.

3.8.4 Other barriers to physical activity that were not associated with fear(s)

Specific environments were deemed important barriers to physical activity by younger obese adults. Most participants described crowded locations and unwelcoming atmospheres as a barrier to physical activity. The current findings that indicate obese adults dislike for gyms and leisure facilities, has been supported in two other studies (Yoosin et al, 2016; Egan et al, 2015). For example, Yoosin et al, (2016) reported data that specifically highlighted gyms and crowded settings as a barrier to physical activity. The paper determined that there was a common theme among overweight and obese adults regarding a feeling of discomfort about exercising in front of other people. Similarly, Egan et al, (2015) reported that obese adults often dislike gyms and report them as a barrier to physical activity. However, the current evidence is still in its infancy and requires further exploration.

Employment and the lack of energy that followed from it, also posed a barrier to physical activity. Younger obese adults described energy expenditure and time spent working as contributing factors that may have prevented physical activity. This finding has been previously been reported by overweight and obese adults (Sharifi et al, 2013;

Boscatto et al, 2011). Qualitative research by Boscatto et al, (2011) determined that more than half of the obese sample (n= 17 out of 30) reported that extensive working hours acted as an external barrier to physical activity. Flannery et al, (2018) also emphasised that work prevented pregnant obese adults from becoming or maintaining active lives. These findings were supported by a later study on overweight and obese women that determined employment as the leading external barriers that influenced physical activity (Sharifi et al, 2013). The current findings provide a rationale that suggests younger obese adults with long employment hours may be at an increased risk of inactivity.

A lack of knowledge in the context of physical activity acted as a barrier for younger obese adults. These findings have been previously been highlighted in other research carried out in obese populations (Wiklund et al, 2011; Alvarado et al, 2015; Flannery et al, 2018). For example, Flannery et al, (2018) discovered a pattern between a lack of knowledge and low activity in obese adults. This was supported in an earlier study by Samir et al (2011) who concluded a lack of knowledge about physical activity was an important barrier to partaking. Identical to the qualitative descriptions in the current study, Alvarado et al (2015), determined that if obese adults had a poor knowledge about the benefits of physical activity, then they were more likely to avoid it. This conclusion has also been corroborated with obese adolescents, who described a lack of knowledge and skills as a barrier to physical activity (Jadkowska et al, 2017). The current data findings highlight a possible need to educate obese adults about the benefits, modes, intensities and durations in which may help them to achieve a healthy weight. However, further research is needed to establish successful educational intervention strategies for younger obese adults.

Participants described a lack of time for physical activity and did not feel it could be part of their daily routines. These findings are consistent with other literature concerning obese adults (Bond et al, 2013; Egan et al, 2013; Sharifi et al, 2013; Flannery et al, 2018; Peacock et al, 2014). In the study by Peacock (2014), over a quarter of obese adults (28.2% of their sample size) perceived that they had no time to participate in physical activity. Bond et al (2013) concluded that it was the most commonly reported barrier to physical activity among obese adults. Similarly, Flannery et al, (2018) discovered that obese adults justified their lack of physical activity with descriptions that centred on time constraints. Alike this study, participants in Flannery et al (2018) spoke in interview about childcare obligations as a priority of their time. Free time was rarely spent engaging in physical activity, although participants acknowledged the risks of physical inactivity. In the current study, perceptions of a lack of time, appeared to be an important barrier to physical activity but this needs further exploration within a larger sample (Egan et al, 2013).

Being a parent of children and having the responsibility to take care of them, was reported by several participants as an important barrier to partaking in physical activity. This barrier has been described in three other studies that included obese adults (Samir et al, 2011; Flannery et al, 2018; Alvarado et al, 2015). Similar to the findings of the current study, Samir et al, (2011) reported that about half of obese adults in the sample, reported a lack of spouse and support for childcare as a barrier to physical activity. Although not prevalent in this study, Flannery et al (2018) highlighted that women are particularly hindered by family commitments as they usually stay home with younger children. Consistent with this study, Alvarado et al (2015) noted that overweight and obese adults often prioritise their social responsibility as a parent but acknowledge this as one of the most important barriers to being active. Alvarado et al (2015) findings also corroborate the refusal of obese adults to blame their children for their inactive lifestyles. The data findings suggest that obese adults who have parental responsibilities may be at an increased risk of inactivity (Alvarado et al, 2015). This risk may be heightened when they lack a supportive social network that can relieve them of their childcare duties.

3.8.5 Discussing facilitators/ motivators to physical activity

3.8.5.1 Fear(s) as a facilitator for physical activity.

The data revealed that fears did not just prompt avoidance beliefs, but they may also act as a facilitator to an increase in physical activity. Younger obese adults described a desire to distance themselves from their fears, using physical activity as a means to overcome them. However, it is important to note that fear as a facilitator was only reported by a small minority of participants. Fears as a facilitator were often explicit to each participant and did not show commonality among the sample. In total, there were four explicit fears that facilitated an increased intension physical activity. The fear of weight related co-morbidities, failing, weight gain and being immobile were reported by a total of five participants. Each fear was described by no more than two participants and often by only one.

The fear of weight related co-morbidities appeared to motivate two younger obese adults to be more active. One younger obese adult described the fear of developing diabetes as his motivator. The second younger obese adult described the fear of weight related still births as a facilitator to increase her activity. The findings of the scoping review in chapter two highlight that these are novel findings as fears have yet to be associated with motivation or facilitation of physical activity in younger obese adults. There are some similarities with the findings of Alquot and Reynolds, (2014) who found that obesity was a concern for several women wanting to become pregnant, and this motivated them to engage in weight loss activities. However, this research did not indicate fear as the facilitator/ motivator, but it does display an emotive link between conception, childbirth and physical activity intensions. These findings are consistent with research that suggests obesity as a risk to fertility and still births (Özcan-Dağ and Dilbaz, 2015). With the findings from the current study, there may be a rationale to further explore these particular fears as they may increase motivation for activity in younger obese adults.

The fear of failing to achieve personal goals (with regard to physical activity) motivated one younger obese adult to be more active. A strong desire to maintain good health and the fear of failing to achieve that, likely facilitated the intension to partake in more physical activity. The findings of the scoping review in chapter two highlight that the fear of failure as a facilitator to physical activity has yet to be reported in younger obese adults. However, the fear of failure has been used by athletes as a motive for success in sports athletics populations (McIlveen, 2006). It is challenging to make recommendations to practitioners based on a fear of failure, as the data indicates that it can also be a barrier to physical activity. Notably, this finding has only been identified in one participant and has no supporting literature. The effects of a fear of failure needs further exploration in younger obese adults before any recommendations can be given.

The fear of gaining weight and becoming even larger, motivated some younger obese adults to engage in physical activity. This prompted some participants to partake in increased physical activity to fight the fear and distance themselves from the chance of weight gain. The findings of the scoping review in chapter two highlight that this is a novel finding in younger obese adults. Research has reported that a ‘fear of fat’ is linked to activity avoidance, but this was in the context of being stigmatised, not gaining more weight (Phelan et al, 2015). Equally, being obese has been linked to an increase motivation to partake in physical activity, but again, research has made no links to fears as a facilitator (Tod and Lacey, 2004). With this finding, practitioners may promote physical activity as an evidence intervention to maintain or lose weight, however further research is needed to confirm and quantify these fears in a larger sample (Dewey, 1999).

The fear of being immobilised by weight and the potential of living from a wheelchair, motivated one younger obese adult to maintain a regular routine of physical activity. This fear was also linked to a desire to maintain functional independence as he was a father to a young daughter. The finding that the fear of being immobile (through excess weight), may facilitate a regular routine of physical activity appears to be novel. Previous research has highlighted that obese adults may increase their physical activity to live longer for the benefit of their family members, but literature has yet to indicate a fear of being immobile as an explicit motive (Tod and Lacey, 2004). Notably, a fear of death has been found to be a facilitator for increased activity in obese adults, but this was not highlighted by the ten younger obese adults in this study (Dikareva et al, 2016). Practitioners may be able to utilise these findings in health promotion messages to appeal to the emotive motivations of some younger obese adults who may have young children. Health promotion messages that educate younger obese adults as to how obesity can reduce functional mobility may be a useful strategy (if used sensitively) to increase motivations and facilitate an increase in physical activity (Vincent et al, 2014).

3.8.5.2 Other facilitators/ motivators to physical activity that were not associated with fear(s)

Partaking in physical activity with the support and compassion of others, likely had a positive impact on younger obese adults. Supportive group dynamics that eased concerns around physical activity, often encouraged and motivated the younger obese adults of this sample to regularly partake in activity. This finding is consistent with literature that has explored the facilitators to physical activity in obese adults

(Greenwood- Hickman et al, 2014; Piana et al, 2013; James et al, 2014). In the study by Piana et al (2013), obese adults acknowledged others as a resource that provide support and assist in the facilitation of increased activity. Similarly, Greenwood-Hickman et al, (2014) discovered that older obese adults considered the encouragement from others a social motivator that could increase daily activity. Although this study did not rank facilitators by importance, literature has demonstrated that this theme holds the most importance among all facilitators. Lidegaard et al, (2016) found that being physically active with others was the primary motivator to a sustained level of activity. Likewise, Kirchhoff et al, (2009) described the camaraderie between overweight adults as a strong facilitator to activity and that without it, overweight and obese adults were unlikely to engage in regular activity. Although the findings of the current study are exploratory, they corroborate a wealth of literature which highlights the need for a strong group dynamic that supports and motivates obese adults to engage in physical activity.

Family support, specifically the positive reinforcement of physical activity, may have facilitated an increase in adherence to activity. In the current study, younger obese adults were often encouraged and motivated by positive commentaries from parents and siblings. This may have prompted a desire to increase their activity levels. This finding is consistent with two recent papers that explored social influences as an enabler to physical activity in overweight and obese adults (Flannery et al, 2018; Sand et al, 2017). In the study by Flannery et al (2018), obese women described their partners or husbands as the most influential factor in them partaking in physical activity. The study highlighted that when members of the family encouraged and pushed for engagement in physical activity, obese women engaged more frequently. Similar results have been found in young overweight and obese adults, who stated that their parents were important influencers in their engagement with physical activity (Sand et al, 2017). Young obese adults made explicit reference to positive reinforcement and supervision from family members as facilitators to increasing their physical activity (Sand et al, 2017). This suggests that physical activity interventions (for younger obese adults) may be more successful with the support of family members whom are willing to provide continual positive reinforcement (Perry et al, 1993).

Younger obese adults reported that a desire for actual weight loss may motivate them and facilitate an increase in physical activity. This is consistent with other findings that have reported weight loss as a facilitator to physical activity in overweight and obese populations (James et al, 2014; Yoosin et al, 2016; Dikareva et al, 2016). In a study conducted by Yoosin et al (2016), overweight and obese adults reported weight loss as the biggest motivator to partaking in physical activity. Likewise, James et al, (2014) reported weight loss as the primary reason why obese adults engage in physical activity. Dikareva et al (2016) added that weight loss motivations in the obese stem from the highly emotive desire for an improved body image and appearance. These findings indicate that educating younger obese adults about the weight loss potential of physical activity, (or utilising weight loss as a motivational tool) may facilitate an increase in activity levels. However, further research is needed to establish the success of educational intervention strategies in populations of younger obese adults.

Both physical and mental weight discomfort and the desire to distance themselves from it, were described by younger obese adults as a possible motivator to physical activity. The discomfort related to ill-fitting clothes and feelings of grief because of poor body image. Both findings are consistent with the discoveries of Dikareva et al, (2016). The study by Dikareva (2016) reported identical data in that obese adult's inability to fit comfortably in their clothes and appear aesthetically pleasing, may have motivated them to be more active. From the current findings, there is some rational to suggest that practitioners could employ education based strategies to inform younger obese adults about the physical and mental discomforts of weight. The current data suggests that this may encourage an increase in motivation for physical activity.

Participants within the study had a desire for improved health, reduced disease risk, and greater level of fitness. These desires were described as facilitators or motivators that may have had a positive impact on physical activity. These findings are consistent with other studies that have explored the facilitators to physical activity (Lee et al, 2012; Sand et al, 2017). In older overweight and obese adults, a desire for an improved health has been reported within the top three motivators to partaking in physical activity (Lee et al, 2012). In younger overweight and obese populations, Sand et al, (2017) found that a desire for better health improved motivation for physical activity. These findings suggest that all population ages with weight concerns may desire a greater improvement in overall health, and that this could be a motivator for physical activity. Further research could explore this finding in further detail to mitigate the limitations of the current study (such as a small sample size).

Younger obese adults in the current study described a sense of accountability to take part in physical activity when accompanied by another person. This finding (with the addition of feeling part of a community), is consistent with other studies that have sampled overweight and obese participants (Kirchhoff et al, 2009; Alvarado et al, 2015; Lidegaard et al, 2016). In the study by Lidegaard et al (2016), elderly obese adults described an accountability to others that facilitated their attendance of physical activity, even when they lacked in any motivation. Importantly, obese adults stated that without the commitment to others, they would not have engaged in activity. Kirchhoff et al (2009) corroborated Lidegaard's findings but added that obese adults can feel strongly accountable to the trainer of a group and this can facilitate an increase in physical activity. Literature involving overweight and obese adults also shows that feeling of accountability to others comes with the consequence of guilt if they failed to partake (Alvarado et al, 2015). The study by Alvarado et al, (2015) states that groups of exercisers who have a strong cohesion will undoubtedly feel a sense of accountability. This suggests that the forming of a strong group cohesion that will encourage accountability, will likely facilitate an increase in regular physical activity. This is important given that a sense of accountability may facilitate activity, even in the absence of motivation.

In the current study, availability of affordable, convenient childcare (close to, or within leisure facilities) was also stated as an important facilitator to physical activity. Young obese parents referred to an ideal scenario whereby they could attend a leisure facility for an exercise class and have the opportunity to leave their child safely with childcare. To the lead researcher's knowledge, literature has yet to report this explicitly as a motivator to physical activity in younger obese adults. However, research has reported on a lack of childcare as a barrier to physical activity (Egan et al, 2013; Samir et al, 2011; Alvarado et al, 2015). This finding could be important for local authorities when planning and delivering promotional campaigns that attempt to tackle inactivity and obesity. However, further research is needed to explore the impact of childcare provisions on activity adherence in younger obese adults.

3.8.5.3 Summary of discussion points relating to fear

The current study raised a number of other potentially novel findings around fears which from the findings of the scoping review have not been adequately explored in younger obese adults. These included fears of pain, breathlessness, failure, leisure facilities, weight gain, immobility, and fertility. However, due to the small sample size and lack of quantification using appropriate measurement tools, further research is warranted on these to confirm their presence, the magnitude of the problem, and explore how they relate to physical activity and body mass index.

3.8.6 A conceptual map to highlight fear avoidance in younger obese adults

Concept maps have been defined as a visual process for new ideas and research issues that help to inform the design of future inquiry (Butler-Kisber and Poldma, 2010). A concept map can quickly and clearly demonstrate research variables and clarify relationships between them (McGaghie et al, 2001). Concepts maps have previously been used to visualise the relationships among factors surrounding barriers to physical activity, and so were appropriate for the findings of this study (Sander et al., 2012). The concept map shown in figure 3.7, graphically illustrates (identified by participants) the barriers to physical activity in younger obese adults aged 18 to 45 years and serves to inform the further stages of research within this PhD. The concept map does not incorporate facilitators because the weighting of data leaned greatly towards barriers.

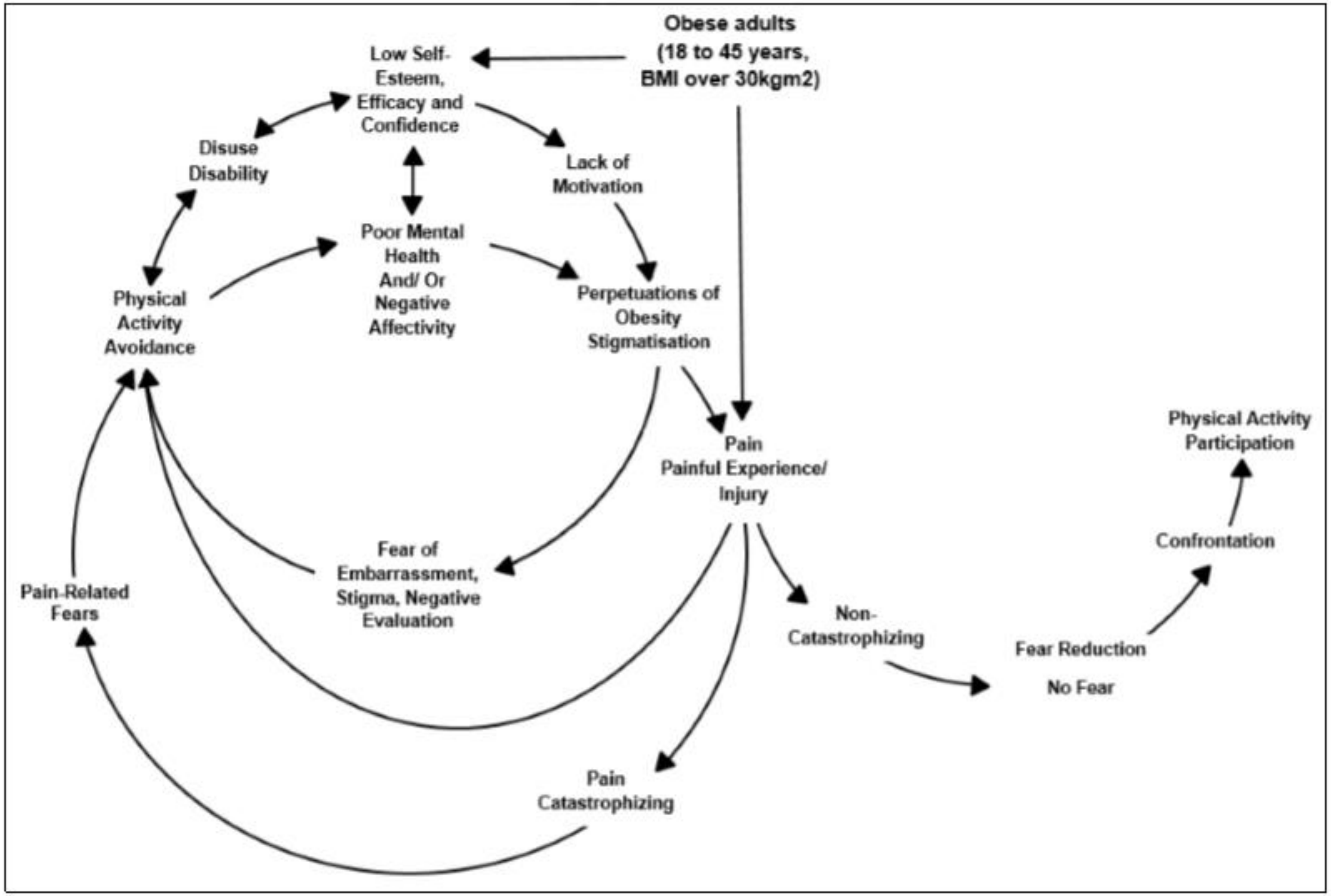
The concept map has been shaped to represent the current findings that suggest that activity related fear can lead to activity avoidance. Fears relating to pain is a key factor within the concept model. This is because these fears were described most often and as having the greatest impact on physical activity participation. This is an important findings because pain-related fears are likely associated with inactivity, increased perceptions of mobility disability and lower quality of life in middle to older aged obese adults (Vincent et al, 2011; Vincent et al, 2014; Cooper et al, 2007). These fears have also been associated with depressive cognitions, catastrophisations and mental illness in adults who are obese (Okifuji and Hare, 2015). The findings of the current study support many of these associations highlighting that pain, perceived disability, activity avoidance, catastrophisations of pain and guarded movements are key factors in how these pain-related fears provoke inactivity in younger adults. Importantly, many of these factors can be conceptualised through existing models of fear avoidance which demonstrate a detrimental cycle of fear avoidance relating to physical activity (Vlaeyen et al, 2000; Vincent et al, 2011).

The current study provides some modest evidence that inactivity may be a consequence of experiences relating to fear. This association appears to be supported by the low levels of physical activity and high prevalence of fears, evidenced in the findings. Inactivity and low levels of activity were also found to be tentatively associated with poor mental health and feelings of negative affectivity. The current study highlighted an exploratory bi-directional relationship with poor mental health and physical activity. Negative affectivity and depressive cognitions frequently prevented the participants of this study from partaking in physical activity. Similarly, negative self-image likely led to reduced motivation and self-esteem. These factors form some exploratory components of a concept map which represents a revision of the fear avoidance cycle, explicitly for younger adults who are obese.

The factors of the concept map can be corroborated by other research that has explored the attitudes and behaviours of obese populations (Napolitano et al, 2011; Ball et al, 2000; Gatineau and Dent, 2011). Research by Gatineau and Dent (2011) identified that obesity can cause mental health disorders that lead to reduced physical activity. Similarly, two studies discovered that unpleasant feelings (relating to depressive weight perceptions), led to a decrease in odds ratio of meeting physical activity guidelines (Atlantis et al, 2008; Boscatto et al, 2011). Although research states that depressive symptoms worsen as BMI rises, the findings in this study did not support this. The qualitative data indicated that class one obese participants described equally poor experiences of mental health than did those of class two obese participants. With a 55% increased risk of obese adults developing depression, it may be beneficial for practitioners to consider personalised interventions (that increase mood) to maximise success and retention (Luppino et al, 2010). These findings reinforce the importance of addressing psychological concerns as a means of tackling weight and increasing physical activity in younger obese adults (McIntosh et al, 2016).

In summary, the findings from the thematic analysis were used to develop a conceptual map of the fear avoidance to physical activity in younger obese adults (aged 18 to 45 years). The exploratory evidence suggests that fear related barriers may be specific to obese populations and may have an important influence on physical activity avoidance. The findings identified that the original model of fear avoidance needed modification to consider a range of barriers that may be prevalent in obese populations (Vlaeyen et al, 2000). The additions of low self-esteem, motivation, perpetuations of obesity, low self-efficacy, low self-confidence and additional fears were constructed from the data evidenced in this study. The concept map indicates some tentative links between barriers that were described by young obese adults. However, the interrelatedness of these barriers has yet to be fully established and must be interpreted with consideration for the studies limitations.

Figure 3.7 Concept map, revision of the fear avoidance cycle for younger adults.



3.8.7 Study limitations and strengths

This qualitative phase of the PhD had several limitations that need to be acknowledged. Firstly, a limitation existed with the recruitment of participants. The recruitment strategy focused mainly within private leisure facilities and university fitness centres (this was due to resource limitations of the PhD programme of studies). Because of this, it is possible that participants who were interviewed were already involved in physical activity and were not wholly inactive. This limitation extended to the participants current and previous physical activity levels as they were only asked generally in interview, and not quantified using a measurement tool. The use of a measurement tool would have assisted in strengthening the link between the barriers and participation in physical activity (Elgar and Stewart, 2008).

A limitation also existed with the reliance upon self-reporting of age, height and weight to measure BMI (Webb and Bain, 2011). Literature has shown that individuals with weight concerns do not accurately report their weight (Elgar, and Stewart, 2008). Obese adults tend to underestimate their weight and so this limitation may not be substantially detrimental to this study given its inclusion criteria and exploratory nature (Elgar, and Stewart, 2008). Importantly, these limitations could have been minimised as participation was voluntary and with the knowledge that weight concerns were an element to their involvement. As participants were assured anonymity, they may not have felt the need to misrepresent their weight. The data also suggest similarities with other studies that have measured BMI and explored barriers to activity among those with weight concerns (Cooper et al, 2017; Vincent et al, 2011). The systematic process of data collection and analysis (that are documented in sections 3.2 through to 3.5) mitigated some of the limitations and strengthened the validity of the study.

Another limitation of qualitative research is that the data collection methods could not be completely uniform from one participant to the next. The nature of the studies exploratory inquiry meant that the interview questions were often adapted based on the responses given by participants (Smith et al, 2009). To avoid questions that were thought to be leading, the researcher avoided direct questioning unless the participants had previously raised a concern. Although these methods created organic responses from each participant (a strength of this study), it limited data analysis in that novel phenomena could not be cross examined through the whole sample. The semi-structured nature of the interviews and interpretation could have also led to observational and researcher bias (Lees, 2011). Consultations with the supervisory team following each interview, guided the inquiry and mitigated some of the researcher bias.

Within the phases of data analysis there were three limitations that need to be considered. Firstly, the researcher's positionality undoubtedly had influence on the analysis. The interpretations of data were made from a specific positionality influenced by a pragmatic ontology, and this may have restricted the themes. Because of this, rich data could have been missed and themes may have been misrepresented (Mercer, 2007). Some themes may have been favoured over others as the researcher held an insider knowledge of the cultures of obesity and physical activity. This may have been detrimental in that obvious questions would not have been asked (Hockey, 1993). Secondly, participant responses and contextual meanings could not be member checked by the researcher due to the time restraints of the PhD. The design would have benefitted from a second round of interviews and member checking (Smith et al, 2009). These additional methods would have been advantageous to affirm or discard data themes and prompt responses about the barriers and facilitators to activity not previously discussed. Thirdly, the researcher had limited knowledge about the theories associated with psychological phenomena, and, as such, some of the theories relating to human emotions may not have been applied systematically. These limitations were lessened by the supervisory team who refined, revised and confirmed the themes. The participant transcripts were also reviewed by a psychologist who gave appropriate guidance on psychological theories that corresponded with the data. This strengthened the phases of analysis and helped shape the key points of the discussion.

As with most qualitative studies, the sample size was small because of the lengthy process of data collection, interpretation and analysis (Smith et al, 2009). Although the qualitative exploration was extensive, there was a limitation in that the data cannot be generalized to all obese adults. Similarly, it would be difficult to transfer the findings to other contexts because the individual experiences of each participant differed (Smith et al, 2009). The study intentionally targeted participants aged 18 to 45 years of age as this was the research gap. However, this meant that the findings do not represent the elderly, adolescents or children who are obese. The studies sample may have also been limited in that more participants were closer to the lower end of the inclusion age.

This was largely because of recruitment from among students within a university. It was clear from the data transcriptions and interviews that most of the participants were within their twenties. However, the sample can also be viewed as a strength of this study. This is because participants were younger adults and there is a dearth of literature within this age range. The gender distribution of the study could also be viewed as a strength as there were more males than females. This distribution is uncommon when compared to other qualitative explorations on this topic as usually more women are recruited (McIntosh et al, 2016). Notably, although the studies sample size was a limitation, the sample met the recommendations for a qualitative exploratory study and reached data saturation throughout the data collection process.

The final limitations is that the findings of the study only related to obese adults. Although many of the participants related their fears to their weight, it is not clear whether these fears are as prevalent in younger adults of healthy weight or if they increase with BMI. Further research is needed to establish if associations between fear and physical inactivity are greater in those with elevated BMI.

3.8.8 Implications for policy, practitioners, and further research

3.8.8.1 Implications for policy

The findings highlight that young obese adult's experience a range of barriers and facilitators to physical activity. Fear may be an important barrier (for younger obese adults) that could cause partial or complete avoidance of physical activity.

The immediate implications for policymakers is that they could consider these barriers and begin to plan strategies through intervention that increases opportunity to partake in regular physical activity. A focus on the emotion of fear could be a foundation to addressing the range of barriers that impact on younger obese adults. The fears identified in the current study have been shown to be exacerbated by high intensity activity that requires participants to perform excessive movements (such as jumping or running), and/or conducting activity when being observed by others. Reducing and lessening these fears through policy that adopts an incremental approach to physical activity might improve activity levels.

The potential broader implications could see the integration of a modified fear avoidance cycle (specifically for obese adults) into interventions as a strategy to tackle inactivity. For example, policy could tackle fear related barriers by ensuring adequate training is provided for leisure staff and there are suitable settings available whereby younger obese adults would feel free from stigma. Integrating the theoretical principles of fear avoidance within educational curricula of exercise specialists and practitioners, may also help to tackle the fear related concerns of obese adults (Vlaeyen and Linton, 2000).

3.8.8.2 Implications for practitioners

The findings are particularly relevant for physical activity practitioners at the point of intervention. The barriers identified in this study are useful to highlight reasons why younger obese adults may not adhere to physical activity recommendations.

The immediate implications for practitioners are that they could employ the exploratory findings to begin to plan and mitigate some of the concerns that may prevent engagement with interventions. With specific reference to fears, practitioners could adapt their intensity, modes and explicit locations of interventions to reduce the concerns of younger obese adults. For example, the intensity and modes of activity could be adapted to minimise exercises such as running, jumping, and twisting. Practitioners could also minimise the use of leisure facilities and locations with crowds of observers as they were found exacerbate fearful cognitions.

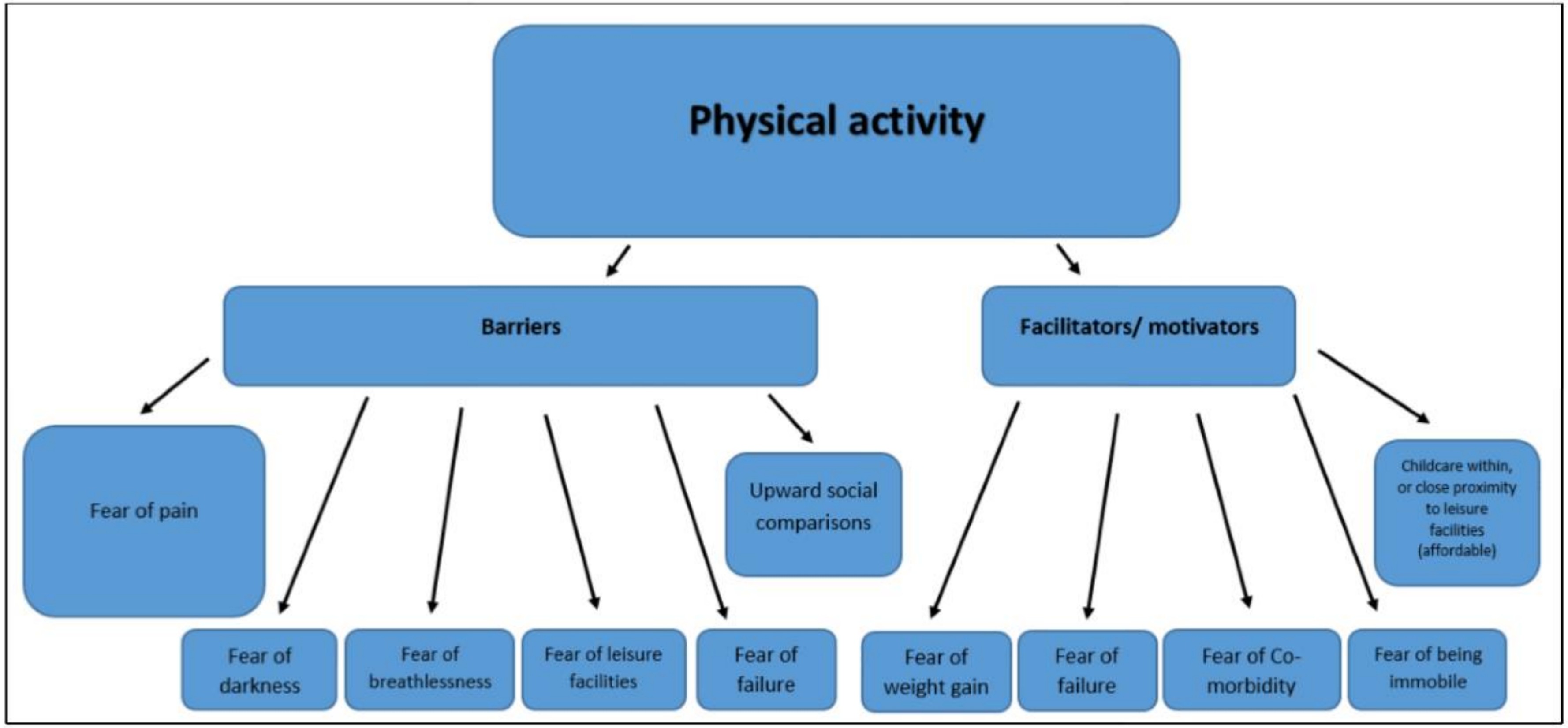
A broader potential implication is that practitioners could consider the measurement of fears to identify fear intensity, and to explore opportunities to personalise physical activity interventions. Practitioners may be able to utilise the findings relating to the measurement to strengthen their strategies to increase activity within interventions. The measurement findings may bring some impact to younger obese adults from practitioners having an improved knowledge of what may restrict their health promoting behaviour (such as physical activity). However, a valid and reliable instrument to measure each explicit fear would need to be identified for measurement, hence this being a potential future implication.

3.8.8.3 Implications for further research

An immediate implication for research is that the current findings highlight several novel fear related barriers within younger obese adults. A recent scoping review publication (highlighting the barriers to physical activity in obese adults) did not refer to any fear related findings (McIntosh et al, 2016). This is partly because the literature is limited in its exploration of fear related barriers in younger obese adults (Rosic et al, 2019). The current findings suggests that a range of fear related barriers could be interrelated and may not be overcome if tackled individually. The inter-relatedness of these barriers may be important in understanding a holistic approach to improving physical activity levels of younger obese adults, and how to minimize activity related fears. The data also suggests that fear could be a facilitator to physical activity in a minority of the sample. This has yet to be explored in research and could be important in establishing emotive motivations for younger obese adults. These fears may have the potential to motivate obese adults to partake in increased physical activity, and therefore could be useful for health promotion practitioners. Research is needed to further explore fear as a barrier and motivator with a larger sample of younger obese adults, and with other populations. This highlights a possible direction of future research and in doing so has achieved the studies exploratory intentions.

The potential broader implications for research is the need to identify valid instruments and measure activity related fears in order to confirm and quantify the phenomena as a risk factor for inactivity in younger obese adults. With a novel finding that pain-related fears were described by more than half the sample of younger obese adults, an epidemiological study to determine its prevalence across BMI ranges would add an original contribution to knowledge.

Figure 3.8. The novel findings relating to the barriers and facilitators/ motivators for physical activity in obese adults aged 18 to 45 years identified by this qualitative study.



3.9 Conclusion

This study provides a modest insight into the experiences of younger obese adults when they attempt to engage in physical activity. Participants within the study faced multiple barriers to physical activity that may have prevented them from regularly partaking. The emotion of fear was particularly important as a barrier, as it appeared to provoke a complete avoidance of physical activity. Activity related fears were described in some capacity by all ten participants, but the objective threat of each fear was diverse for each individual. In total, there were ten fear related barriers to activity. These fears were largely consistent with other literature that have explored barriers to physical activity in obese adults. However, the fear of pain, darkness, failure, leisure facilities and breathlessness appear to be novel findings among younger obese adults (aged 18 to 45 years). The most notable fear related barrier of this study was pain-related fear which likely posed a risk to participation in physical activity. This was reported by more than half of the sample and may be a risk factor for inactivity in younger obese adults. However, this needs to be confirmed in a larger sample employing quantitative methods. The findings also highlighted that some fears appeared to facilitate and motivate an increase in intention for physical activity. The fear of weight gain, failure, being immobile and co-morbidities (diabetes/ still births), may have prompted younger obese adults to engage in physical activity to distance themselves from that in which they feared. However, fears that facilitated activity were infrequent and singular among the study sample.

Overall, this chapter highlights that younger obese adults aged 18 to 45 years may find it challenging to meet basic physical activity recommendations. The findings indicate that fear appears to be a barrier that increases inactivity among younger obese adults. The most notable of these fears were those that related to pain. This was because they were described most often and had the greatest impact on physical activity participation (in this sample). This is an important finding given that pain-related fears have already been associated with inactivity and increased perceptions of mobility disability in middle to older aged obese adults (Vincent et al, 2011; Cooper et al, 2007). With limited literature that has explored pain-related fear in younger adults, there is now a need for further research to confirm and quantify these as a risk factor for inactivity. The next chapter will address this need by conducting a larger quantitative study that focuses upon the measurement of pain-related fears in adults aged 18 to 45 years.

Chapter 4

Measuring Pain-Related Fear of Activity in Younger Adults - A Quantitative Study

4.0 Background

In the first phase of this PhD, a qualitative study (exploring the reasons why obese young people aged 18 to 45 years do not undertake physical activity) revealed several important barriers to activity. Pain-related fears were frequently reported as a barrier, described by more than half the sample. Pain-related fear is one of the concepts making up the fear avoidance model, which was originally developed for chronic pain sufferers who would not participate in activity (Vlaeyen et al, 2000). This theoretical model attempts to explain why individuals who suffer musculoskeletal pain, do not always recover and return to their pre-pain activity levels (Gorczyca et al, 2013). It proposes that pain leads to a downward spiral of pain catastrophizing, maladaptive psychological responses (pain-related fear), negative cognitions (depression, disability) and the avoidance of physical activity (Vincent et al, 2013; Vlaeyen and Linton 2000). Fear is considered the most important factor in understanding why pain and associated factors (e.g. depression and disability) persist once the pain or injury has subsided (Luque-Suarez et al, 2018). Literature has previously identified pain-related fears in middle-aged to older obese adults (particularly in those with chronic pain), but pain-related fear is a novel finding in younger obese adults (Vincent et al, 2011; 2013; 2014). As stated in chapter three, further research is needed to both quantify this finding in a larger group and to explore whether the frequency of pain-related fear differs across healthy, overweight and obese younger adults (Vincent et al, 2014). However, to do this an instrument is needed to quantify pain-related fear in younger adults.

Several instruments that explore the concept of pain-related fear have already been developed (McCracken et al, 1992). A systematic review of pain-related fear measurement instruments has previously identified five questionnaires: the Fear of Pain Questionnaire (FPQ), the Pain Anxiety Symptoms Scale (PASS), the Fear Avoidance Beliefs Questionnaire (FABQ) the Fear Avoidance of Pain Scale (FAPS) and the Tampa Scale for Kinesiophobia (TSK) (Lundberg et al, 2011). The systematic review deemed that the PASS was the best available instrument to measure pain-related fear (Cronbach's alpha, 0.94, Concurrent validity- PASS-*total*: r= 0.45 with PDI-*total*; r= 0.41 with TSK-*total*; r= 0.23 with MPQ-*total*). The TSK was deemed the best available instrument for the measure of fears relating to movement (Cronbach's alpha, 0.81, Concurrent validity- TSK-*total*: r= 0.44 with PDI-*total*; r= 0.21 with MPQ-*total).* (Lundberg et al, 2011).

The most recent PASS instrument, the PASS-20 comprises four construct factors: Cognitive, Escape/Avoidance, Fear and Physiological Anxiety (Roelofs et al, 2004). The cognitive factor is described as an impairment of concentration because of catastrophizing of pain (Roelofs et al, 2004). The escape/ avoidance factor is described as a behavioural response to avoid, reduce or terminate pain (McCracken, Zayfert and Gross, 1992). The factor termed fear is the anticipation of negative consequences and fearful cognitions (relating to pain) (McCracken, Zayfert and Gross, 1992). Finally, the psychological anxiety factor describes mental arousal in response to pain (Coons et al, 2004). Research has indicated that PASS-20 scores exceeding a threshold of 30 may be indicative of high levels of pain-related fear, and could increase the risk of fear avoidance behaviours (Admundson et al, 2004; Abrams et al, 2007). Typically, chronic pain sufferers have recorded mean scores of 38.62 (SD 20.83), whilst adults without pain have recorded mean scores of 24.04 (SD 13.45) (McCracken and Dhingra, 2002; Abrams et al, 2007). This is important given that the higher scores in chronic pain sufferers have been associated with lower levels of physical activity (Vincent et al, 2014). Notably, the validity and reliability of this measure for obese adults has not been established.

Many of the instruments that measure pain-related fear have been criticised because of an absence of evidence relating to their construct validity (Lundberg et al, 2011). Most notably, literature has highlighted that the fundamental constructs around existing measurements have not been made clear (Lundberg et al, 2011). This is because a conceptual model to define pain-related fear or its construct factors has not been developed to support the different instruments (Lundberg et al, 2011). Because of this, data collected using pain-related fear instruments (including Pain Anxiety Symptoms Scale and the Fear Avoidance Beliefs Questionnaire) may be limited because of concerns that they may not capture all of the factors relating to the construct (De Vet et al, 2011). Lundberg et al, (2011) suggested that existing measurement instruments would benefit from research that could establish a conceptual model reflecting upon the underpinning construct and its factors.

The qualitative phase of this PhD, presented in chapter three, has gone someway to highlight the construct factors that may underpin pain-related fear as the findings were used to propose a conceptual model of pain-related fear for younger obese adults. The qualitative findings suggested that factors associated with pain-related fear contributed to a cycle of fear avoidance that was detrimental to physical activity. This provided some evidence that pain-related fear may be a multi-dimensional construct for younger obese adults. Overall, a total of six construct factors were identified that could represent the construct of pain-related fear through a conceptual model: fear beliefs, disability, physiological responses/ guarded movements, pain catastrophizing, avoidance/ escape and experienced pain. This can be seen in figure 4.1.

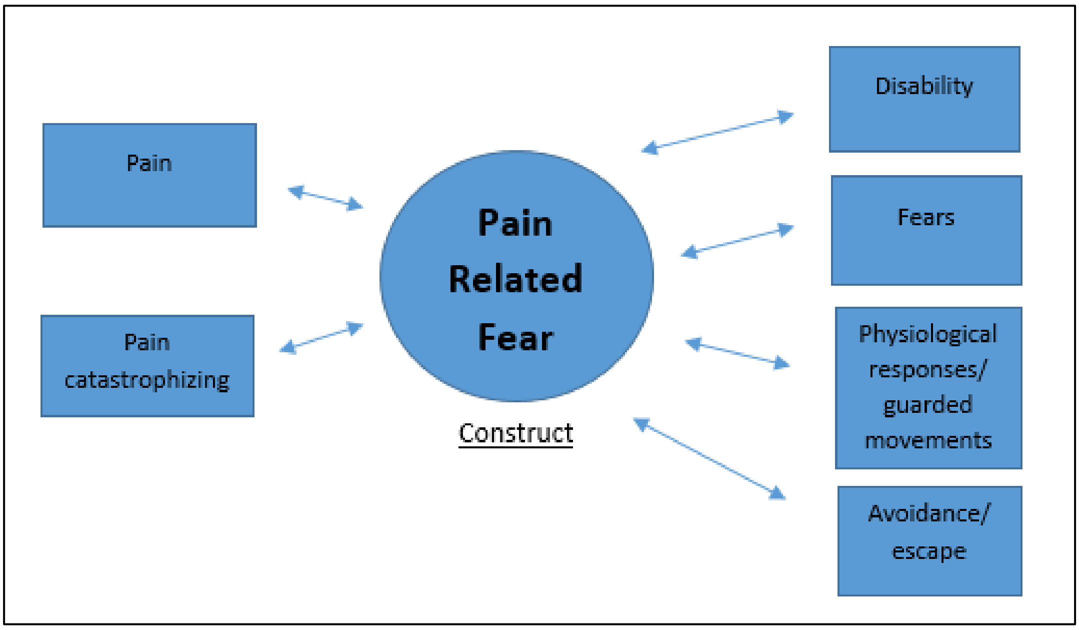


Figure 4.1. Conceptual model of the construct pain-related fears

These construct factors are similar to those measured by existing pain-related fear instruments (Vlaeyen et al, 2012; Vincent et al, 2013), but none of the existing pain-related instruments measure all of the factors highlighted by the conceptual model. Some of the factors within the conceptual model have distinct similarities to factors within existing instruments, for example, the TSK and PASS-20 measure fear avoidance responses, which align with fear and avoidance factors identified in the conceptual model. Notably, the PASS-20 has some advantages over the TSK in that it measures a cognitive factor, which has similarities to the pain catastrophizing factor in the conceptual model. Importantly, the TSK and PASS-20 do not have construct factors that share similarities with the disability or experienced pain factors in the conceptual model. However, several other measurement instruments, such as the Pain Disability Index (PDI) and the Numeric Pain Rating Scale (NRS) do map onto these constructs. The PDI and NRS could be combined with the PASS-20 to cover all the construct factors proposed in the conceptual model. Employed together, these instruments could measure the constructs of pain-related fear highlighted by younger obese adults in the qualitative phase of this PhD. However, in combining the PASS-20, PDI, and NRS there is likely to be some overlap in constructs between the instruments. Because of this, it is expected that there will be redundant items and items that do not map well with the proposed construct factors. Therefore, the development of a new instrument from a combination of these three instruments will require testing of its psychometric properties. Determining the psychometric properties of the measurement instrument will indicate if it is valid and reliable for the population, whether it requires adaptation, and how its factor dimensions align with the conceptual model. Figure 4.2 shows how these constructs may map from existing instruments to proposed conceptual model factors.

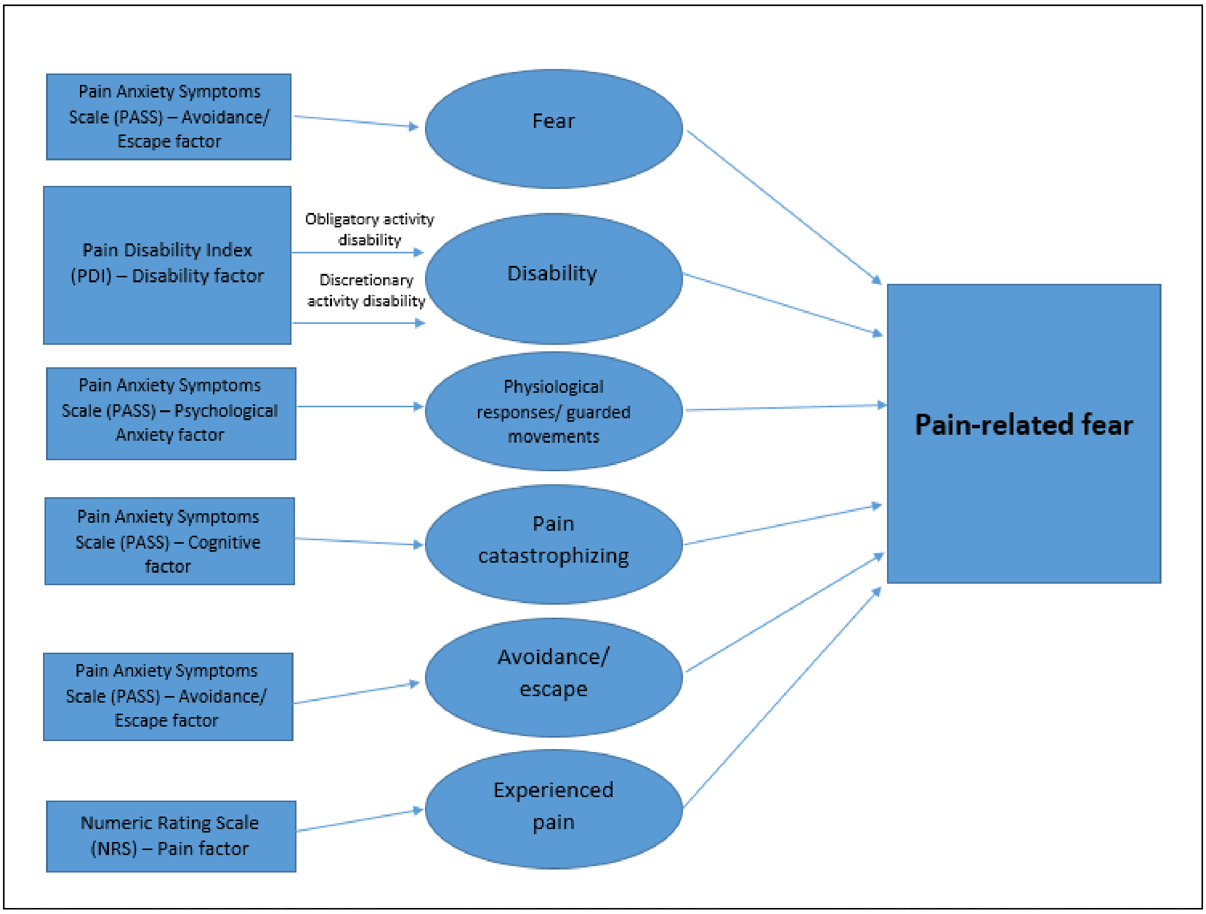


Figure 4.2. The mapping of constructs from existing instruments to proposed conceptual model factors.

In summary, a qualitative study (of reasons why obese young people aged 18 to 45 years do not undertake physical activity) revealed that pain-related fears were reported by more than half the sample. A published systematic review has suggested that the best measure of pain-related fear is the PASS (Lundberg et al, 2011), but this instrument does not cover all the constructs of pain-related fear identified among younger obese adults in the qualitative study (reported in chapter 3 of this PhD). However, a combination of the PASS, NRS and PDI does map onto all the constructs. This study seeks to explore the validity of these measures alone and in combination in younger adults and explore differences in pain-related fear across different BMI categories.

4.1 Aims and objectives

4.1.1 Aims

The aim of this study was to explore the validity of pain-related fear measurement instruments in adults aged 18 to 45 years.

4.1.2 Objectives

Primary objectives

The primary objectives of this study were to assess the validity of existing pain-related fear measures in adults aged 18 to 45 years through:

1. Determining construct validity (hypothesis testing) through observation of increased pain-related fear as measured by existing instruments in less active groups compared with more active groups.

2. Determining criterion validity through the correlation between the pain-related fear measurement instruments (Pain Anxiety Symptoms Scale- 20, Pain Disability Index, Numeric Pain Rating Scale) and a previously validated measure of fear of movement (the Tampa Scale of Kinesiophobia, TSK).

Having established the validity of the measures in the target population, the secondary objective was to:

3. To explore whether a combination of instruments/instrument subscales/instrument items improves the construct and criterion validity of an instrument for measuring pain-related fear.

4.2 Methods

4.2.1 Study design

A quantitative cross-sectional survey design using existing measurement instruments was employed to establish the validity of pain-related fear in adults aged 18 to 45 years. This research design has advantages in that it can gather information from a large sample of the population economically and efficiently (Showkat and Parveen, 2017). The design also has advantages in that it provides appropriate data to analyse relationships between instruments for the purpose of establishing validity (De Vet et al, 2011).

According to the COnsensus-based Standards for the selection of health Measurement INstruments (COSMIN, 2010), validity is defined as the degree to which an instrument truly measures the construct it purports to measure. In this study, validity is explored using the known group's method (construct validity, hypothesis testing) and through correlation with a reference measure (criterion).

4.2.2 Construct validity

Construct validity has been defined as the degree to which the scores of a measurement instrument are consistent with a hypothesis (e.g., with regard to internal relationships, relationships with the scores of other instruments or differences between relevant groups) (De Vet et al, 2011. Pg. 169).

The hypothesis to establish construct validity was as follows:

- There will be increased pain-related fear in less active groups compared with more active groups by at least 7.

The known group's method compares measurement scores of groups that should differ based on trait, ability or previous research findings (Keating and Silverman 2004). Applying the method to this study, previous research has highlighted that non active adults score higher (approximately 14 points) than active adults within the construct factors of pain-related fear and physical activity avoidance (pain, fear, avoidance, pain catastrophizing) (Vincent et al, 2013; 2014). However, the difference in these scores is limited to research in older adults aged 65 or over and has yet to be explored in younger adults. Differences in scoring are discussed further in the section on sample size.

Qualitative data from this PhD has highlighted that a sample of younger obese adult described pain-related fear as a reason for activity avoidance. Similar findings have been highlighted in middle to older age obese adults (Vincent et al, 2014). Assuming that pain-related fears lead to activity avoidance, it might be expected that high pain-related fear construct scores (Fear beliefs, disability, physiological responses, pain catastrophizing, avoidance/ escape and psychogenic pain) will be correlated with low levels of physical activity.

4.2.3 Criterion validity

Criterion validity is defined as the degree to which the scores of a measurement instrument are an adequate reflection of a gold standard (De Vet et al, 2011. Pg. 159). In this study, criterion validity is investigated by correlating the scores from the pain-related instruments and a gold standard measurement instrument (De Vet et al, 2011). The hypothesis of establishing this validity is implicit in that the measurement instrument under study is as valid as the gold standard instrument. In this study the PASS-20, PDI and NRS were the measurement instruments and the TSK was the assumed gold standard measure. The TSK was chosen as it measures similar construct factors as the PASS-20, and was the other measure identified by the systematic review as the best available measure of fear-related movement. Relationships between the PASS-20 and the TSK instrument (assumed gold standard) will measure the adequacy of fear avoidance factors within the context of physical activity. A correlation of at least 0.3 is considered satisfactory for scores of similar constructs between the related measurement instruments for criterion validity (De Vet et al, 2011).

The development of the new instrument was conducted using exploratory and confirmatory factor analysis. Exploratory factor analysis explored Items that correlated highly with each other and that shared a variance which explained the underlying dimensions (De Vet et al, 2011). The PASS-20, PDI and NRS were analysed together using the reliability analysis function in SPSS. This produced a matrix which represented how each item loaded on a particular factor. The factors were taken into further stages of the factor analysis based on the guidelines of De Vet et al (2011), if they had an eigenvalue greater than one. To optimise the dimensionality of the factors, item reduction was conducted to remove items which did not load substantially on one factor (<0.5) or loaded on more than one factor (>0.3) (De Vet et al, 2011; Nunnally and Bernstein, 1994). Once complete, the AMOS software was employed to conduct confirmatory factor analysis. Different models were tested to assess the model fit using the thresholds proposed in De Vet et al, (2011); comparative fit index >0.95; goodness of fit index >0.95; adjusted goodness of fit index >0.9; P Value < 0.05; root means square error of approximation <0.06; Chi squared <0.05.

4.3 Participants

A sample of younger adults aged 18 to 45 years of age were asked to complete a set of measurement instruments.

4.3.1 Exclusion criteria

The study excluded anyone who was unable to understand and interpret the English language. This was a necessary exclusion because the measurement instruments have yet to be cross-culturally validated in all languages, and participants may be unable to provide informed consent.

4.3.2 Setting

The data collection was carried out within Edge Hill University and in community settings, including weight management groups and leisure centres.

4.3.3 Identification of research participants

This research identified participants through several pathways. Most of the participants were identified through community weight management groups (primarily younger overweight and obese adults) and undergraduate student cohorts within Edge Hill University (younger heathy weight, overweight and obese adults). Social media, leaflet and poster advertisement helped market the study.

4.3.3.1 Community weight management groups, leisure facilities, healthy lifestyle groups, council health initiatives and healthy weight support groups (non-NHS)

Community weight management groups were identified through the World Wide Web. Following this, the lead researcher contacted the organisation leaders via telephone and email with some information outlining the intentions of the research. The leaders of these organisations acted as the gatekeepers to the groups. When the gatekeepers of the weight management groups responded positively, the lead researcher spoke to the groups during their usual meeting. A brief of the project was verbally relayed to prospective participants. Those that expressed interest were given a full participant information sheet and the questionnaire pack (Seen in appendix N). The lead researcher gave participants 24 hours to consider the information about the study. Some participants opted to forgo this period and complete and return the questionnaire pack immediately. They participated in person at Edge Hill University, in a public community setting or later via the postal return of the questionnaire pack (once collected from the lead researcher at Edge Hill University or a public community setting).

4.3.3.2 Student cohorts within Edge Hill University

The lead researcher approached programme and module leaders of several teaching programs at Edge Hill University by telephone and email (example email seen in appendix M). The program leaders acted as the gatekeepers to the cohorts of students. A brief of the project was verbally relayed to the students. Those students that expressed an interest in participating were given a full participant information sheet and the questionnaire pack. The lead researcher ordinarily gave participants 24 hours to consider the information about the study unless they opted to forgo this period and complete and return the questionnaire pack immediately. Students participated in person at Edge Hill University, in a public community setting or later via the postal return of the questionnaire pack.

4.3.3.3 Direct email marketing aimed at students of Edge Hill University

An email (example seen in appendix M) was delivered to students via the weekly notification and announcement system (with assistance from Alexandra Bradshaw). This briefly outlined the research intention and requested that prospective participants express an interest in partaking in the project to the lead researcher via email. When participants made contact with the lead researcher, contact data was recorded in an excel spreadsheet and electronically stored in OneDrive via Edge Hill University (password protected user domain). Following this, the prospective participants were sent a participant information sheet and the questionnaire pack. The lead researcher ordinarily gave participants 24 hours to consider the information unless they opted to forgo this period and complete and return the questionnaire pack immediately. Students participated in person at Edge Hill University, in public community settings or via the postal return of the questionnaire pack (once collected from the lead researcher at Edge Hill University or a public community setting). Contact details were destroyed following participation.

4.3.3.4 Social media advertisement

Social media advertisements were conducted on Facebook, Twitter and Instagram. The lead researcher used accounts headed with the lead researcher's name and identified that the research was for a PhD. The pages highlighted the research intentions and provided contact information for the lead researcher. When participants contacted the lead researcher, contact data was recorded in an excel spreadsheet and electronically stored in OneDrive via Edge Hill University (password protected user domain). Those that expressed interest were given a full participant information sheet and the questionnaire pack. The lead researcher ordinarily gave participants 24 hours to consider the information about the study unless they opted to forgo this period and complete and return the questionnaire pack immediately. Participants completed the questionnaire pack in person at Edge Hill University, in a public community setting or at a later date via postal return of the questionnaire pack (once collected from the lead researcher at Edge Hill University or a public community setting). Contact details were destroyed following participation.

4.3.4 Sampling

This study largely sampled from a student population which allowed for a greater likelihood of obtaining a large sample size within a short time period. To ensure that there were sufficient numbers of obese adults, adults with a greater age range, and those with lower levels of physical activity within the sample, the study also drew participants from community weight management groups. Community weight management groups contained younger adults, often over the age of 25 and with high BMI. This strategy ensured that inactive groups with obesity were represented within the study sample. However, this study did not intend to be representative as it its aim was primarily about the measure validation and not prevalence.

4.3.5 Recruitment

The recruitment material stated clearly that the study is research, showed affiliation with Edge Hill University, provided contact information and was respectful and appropriate to the audiences. The advertisements included:

- the name and office number of the lead researcher and/or research facility.
- the condition under study and/or the purpose of the research.

- in summary form, the criteria that will be used to determine eligibility for the study.
- the time commitment required of the subjects.

4.3.6 Patient and public involvement (PPI)

Young adult service users of Edge Hill University were consulted to assist with the development of front facing documents (participant information sheet and poster) through the Service User and Carer Council within the Faculty of Health, Social Care and Medicine, Edge Hill University. Feedback from the service users helped phrase the issues and improve the language in a manner that would appeal to younger adult participants (in all front facing documents).

4.4 Informed consent and the right to withdraw

Implied consent was attained via the completion and return of the questionnaire pack. As participation was voluntary and anonymous, consent was implied with statements in the participant's information sheet and at the beginning of the questionnaire pack. The right to withdraw, without prejudice, was emphasised during the stages of recruitment and immediately before data collection takes place. Participants had the option to leave at any point during the completion of the questionnaires. The participants were reminded that withdrawal held no consequences to their employment, personal or academic lives. The participants held no obligation, either by contract, employment, academic or researcher coercion to engage with the study. Participants were informed that they once they have submitted the set of measurement instruments back to the lead researcher (following completion), they were unable to withdraw. This is because of the anonymity of the questionnaire pack, and because no identifiable data was collected.

4.4.1 Additional Information

At the point of data collection, participants were asked to complete sociodemographic and anthropometric information on their age, gender, height, weight, employment status and any functional limitations and/ or balance problems that may affect physical activity.

4.5 Ethical approval and governance

The research was approved by the research ethics committee of Edge Hill University (appendix J). There were four main ethical issues with this study that were considered: Lost or stolen data, participant upset and harm, researcher isolation through lone working, and issues relating to research conducted with EHU students.

4.5.1 Lost or stolen data

The data has no identifiable information; however, the research had a data management plan implemented prior to and throughout the data collection to mitigate risk. Demographic and instrument data were securely locked in cabinet that was within the lead researcher’s office (Confucius institute, Edge Hill University). Shared folders on the University OneDrive (with restricted access to the research team) were used as a secure means of sharing files within the research team. Contact details of participants were deleted following recruitment.

4.5.2 Upset and harm

It was possible within the study that embarrassment or upsets may have occurred by responding to questions regarding weight, fears and pain. This did not occur, but the researcher was prepared to signpost them to their GP, or the services provided on the participant information sheet. The participants were also given the option to leave at any point, without having to complete the questionnaire. The study adhered to Edge Hill University’s wellbeing policy throughout the research.

4.5.3 Lone working

During all research whereby lone working may be prevalent for extended periods, steps to ensure the safeguarding of the lead researcher were put in place using a buddy system. The study adhered to Edge Hill University’s Safe Fieldwork and the Health and Safety policy. When the research was conducted alone and off site, one of the research supervisory team acted as a buddy and was given details of addresses, time and dates relating to the lone working data collection. Once data collection had taken place, the member of the supervisory team was contacted to confirm the researcher was safe and unharmed. This contact was made within 4 hours of the lone working data collection to confirm the safety of the researcher. The study adhered to Edge Hill University lone working policy throughout the research.

4.5.4 Conducting research with EHU students

The lead researcher read and understood the ethical guidance and policy for undertaking research with Edge Hill University students. The research did not require student grades, records or assessment information. The lead researcher highlighted on more than one occasion that participation or non-participation would have no detrimental effect on relations with the researcher, grades or academic achievements. No financial, academic, grade or other incentives were used to promote participation within the study. The researcher avoided any coercive acts to persuade participant involvement. Participation was entirely on a voluntary basis.

4.6 Data collection method

A brief of the project was verbally relayed to prospective participants. Those that express interest were given a full participant information sheet (Seen in appendix N). Participants were given 24 hours to consider the information about the study unless they opted to forgo this period and complete and return the questionnaire pack earlier. Participants were given the option to take away the information and were given a pre-paid postage return envelope to return the pack if they opted to participate at a later date. There were five measurement instruments with 58 total items. Most of the questions were completed via Likert scale and only required participants to circle their preferred answer (the instruments can be seen in appendix O). The instrument pack was piloted to determine how long participation would take and did not take longer than 15 minutes to complete.

4.6.1 Measurement instruments (data collection) –

The five measurement instruments used in this study were as follows.

Three measures used to establish construct and criterion validity:

- Pain Anxiety Symptoms Scale (PASS-20)
- Pain Disability Index (PDI)
- Pain Numeric Rating Scale (NRS)

One additional measure used as the ‘gold standard’ to establish criterion validity:

- Tampa Scale of Kinesiophobia (TSK)

One measure to establish construct validity through hypothesis testing (known group's difference method):

- International Physical Activity Questionnaire- Last 7 days Short form (IPAQ-L7S)

These can be seen in appendix O. The questionnaires were administered as paper versions as they have only been validated in this format (Miller et al, 1991; McCracken et al, 1993).

4.6.2 Justification for the selection and use of each measurement instrument

4.6.2.1 Pain-related fear measures

Pain Anxiety Symptoms Scale - 20

The PASS-20 has been described by Lundberg et al, (2011) as the best available instrument to measure pain-related fear. The PASS-20 instrument has 20 items. Confirmatory factor analysis has indicated that the PASS-20 construct factors adequately fit its four factors, but this data is limited to populations of chronic pain sufferers (Roelofs et al, 2004). Notably, all measurement instruments of pain-related fear have been criticised by Lundberg et al, (2011) because of the inadequate conceptual modelling that underpins them. Other measurement instruments such as the Fear of Pain Questionnaire (FPQ) (McNeil and Rainwater, 1998) and Fear Avoidance Beliefs Questionnaire (FABQ) (Waddell et al, 1993) were not considered because of concerns that the item factors did not match the conceptual model and that the contexts of the items did not evaluate physical activity. The creators have made the PASS-20 free and available to use for research purposes (Roelofs et al, 2004). The PASS-20 has proposed severity cut off points: mild = 0 to 34; moderate = 35 to 67; and severe = 68 to 100 (Brede et al, 2011).

Pain Disability Index

The PDI has seven items. The PDI measures two construct factors of disability named obligatory (activities required to maintain life) and discretionary (voluntary activities) (Soer et al, 2013). The PDI has adequate factor structure, adequate construct validity (r= 0.70 with Pain Disability Questionnaire) and good test-retest reliability (r= 0.94 to 0.96) (Giordano et al, 2012; Jerome and Gross, 1991; Tait et al, 1990). This instrument is particularly relevant given its item factor contexts within several contexts of physical activity. It holds advantages over other instruments that measure pain-related disability (e.g. Roland Morris Disability Questionnaire, Quebec Back Pain Disability Questionnaire) because it can be utilised in a range of activity contexts (Soer et al, 2013). The creators have made the PDI free and available to use for research purposes (Tait et al, 1990). The PDI has proposed cut off points for the interpretation of severity that are suggested to be; mild corresponds to scores ≤27, moderate corresponds to scores between 28 and 42, and severe corresponds to scores ≥43 (Beemster et al, 2018).

Numeric Rating Scale

This scale is unidimensional in its construct factor of pain. The NRS has been correlated with the Virtual Analogue Scale (VAS), showing adequate construct validity among chronic pain sufferers (Ferraz et al, 1990; Downie et al, 1978). The NRS has previously been favoured by chronic pain patients over other measures (VAS, MPQ) because of its comprehensibility (De Williams et al, 2000). The NRS has good test-retest reliability (r= 0.87 to 0.90) and concurrent validity when correlated with other measures (r= 0.653 with Visual Analogue Scale) (Firdous et al, 2017; Ferraz et al, 1990; Downie et al, 1978). Other measures, such as the McGill Pain Questionnaire (MPQ) were considered but excluded because of their complex, lengthy designs that were not be feasible for this study (Hawker et al, 2011). The creators have made the NRS free and available to use for research purposes. Results from previous literature state that severity cut off points for the NRS are: ≤3 corresponding to mild pain, 4–6 corresponding to moderate pain and ≥7 corresponding to severe pain (Boonstra et al, 2016; Hirschfeld and Zernikow, 2013; Oldenmenger et al, 2013).

4.6.2.2 Activity measure for known group's difference method of construct validity

The International Physical Activity Questionnaire – Last 7 days Short form (IPAQ- L7S), was used as a measure of physical activity levels to test the hypothesis that there will be increased pain-related fear in less active groups compared with more active groups (the known group's difference method). The IPAQ has been deemed the most extensively used self-reported physical activity questionnaire worldwide (Silsbury et al, 2015). The conclusions of a systematic review (self-reported physical activity measurements) identified the IPAQ- L7S as the most appropriate outcome measure for use in research (Silsbury et al, 2015). Research has highlighted that the IPAQ-L7S demonstrates excellent test–retest reliability (r= 0.74- 0.79) and has acceptable criterion validity (r= 0.43 with double labelled water technique) (Silsbury et al, 2015; Van der Ploeg et al, 2010; Boon et al, 2010). Other self-reported physical activity questionnaires, such as, the Recent Physical Activity Questionnaire (RPAQ), Human Activity Profile (HAP) and Godlin-Shepard -1 (G-S 1) were excluded because of their weaker reliability and poorer correlations with gold standard measures (Webster et al, 2011; Besson et al, 2010: Sirard et al, 2013). The creators have made the IPAQ free and available to use for research purposes.

4.6.2.3 Reference standard for concurrent validity: Tampa Scale of Kinesiophobia

The TSK was used to establish concurrent validity (Miller et al, 1991). The TSK has 17 items. The background section of this chapter (4.1) highlights how the TSK is a credible reference standard for comparison with the PASS-20 instrument. The TSK has two validated construct factor dimensions (Milller et al, 1991). One factor dimension is described as harm/ somatic focus and the second factor is fear avoidance (which incorporates activity avoidance and fear of movement/ injury). The fear avoidance factor dimension of the TSK was used in comparison with the fear avoidance dimensions of the PASS-20 to establish construct validity. Moderate to strong correlations were initially expected between the fear and avoidance subscales of the PASS-20 and TSK instruments. The remaining dimensions of the TSK and PASS-20 were considered for analysis but were difficult to compare because the construct dimensions lack adequate descriptions from a conceptual model. However, the TSK has been identified as the best available measure for fear avoidance beliefs of physical activity (specific to movement and injury) (Lundberg et al, 2011). Previously, adults who were not obese have reported mean TSK scores of 23.0, whilst obese adults of similar age have reported mean scores of 26.1 (Vincent et al, 2011). Other than the data presented by Vincent et al (2011), research has yet to establish a threshold for TSK score that could indicate elevated fear levels (Vincent et al, 2014). However, higher mean scores of 26.1 have been associated with excess weight, increased pain, poorer perceived quality of life and perceived disability (Vincent et al, 2011).

Having analysed each fear of pain/ movement instrument the TSK was chosen because of its comparable item factors of fear avoidance and its contexts within physical activity (Miller et al, 1991). It was not chosen to be the pain-related fear measure of this study because the PASS-20 was deemed to have superior construct validity and contextual relevance (Lundberg et al, 2011). Other instruments such as the Fear of Pain Questionnaire (FPQ-3) and the Fear Avoidance Beliefs Questionnaire (FABQ) were rejected as the reference standard because they did not set their items within contexts of physical activity, and/ or were limited to the measurement of back pain-related fears (Waddell et al, 1993; Lundberg et al, 2011). The creators have made the TSK free and available to use for research purposes.

4.6.2.4 Verification of the conceptual model using the measurement instruments

The qualitative phase of the PhD suggested that the construct of pain-related fear for younger adults is multidimensional with six factors: fear beliefs, disability, physiological responses/ guarded movements, pain catastrophizing, avoidance and pain. The combined use of the PASS-20, PDI and the NRS instruments ensures that the six construct factors could be analysed and validated in a larger sample. The advantages of using the existing instruments is that they provide a set of potentially relevant items without the need to develop them from scratch (De Vet et al, 2011).

4.7 Data analysis

4.7.1 Description of the study sample

Descriptive statistics were used to outline the sociodemographic characteristics of the sample: body mass index categories, age groups, and gender and occupation. The mean, median and standard deviation of all pain-related fear questionnaires (PASS-20, TSK, PDI and NRS) were estimated for the overall sample.

4.7.2 Questionnaire data

4.7.2.1 Scoring of fear related questionnaires

The PASS-20 is scored with 20 items, each item has a score from zero to five which five is always and zero is never. There are five questions making up each of the subscales of cognitive, fear, avoidance/ escape and physiological anxiety. The cognitive (anxiety) subscale relates to interrupted cognition caused by pain (McCracken et al, 1992). The fear subscale relates to fearful cognitions around pain (McCracken et al, 1992). The avoidance/ escape subscale relates to the avoidance of activity that causes pain, and the physiological anxiety subscale relates to somatic physiological reactions (such as sickness) associated with pain (McCracken et al, 1992). Subscale scores are calculated by adding the total of the five items within each subscale. Therefore, the range of subscales scores are from zero to 25. The total score for the PASS is calculated by adding up the subscale scores. The total PASS score can range between zero to 100 (Roelofs et al, 2004).

The TSK is scored with 17 items, each item has a score from one to four which four is strongly agree and one is strongly disagree. There are eight items making up the subscales of activity avoidance and five making up the subscale somatic harm/ focus. Subscale scores are calculated by adding the total of the items within each subscale. Therefore, the range of subscales scores are from five to 20 within the somatic harm/ focus and eight to 32 in the activity avoidance subscale. The total score for the PASS is calculated by adding up the subscale scores. The total TSK score can range between 17 and 68 (Miller et al, 1991).

The PDI is scored with seven items, each item has a score from zero to 10, where 10 is worst disability and zero is no disability. There are five questions making up the discretionary subscale and two questions making up the obligatory subscale. The discretionary subscale relates to activities that are voluntary such as social, recreational and occupational, and the obligatory subscale relates to activities required to stay alive such as eating and sleeping. Subscale scores are calculated by adding the total of the items within each subscale. Therefore, the range of subscales scores are from zero to 50 for discretionary subscale and zero to 20 for the obligatory subscale. The total score for the PDI is calculated by adding up the subscale scores. The total PDI score can range between zero to 70 (Soer et al, 2013).

The NRS is scored with one item. The item has a score from zero to ten which ten is worst pain possible and zero is none. The total NRS score can range between zero to 10 (Williamson and Hoggart, 2005).

4.7.3 Categorisation of other variables

The participant IPAQ data was analysed using the IPAQ research committee (2005) protocol guidelines in order to identify participant's level of physical activity. The protocol established three categories in which participants were grouped: high, moderate and low levels of physical activity (IPAQ research committee, 2005). Physical activity levels were deemed high if participants reported vigorous-intensity activity on at least three days and accumulating at least 1500 MET-minutes per week or if they reported seven or more days of any combination of walking, moderate, or vigorous- intensity activities accumulating at least 3000 MET minutes per week. Physical activity levels were deemed moderate if participants reported three or more days of vigorous-intensity activity of at least 20 minutes per day or five, or more days of moderate-intensity activity and/or walking of at least 30 minutes per day, or five or more days of any combination of walking, moderate-intensity or vigorous intensity activities achieving a minimum of at least 600 MET minutes per week. Physical activity levels were deemed low if no activity was reported or some activity was reported but not enough to meet the criteria set out by the moderate or high category.

MET values were calculated using a formulae recommended by the IPAQ committee, dependant on the intensity of physical activity (Craig et al, 2003; IPAQ research committee, 2005). The computation of MET-minutes per week was achieved using the following formulae:

- Walking MET-minutes/week = 3.3 * walking minutes * walking days
- Moderate MET-minutes/week = 4.0 * moderate-intensity activity minutes * moderate days
- Vigorous MET-minutes/week = 8.0 * vigorous-intensity activity minutes * vigorous-intensity days

Total physical activity MET-minutes per week equalled the sum of the walking, moderate and vigorous MET minute per week scores (Ainsworth et al, 2000; IPAQ research committee, 2005).

BMI was calculated using participant's height and weight. The formula used was weight in kilograms divided by height in metres squared (WHO, 2018). BMI was categorised into four groups: underweight (below 18.5kg/m^2), healthy weight (18.5-24.9kg/m^2), overweight (25-29.9kg/m^2) or obese (greater than 30kg/m^2) based on the World Health Organisation classifications (WHO, 2018). Age was categorised into seven groups: 18 to 21 years, 22 to 25 years, 26 to 29 years, 30 to 33 years, 34 to 37 years, 38 to 41 years or 42 to 45 years. Occupation was categorised into seven groups: Employed full time (40 or more hours a week), employed part time (up to 39 hours per week), unemployed and currently looking for work, unemployed and not currently looking for work, student, self-employed or other.

4.7.4 Analysis of the primary objectives

- Determining construct validity (hypothesis testing) through observation of increased pain-related fear as measured by existing instruments in less active groups compared with more active.

For each questionnaire, there was a comparison of overall mean or median scores between the groups of participants with high, medium and low levels of physical activity using an analysis of variance (ANOVA) with pairwise testing. The pairwise test was conducted using a post hoc Bonferroni test to identify the statistical significance across the different subgroups. Statistical significance was set at $P<0.05$.

- Determining criterion validity through the correlation between the pain-related fear instruments and a previously validated measure of fear avoidance (the Tampa Scale of Kinesiophobia, TSK).

The correlation coefficient (Pearson's *r*) and 95% CI lower limit was calculated to determine the strength of the relationships between the comparable dimensions of the PASS-20, PDI and NRS with the criterion TSK instrument. The fear and avoidance factor dimensions of the TSK and PASS-20 instruments were also analysed. The level of acceptability was a correlation above 0.4 but with the lower limit of the 95% confidence interval being no less than 0.3 (De Vet et al, 2011).

4.7.5 Analysis of the secondary objectives

- Exploring whether a combination of instruments/instrument subscales/instrument items improves the construct and criterion validity of an instrument for measuring pain-related fear.

Inter item correlations were analysed between the sub dimensions of each instrument by estimating Pearson's correlation for each item as they compared to another. It was expected that items within one dimension would correlate between 0.3 and 0.5 to indicate that they measure the same construct. Inter item correlations that exceeded 0.7 would indicate similar scoring and perhaps an identical measurement. In this instance, one or both of the items may be considered for deletion because they attain the same response.

Item total correlations were analysed to determine whether the items discriminated between participants with higher pain-related fear scores and those with lower levels. Items that correlated with total scores for the instruments (PASS-20 and TSK) of less than 0.3 were considered for deletion because they did not contribute much to distinguishing participants with different severity of the measures (De Vet et al, 2011). Additional analysis was employed to calculate Cronbach's alpha scores to evaluate the internal consistency. Cronbach's alpha scores of 0.70 to 0.90 were accepted. Instrument Items were considered for deletion if the internal consistency could be improved by doing so.

Factor analysis was conducted to investigate the variable relationships between the factors and if they were associated with the construct of pain-related fear (Byrne, 2009). Initially, exploratory factor analysis was employed to identify if the 28 total items among the PASS-20, PDI and NRS instruments interrelate to create a construct (Bryne, 2009). The three instruments measured a combined total of 6 construct factors (Lundberg et al, 2011; Waddell et al, 1993). Confirmatory factor analysis was employed to test the model fit of the six factors against other models to determine the best fitting model. This process was beneficial because it helps to eliminate variables that were not associated with others and reduce items that produced overlapping responses, which provides a more efficient instrument (Krabbe, 2017). Initially, factors were only retained if they produce an eigenvalue greater than 1. Following this, factors were considered by how much they contribute when each additional factor dimension was added.

The comparative fit index (CFI), the goodness of fit statistic (GFI), the adjusted goodness of fit index (AGFI) and the root means square error of approximation (RMSEA) were used to evaluate the fit of the models following factor analysis (Hu and Bentler, 1999; De vet et al, 2011). The comparative fit Index assesses the fit of the model by comparing it to a hypothesized model, while adjusting for sample size (Bentler, 1990). Assuming that all variables are uncorrelated, the equation compares the X^2 value of the existing model to the X^2 value of a hypotheses model that represents the worst-case scenario (Hooper, Coughlan and Fau, 2008; Bentler, 1990). This has advantages over other structural equation modelling indices in that it can account for smaller sample sizes (Tabachnick and Fidell, 2007). The GFI calculates the proportion of variance that is accounted for by the population covariance, and how closely it replicates the covariance matrix (Hooper, Coughlan and Fau, 2008; Tabachnick and Fidell, 2007). The AGFI corrects the GFI dependant on the number of indicators in each variable (Baumgartner and Hombur, 1996). The RMSEA indicates how well a model, with unknown but optimally chosen parameters fits with the sample (Bryne, 2009; Hooper, Coughlan and Fau, 2008).

The new instrument was validated using the known group's hypothesis and with correlations between the new instruments and the previously validated measures including the PASS-20, PDI and NRS:

4.7.6 Sample size

The total sample size for the study was determined by examining the sample size requirements of the study objectives. Recommendations for establishing criterion validity rely upon a correlation coefficient of at least 0.3 (De Vet et al, 2011). This study aimed for a correlation coefficient of 0.3 and so the sample size was predicted on 0.4 with a lower confidence interval of at least 0.3. It was calculated that a sample size of at least 220 was needed to be sure that the lower limit of a confidence interval was at least 0.3 with 95% confidence (CI).

Known group hypothesis testing is dependent on demonstrating an important statistically significant difference between groups, in the case of this study, pain-related fear scores across three activity groups (high, medium and low). To establish statically significance with sufficient power, De Vet e al, (2011) suggests that a minimum of 50 participants per group is needed. Pain-related fear scores have largely been attained from chronic pain sufferers (Vincent et al, 2014). However, there is some data that outlines scores for the general population who have not suffered with chronic pain (Beemster et al, 2018; Mewes et al, 2009). PASS-20 scores from two studies indicate that the mean score from clinical chronic pain sufferers was 38.62 (SD, 20.38) compared to 24.04 (SD, 13.45) for a general population who were not suffering pain (Abrams et al, 2007; McCracken and Dhingra, 2002).

A calculation for sample size was carried out on the assumption that mean PASS-20 scores would be 24.04 (SD, 13.45) for those with little to no pain-related fear, and 31.04 for those with higher levels of pain-related fear. The score of higher levels of pain-related fear were lowered from 38.62 to 31.04 because it was not expected that the younger population would record differences as high as older aged chronic pain sufferers. This is because increasing age is strongly associated with greater experiences of pain and fear (Vincent et al, 2011). The sample size to detect a mean difference of 7 points with statistical significance of less than 0.05 (two sided) and a power of at least 80% suggested that a minimum of 51 participants in each group were needed to show a pairwise differences between the three subgroups (high, medium and low physical activity levels).

Sample size recommendations for exploratory and confirmatory factor analysis are a minimum of 4 to 10 participants per item (De Vet et al, 2011). This study was designed to test factor models based upon the PASS-20, NRS and PDI that equated to 28 items.

Working on the assumption of 8 participants per item, the number of participants completing the questionnaires required was 224.

As 224 was the largest sample size estimate required to meet objectives, it was set for the whole study. To account for a potential loss of data due to missing values, the sample size was inflated by a further 5% and the number needed to recruit was estimated to be 235.

4.8 Data input, cleaning and editing

4.8.1 Data input

The participant data was inputted into SPSS (IBM SPSS statistics version 25) within 6 weeks of data collection. The SPSS spreadsheet listed the variables in column order that they appeared on the master copy of the questionnaire pack (version 1, seen in appendix P). Two additional variable columns were computed (using SPSS compute variable function) that represented BMI as a numerical figure and the corresponding BMI categorisation according to the World Health Organisation (Seen in appendix P). These were calculated using participant's height and weight data. Additional variable columns were computed that displayed the subscale scores, total scores and mean scores of the five-measurement instrument (PASS-20, TSK, PDI, NRS, and IPAQ-L7S). A further variable column identified participant's levels of physical activity (low, moderate and high) which were computed from the IPAQ-L7S score data. During data input, missing data was provided with different codes dependant on if the values were legitimate or illegitimate. Legitimate missing data was classified as an absence of data when it was appropriate for there to be an absence, i.e., left blank if a participant were directed to skip to a follow up question because of an earlier response (Osborne, 2013). Illegitimate missing data was classified as blank items when the researcher expected to receive a response, or during instances when a participant failed to complete the questionnaire pack (Osborne, 2013). A code of 99.0 was given to illegitimate missing data and a value of 88.00 was given to legitimate missing data. Also, a code of 100.0 was given to legitimate missing values of item responses of 'don't know/ not sure'. This was appropriate because the IPAQ-L7S gave participants an opportunity to answer 'don't know/ not sure' to several items.

4.8.2 Data cleaning

Data cleaning was employed to identify input errors amongst the data set and minimise their impact on the results (Osborne, 2013). The data was screened for missing data, outliers and strange patterns of data that may have been caused by miscalculation or typing errors (Van den Broeck et al, 2005). Initially, the SPSS spreadsheet was browsed visually, and printouts were made to inspect the variables. The descriptive analysis tools in SPSS were then used to explore the range, minimums and maximums to identify if the data corresponded with the Likert scale scoring of the individual measurement instruments. Box plots and histograms were created to graphically represent the data and to determine whether the variables were normally distributed and if there were any outliers (Osborne, 2013). The frequency function in SPSS was also used to identify if any participants and their data had been duplicated in error. Mean data from each instrument was computed in separate columns (for each participant) to help identify values that were incorrectly entered, entered in the wrong field, or were outside of the expected range. This assisted with identifying any blank missing data and logically impossible scores that may have been overlooked during the data input phase.

4.8.3 Data verification

The data verification process was based on procedures set out by Houston et al, (2015) to improve quality and accuracy. Data was verified by conducting a 100% manual check on a random 10% sample of participant questionnaires (23 participants) against the electronic records (Osborne, 2013). An acceptable data entry error rate is suggested at anything less than 3% (Houston et al, 2015; Mealer et al, 2013). If the initial sample produced an error rate greater than 3%, a full manual screen of all questionnaires against the electronic records would have been performed.

The 10% sample were selected randomly by splitting participants into 23 equal groups (group 1= participant ID's 1-10, group 2= participant ID's 11-20, group 3= participant ID's 21-30 etc.). One participant was randomly selected from each group. The 'compute variable' function in SPSS was used to create the random set of numbers between the participants ID ranges within each group. The reason for this method was because participant's' data was entered into SPSS during five input sessions and it may be possible that an increased number of errors may have been made towards the end of each data input sessions. It was thought that a random number generation of the total sample may have produced participant IDs that were bunched together or did not include

IDs entered at later points of the data input sessions. It was hoped that this method could have increase the chance that a more accurate error rate would be estimated (Houston et al, 2015).

After 10% of the sample had been checked for accuracy (23 participants), 18 input errors were found from a total of 1334 items, an error rate of 1.3%. The error rate within each individual measurement instrument did not exceed the accepted threshold of 3%, with the exception of the IPAQ-L7S (3.1%) (De Vet et al, 2011). Due to the higher percentage of errors with the IPAQ-L7S, all participant IPAQ instrument data were checked for accuracy. The error rate for the IPAQ-L7S instrument was 1.9% (33/1652). These errors were likely due to miscalculations and mistypes during data input. All errors were corrected, and the verification sample data was re-checked to ensure no input errors remained. The low error rate meant that other procedures such as double data entry were not necessary (Houston et al, 2015).

4.8.4 Missing values

There was a total of 54 illegitimate missing values identified within the dataset (seen in table 4.1). These missing values were checked against the questionnaires to verify that they were not a result of error during data input. The SPSS spreadsheet was checked manually to identify if any patterns were apparent. The missing value analysis function on SPSS was also used to identify if any of the items had a missingness percentage over 3%. The IPAQ-L7S had the highest total of illegitimate missing values with 18 but totalled just 1.08% of responses within the item variables. Because the missing values did not exceed more than 3% in any one item variable throughout the data set, it could be assumed that the missingness was completely at random (Osborne, 2013).

Table 4.1. Illegitimate Missing Data sources

Questionnaire/ Subscale/ item	**Frequency of missing data**	**Percentage of variable**
Weight	2	0.84%
PASS -20		
• Cognitive subscale	1	0.08%
• Avoidance subscale	3	0.2%
• Fear subscale	5	0.4%
• Anxiety subscale	5	0.4%
TSK		
• Avoidance subscale	2	0.1%
• Somatic subscale	1	0.08%
• Reversed questions	13	1.4%
NRS	4	1.7%
IPAQ		
• Activity levels questions	13	0.9%
• IPAQ sitting question	5	2.1%

There was a total of 278 legitimate missing values, of which 180 items that were left blank because the instrument instructed them to do so based on other item responses. Of the 278 missing values, 98 represented don't know/ not sure responses. Among the total sample, legitimate missing values totalled 16.8% of the IPAQ-L7S item variables. The highest frequency of 'don't know/ not sure' responses (46/98) were identified within the IPAQ-L7S seventh item that asked participants about their daily number of hours spent sitting. The 'don't know/ not sure' response totalled 19.4% of the IPAQ-L7S seventh item. As this item was not needed to calculate (for categorisation) participants' activity levels or to meet key objectives, it did not have any impact on the study.

SPSS was used to analyse the pattern of illegitimate missing data to establish if further investigation was needed to diagnose missingness. Missing value analysis did not reveal substantial monotonicity (see figure 4.3). This meant that the missing values chart did not reveal a common variable pattern of missing data (Osborne, 2008). However, several items within the IPAQ-L7S did have high percentages of missingness that warranted further investigation.

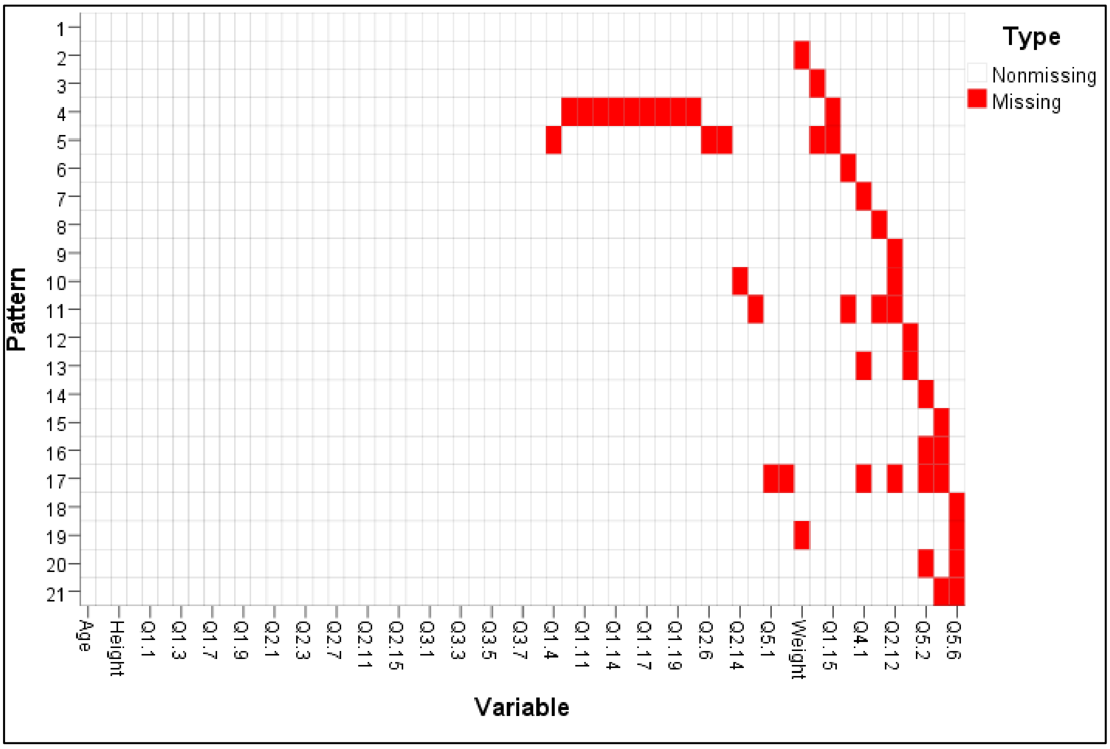


Figure 4.3. Missing value analysis

4.8.4.1 Missing values relating to the IPAQ-L7S items one to six

Several missing items within the IPAQ-L7S were problematic for the study objectives because they prevented participants from being accurately classified into either low, moderate or high activity groups. These missing values were largely ‘don’t know/ not sure’ responses that were identified in the second, fourth and sixth items that asked participants to estimate how many hours/ minutes they engaged in a specific intensity of activity. As physical activity status was important to a key objective of the study, it was necessary to further investigate the missingness of this data.

4.8.4.2 Frequency and characteristics of participants with missing values relating to the IPAQ-L7S items one to six

There was a total of 44 (18.6%) participants with missing IPAQ-L7S data. Using the SPSS missing values function, age (specifically under 30 years of age) was identified as a characteristic that may have impacted on missing value frequency. For this reason, participant characteristics were compared to determine if there were any statistically significant differences in instrument scores between those who had missing data and those who did not.

4.8.4.3 Likelihood-based analysis of incomplete data- a comparison between participants with missing data in the IPAQ-L7S and those without missing data.

SPSS was employed to compare demographic, anthropometric characteristics and mean instrument scores of participants with and without missing data (in items one to six of the IPAQ-L7S) (seen in table 4.2). Descriptive statistics were used to compare the categorical variables (age, gender and occupation). A comparison of means and one-way ANOVA tests identified any significant differences between BMI and instrument scores.

Table 4.2. Comparison of participant characteristics between observations with and without missing IPAQ-L7S data

	Category	**Participants without any missing data N=192 (81 %)**	**Participants with missing data N = 44 (19%)**	**df**	**F**	**Statistical significance P (between groups)**
Age	18 to 21 years 22 to 25 years 26 to 29 years 30 to 33 years 34 to 37 years 38 to 41 years 42 to 45 years	97 (51) 35 (18) 20 (10) 7 (4) 14 (7) 13 (7) 6 (3)	34 (77) 5 (11) 0 2 (5) 1 (2) 2 (5) 0	6	1.258	0.278
Gender	Male Female	58 (30) 134 (70)	10 (23) 34 (77)	1	0.171	0.679
Body Mass Index	Underweight Healthy weight Overweight Obese	6 (3) 73 (38) 56 (29) 57 (30)	2 (5) 20 (45) 15 (34) 7 (16)	3	5.280	0.067
Occupation	Employed full time (40 or more hours a week) Employed part time (up to 39 hours per week) Unemployed and currently looking for work Unemployed and not currently looking for work Student Self employed Other	18 (9) 52 (27) 4 (2) 4 (2) 112 (58) 2 (1) 0	1 (2) 10 (23) 1 (2) 1 (2) 30 (68) 0 1 (2)	6	1.670	0.129

*df= Degrees of freedom, F= F-test statistic.

From initial analysis, although there was difference in participant characteristics between those that had missing IPAQ-L7S data and those that did not, in that the former were largely younger in age, this was not statistically significant (F= 1.258, P= 0.278). Further analysis revealed that there were no statistically significant differences in participant characteristics between those with or without missing IPAQ data (see table 4.2 and 4.3).

Table 4.3 Comparison of mean instrument scores of those with missing IPAQ-L7S data and those without missing data

	Mean PASS-20 score	Mean TSK score	Mean PDI score	Mean NRS score
44 participants with missing IPAQ-L7S data	38.3 (SD= 15.94)	34.9 (SD=5.64)	8.5 (SD=14.04)	2.1 (SD=2.06)
192 Participants without missing data in the IPAQ-L7S	39.1 (SD=18.50)	35.9 (SD=7.026)	10.1 (SD=13.14)	2.4 (SD= 2.41)
Statistical significance of the difference between groups	P= 0.798	P= 0.371	P= 0.457	P= 0.458
df	1	1	1	1
F	0.660	0.803	0.554	0.551

* SD= standard deviation, df= degrees of freedom, F= test stat.

In summary, the weight of evidence from the statistical analysis indicates that the missingness of IPAQ-L7S data was likely missing at random (MAR). This meant that imputation of missing values could be performed using a regression method (Osborne, 2009).

4.8.5 Investigating multicollinearity issues to determine variables for regression method of missing value imputation

Analysis was conducted to investigate multicollinearity which can be identified if the variables used to predict imputations are correlated. This is important as they could consequently provide redundant information within the regression modelling used to impute missing values (Hair et al, 2010). Multicollinearity was measured by variance inflation factors (VIF) and tolerance (cut off point for VIF greater than 4.0, or tolerance of below 0.2) (Hair et al, 2010). Regression analysis between the two groups did not identify any multicollinearity among participant characteristics (seen in table 4.4). This data suggests that participant characteristics were not correlated and could be used as reliable and stable predictor variables without impacting on the estimates of regression coefficients (Allison, 2001; 2006).

Table 4.4 Collinearity diagnostic of participant characterises through linear regression

Dependant variable	Group	Variable	Tolerance	VIF
Age	Participants without missing IPAQ-L7S data	Gender	.977	1.023
		BMI	.971	1.030
		Occupation	.961	1.040
	Participants with IPAQ-L7S data	Gender	.775	1.290
		BMI	.732	1.365
		Occupation	.932	1.073
Gender	Participants without missing IPAQ-L7S data	BMI	.916	1.091
		Occupation	.887	1.127
		Age	.833	1.200
	Participants with IPAQ-L7S data	BMI	.944	1.059
		Occupation	.936	1.068
		Age	.991	1.009
BMI	Participants without missing IPAQ-L7S data	Occupation	.868	1.152
		Age	.877	1.141
		Gender	.970	1.031
	Participants with IPAQ-L7S data	Occupation	.992	1.009
		Age	.960	1.042
		Gender	.968	1.033
Occupation	Participants without missing IPAQ-L7S data	Age	.916	1.091
		Gender	.992	1.008
		BMI	.917	1.091
	Participants with IPAQ-L7S data	Age	.957	1.045
		Gender	.752	1.330
		BMI	.777	1.287

*BMI= Body Mass Index, VIF= variance inflation factors

4.8.6 Imputation of missing IPAQ-L7S items one to six values using the regression method

Several methods of imputation were considered, but a regression (multiple imputation) method was chosen because other variables were available that could be used as reliable predictors (De Vet et al, 2011). The regression method (sometimes termed strong imputation) is stated to estimate values for missing cases much more accurately than other imputation methods such as single value or assumption (Osborne, 2013). The imputed values were obtained by regressing missing values on variables of age, gender, BMI, occupation, PASS-20 scores, PDI scores, NRS scores and other IPAQ-L7S scores (seen in table 4.5). This method has its advantages in that it preserves relationships among other variables involved in the imputation modelling (Sterne et al, 2009; De Vet et al, 2011). The missing value imputation function in SPSS was employed to carry out 50 cycles of imputation. Once complete, the 50 dataset imputations were pooled, and the mean value calculated. This value was used as the final imputation into the dataset (seen in appendix Q).

Table 4.5 Imputation regression method of the missing IPAQ-L7S values

	Model		Missing Values	Imputed Values
	Type	Effects		
IPAQ data item 1	Linear Regression	Age, Gender, BMI, Occupation, PASS-20 scores, PDI scores, NRS scores, IPAQ items 2,3,4,5,6	1	5
IPAQ data item 3	Linear Regression	Age, Gender, BMI, Occupation, PASS-20 scores, PDI scores, NRS scores, IPAQ items 1,2,4,5,6	1	5
IPAQ data item 2	Linear Regression	Age, Gender, BMI, Occupation, PASS-20 scores, PDI scores, NRS scores, IPAQ items 1,3,4,5,6	9	45
IPAQ data item 4	Linear Regression	Age, Gender, BMI, Occupation, PASS-20 scores, PDI scores, NRS scores, IPAQ items 1,2,3,5,6	23	115
IPAQ data item 6	Linear Regression	Age, Gender, BMI, Occupation, PASS-20 scores, PDI scores, NRS scores, IPAQ items 1,2,3,4,5	28	140

*BMI= Body Mass Index

Following imputation using the regression method, participants were grouped into low, moderate or high activity groups using the IPAQ scoring protocol (IPAQ research committee, 2005). Eighteen participants were categorised in the low activity group, 11 in the moderate activity group and 15 in the high activity group. Figure 4.4 and 4.5 indicate that the distribution of participant physical activity levels (low, moderate, and high groups) was comparable following multiple imputation using the regression method.

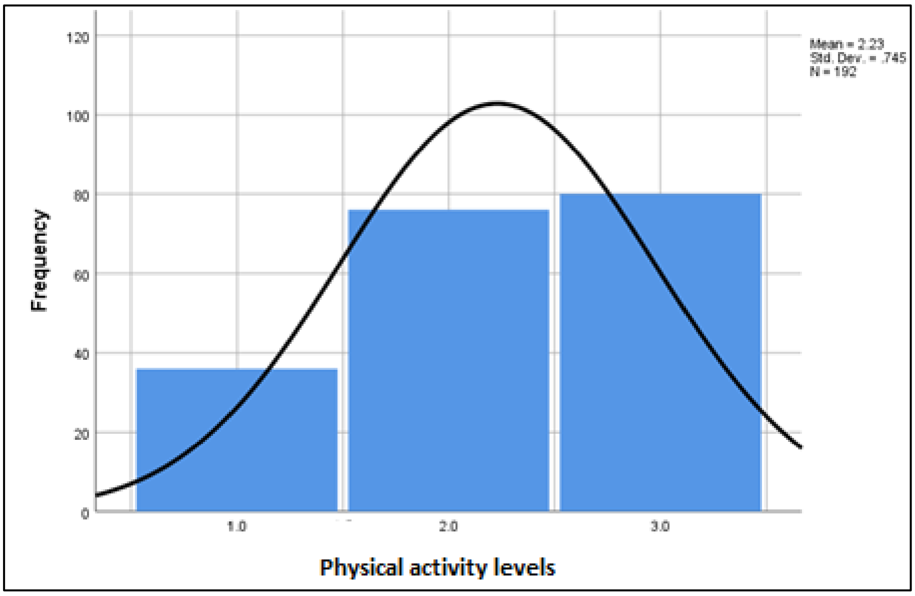


Figure 4.4. Distribution of participant physical activity levels (low, moderate, high groups) within participants with no missing data prior to imputation (n= 192). *Y Axis- 1= Low, 2= Moderate, 3= High activity levels.

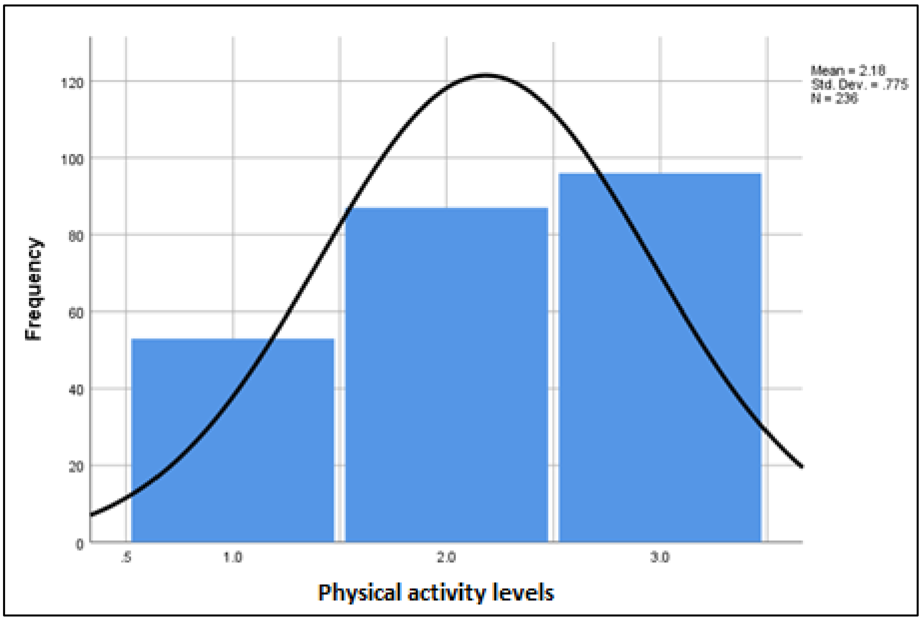


Figure 4.5. Distribution of participant physical activity levels (low, moderate, high groups) within participants following imputation using the regression method (n= 236). *Y Axis- 1= Low, 2= Moderate, 3= High activity levels.

4.8.7 Imputation of missing IPAQ-L7S items one to six values using the mean substitution method

The mean substitution and case deletion methods were also used to estimate missing values to determine what impact it would have on the missing data. This can be seen in appendix R. Comparisons between the two methods suggest that the regression method was superior because it resulted in a greater percentage of the missing data group being categorised in higher activity group. This likely reflected the truer activity levels of those with missing IPAQ-L7S data. These comparisons are shown in appendix S. Therefore, the values generated by the regression method were used in further analysis of the dataset.

4.8.8 Mean substitution method of imputation for missing values relating to pain-related fear instruments

After careful consideration it was decided that missing values in the remaining instruments would be substituted with mean instrument dimension scores (Osborne, 2013). The justification for imputing the sub dimension means over regression imputations was because it is said that subscale responses are often highly correlated, and more reliable than regressed imputations when other subscale scores are available (Osborne, 2013; Schafer and Graham, 2002). This method is only preferred when several items measure a single construct factor, and the missing values can be substituted using information from other sub dimension responses (Osborne, 2013). In this study, an example of this would be that a missing value within the first five items of the PASS-20 would be identified as part of the instruments 'cognitive' subscale, and that the mean score of available items within the 'cognitive' subscale would be used to impute the missing value.

4.8.9 Data editing- regression method of imputation for missing values relating to anthropometrical data

The two missing values relating to the anthropometric data were imputed using the regression method similar to the process performed on IPAQ-L7S data. Predicted values were obtained by regressing missing variables on age, gender, height, occupation, PASS-20 scores, PDI scores, NRS scores and IPAQ-L7S scores. (Osborne, 2013). The imputed values were determined by conducting fifty cycles of imputation (using SPSS), and imputing the pooled mean value. Figure 4.6 and 4.7 indicate that the distribution of participant BMI (underweight, healthy weight, overweight and obese) was comparable following multiple imputation using the regression method.

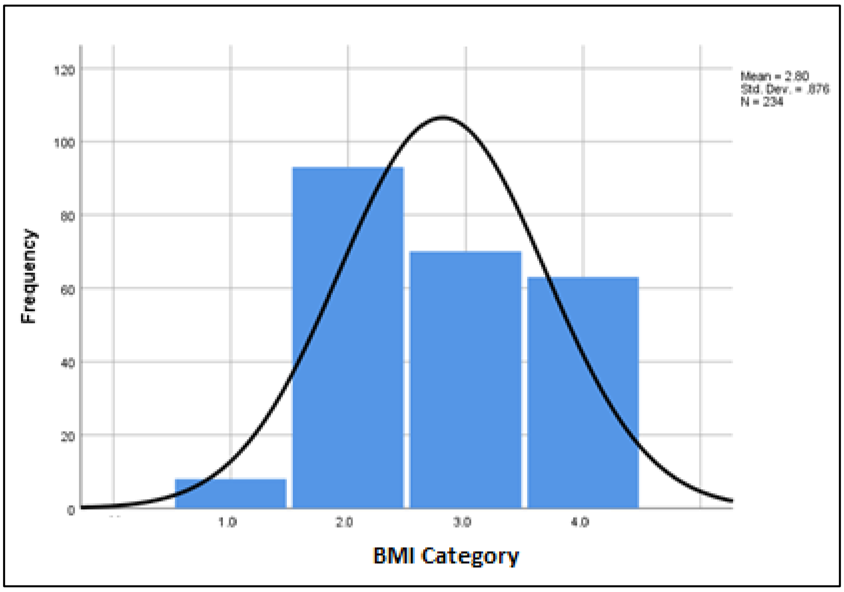


Figure 4.6. Distribution of BMI (Underweight, healthy weight, overweight, obese) within participants with no missing data, prior to imputation (n= 234). *Y Axis- 1= underweight, 2= healthy weight, 3= overweight, 4= obese.

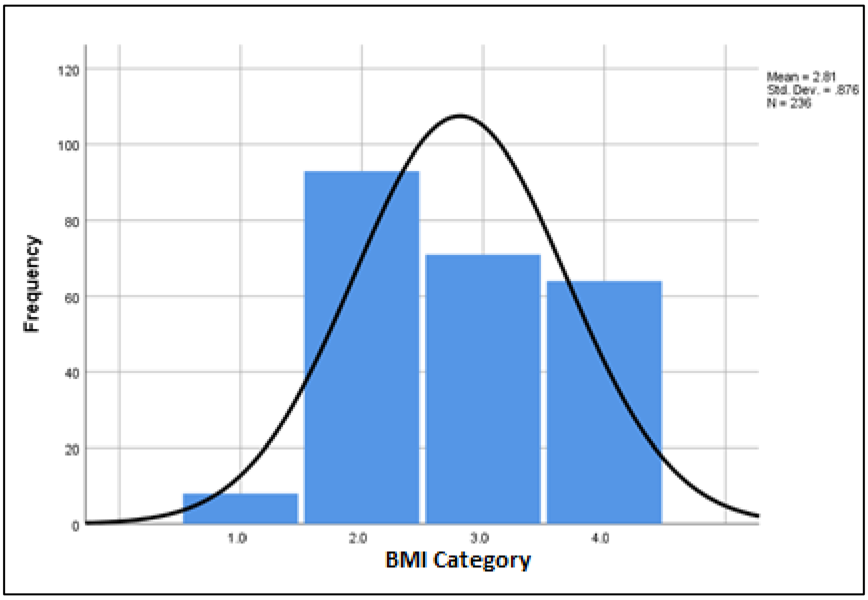


Figure 4.7. Distribution of BMI (Underweight, healthy weight, overweight, obese) within participants following multiple imputation using the regression method (n= 236). *Y Axis- 1= underweight, 2= healthy weight, 3= overweight, 4= obese.

4.9 Results

4.9.1 Participant characteristics

A total of 236 responses were received. Table 4.6 shows the distribution of the participant characteristics before and after imputation. As discussed previously (section 4.8.4), imputation mainly affected the proportion of participants in different physical activity groups (table 4.6). The imputed data is used in all remaining analyses.

Of the participants, 142 (61%) were from the student body. Participants were largely under 30 years old (n= 191, 81%) and female (n=168, 71%). Participants BMI ranged from 16.2 to 42.4 kg/m^2, with a sample mean of 26.6kg/m^2 (SD 5.58; 95% CI 25.8 to 27.3); 93 participants (39%) were healthy weight, 71 (30%) overweight and 64 were obese (27%). There were only eight (3%) participants who were underweight. Only 53 participants (22%) had low levels of activity.

Table 4.6. Characteristics of the 236 participants

		Before imputation		**Following imputation**	
	Category	**n**	**(%)**	**n**	**(%)**
Age	18 to 21 years	131	(55)	131	(55)
	22 to 25 years	40	(17)	40	(17)
	26 to 29 years	20	(9)	20	(9)
	30 to 33 years	9	(4)	9	(4)
	34 to 37 years	15	(6)	15	(6)
	38 to 41 years	15	(6)	15	(6)
	42 to 45 years	6	(3)	6	(3)
Gender	Male	68	(29)	68	(29)
	Female	168	(71)	168	(71)
BMI	Underweight	8	(3)	8	(3)
	Healthy weight	93	(41)	93	(40)
	Overweight	70	(30)	71	(30)
	Obese	63	(26)	64	(27)
Occupation	Employed full time	19	(8)	19	(8)
	Employed part time	62	(26)	62	(26)
	Unemployed, looking for work	5	(2)	5	(2)
	Unemployed, not looking for work	5	(2)	5	(2)
	Student	142	(61)	142	(61)
	Self employed	2	(1)	2	(1)
	Other	1	(1)	1	(1)
Physical activity levels	Low	35	(18)	53	(22)
	Moderate	76	(40)	87	(37)
	High	81	(42)	96	(41)

*BMI= Body Mass Index, SD= Standard Deviation

4.9.1.1 Cross tabulation of BMI and physical activity levels

A cross tabulation of BMI and activity levels showed that the obese group reported the highest number of participants who engaged in low levels of activity. The results also showed that the obese group had the fewest participants who engaged in high levels of physical activity (seen in table 4.7). However, a Chi Squared test showed that the two variables were not significantly associated (P= 0.05, df= 6, a= 12.604).

Table 4.7. Cross tabulation of BMI and physical activity levels.

BMI/ Activity levels	**Low** **N (%)**	**Moderate** **N (%)**	**High** **N (%)**	Total n (%)
Underweight n (percentage of group)	4 (50%)	1 (12.5%)	3 (37.5%)	8
Healthy weight n (percentage of group)	16 (17.2%)	35 (37.6%)	42 (45.1%)	93
Overweight n (percentage of group)	14 (19.7%)	23 (32.9%)	34 (47.8%)	71
Obese n (percentage of group)	19 (26.7%)	28 (39.4%)	17 (23.9%)	64
Total N (%)	53 (100%)	87 (100%)	96 (100%)	236

*BMI= Body Mass Index

4.9.2 Objective 1 - Determining the construct validity of existing instruments

The following section will determine construct validity (hypothesis testing) through observation of increased pain-related fear as measured by existing instruments in less active groups compared with more active groups.

4.9.2.1 Pain-related fear- PASS-20 scores

PASS-20 scores ranged from 2 to 86 with a median of 39. The mean PASS-20 score of the sample was 38.9 (SD 18.02, 95% CI 36.7 to 41.3) (table 4.8).

Table 4.8. Mean pain anxiety symptom scores (PASS-20) in adults aged 18 to 45 years.

	PASS-20 scores
Mean	38.9
95% CI: Upper Lower	41.28 36.66
Standard Deviation	18.02
Median	39.0
Minimum	2
Maximum	86
Missing	14
Total participants	236

4.9.2.2 Severity of pain-related fear (PASS-20) distributed among each activity group

The data indicated that there was a linear trend in severe pain-related fear in the low activity group and mild pain-related fears in the high activity groups. There was notable low frequency of participants whose scores reached the threshold of severe pain-related fear. A Chi Squared test confirmed that the two variables were significantly associated (P=0.02, df= 4, a= 16.992). This can be seen in table 4.9.

Table 4.9. Severity of pain-related fear among activity groups.

	Severity			
Activity levels	Mild (0 – 34)	Moderate (35 – 67)	Severe (68 – 100)	Total
Low	13 (25%)	34 (64%)	6 (11%)	53 (100%)
Moderate	31 (36%)	47 (54%)	9 (10%)	87 (100%)
High	52 (54%)	42 (44%)	2 (2%)	96 (100%)
Total	96	123	17	236

4.9.2.3 Comparison of PASS-20 scores with levels of physical activity.

Participants mean PASS-20 scores were calculated for each of the three activity groups. The low activity group had the highest mean score of the three groups with 45.2 (SD 16.86). There was a linear trend with lowest PASS scores in the high activity group and highest in the low activity group. The differences were statistically significant (F = 11.1, p=0.01) (seen in table 4.10).

Table 4.10. Mean PASS-20 scores in low, moderate and high physical activity groups

Physical activity levels	**Low**	**Moderate**	**High**	**Total**	**Between groups**
n	53	87	96	236	
Mean	45.2	40.0	34.1	38.9	
SD	16.86	17.98	17.58	18.02	
Median	45.0	39.5	32.5	29.0	
Statistical significance (ANOVA)					0.001
df					2
F					7.115

* SD= Standard Deviation, ANOVA= Analysis Of Variance

Bonferroni tests established that not all mean differences in the scoring were statistically significant between groups. For example, the mean difference of 11.1 was statistically significant between high and low activity groups (P= 0.001) but the mean difference of 5.1 between the low and moderate groups (P= 0.265) was not statistically significant. Similarly, mean difference in scores were not statistically significant between moderate to high activity groups (P=0.069). This can be seen in table 4.11.

Table 4.11. Statistical significance of mean PASS-20 score differences between each combination of activity group.

Statistical tests	Activity levels (I)	Activity levels (J)	Mean difference (I-J)	Std. Error	Significance (P value)	95% CI (Lower bound)	95% CI (Upper bound)
Bonferroni	Low	Moderate	5.1	3.014	.265	-2.11	12.42
	Moderate	High	5.9	2.606	.069	-.32	12.25
	High	Low	11.1	3.026	.001*	3.83	18.42

*Mean difference significance at 0.05.

4.9.2.4 Comparison of PASS-20 Subscale scores among low, moderate and high physical activity groups.

Three subscale dimensions (cognitive, avoidance/escape and fear) showed higher mean scores in the less active group compared with the more active groups. The fourth subscale dimension of physiological anxiety showed higher mean scores from the moderate activity group compared to the low activity group and high activity group (seen in table 4.12). An analysis of variance (ANOVA) test showed that the cognitive, avoidance/ escape and fear subscale scores were statistically significant between the low, moderate and high activity groups (P= 0.002, P= 0.0001 and P= 0.02 respectively). However, the physiological anxiety subscales showed no statistically significant between the scores of the different activity groups (P=0.065).

Table 4.12. Mean PASS-20 subscale scores in low, moderate and high activity groups

PASS-20 mean scores/ Physical activity levels	**Cognitive subscale**	**Avoidance/ escape subscale**	**Fear subscale**	**Physiological anxiety subscale**
Low	14.3 (SD 5.01)	12.3 (SD 5.82)	9.2 (SD 5.26)	8.7 (SD 4.87)
Moderate	12.9 (SD 5.40)	10.5(SD 4.86)	8.3 (SD 5.24)	9.0 (SD 5.57)
High	11.4 (SD 5.49)	8.3 (SD 4.65)	6.9 (SD 5.49)	7.2 (SD 5.54)
Statistical significance P	0.002	0.000	0.029	0.065
df	2	2	2	2
F	5.14	11.36	3.61	2.76

*df= degrees of freedom

4.9.2.5 Disability- PDI scores

PDI scores across the sample ranged from low perceptions of disability scores of 0 to more severe perceptions of disability of 56 (seen in table 4.13). However, it is important to note that the majority had a score of 0, suggesting a floor effect for the PDI instrument in this population. The mean PDI score across the sample was 9.8 (SD 13.29). In this instance, the median was substantially lower than the mean, indicating a positively skewed distribution and because of this the median was used to compare groups (Seen in figure 4.8).

Table 4.13. Disability scores in adults aged 18 to 45 years.

	PDI scores
Mean	9.8
95% CI: Upper Lower	11.55 8.14
Standard Deviation	13.29
Median	3.5
Minimum	0
Maximum	56
Total participants	236

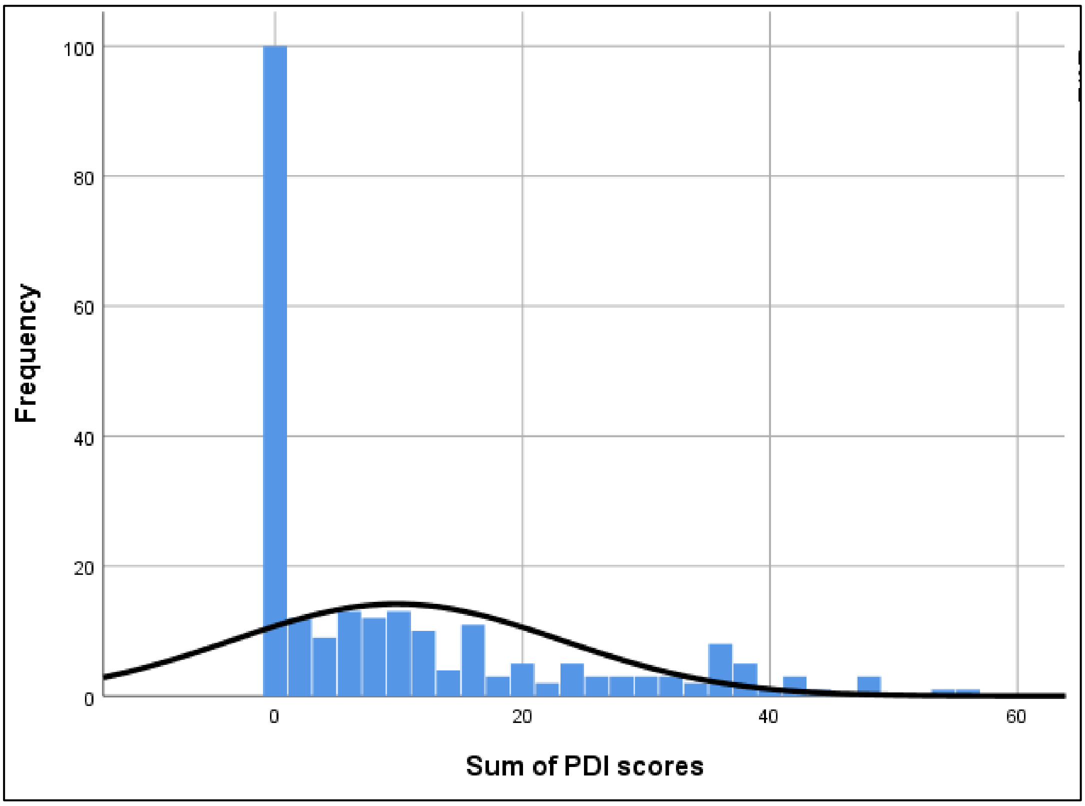


Figure 4.8. Distribution of PDI scores among the sample

4.9.2.6 Severity of disability distributed among each activity group

No trend could be identified from the severity of perceived disability among the activity groups. However, it was noted that the most active participants had the greatest percentage of those reporting mild perceptions of disability (seen in table 7.14). A Chi Squared test confirmed that the two variables were not significantly associated (P= 0.435, df= 4, a= 3.789). Mild severity corresponds to ≤27, moderate corresponds to scores between 28 and 42, and severe corresponds to scores ≥43.

Table 7.14. Severity of perceived disability among activity groups.

	Severity			
Activity levels	Mild (≤27)	Moderate (28 – 42)	Severe (≥43)	Total
Low	44 (83%)	8 (15%)	1 (2%)	53 (100%)
Moderate	71 (82%)	13 (15%)	3 (3%)	87 (100%)
High	87 (91%)	7 (7%)	2 (2%)	96 (100%)
Total	202	28	6	236

4.9.2.7 Comparison of PDI scores with physical activity levels

In this instance because the distribution was skewed within all activity groups, the median reflected the best representation of the central location within the data (seen in figure 4.9). Similar to the PASS-20 and TSK, there was a trend that identified the lowest median values in the high activity group and highest median in the low activity group (seen in table 4.15). Similarly, there were higher proportion of those with a score of 0 in the high activity group. However, there were also higher frequency of those with greater scores within the moderate group.

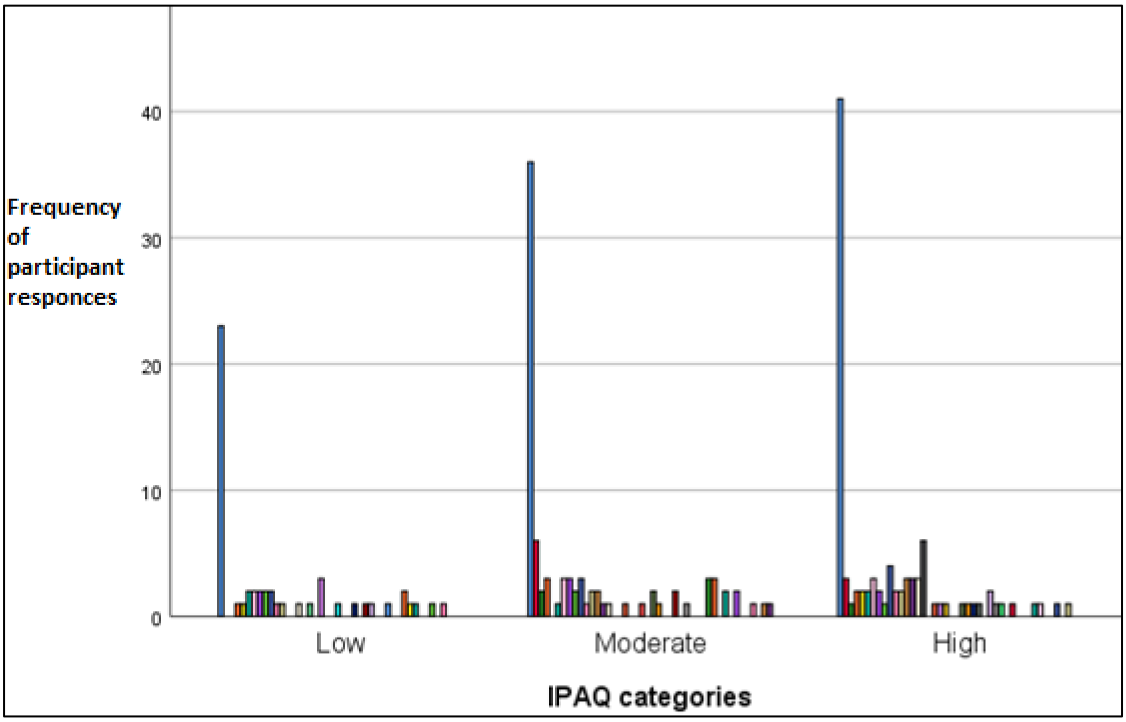


Figure 4.9. Distribution of PDI scores among activity groups

Table 4.15. Median PDI scores in low, moderate and high physical activity groups

Physical activity levels	**Low**	**Moderate**	**High**	**Total**
Frequency	53	87	96	236
Median	5.0	2.0	4.00	3.5
Mean	10.9	10.5	8.4	9.8
SD	14.05	14.82	10.96	13.29

* SD= Standard Deviation, df= degrees of freedom

4.9.2.8 Comparison of PDI Subscale scores among low, moderate and high physical activity groups.

Median scores for the two PDI subscales were calculated for the low, moderate and high activity groups. The discretionary subscale dimension showed a higher median for the low activity group compared with the high activity group (seen in table 4.16). However, the obligatory subscale dimension had identical scores between each activity group. The 0.0 scores in the obligatory subscale was likely due to the floor effect observed in the scoring of the PDI instrument.

Table 4.16. Mean PDI subscale scores in low, moderate and high physical activity groups

PDI median scores/ Physical activity levels	**Discretionary subscale**	**Obligatory subscale**
Low	4.0	0.0
Moderate	2.0	0.0
High	3.5	0.0
df	2	2
F	0.586	0.202

4.9.2.9 Pain- NRS scores

The mean NRS score across the sample was 2.4 (SD 2.35) (table 4.17). This score suggested that on average participants had mild pain (Boonstra et al, 2016). Results from previous literature state that severity cut off points for the NRS are; ≤3 correspond to mild pain, 4–6 correspond to moderate pain and ≥7 correspond to severe pain (Boonstra et al, 2016; Hirschfeld and Zernikow, 2013; Oldenmenger et al, 2013).

Table 4.17. Mean pain scores in adults aged 18 to 45 years.

	NRS scores
Mean	2.4
95% CI: Upper Lower	2.72 2.12
Standard Deviation	2.35
Median	2.0
Minimum	0
Maximum	10
Missing	4
Total participants	236

4.9.2.10 Severity of pain distributed among each activity group

The pain severity across each activity group was largely mild. The data did not indicate a trend between pain severity and levels of activity in younger adults. A Chi Squared test confirmed that the two variables were not significantly associated (P= 0.957, df= 4, a= 0.651) (this can be seen in table 4.18).

Table 4.18. Severity of pain among activity groups.

Severity / activity levels	Mild (≤3)	Moderate (4 – 6)	Severe (≥7)	Total
Low	39 (74%)	10 (19%)	4 (7%)	53 (100%)
Moderate	63 (72%)	18 (21%)	6 (7%)	87 (100%)
High	69 (72%)	22 (23%)	5 (5%)	96 (100%)
Total	171	50	15	236

4.9.2.11 Comparison of NRS scores with physical activity levels

Like other instruments, the low activity group had the highest mean NRS scores with 2.6 (SD 2.49) (seen in table 4.19). There was a linear trend with lowest NRS scores in the high activity group and highest in the low activity group. However, the differences were not statistically significant (F = 3.89, p=0.632).

Table 4.19. Mean NRS scores in low, moderate and high physical activity groups

Physical activity levels	**Low**	**Moderate**	**High**	**Total**	**Between groups**
Frequency	53	87	96	236	
Mean	2.6	2.4	2.2	2.4	
SD	2.49	2.47	2.14	2.35	
Median	2.0	2.0	2.0	2.0	
Statistical significance (ANOVA)					.632
df					2
F					0.136

* SD= Standard Deviation, ANOVA= Analysis Of Variance

A multiple comparison test with NRS scores as the dependent variable, confirmed that there was no statistical significance between the instrument scores and the mean differences in the activity groups. This can be seen in table 4.20.

Table 4.20. Statistical significance of mean NRS scores differences between each combination of activity group.

Statistical tests	Activity levels (I)	Activity levels (J)	Mean difference (I-J)	Std. Error	Significance (P value)	95% CI (Lower bound)	95% CI (Upper bound)
Bonferroni	Low	Moderate	0.2	.404	1.000	-.72	1.23
	Moderate	High	0.1	.349	1.000	-.71	.98
	High	Low	-0.3	.406	1.000	-1.37	.59

*Mean difference significance at 0.05.

4.9.2.12 Objective 1 summary - Comparison of pain-related fear scores as measured by the PASS-20, PDI and NRS instruments in low, moderate and high physical activity groups.

The findings showed a trend of heightened levels of pain-related fear and pain in those engaged in lower activity compared to those engaged in higher activity. However, these differences were only statistically significant in the PASS-20 scores (P= 0.001), but not significant in the PDI or NRS scores (PDI- P= 0.450; NRS- P= 0.632). There were notable issues about the validity of the PDI given the distribution of scores. This was because the floor effect observed in the scoring made it difficult to interpret the instrument. In this case, the study's hypothesis that there will be an observed increase in pain-related fear in less active groups compared with more active groups, is accepted, but only for the PASS- 20.

4.9.3 Objective 2 - Establishing criterion validity

Criterion validity was established using correlation coefficient (*r*) to determine the strength of the relationships between the comparable dimensions of the PASS-20 and the criterion TSK measures (De Vet et al, 2011).

4.9.3.1 Correlations between the PASS-20 and the TSK, including sub dimension.

Criterion validity of the PASS-20 and sub dimensions was investigated by correlating with the TSK instrument and sub dimensions using Pearson's correlation coefficient (*r*). The two sub dimensions from the TSK and four sub dimensions from the PASS-20 were analysed to determine the strength of the association. The correlation of scores between the PASS-20 and TSK instruments showed a moderate strength association, with a lower confidence limit exceeding 0.3 (r= .500, P< 0.00, 95% CI 0.397 to 0.619).

Various strengths of associations were found between the subscale dimensions of the two instruments. The numerically highest association was shown between the PASS avoidance/ escape dimension and the TSK activity avoidance dimension. The correlation was of moderate strength (r= .516, P= 0.00, 95% CI 0.406 to 0.626). Many of the correlations between the sub dimensions of the instruments were greater than 0.4 with the 95% CI lower bound greater than 0.3. These included the PASS-20 cognitive, fear and avoidance sub dimensions that adequately correlated with the activity avoidance subscale of the TSK (seen in table 4.21).

The correlations between the sub dimensions of both scales that had weaker correlations included: the physiological anxiety and cognitive sub dimensions of the PASS-20 with the TSK activity avoidance and somatic focus sub dimensions (r= 0.293 and r= 0.332 and r=0.354).

Table 4.21. Sub dimension correlation and overall correlation between the PASS-20 and TSK instruments

Instrument subscales (Pearson's correlation)	**PASS-20 Cognitive**	**PASS-20 Avoidance**	**PASS-20 Fear**	**PASS-20 Physiological**	*PASS-20 Instrument*
TSK Activity avoidance	*r* = 0.432 (95% CI- 0.315 to 0.548)	*r* = 0.518 (95% CI- 0.406 to 0.626)	*r* = 0.477 (95% CI- 0.363 to 0.590)	*r* = 0.293 (95% CI- 0.170 to 0.416)	
TSK Somatic anxiety	*r* = 0.354 (95% CI- 0.234 to 0.475)	*r* = 0.429 (95% CI- 0.312 to 0.545)	*r* = 0.465 (95% CI- 0.351 to 0.579)	*r* = 0.332 (95% CI- 0.210 to 0.53)	
TSK Instrument					*r* = 0.500 (95% CI 0.397 to 0.619)

**r*= Pearson's correlation value, CI= Confidence interval

4.9.3.2 Correlations between the PDI and the TSK, including sub dimensions

The correlation of scores between the PDI and TSK instruments showed a moderate strength of association (*r*=0.428, P <0.00, 95% CI 0.303 to 0.537). The PDI discretionary subscale dimension was adequately correlated with both subscale dimensions of the TSK (table 4.22). However, the PDI obligatory sub dimension was not (table 4.22).

Table 4.22. Sub dimension correlation and overall correlation between the PDI and TSK instruments

Instrument subscales (Pearson's correlation)	**PDI Discretionary**	**PDI Obligatory**	*PDI Instrument*
TSK Activity avoidance	*r* = 0.451 (95% CI- 0.336 to 0.566)	*r* = 0.317 (95% CI- 0.195 to 0.439)	
TSK Somatic anxiety	*r* = 0.428 (95% CI- 0.312 to 0.544)	*r* = 0.338 (95% CI- 0.216 to 0.459)	
TSK Instrument			*r* = 0.428 (95% CI- 0.303 to 0.537)

**r*= Pearson's correlation value, CI= Confidence Interval

4.9.3.3 Correlations between the NRS and the TSK, including sub dimension.

The correlation of scores between the NRS and TSK identified weaker associations between the construct of each instrument (seen in table 4.23). This was somewhat expected given that the TSK does not include a sub dimension specifically characterised as pain (Miller, Kopri and Todd, 1991).

Table 4.23. Sub dimension correlation and overall correlation between the NRS and TSK instruments

Instrument subscales (Pearson's correlation)	**NRS (unidimensional)**	*NRS Instrument*
TSK Activity avoidance	*r* = 0.334 (95% CI- 0.213 to 0.455)	
TSK Somatic anxiety	*r* = 0.370 (95% CI- 0.251 to 0.490)	
TSK Instrument		*r* = 0.367 (95% CI- 0.247 to 0.487)

**r*= Pearson's correlation value, CI= Confidence Interval

4.9.4 Objective 2 summary – Criterion validity of the PASS-20 instrument compared to the proposed gold standard TSK instrument.

The analysis showed that the PASS-20 instrument was adequately correlated with the criterion TSK instrument (*r*= .508, 95% CI 0.397 to 0.619). The PASS-20 cognitive, fear and avoidance sub dimensions adequately correlated with the activity avoidance subscale of the TSK, meeting the acceptability threshold with correlations above 0.4 with a 95% CI lower bound greater than 0.3. The PASS-20 avoidance/ escape subscale and the TSK activity avoidance dimension held the strongest association (*r*= .518, 95% CI- 0.406 to 0.626). The PDI adequately correlated with the TSK measure (*r* = 0.42, 95% CI- 0.303 to 0.537), however its obligatory sub dimension did not correlate within the thresholds of any TSK sub dimensions (below Pearson's *r* = 0.4). The NRS instrument showed weak correlation with the TSK and did not exceed thresholds above 0.4 for any associations between sub dimensions. These findings highlight that the PASS-20 and PDI both measure similar constructs to the TSK but that the NRS has weaker associations, suggesting that they may not be measuring conceptually similar constructs (De Vet et al, 2011).

4.9.5 Objective 3 – Developing a new measure of pain-related fear

Having established that existing measures individually show adequate but not desirable validity, testing was conducted to see if validity could be improved if the three instruments were combined together (PASS-20, PDI and NRS). The rationale for combining the three existing instruments was because together they encompassed the important construct factors in the conceptual model developed from the qualitative study in section 4.1. In doing so, it was likely that some subscales may overlap, highlighting a redundancy in items when combining the three instruments as a whole. Therefore, a new instrument might reduce the participant burden when completing the instrument.

SPSS was used to establish inter item, item total correlations and Cronbach's Alpha scores. Inter item correlations were analysed within and between the sub dimensions of each instrument. Exploratory and confirmatory factor analyses were used improve the construct validity of the existing instruments when combined to measure pain-related fear in younger adults.

4.9.5.1 Inter item correlation and Cronbach's alpha scores.

Inter item correlations between the different instruments showed weak associations. When items from one instrument were compared to another, inter item correlations ranged between 0.015 and 0.368 and hence did not meet acceptability thresholds of 0.4 (De Vet et al, 2011). However, the inter item correlations had moderate to strong associations when compared within each instrument.

The PASS-20 sub dimensions largely met acceptability thresholds as inter item correlations ranged between 0.3 and 0.7 (De Vet et al, 2011) (seen in table 4.24, 4.25 and 4.26). Analysis of the sub dimensions revealed that there were six items that did not range between 0.3 and 0.7. Inter item correlations between items one and two, and 18 and 19 exceeded 0.7 with items six and eight correlating below 0.3. According to the protocol proposed by De Vet et al (2011), these items could be considered for deletion. However, item deletion was not conducted at this stage but was revisited upon the completion of exploratory and confirmatory factor analysis. This was because the item total correlations showed that all PASS-20 items exceeded 0.4 suggesting that they contribute toward distinguishing participants who have a mild, moderate or severe fear avoidance beliefs (De Vet et al, 2011). The PASS-20 instrument also had strong internal consistency with a Cronbach's Alpha score of 0.931, which could not be improved with item reduction.

Table 4.24. Inter item correlation of PASS-20 cognitive subscale dimension

	PASS-20 item 1	PASS0-20 item 2	PASS-20 item 3	PASS-20 item 4	PASS-20 item 5
PASS-20 item 1	1.000	0.722	0.545	0.613	0.434
PASS-20 item 2	0.722	1.000	0.699	0.680	0.529
PASS-20 item 3	0.545	0.699	1.000	0.695	0.566
PASS-20 item 4	0.613	0.680	0.695	1.000	0.566
PASS-20 item 5	0.434	0.529	0.566	0.566	1.000

Table 4.25. Inter item correlation of PASS-20 physiological anxiety subscale dimension

	PASS-20 item 16	PASS0-20 item 17	PASS-20 item 18	PASS-20 item 19	PASS-20 item 20
PASS-20 item 16	1.000	0.537	0.381	0.397	0.464
PASS-20 item 17	0.537	1.000	0.549	0.482	0.557
PASS-20 item 18	0.381	0.549	1.000	0.719	0.593
PASS-20 item 19	0.397	0.482	0.719	1.000	0.607
PASS-20 item 20	0.464	0.557	0.593	0.607	1.000

Table 4.26. Inter item correlation of PASS-20 fear subscale dimension

	PASS-20 item 6	**PASS0-20 item 7**	**PASS-20 item 8**	**PASS-20 item 9**	**PASS-20 item 10**
PASS-20 item 6	1.000	0.432	0.201	0.343	0.411
PASS-20 item 7	0.432	1.000	0.403	0.543	0.465
PASS-20 item 8	0.201	0.403	1.000	0.461	0.381
PASS-20 item 9	0.343	0.543	0.461	1.000	0.559
PASS-20 item 10	0.411	0.465	0.381	0.559	1.000

The PDI instrument had strong inter item correlations and item total correlations within both its subscale dimensions. Most items correlated with totals that exceeded 0.7 (seen in table 4.27 and 4.28). The strong inter item correlations suggested that several PDI items could be considered for deletion because they were measuring identical construct factors (De Vet et al, 2011). This was a rationale to collapse the two existing sub dimensions of the PDI to form one dimension. This could also be reinforced by observation of the distribution of scores which showed mostly 0's for several of the items between the sub dimensions. The Cronbach's alpha score of the PDI was 0.947. Reliability analysis showed that Cronbach's alpha score could not be improved by deleting any of the items. The NRS is a single item scale so this step was not undertaken.

Table 4.27. Inter item correlation of PDI discretionary subscale dimension

	PDI item 1	**PDI item 2**	**PDI item 3**	**PDI item 4**	**PDI item 5**
PDI item 1	1.000	0.756	0.745	0.722	0.705
PDI item 2	0.756	1.000	0.800	0.803	0.645
PDI item 3	0.745	0.800	1.000	0.768	0.679
PDI item 4	0.722	0.803	0.768	1.000	0.655
PDI item 5	0.705	0.645	0.679	0.655	1.000

Table 4.28. Inter item correlation of PDI obligatory subscale dimension

	PDI item 6	**PDI item 7**
PDI item 6	1.000	0.794
PDI item 7	0.794	1.000

Using SPSS, analysis was employed to identify if item deletion would strengthen the internal consistency when the three instruments were combined (PASS-20, PDI and NRS). The Cronbach's alpha score of the combined instruments was 0.926. The reliability analysis indicated that Cronbach's alpha score could not be improved with item reduction. Because the Alpha could not be improved, all 28 items from the PASS-20, PDI and NRS were retained at this stage. It was decided that item reduction would be conducted using factor analysis because it has been found to increase construct validity compared to solely employing item reduction by Cronbach's alpha values (Keetharuth et al, 2019).

4.9.5.2 Exploratory factor analysis

Exploratory factor analysis was conducted to identify if the items could be grouped into meaningful dimensions important for scoring the instrument (De Vet et al, 2011). This process also served item reduction because items that did not contribute adequately to the dimensions were deleted (De Vet et al, 2011). Factor analysis was conducted using the dimension reduction factor feature within SPSS. The PASS-20, PDI and NRS items were included as the variables (a total of 28 items). Initial analysis revealed 28 variables totalling 100% of explained variances. However, only the first five factors (explaining 67.37% of the variance) were analysed because of the criterion to retain only those with an eigenvalue greater than one (seen in table 4.29). In addition to the elbow plot, the construct of pain-related fear developed in the qualitative phase of the PhD supported the factor dimensions. Following the extraction of the five factors, orthogonal rotation (varimax feature in SPSS) was chosen to create a component matrix (table 4.30).

Table 4.29. Output factor analysis of PASS-20, PDI and NRS 28 items.

	Initial Eigenvalues		
Component	**Total**	**% of Variance**	**Cumulative %**
1	10.017	35.777	35.777
2	4.488	16.028	51.805
3	1.791	6.396	58.200
4	1.538	5.494	63.695
5	1.031	3.682	67.377
6	.901	3.218	70.594
7	.818	2.920	73.514
8	.753	2.690	76.204
9	.627	2.238	78.442
10	.587	2.095	80.537

The rotated components matrix identified how each item loaded on one of the five factors. A minimum score of 0.5 was employed as an adequate threshold for item factor loading (Nunnally and Bernstein, 1994; De Vet et al, 2011). Using this threshold, seven items loaded substantially on factor one, seven items loaded substantially on factor two, five items loaded substantially on factor three, four items loaded substantially on factor four and four items loaded substantially on factor five.

Table 4.30. Rotated component matrix for the five factors

Items	Factor 1 (Disability)	Factor 2 (Fear)	Factor 3 (Pain catastrophizing)	Factor 4 (Physiological responses)	Factor 5 (Activity avoidance)
Item 1 (PASS-20 Q1*)	.215	.077	.778	.158	.083
Item 2 (PASS 20 Q2*)	.136	.142	.815	.186	.200
Item 3 (PASS 20 Q3*)	.146	.330	.714	.030	.302
Item 4 (PASS 20 Q4*)	.045	.181	.788	.229	.214
Item 5 (PASS 20 Q5*)	.033	.546	.573	.127	.126
Item 6 (PASS 20 Q6*)	.077	.083	.441	.188	.410
Item 7 (PASS 20 Q7*)	.109	.239	.267	.035	.721
Item 8 (PASS 20 Q8*)	.082	.230	.082	.246	.583
Item 9 (PASS 20 Q9*)	.107	.277	.303	.217	.652
Item 10 (PASS 20 Q10*)	.100	.337	.286	.146	.581
Item 11 (PASS 20 Q11*)	.176	.612	.217	.152	.324
Item 12 (PASS 20 Q12*)	.058	.730	.205	.199	.201
Item 13 (PASS 20 Q13*)	.005	.676	.282	.379	-.023
Item 14 (PASS 20 Q14*)	.024	.782	.242	.157	.232
Item 15 (PASS 20 Q15*)	.155	.742	-.016	.008	.285
Item 16 (PASS 20 Q16*)	.145	.557	.040	.323	.371
Item 17 (PASS 20 Q17*)	.105	.293	.124	.675	.150
Item 18 (PASS 20 Q18*)	.076	.127	.167	.822	.213
Item 19 (PASS 20 Q19*)	.089	.107	.219	.812	.178
Item 20 (PASS 20 Q20*)	.186	.450	.245	.639	.068
Item 21 (PDI Q1*)	.878	.061	.091	.048	.108
Item 22 (PDI Q2*)	.856	.023	.112	.044	.164
Item 23 (PDI Q3*)	.883	.105	.102	-.010	.059
Item 24 (PDI Q4*)	.875	-.056	.169	.047	.085
Item 25 (PDI Q5*)	.805	.164	.005	.039	.050
Item 26 (PDI Q6*)	.874	.086	.093	.106	.062
Item 27 (PDI Q7*)	.854	.018	.069	.109	-.039

Item 28 (Pain NRS Q1*)	.477	.275	.027	.235	.085

*Q identifies the question of the instrument i.e. 'PASS-20 Q1' identifies item 1 of the PASS-20 instrument

Following the initial analysis, a process of item reduction was employed to optimise factor dimensionality (Dev Vet et al, 2011). In this stage, several items were deleted because they did not adequately load (scores below 0.5) onto one factor or loaded substantially (exceeding 0.5) on more than one factor. Item six which asked participants 'I will stop any activity as soon as I sense pain coming on' and item 28 which asked participants to 'rate their pain experience from one to ten', were deleted because they did not adequately load on any factor (De Vet et al, 2011). Item five related to a broader worry of pain and was deleted because it loaded on two factors (at 0.544 on factor 2 and 0.568 on factor 3).

Following the deletion of these items, the factor analysis identified only four factors with eigenvalues that exceeded one. With four factors, analysis revealed that Item eight which asked participants 'As soon as pain comes on, I take medication to reduce it' did not load adequately onto any of the factors and so was deleted. This process left 24 items that loaded within acceptable parameters on one of the four factors. Once the instrument items had been grouped into factors, each factor was examined to establish a common theme. Based on the researcher's interpretation, factors were named under the titles of perceived disability, fear avoidance, pain catastrophizing and physiological responses. These represented the content of the items within each factor and the overall construct factor of pain-related fear. The factors and the item loading can be viewed in table 4.31.

Table 4.31. Distribution of Item loading on the four factors

Factor 1 (Perceived disability)	**Factor 2 (Fear avoidance)**	**Factor 3 (Pain catastrophizing)**	**Factor 4 (Physiological responses)**
Item 21 (0.878) (PDI Q1)	Item 7 (0.526) (PASS-20 Q7)	Item 1 (0.777) (PASS-20 Q1)	Item 17 (0.697) (PASS-20 Q17)
Item 22 (0.858) (PDI Q2)	Item 9 (0.510) (PASS-20 Q9)	Item 2 (0.830) (PASS-20 Q2)	Item 18 (0.820) (PASS-20 Q18)
Item 23 (0.885) (PDI Q3)	Item 10 (0.549) (PASS-20 Q10)	Item 3 (0.746) (PASS-20 Q3)	Item 19 (0.816) (PASS-20 Q19)
Item 24 (0.876) (PDI Q4)	Item 11 (0.681) (PASS-20 Q11)	Item 4 (0.789) (PASS-20 Q4)	Item 20 (0.680) (PASS-20 Q20)
Item 25 (0.806) (PDI Q5)	Item 12 (0.717) (PASS-20 Q12)		
Item 26 (0.877) PDI Q6)	Item 13 (0.569) (PASS-20 Q13)		
Item 27 (0.851) (PDI Q7)	Item 14 (0.795) (PASS-20 Q14)		
	Item 15 (0.801) (PASS-20 Q15)		
	Item 16 (0.678) (PASS-20 Q16)		

To conclude, the exploratory factor analysis revealed that together the PASS-20, PDI and NRS instrument items fit best within a 24 item, four-factor model compared to a 28 item, five-factor model. Factors varied in the number of items, however they each exceeded the acceptable minimum of 3 items per dimension (De Vet et al, 2011). It is notable that the factors formed by the EFA support most factors of the conceptual model shown in section 4.1, with the exception of a construct factor relating to pain.

4.9.5.3 Confirmatory factor analysis

Following exploratory factor analysis, confirmatory factor analysis was undertaken using the AMOS modelling program (Byrne, 2009). Confirmatory factor analysis was employed to examine the structural validity of the new four factor instrument. The factors were analysed to establish model fit of the construct, and how well they perform against other possible factor solutions (De Vet et al, 2011).

The 24 items that were retained during exploratory factor analysis were inputted into a four-factor model and analysed for model fit. Analysis seen in table 4.33 revealed that the four-factor model with 24 items (A) did not meet the thresholds of CFI, GFI, AGFI and RMSEA that represent adequate model fit indices (De Vet et al, 2011). Using the AMOS standardised residual covariance's output, it was established that several of the items were not fitting adequately within their factor dimensions. The items with the highest standardised residual covariance's above the acceptability threshold of 0.5 were chosen for deletion because they indicated discrepancies between the estimated and proposed models (Hu and Bentler, 1999; De vet et al, 2011). Table 4.32 identifies each item that was deleted during this phase of factor analysis in the order in which it was deleted.

Items were deleted one by one until one or more of CFI, GFI, AGFI, RMSEA or Chi squared thresholds (for adequate model fit) had been met. A second four factor model (B) containing 15 of the original 24 items was established when CFI met the acceptability threshold exceeding 0.95. However, further item reduction was conducted (using standardised residual covariance) because GFI, AGFI, RMSEA and chi squared remained outside of acceptable thresholds for good model fit.

Table 4.32. Items chosen for deletion during confirmatory factor analysis.

Instrument	Instrument Item number	Item question
PASS-20	14	When I hurt I think about pain constantly
PASS-20	19	I worry when I am in pain
PASS-20	3	I go immediately to bed when I feel severe pain
PASS-20	8	As soon as pain comes on I take medication to reduce it
PASS-20	1	I think that if my pain gets too severe it, will never decrease
PASS-20	2	When I feel pain, I am afraid that something terrible will happen
PASS-20	9	When I feel pain, I think I might be seriously ill
PASS-20	13	Pain sensations are terrifying
PASS-20	16	When pain comes on strong I think that I might become paralyzed or more disabled
PASS-20	4	I begin trembling when engaged in activity that increases pain
PASS-20	7	Pain seems to cause my heart to pound or race
PDI	1	Family/Home Responsibilities: This category refers to activities of the home or family. It includes chores or duties performed around the house (e.g. yard work) and errands or favors for other family members (e.g. driving the children to school).
PDI	2	Recreation: This disability includes hobbies, sports, and other similar leisure time activities.
PDI	5	Sexual Behavior: This category refers to the frequency and quality of one's sex life.
PDI	6	Self-Care: This category includes activities, which involve personal maintenance and Independent daily living (e.g. taking a shower, driving, getting dressed, etc.)
NRS	1	Please circle the number that best represents the average intensity of your pain in the past 24 hours on a 0-to-10 scale, where 0= no pain and 10= pain as intense as you can imagine

Following the deletion of three further items (PASS-20 items three, eight and 14), a four-factor model (C) with 12 items was established that met most acceptability thresholds for a good fitting model (with a CFI of 0.983, GFI of 0.953 and RMSEA of 0.046 (seen in table 4.33) (Hu and Bentler, 1999; De vet et al, 2011).

Table 4.33. Fit indices comparing the four confirmatory factor analysis models

Model	CFI	GFI	AGFI	P value	RMSEA	Chi square
4 factor model A – 24 items	0.898	0.813	0.772	0.00	0.082	635.947
4 factor model B – 15 items	0.959	0.921	0.887	0.00	0.064	163.864
4 factor model C – 12 items	0.983	0.953	0.924	0.01	0.046	71.597
6 factor model – 28 items	0.883	0.797	0.754	0.00	0.08	834.466
Thresholds for good fitting models (De Vet et al, 2011)	*>0.95*	*>0.95*	*>0.9*	*Less 0.05*	*Less 0.06*	*Less 0.05*

*CFI= Comparative Fit Index, GFI= Goodness of Fit Index, AGFI= Adjusted Goodness of Fit Index, RMSEA= Root Mean Square Error of Approximation.

An acceptable threshold for chi-square was not be achieved with the four factor model. Literature has stated this may be because the chi-squared statistic is sensitive and nearly always rejects a model when large samples are used (Hooper, Coughlan and Mullen, 2008). For this reason, because the alternative indices of CFI, GFI, AGFI and RMSEA were observed as indicating a good model fit , the CFA was concluded with the 12 item four factor model (seen in figure 4.10) (Hu and Bentler, 1999). The standardised residual covariance for the 12-item model suggested that further items could be deleted for better model fit. However, the decision was made to cease item reduction because of guidelines that advocate for a minimum of 3 items per factor dimension (De Vet et al, 2011).

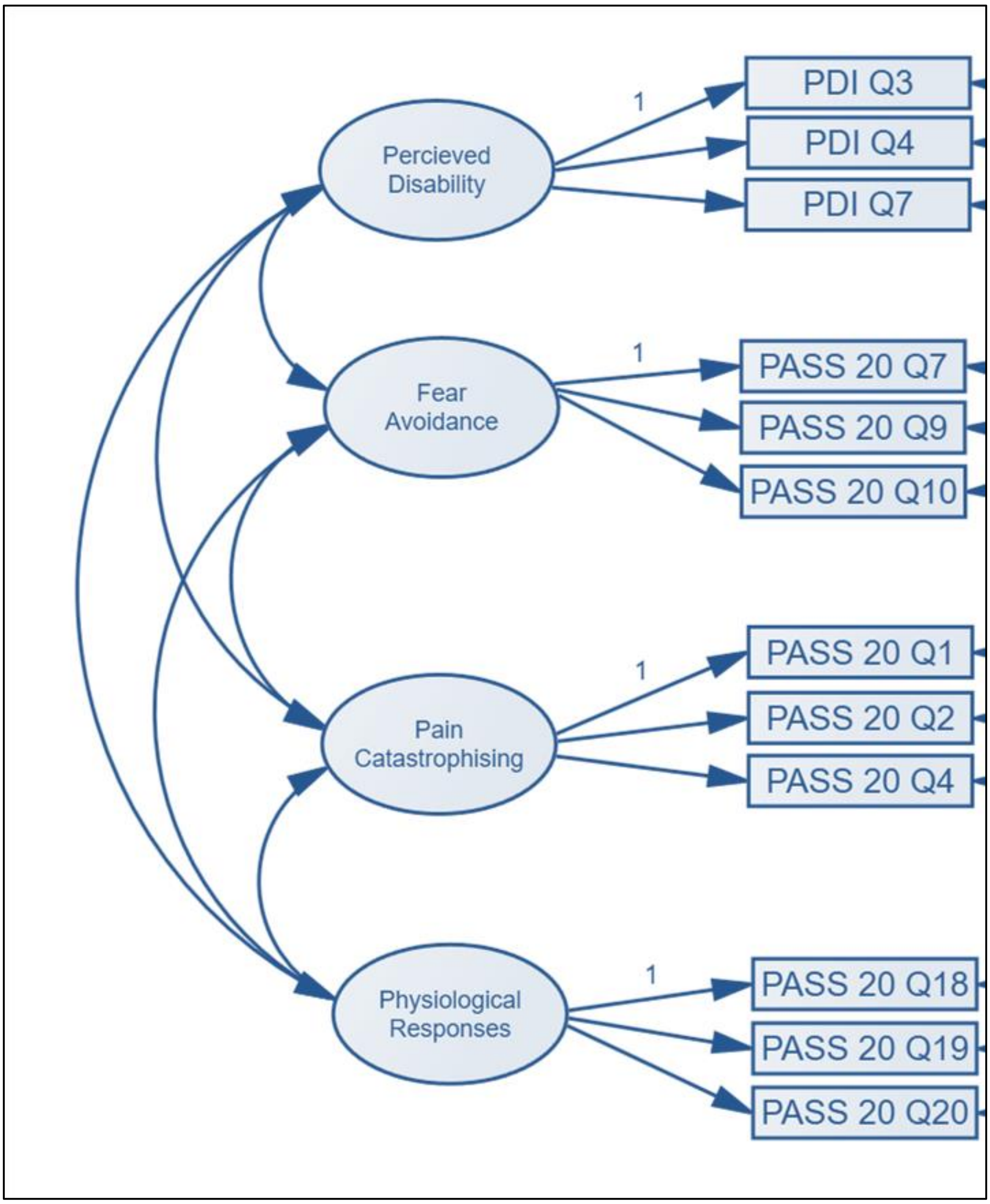


Figure 4.10. 12 item four factor model following item reduction of CFA.

To support the validity of the 12-item instrument, the four-factor model (12 items, C) was compared to the model derived from the 28 items of the PASS-20, PDI and NRS instruments. Confirmatory factor analysis was conducted using a six-factor model that represented the original sub dimensions of each instrument (seen in figure 4.11).

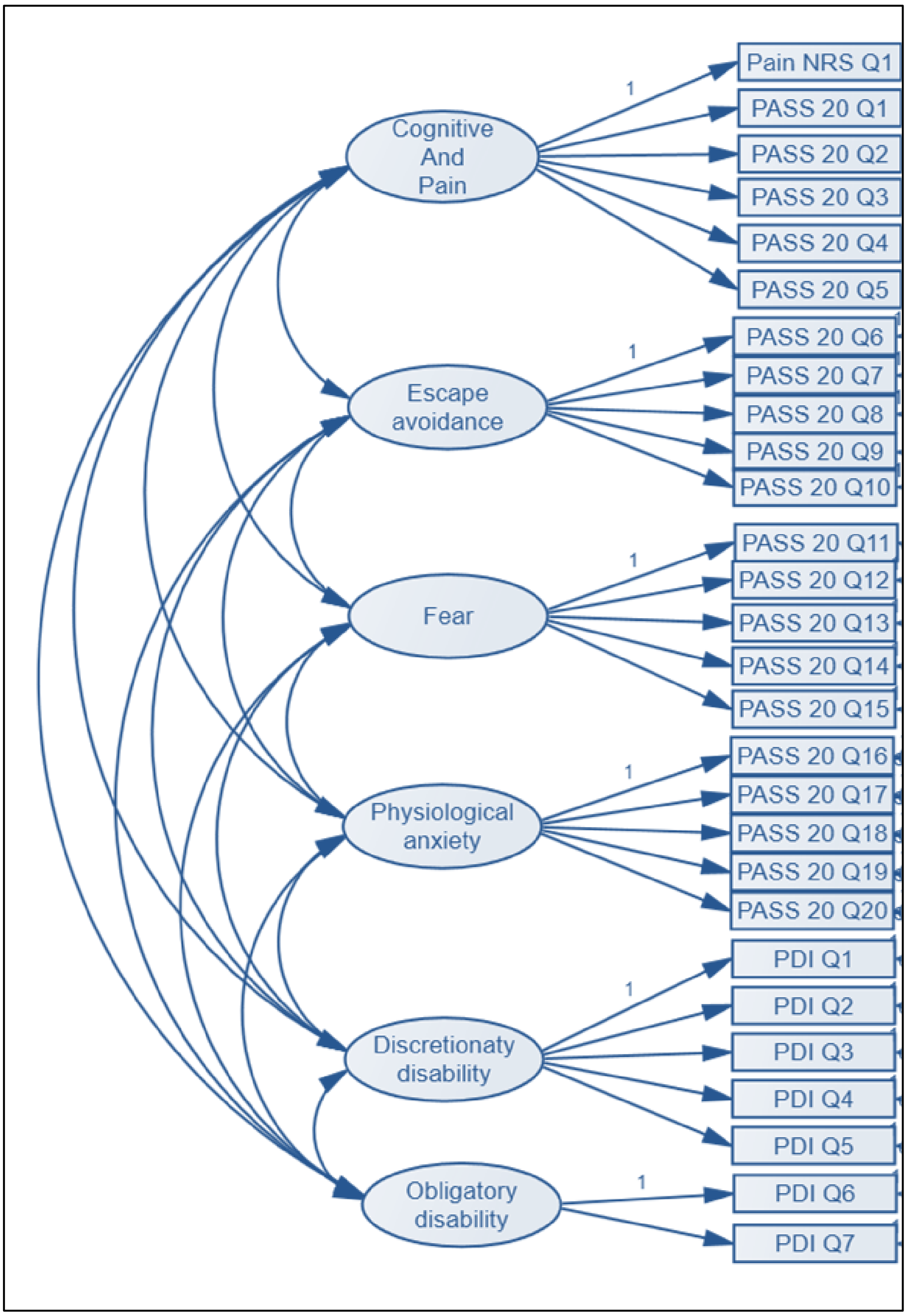


Figure 4.11. 28 item six factor model following CFA.

The factor analysis showed that the six-factor model did not have adequate model fit indices that met the proposed thresholds (Hooper, Coughlan and Mullen, 2008). The four-factor model with 12 items performed well in comparison to the other possible factor solutions, implying that when combined the PASS-20 and PDI fit best with 12 items and four factor dimensions. The full 12 item instrument is shown in figure 4.12.

Pain-Related Fear Scale (PRFS)

In the first 9 questions we would like to know what you do and what you think about when in pain. Please use the rating scale below to indicate how often you engage in each of the following thoughts or activities.

Please circle one number	**0 (NEVER) to 5 (ALWAYS)**					
1. I can't think straight when in pain	0	1	2	3	4	5
2. During painful episodes it is difficult for me to think of anything besides the pain	0	1	2	3	4	5
3. I find it hard to concentrate when I hurt	0	1	2	3	4	5
4. I will stop any activity as soon as I sense pain coming on	0	1	2	3	4	5
5. I avoid important activities when I hurt	0	1	2	3	4	5
6. I try to avoid activities that cause pain	0	1	2	3	4	5
7. When I sense pain, I feel dizzy or faint	0	1	2	3	4	5
8. Pain makes me nauseous	0	1	2	3	4	5
9. I find it difficult to calm my body down after periods of pain	0	1	2	3	4	5

In the final 3 questions we are interested in which aspects of your life (if any) are disrupted by pain. Respond to each category indicating the overall impact of pain in your life, not just when pain is at its worst.

Circle one number on the scale that describes the level of disability you typically experience.	**0 (No Disability) to 10 (Worst Disability)**										
10. Social Activity: This category refers to activities, which could involve participation with friends and acquaintances.	0	1	2	3	4	5	6	7	8	9	10
11. Occupation: This category refers to activities that are part of or directly related to one's job. This includes non-paying jobs as well, such as that of a housewife or volunteer.	0	1	2	3	4	5	6	7	8	9	10
12. Life-Support Activities: This category refers to basic life supporting behaviours such as eating, sleeping and breathing.	0	1	2	3	4	5	6	7	8	9	10

Figure 4.12. Pain-Related Fear Scale

In summary, a four-factor model with 12 items performed well and met the thresholds for a good fitting model (seen in table 4.31) However, the other four factor models (with 15 and 24 items) and the six-factor model did not meet the thresholds for an adequate fitting model (seen in table 4.33). The factors represented in the four factor model mapped onto the original conceptual map shown in section 4.1. However, there were two noticeable differences following factor analysis in that the factor of fear and avoidance had been integrated together and the factor of pain had been excluded.

4.9.5.4 Establishing the reliability and validity of the new 12 item measure of pain-related fear.

The new 12 item instrument was analysed to determine construct validity, criterion validity and reliability. The data from the original sample of 236 participants was used to analyse the new instrument. There were some notable differences when interpreting the new instrument mean scores because the maximum score was a possible 75 whilst the minimum possible score was 0. The distribution of the new instrument scores was approximately normal (seen in figure 4.13).

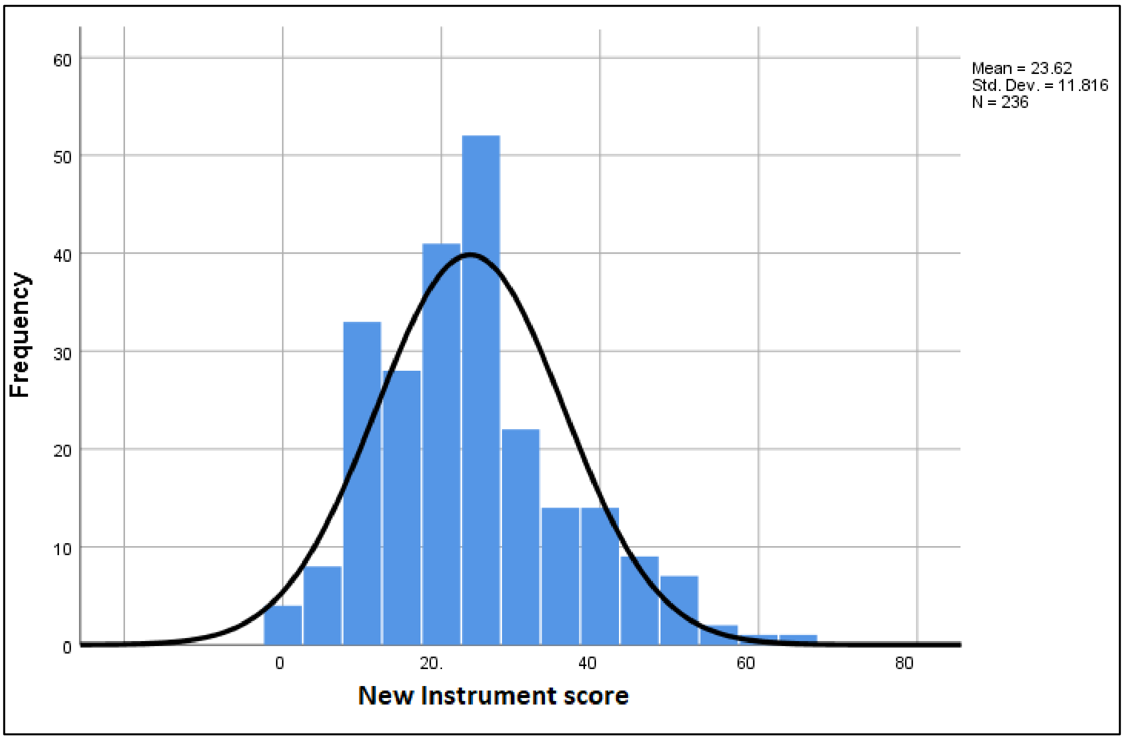


Figure 4.13. Distribution of new instrument scores

4.9.5.5 Reliability- Cronbach's alpha of new 12 item instrument

The analysis revealed that the new 12 item instrument had a Cronbach's alpha score of 0.842, deemed above acceptable for a measurement instrument. De Vet et al, (2011) established that a Cronbach's alpha of 0.70 and above is acceptable, 0.80 and above is good and 0.90 and above is excellent. Item total statistics were analysed and established that Cronbach's alpha scores could not be improved through item reduction (seen in table 4.34). This showed that the new instrument had the highest possible Cronbach's alpha score with 12 items. Both results can be used as an index to show that the construct of pain-related fear can be reliably measured using the new 12 item instrument (Reynaldo and Santos, 1999).

Table 4.34. Item total statistics for new 12 item instrument.

	Corrected Item-Total Correlation	**Squared Multiple Correlation**	**Cronbach's Alpha if Item Deleted**
Instrument item 1	.565	.586	.827
Instrument item 2	.597	.637	.826
Instrument item 3	.557	.556	.828
Instrument item 4	.463	.375	.833
Instrument item 5	.544	.491	.828
Instrument item 6	.475	.397	.832
Instrument item 7	.488	.592	.831
Instrument item 8	.507	.596	.830
Instrument item 9	.562	.489	.827
Instrument item 10	.540	.692	.829
Instrument item 11	.541	.640	.832
Instrument item 12	.484	.579	.834

4.9.5.6 Reliability – inter item correlations within the four factor dimensions of new 12 item instrument

Inter item correlation within the four factor dimensions of the new instrument revealed moderate to strong associations. All inter item correlations exceeded the acceptability value of 0.4. Notably, most items strongly correlated (values that exceed 0.6) with other items within their factor dimension. The fear avoidance subscale achieved the lowest inter item correlations with values between 0.4 and 0.5, however these were still considered above acceptable strengths of associations (seen in table 4.35) (De Vet et al, 2011).

Table 4.35. Inter item correlations of pain catastrophizing factor dimension of the new 12 item instrument

12 item instrument	**item 1**	**item 2**	**item 3**	**Item 4**	**Item 5**	**Item 6**	**Item 7**	**Item 8**	**Item 9**	**Item 10**	**Item 11**	**Item 12**
item 1	1.0	.722	.613									
item 2	.722	1.0	.680									
item 3	.613	.680	1.0									
Item 4				1.0	.543	.465						
Item 5				.543	1.0	.559						
Item 6				.465	.559	1.0						
Item 7							1.0	.719	.593			
Item 8							.719	1.0	.607			
Item 9							.593	.607	1.0			
Item 10										1.0	.768	.729
Item 11										.768	1.0	.678
Item 12										.729	.678	1.0

4.9.5.7 Construct validity- using the known group's difference method to compares scores between physical activity groups

The results showed that there was an observed increase of mean score in less active groups compared to more active groups (seen in table 4.36). An analysis of variance (ANOVA) with pairwise testing showed that the mean differences within the new 12 item instrument were significant between activity groups (P= 0.01).

Table 4.36. New 12 item mean instrument scores in low, moderate and high physical activity groups

Physical activity levels	**Low**	**Moderate**	**High**	**Total**	**Between Groups**
Frequency	53	87	96	236	
Mean	26.5	24.7	20.9	23.6	
SD	12.12	12.46	10.52	11.81	
Median	24	23	21.5	23	
Statistical significance					P= 0.01
df					2
F					4.684

*SD= Standard Deviation, F= test stat, df= degrees of freedom

Bonferroni tests showed that the new instrument score was significantly higher in the low activity group compared to the high activity group (P=0.015). However, mean instrument scores were not statistically significant between low to moderate activity groups and moderate to high activity groups (as seen in table 4.37).

Table 4.37. Statistical significance of new 12 item mean scores differences between each pairing of activity group.

Statistical tests	**Activity levels (I)**	**Activity levels (J)**	**Mean difference (I-J)**	**Std. Error**	**Significance (P value)**	**95% CI (Lower bound)**	**95% CI (Upper bound)**
Bonferroni	Low	High	5.6	1.99112	.015	.8272	10.4299
	Moderate	Low	-1.7	2.02742	1.000	-6.673	3.1045
	High	Moderate	-3.8	1.72229	.080	-7.997	.3090

*CI= confidence interval

4.9.5.8 Criterion validity- Pearson's correlation between the new and pre-existing instruments

Criterion validity of the new 12 item instrument was established using Pearson's correlation coefficient (r) against the TSK instrument. Using SPSS, the correlation function showed that the new 12 item instrument and the TSK instrument had moderate strength of association (*r*= 0.508, P= 0.00, 95% CI lower bound= 0.389). The strength of this association exceeded 0.4 and a 95% lower bound confidence interval greater than 0.3 and so met the acceptability level of criterion validity between two instruments that propose to measure similar constructs. Notably, the new 12 item instrument performed as reliably as the PASS-20 when compared against the criterion TSK measure (*r*= 0.500. 95% CI lower bound= 0.344). The new 12 item instrument was also correlated to the other measurement instruments to evaluate and strengthen validity. Pearson's correlations showed that both the PASS-20 and PDI had strong associations with the new instrument, but this was expected because several items were taken from these instruments (*r*= 0.818 and *r*= 0.734 respectively). The NRS had moderate strengths of association (*r*= 0.488). This data showed that the new 12 item instrument measures similar factors of fear, avoidance, pain catastrophizing, physiological anxiety, disability and pain at an acceptable level for a measurement instrument (De Vet et al, 2011). Correlations and Confidence Intervals between the instruments can be seen in table 4.38.

Table 4.38. Correlation between the new 12 item Instrument and PASS-20, PDI and NRS instruments

Instrument	**PASS-20 Instrument score**	**PDI Instrument score**	**NRS Instrument score**	**TSK Instrument score**
New 12 Item Instrument score	*r*= .818 (95% CI lower bound= 0.744)	*r*= .734 (95% CI lower bound= 0.647)	*r*= .488 (95% CI lower bound= 0.376)	*r*= .508 (95% CI lower bound= 0.389)
Sig. (2-tailed)	.000	.000	.000	.000

**r*= Pearson correlation value, * CI= confidence interval.

4.9.5.9 Comparing standardised mean differences between the new 12 item instrument and the combination of the PASS-20 and PDI in physical activity groups

The new instrument contained several items from the PASS-20 and PDI so further analysis was explored to determine if the new instrument could discriminate between groups to a greater degree than existing instruments. This was achieved by analysing mean differences between known groups related to physical activity and BMI. Initially, the PASS-20 and PDI were combined to form a 27 item instrument for the purposes of analysis but this meant that the range of total scores was greater than the existing instrument (new instrument range= 0-75 versus existing instruments range= 0-170). Because of this, a method of standardisation was conducted to calculate z-scores, which meant that comparisons of mean score differences between the instruments were meaningful.

Standardised mean differences between physical activity groups scored by the new and existing instruments showed that the instruments performed almost identically. This indicated that there was no meaningful difference between employing the new or existing instruments in discriminating between participants of the known activity groups. This highlights that the new instrument can perform identically but with 15 less items compared to existing instruments. Statistics can be seen in table 4.39.

Table 4.39. A comparison of standardised mean difference between physical activity groups of new and existing instruments.

	Physical activity levels	**Low**	**Moderate**	**High**	**Between Groups (sig.)**
Existing Instruments (Combination of PASS-20 and PDI)	Frequency	53	87	96	
	Standardised Means	0.25	0.10	-0.22	
	SD	1.02	1.05	0.89	
	Statistical significance				P= 0.008
	df				2
	F				4.932
New 12 item instrument	Frequency	53	87	96	
	Mean	0.25	0.09	-0.23	
	SD	1.02	1.05	0.88	
	Statistical significance				P= 0.010
	df				2
	F				4.684

*SD= Standard Deviation, F= test stat, df= degrees of freedom

4.9.5.10 Comparing standardised mean differences between the new 12 item instrument and the combination of the PASS-20 and PDI in BMI groups

Similar findings were found when standardised mean differences were compared between BMI groups from scores of the new and existing instruments. Equally, this meant that that there was no meaningful difference between employing the new and existing instruments in discriminating between participants of known BMI classifications. This can be seen in table 4.40.

Table 4.40. A comparison of standardised mean difference between BMI groups of new and existing instruments.

Instrument	BMI	Underweight	Healthy weight	Overweight	Obese	Between Groups (sig.)
Existing Instruments (Combination of PASS-20 and PDI)	Frequency	8	93	71	64	
	Mean	-0.51	-0.14	-0.23	0.53	
	SD	0.772	0.904	0.929	0.130	
	Statistical significance					0.000
	df					3
	F					9.862
New 12 item instrument	Frequency	8	93	71	64	
	Mean	-0.52	-0.10	-0.27	0.52	
	SD	0.770	0.938	0.108	0.127	
	Statistical significance					0.000
	df					3
	F					9.727

*SD= Standard Deviation, F= test stat, df= degrees of freedom.

Bonferroni tests showed that statistical significance of standardised mean score differences between activity groups, did not differ when comparing the new and existing instruments. This can be seen in table 4.41.

Table 4.41. Statistical significance of new and existing instrument mean scores differences between each pairing of activity group.

Instrument	Statistical tests	Activity levels (I)	Activity levels (J)	Mean difference (I-J)	Significance (P value)	95% CI (Lower bound)	95% CI (Upper bound)
Existing Instruments (Combination of PASS-20 and PDI)	Bonferroni	Low	High	0.48	.012	0.081	0.893
		Moderate	Low	-0.15	1.000	-0.566	0.260
		High	Moderate	-0.33	.067	-0.686	0.016
New 12 item instrument	Bonferroni	Low	High	0.47	.015	0.070	0.883
		Moderate	Low	-0.15	1.000	-0.565	0.262
		High	Moderate	-0.32	.080	-0.677	0.026

*CI= confidence interval

Similarly, Bonferroni tests showed that statistical significance of standardised mean score differences between BMI groups, also did not differ when comparing the new and existing instruments. This can be seen in table 4.42.

Table 4.42. Statistical significance of new and existing instrument mean scores differences between each pairing of activity group.

Instrument	Statistical tests	BMI groups (I)	BMI groups (J)	Mean difference (I-J)	Significance (P value)	95% CI (Lower bound)	95% CI (Upper bound)
Existing Instruments (Combination of PASS-20 and PDI)	Bonferroni	Healthy weight	Obese	-0.66	0.00	-1.096	-0.277
		Overweight	Healthy weight	-0.08	1.000	-0.481	0.313
		Obese	Overweight	0.77	0.00	0.335	1.205
New 12 item instrument	Bonferroni	Healthy weight	Obese	-0.62	0.00	-1.038	-0.218
		Overweight	Healthy weight	-0.17	1.000	-0.570	0.225
		Obese	Overweight	0.80	0.00	0.365	1.236

*CI= confidence interval

To conclude, comparisons of standardisation mean scores between the new and existing instruments indicated that both performed almost identically to each other when discriminating differences between activity and BMI groups.

4.9.6 Objective 3 summary

When combined together, analysis of the existing measures suggested that several items within each instrument were either highly correlated or did not correlate adequately. This indicated that item reduction was needed to remove redundant questions. This was supported by the Cronbach's Alpha that suggested internal consistency could be improved through item reduction. Exploratory factor analysis revealed that four items did not load adequately or loaded substantially on two factors and so needed to be deleted. Following the deletion of the items, the analysis revealed that only four factors could be retained (based on criterion that eigenvalues needed to be greater than one). Four factors containing 24 items were included in the confirmatory factor analysis. Confirmatory factors analysis suggested that the 24 item, four factor model did not have a good model fit and failed to meet acceptability thresholds (De Vet et al, 2011). Item reduction was carried out to improve the model fit which produced a 12 item, four factor model that met acceptability thresholds. These 12 items formed a new measurement instrument for pain-related fear in younger adults that proved to have good validity and reliability (seen in figure 4.12). The construct factors of the new instrument maps onto several factors of the conceptual framework of pain-related fear proposed in this PhD.

4.10 Discussion

The aim of this study was to explore the validity of pain-related fear instruments in adults aged 18 to 45 years. The primary objectives were to determine the construct and criterion validity of the PASS-20, PDI and NRS instruments in younger adults aged 18 to 45 years. A secondary objective was to explore whether a combination of these instruments/ subscales/ items could be used to develop a new instrument for measuring pain-related fear. The key findings suggest that existing pain-related measures (PASS-20, PDI and NRS) have evidence of construct and criterion validity. This is most convincing for PASS-20 total and the cognitive, fear and avoidance sub dimensions. Although there is some evidence of criterion validity for the PDI particularly for the discretionary sub dimension, the measure demonstrated substantial floor effects with 42% (n= 100) of the sample scoring 0 and only 76 participants (41%) scored more than 0 in the obligatory sub dimension. The NRS showed no evidence of construct or criterion vali dity for measuring pain-related fears in younger adults aged 18 to 45 years.

These finding provided some evidence for construct factors of fear avoidance, disability, physiological responses and pain catastrophizing in the model and less evidence for the construct factor of pain. However, given there was some support for all constructs, all the items from the three measurement instruments were considered when designing a shorter pain-related instrument using factor analysis. The findings of this analysis suggested a 12 item four factor instrument, which included three questions from the PDI and nine from the PASS-20 performed well with good construct validity. This new instrument also mapped onto four construct factors of fear avoidance, disability, physiological responses and pain catastrophizing in the conceptual map. Pain as measured by the NRS was not included in the final model. This new instrument had similar validity as the existing measures, with no evidence of floor and ceiling effects (seen in figure 4.13). This new instrument was used to explore if there were differences in pain-related mean scores across different BMI groups; there were significantly higher scores in obese adults compared to healthy weight adults (P=0.000), and in obese adults compared with overweight adults (P=0.000).

The following discussion will begin by highlighting the key characteristics and instrument scores of the participants. Further sections will discuss the significant associations between pain-related fears and low levels of physical activity and outline how existing instruments used to measure pain-related fear have adequate, but not desirable validity for use in younger adults. Finally, the discussion will provide a rationale with evidence that pain-related fear can be more validly measured using a 12 item, four factor instrument in populations of younger adults.

4.10.1 Participant characteristics and pain-related fear scores

Increasing levels of obesity and inactivity are a growing public health issue that is becoming more of a concern among younger adults (Samir et al, 2014). The current findings show that physical activity levels were largely similar to those found by Buckworth and Nigg, (2010). Approximately 20% of younger adults participated in low levels of activity and 80% participated in moderate to high levels of activity. High levels of activity are not uncommon among younger adults as recent literature suggests that those aged 18 to 35 engage in approximately 250 minutes of moderate to vigorous activity per week (Unick et al, 2017). This study supports findings that suggest over 20% of younger adults (aged 18 to 45 years) participate in low levels of physical activity (Baptista et al, 2012; Unick et al, 2017; Buckworth and Nigg, 2010). This is despite recent efforts by government to promote initiatives (such as active travel) to increase activity in early adulthood (Clemente et al, 2016).

Distributions of participant BMI in the current study was also similar to the general population (NHS Digital, 2018; Health Survey for England, 2015). Approximately 40% were of healthy weight, 30% overweight, 27% obese and 3% underweight, closely resembling England’s current BMI estimates for younger adults which are; 40% healthy weight, 33% overweight, 25% obese and 2% underweight (Baker, 2018). Amongst the BMI groups, obese participants were substantially less active than those who were not obese, reporting the highest frequency and percentage of inactivity (low activity group). These findings are in line with the literature that physical activity has an inverse association with increased BMI (Bradbury et al, 2016; Cooper et al, 2000; Jakicic et al, 2018).

Previously, some fear related barriers to activity have been found to be independently associated with lower levels of activity (Marshal, Schrabrun and Knox, 2017; Somers et al, 2009; Rosic et al, 2019). Several instrument such as the PASS-20 and TSK have previously been used the measure activity related fears but these have only been validated in older adults and adults suffering from chronic pain, with a dearth of measurement in younger adults (Roelofs et al, 2004; Abrams et al, 2007; Vincent et al, 2014; McCracken and Dhingra, 2002). An interesting finding of the current study is that younger adults reported a mean PASS-20 score of 38.97 (SD=18.02). This is a marginally greater mean score than that of a clinical sample of middle-aged chronic pain sufferers (n= 282; mean age= 46.5 years, SD= 13.8; mean PASS-20 score= 38.62, SD= 20.38) (McCracken and Dhingra, 2002). The mean score was also substantially greater than previously found in a comparable non- clinical sample of similar age (n= 155; mean age= 20.7 years, SD= 3.6; mean PASS-20 score= 24.04, SD=13.45) (Abrams, Carleton and Asmundson, 2007). Further to this, the current study population reported low levels of pain (mean= 2.42, SD= 2.35). This is an interesting finding because it suggests that heightened pain-related fears may not be associated with pain. It is likely that the increased pain-related fear scores could be attributed to the high number of overweight and obese adults (57.2%) within the sample. Research supports the rationale that heightened pain-related fear is associated with greater BMI, particularly in those above 30kg/m^2 (Vincent et al, 2014).

In contrast, perceived disability scores were not elevated compared with previous literature (Wingo et al, 2011). The mean PDI scores was similar to mean PDI scores reported by a non-clinical sample of middle-aged adults (9.43, SD= 14.06) (Wingo et al, 2011). It was substantially lower than the disability scores of chronic and acute pain sufferers that often range upwards of 36.5 (seen in table 4.43) (Soer et al, 2103; Koke et al, 2017; Soer et al, 2012). The perception of disability among the current sample was considered mild (scores ≤27) (Beemster et al, 2018). There is some evidence that cases of physical and psychological disability increase with age and may be less frequent for those in early adulthood (Nelson and Churilla, 2015).

Table 4.43. Comparison of PDI scores in the present study and the findings of previous literature

Diagnosis/ group	N	PDI Mean (SD)	Reference
General population	236	9.8 (13.2)	Present study
General population	2510	6.8 (11.4)	Mewes et al, 2009
Obese	64	16.3 (14.6)	Present study
Acute back pain	178	38.0 (15.9)	Soer et al, 2012
Chronic back pain	425	36.5 (13.8)	Soer et al, 2013
Widespread pain	365	41.4 (10.9)	Soer et al, 2013
Chronic pain	4867	38.9 (13.3)	Koke et al, 2017

A comparison of pain scores between the current study and previous research identified some novel findings (Bell et al, 2017). The mean value attained from the current study sample was 2.4 (SD= 2.3), indicating a mild severity of musculoskeletal pain (Boonstra et al, 2016). This was marginally greater than previously found in other none clinical samples (mean NRS, 2.1) (Michener, Synder and Leggin, 2011; Anderson, 1999). However, the current study had a higher percentage of participants with a BMI that exceeded 30 kg/m^2, and this could be a rationale for the marginal increase. This view is supported by research that highlights an increase in musculoskeletal pain in obese adults compared to healthy weight adults (Okifuji and Hare, 2015). Importantly, the current study sample had substantially lower scores than previously found in clinical pain patients (chronic pain patients NRS range from 5 to 8.1) (Vleeming et al, 2008; Forsythe et al, 2008; Tichonova et al, 2015; Boonstra et al, 2016; Alghadir et al, 2018). This could suggest that the current sample were unlikely to be clinical pain patients. This is particularly interesting given that the sample reported moderate to severe pain-related fears. This is the first study showing younger adults to have a substantial fear of pain, possibly in the absence of current musculoskeletal pain. This finding suggests that prominent fear related barriers to activity may manifest in younger adults, through pathways not associated with experiences of pain (Vlaeyen and Linton, 2012). It is possible that younger adult's manifestations of pain-related fear could be explained by social learning through observation and verbal transfer (Olsson, 2007). This challenges the theoretical conceptions of the fear avoidance model in that pain is said to be the catalyst for most manifestations of pain-related fear (Vlaeyen et al, 2016). However, it is also possible that the absence of pain within the sample may be a result of a reduction of activities that produce pain (Cooper et al, 2017). In the study by Cooper et al, (2017) participant's experiences of previous pain meant that they developed a defensive response of avoidance to all activity that had the potential to produce pain. Fearful cognitions relating to pain reinforced activity avoidance behaviour which led to reductions in the occurrence of pain (Cooper et al, 2017). Because the measurement instrument employed in this PhD study asked participants to identify their current levels of pain, it is possible that younger adults reported low levels of pain because of previous fear avoidance behaviours that minimise musculoskeletal pain. Nevertheless, the findings highlight a modest but novel perspective that constructs of pain-related fear have distinct differences when comparing older and younger adults (Vincent et al, 2014). This study suggests that younger adults appear to present with greater psychological impairment and less physical impairment as a result of fear related barriers to activity (Wittink et al, 2006).

4.10.2 Pain-related fear scores differed significantly among physical activity groups

This quantitative study findings support existing literature that pain-related fear is greater in those that are least active. This was somewhat expected given that literature has highlighted differences in fears between activity groups (Cho et al, 2010). This trend among younger adults is consistent with findings relating to middle aged adults, whereby pain-related fear is associated with poorer physical functioning (Cho et al, 2010). They are also consistent with research conducted on older adults that showed an association between fears of movement (due to pain) and fewer leisure time activities (Elfving et al, 2007; Knapik et al, 2019; Odole et al, 2016). The current study provides modest evidence that pain-related fear may be a risk factor for inactivity among younger adult populations (Trost et al, 2012; Koho et al, 2011).

Although these findings were anticipated, the current study findings show that this association was evident in a non-clinical sample, who largely were not suffering chronic pain. This suggests that pain-related fear could be an important barrier to activity that is perceived independent from pain in younger adults who are healthy weight, overweight and obese. These findings provide some support for the sequential relationships of the fear avoidance model specifically relating to negative affectivity that leads to the manifestations of pain-related fear (which provokes activity avoidance) (Vlaeyen et al, 2012). The fear avoidance model proposes that pain is a key component in conceptualising pain-related fear avoidance, however the current study provides little evidence to support this relationship in younger adults (Vlaeyen and Linton, 2000).

4.10.3 Pain-related fear scores of existing instruments differed significantly among BMI groups

The current study found a significant increase in fears reported by younger obese adults compared with younger overweight and healthy weight adults. This is consistent with several studies that found significantly greater pain-related fears in obese patients, compared to none obese patients (Vincent et al, 2010; Vincent et al, 2011). However, this is the first study to identify this in a non-clinical sample, and with the use of the PASS-20 instrument. Previous research has measured these fears in clinical pain patients, largely using the TSK (Miller et al, 1991; Koho et al, 2011). The current findings are important because obese adults aged 18 to 45 years appear to be at an increased risk of activity avoidance through similar relationships with fear than older adults (Vlaeyen et al, 2012). This supports the conceptual principles of the fear avoidance model that shows a dynamic relationship between fearful cognitions, activity avoidance and musculoskeletal disuse (Vlaeyen et al, 2012). It also provides some rationale as to why obese adults remain inactive for long periods, unable to enact health promoting behaviour change (Mitchie, Atkins and West, 2014).

There is a rationale to suggest that the prevalence of pain-related fears in this study may be associated with a recent rise in stress and poor mental wellbeing among young adults (Hubble and Bolton, 2020). This may be particularly relevant in this sample (largely made up of students) as student mental illness in younger adults has seen a sharp rise, increasing fivefold since 2010 (Hubble and Bolton, 2020). Previous research has found some evidence that poor mental health is associated with greater fears and that this can often reduce physical functioning (Stafford, Chandola and Marmot, 2007). The close proximity living, and diverse social interactions of students could have contributed to the increased pain-related fears because fear(s) can be verbally transmitted from one young person to another (Thomas, 2012). These factors could also explain a heightening of fears in the absence of pain among the younger adults in this study.

4.10.4 The reliability and validity of existing instruments

Criterion validity of the PASS-20 instrument with a younger adult population was supported by a significant positive correlation with the TSK (r= 0.50, p= 0.000). This is consistent with previous research that found correlations ranging from *r*=0.46 to *r*=0.54 in chronic pain patients (McCracken et al, 1996; Kreddig et al, 2002; Shanbehzadeh et al, 2017; Roelofs et al, 2003; Cho et al, 2010). However, the current findings are novel in validating the PASS-20 in a non-clinical sample of younger adults. The construct validity of the PASS-20 was also supported through the known group's difference method (Keating and Silverman, 2004). This current study showed that construct factors of pain-related fear in the existing instrument were valid given that fears were significantly greater in inactive adults compared to more active adults. This is consistent with previous research that none active adults score higher than active adults within the construct of pain-related fear (Vincent et al, 2013). The current findings provide evidence that the PASS-20 is consistent with the hypothesis of literature with regard to differences between individuals who partake in different physical activity levels (De Vet et al, 2011). The validity established in the PASS-20 is important given that many of its items formed a large portion of the new 12 item instrument. This strengthens the relationships within the conceptual map that propose that pain-related fear leads to activity avoidance (figure 4.14).

The current study identified that the PASS-20 has strong internal consistency (Cronbach's Alpha of 0.93). This is consistent with the findings of several studies that found coefficients ranging from 0.83 to 0.91 (Coons et al, 2004; Kreddig et al, 2002; Abrams et al, 2007; McCracken and Dhingra, 2002). These findings indicate that items within the PASS-20 are highly correlated and is likely that the instrument is a reliable measure of pain-related fear in populations of younger adults (De Vet et al, 2011). However, the alpha in the current study was greater than 0.90 which indicated that PASS-20 required item reduction because many items were measuring similar constructs (De Vet et al, 2011).

The data presented in this study showed that the PDI instrument had a strong Cronbach's alpha of 0.94, sufficient for measuring perceptions of disability in younger adults. However, with the alpha value being greater than 0.90, there was some indication that several items were measuring the same construct (De Vet et al, 2011; Bot et al, 2004). The current alpha value is notably higher than previous Cronbach's alpha of 0.83 and 0.89 found in chronic lower back pain patients and multisite pain patients (Soer et al, 2013; Chibnall, Raymond and Tait, 1994). This indicates that PDI items were highly correlated, giving a strong rationale for item reduction and the need to combine factor dimensions (De Vet et al, 2011). It may be the case that the observed floor effect played a part in the alpha value of the PDI because a high percentage of the sample were found at the lower end of the scale (De vet et al, 2011). The heightened Cronbach's Alpha could also be a result of the instrument being applied to a non-clinical population as opposed to its original intended population of clinical pain patients (Soer et al, 2013).

As with the PDI instrument, the Cronbach's alpha score of the combined instruments was 0.926 (PASS-20 and PDI). This was important because it showed that the sub dimensions of each instrument were likely measuring one construct that related to fears of pain (De Vet et al, 2011). However, the high alpha score suggested that there was evidence of item or sub dimension redundancy within the population. This demonstrated the need for item reduction to develop a new shorter instrument which combined items from the PASS-20 and PDI (De Vet et al, 2011). Item reduction of the instruments had several advantages in that it provided an instrument which was less burdensome on participants and was redundant of any sub dimensions that did not perform well within the construct of pain-related fear (De Vet et al, 2011).

4.10.5 The development of a new instrument designed to measure pain-related fear in adults aged 18 to 45 years.

The qualitative phase of this PhD highlighted that pain-related fear may be an important barrier to physical activity for younger obese adults. However, a theoretical foundation of pain-related fear as a construct did not exist for younger obese adults or adults who do not experience chronic pain (Lundberg et al, 2011). Previous research also identified that there is no conceptual model to support any of the existing measures of pain-related fear (Lundberg et al, 2011). The qualitative findings of this PhD addressed this gap showing that several factors, such as, fear, disability, guarded movements, pain catastrophizing, avoidance and pain, could characterise a construct of pain-related fear for younger adults (shown in the concept map within section 3.8.5). The findings of this quantitative phase contributed evidence to support and refine this model, partly as discussed above, but also through the development and validation of a new instrument for pain-related fear in younger adults with obesity.

The new instrument was developed using several statistical methods comprising of reliability analysis, exploratory factor analysis and confirmatory factor analysis (De Vet et al, 2011). During validation, a process of item reduction was carried out that reduced an initial 28 items to 12 items. Several important observations were made about the deleted items. The findings suggested that responses from younger adults indicated a strong correlation and possible redundancy of several items relating to disability. This suggested that the items were perceived similarly and may not have seemed relevant to younger adults given the low scoring. This assumption is supported by literature that has previously found perceptions of disability as a key concern for older adults, but not for younger adults (Vincent et al, 2014; Anjali and Sabharwal, 2018). However, heightened perceptions of disability have been identified by younger obese adults and play an important part in constructs of pain-related fear (Cooper et al, 2018). Further findings highlighted that the principle item relating to pain, (the NRS) did not adequately correlate with other items in regard to the construct of pain-related fear (Hjermstad et al, 2011). This finding was inconsistent with the earlier PhD findings that showed pain to be a factor in manifestations of fear. However, the quantitative data supported the deletion of this factor given that younger adults reported only mild severities of pain and there was also no significant difference between pain scores reported by younger obese, overweight or healthy weight adults.

A rationale for the absence of correlation between items of pain and fear, is that younger adults have higher pain thresholds and present lower levels of pain-related distress compared to older adults (Tumi et al, 2017; Molton et al, 2014). Aside from this, these findings also might suggest that the exploratory qualitative PhD findings relating to pain (in a small sample of obese younger adults) may not have been representative of the wider population of younger adults with obesity (Pazzianotto-Forti et al, 2018). This highlights the importance of quantitative methods in quantifying qualitative data, and the re-evaluation of construct factors of the initial conceptual model relating to pain-related fear in younger obese adults (Creswell, 2015; Vlaeyen et al, 2016).

4.10.6 The strength of the new 12 item instrument compared to existing instruments

Following its development, the new instrument showed modest evidence to suggest it may be a superior alternative to pre-existing instruments. This is supported by four key points: firstly, the new instrument was more strongly correlated with the TSK compared to the PASS-20, PDI and NRS (r= .508 compared to r= .500, r= .438 and r= .367) (De Vet et al, 2011). This shows that the new instrument measures similar constructs to an existing instrument relating to fear avoidance. The new instrument was more strongly correlated with the PDI than the PASS-20 and NRS (r= .734 compared to r=.487 and r= .365). (Roelofs et al, 2003). However, this was somewhat expected given that some items from the PDI were utilised in the new instrument. Secondly, analysis of construct validity showed significant differences in mean scores of pain-related fear between younger adults who participated in low levels of activity groups compared to those who participated in high levels of activity. The significant differences found between these groups are consistent with research in older adults, but are unique in that they provide validity for younger adults (Vincent et al, 2014; Vincent et al, 2013; Keating and Silverman, 2004). Thirdly, the instrument only has 12 items which substantially reduces the burden on participants compared to existing instruments (McCracken et al, 1996; Roelofs et al, 2003). Reducing response burden is important for research in that it can increase response rates and lessens administration time (Rolstad, Adler and Ryden, 2011). Finally, it also has advantages in that is has been developed with a conceptual map that provides a detailed definition of the constructs and is relevant to the target population (De Vet et al, 2011).

The conceptual map shown in figure 4.14 has been revised with findings from each phase of this PhD. This is the first measurement instrument of pain-related fear to provide conceptual details regarding its construct. This is key because recent guidelines in the COnsensus–based Standards for the selection of health Measurement INstruments (COSMIN) suggest that this is an important step in the development of measurement instruments (Mokkink et al, 2016). It could be argued that the conceptual map improves the instruments construct validity and its relevance for younger adults with respect to age, BMI, gender, language and several contexts relating to activities of daily living (De Vet et al, 2011; Lundberg et al, 2011).

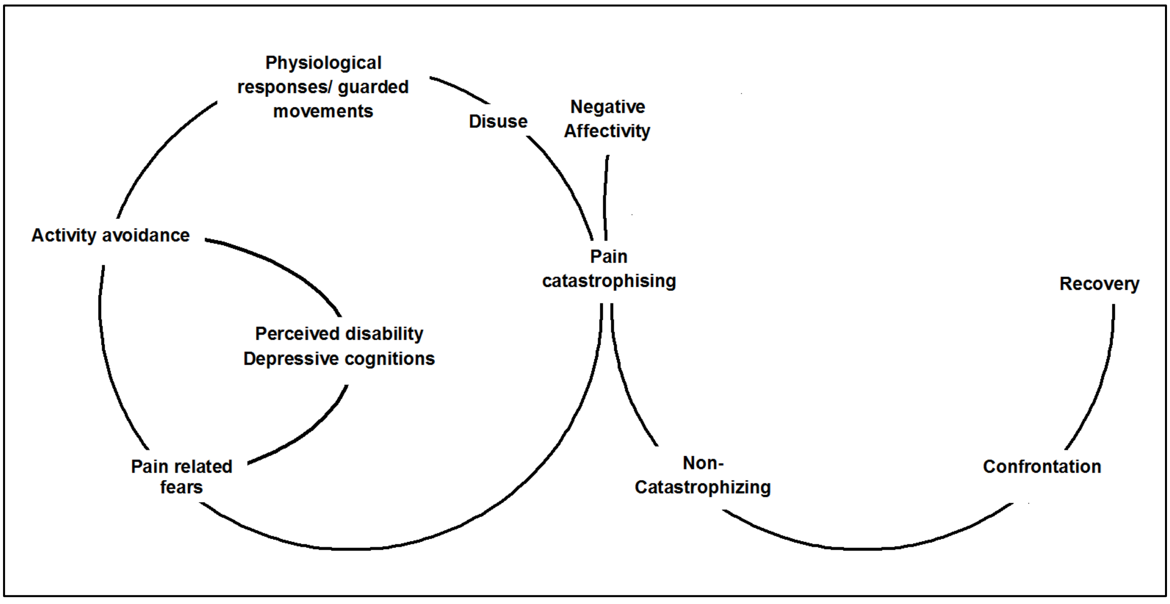


Figure 4.14. Conceptual map of pain-related fear in younger adults

In summary, the new instrument that has been developed in this study appears to be a valid and reliable measure of pain-related fear in younger adults, specifically for those who are obese. This instrument may be important because existing measures of pain-related fear have not been validated in younger adults, and they do not explicitly represent all the construct factors that were important for younger adults in the qualitative study of this PhD (Lundberg et al, 2011; McCracken, Zayfert, and Gross, 1992).

4.11 Strengths and limitations

A strength of this study is that it adhered to strict guidelines set out bet De Vet et al, (2011) around how to develop a measurement instrument for psychometric assessment. These guidelines included the validation of the new instrument using criterion validity, construct validity, factor analysis and internal consistency. Within this process, the study recruited sufficient participants to achieve statistical significance for important outcomes and thresholds, which strengthens confidence in the results (Stewart, 2007). This sample was sufficiently large for complex statistical analysis and structural equation modelling to develop and validate the new instrument (Byrne, 2009). A strong point of employing the guidelines is how the study utilised previous qualitative data in the form of a conceptual map (for pain-related fear), to inform the sub dimensions of the new instrument. The study provided further knowledge that helped refine the conceptual map.

A limitation of this study was that the researcher was unable to recruit greater numbers of inactive participants of 30 plus years of age with weight concerns. This was largely because the recruitment of this age group relied upon weight management groups which were difficult to access. Some of the managers of the weight management groups refused access because of concerns that the research was too sensitive for the members. Because of this, the sample characteristics limit the generalisability of the findings to the target population of adults between 30 and 45 years. It could also limit the interpretation of the conceptual framework toward the younger end of the 18 to 45 years age range. However, there is some literature that suggests that this may not be a substantial limitation because existing pain-related fear measurement instruments (e.g. the PASS-20) are likely to represent the concerns of both older and younger adults (Martin et al, 2005).

A further limitation that compromised the generalisability of the study can be identified because of the non-random convenience method of sampling (Stewart, 2007). This method was problematic in that the recruitment strategy targeted one university and several weight management groups within a narrow geographic area (North West of England). An example of how this limited the study was particular evident in the gender distribution of the sample. At the time of the study, the university and weight management groups had proportionately more females registered than males and this is reflected in the sample. This is likely to have an impact on fear related findings given that females generally have a higher prevalence of fear and report greater intensity of fears (Fredrikson et al, 1996). Because of this, it is unlikely that the sample is representative of the national population of adults aged 18 to 45 years, or that the study could be easily replicated (Stewart, 2007). However, this method had its advantages in that it was cost effective, time efficient and pragmatic. The convenience sampling could be considered a strength in that it provided the researcher with a large sample that allowed for enhanced methods of statistical analysis within a logistical timeframe (De Vet et al, 2011).

A limitation existed with the reliance upon self-reported participant characteristics and instrument scores (Webb and Bain, 2011). Literature has recognised that questionnaire data is subject to error through recall bias and misinterpretation of items (Vincent et al, 2011). This can result in several characteristics being underestimated and some instrument scores may be overestimated (Stewart, 2007). For example, obese adults tend to underestimate their weight compared to clinical measurement methods and inactive individuals often overestimate their levels of physical activity when completing the IPAQ-L7S (Silsbury et al, 2015; Bermudez et al, 2013). Another concern of self-reported data is that participants often give invalid and blank responses (De Vet et al, 2011). This was an important issue pertaining to this study as 44 participants (18.6%) had missing data, largely from the IPAQ-L7S. As a consequence of this, some of the data required imputation. Research states that this may be a concern because imputed data cannot completely recapture population parameters and may result in higher standard errors (Gedikoglu and Parcell, 2019). This is a notable limitation because it could have had an impact on interpretations of the associations between variables (such as physical activity levels and fear related barriers) and group mean data (Altman and Bland, 2005). However, this study mitigated these limitations by largely employing a multiple imputation method which has been shown to make the results a better estimate of the population, and increase the goodness of inferences drawn from the data (Osborne, 2009). It could be argued that these limitations were only substantial within the IPAQ-L7S data which was employed to compute physical activity levels. Although research suggests that the IPAQ-L7S is one of the most valid and reliable physical activity questionnaires, studies have identified that missing data is inherent among approximately 20% of respondents (Nolan et al, 2016; Limb et al, 2019). With this being said, it is likely that there are some issues with interpretation of the IPAQ-L7S instrument and unlikely that this study could have done anything to reduce missing data. However, the current findings relating to physical activity are consistent with previous research which strengthens the reliability of the self-reported data and mitigates some of these limitations (Vincent et al, 2014; Cooper et al, 2018).

4.12 Implications for research

The current findings provide an original contribution to knowledge within literature that identifies how pain-related fear could be a risk factor for inactivity in younger adults with obesity. The study also highlights that younger adults with obesity perceive greater levels of disability than their healthy weight counterparts. The immediate implications of the findings provide some evidence that the relationships of the conceptual fear avoidance model are valid for younger adults (Vlaeyen et al, 2012). However, there is a modest rationale to suggest that conceptualisations of fear avoidance may need to be revised to reflect how younger obese adults experience pain related fears, often in the absence of pain itself.

Further implications are that the new 12 item instrument appears to provide a valid and relevant instrument for the measurement of pain-related fear in younger adults. With epidemiological data suggesting an upward trend of obesity worldwide, the instrument may provide a more accurate and standardised measurement of pain-related fear in this population. This may help to establish the nature of relationships between fear, inactivity, disability, BMI and other factors that have yet to be explored (Nelson and Churilla, 2015). However, further research is required to provide evidence for the measurement properties of the instrument. The guidance outlined by the COSMIN study states that the instrument requires an evaluation of test re-test reliability, measurement error rate and analysis of interpretability (Mokkink et al, 2010; De Vet et al, 2011). Research is also needed to establish cut off points to classify the severity of pain-related fear within the new instrument (De Vet et al, 2011). Once established, researchers and practitioners could use the instrument to measure pain-related fear to improve understanding of individual severity in younger obese adults. This could lead to adaptations of activity interventions to minimize fear, which may increase retention. Changes could be as little as reductions in exercise intensity, use of different equipment to avoid excessive impact, or additional activity inductions to minimise catastrophisations (Rosic et al, 2019; Janney and Jakicic, 2010). The impact of these changes could be evident on the activity levels of obese adults within a short timeframe. Accurate measurement may also result in speedier referrals to appropriate professionals who can treat underlying fears (Cooper, Fairburn and Hawker, 2004).

4.13 Implications for practitioners

An immediate implication of the current findings are that they provide modest evidence that fear related barriers are likely associated with low levels of physical activity in younger adults with weight concerns. This provides practitioners and exercise specialists with an improved understanding of the barriers to physical activity experienced by obese adults.

The broader implications of this research are that these barriers may restrict efforts by practitioners, because they can weaken perceptions of exercise capability and exacerbate functional limitations. The current research identified that fearful cognitions likely lead to heightened perceptions of disability, and may also reduce the success of interventions because they limit motivations and opportunities for health promoting behaviour change. In broader health promotion efforts, practitioners may need to integrate strategies to tackle fear through novel interventions in order to decrease perceptions of disability and increase the likelihood that obese adults feel physically and psychologically capable to engage in sustained activity.

4.14 Chapter summary

In this chapter, a new instrument to measure pain-related fear was developed from the items of two (PASS- 20, PDI) instruments considered by literature to be good measures of pain-related fear (Lundberg et al, 2011). These instruments were shown in this study to have good validity in the study population of adults aged 18 to 45 years. They also mapped onto constructs in a conceptual map developed from the findings of the qualitative phase of the PhD (chapter three).The process of validation of the measurement instruments and the development of the new instrument suggested that the construct factor of pain as measured by the NRS was not a key component of pain-related fear in this population of younger adults. This led to refinement of the conceptual map that was originally developed to include pain following the qualitative study in chapter three.

The new instrument was named the Pain-Related Fear Scale and is based on the construct of pain-related fear in younger adults. It has four sub dimensions: fear avoidance, perceived disability, pain catastrophizing and physiological anxiety. It is 12 items long compared to 27 items which make up the two measures, PASS 20 and PDI, and as such is not only conceptually based but also less burdensome on participants and researchers. The Pain-Related Fear Scale had good construct and criterion validity.

Following the development of the instrument there is a need to establish if the Pain-Related Fear Scale can identify differences in scoring between a range of BMI categories. In the following chapters, there will be an exploration of relationships between pain-related fear and BMI, and a general discussion of the PhD thesis that summarises the key findings of chapters two, three and four.

Chapter 5

An exploration of relationships between pain-related fear and body mass index

5.0 Background

Findings from the previous chapter highlight that a newly developed 12 item instrument appears to be valid and relevant instrument for the measurement of pain-related fear in younger adults. This instrument was named Pain-Related Fear Scale. The Pain-Related Fear Scale was found to be superior to existing instruments for the measurement of pain related fear in younger adults aged between 18 to 45 years (McCracken et al, 1996; Roelofs et al, 2003). This was supported by correlations with existing instruments, significant differences in scores between physical activity groups and a conceptual underpinning that provides a detailed definition of the construct to be measured (De Vet et al, 2011). Having identified a valid instrument to measure pain related fear in younger adults, the next step was to explore if pain related fear differs between BMI categories. As a first step, this was explored using the survey data from participants in the quantitative study of chapter four. An observation of greater scores among obese compared to healthy weight adults could strengthen the construct validity of the new instrument and the conceptual underpinning for the construct of pain related fear in a younger adult obese population (concept map seen in chapter three and four).

5.1 Aim

The aim was to explore if the new pain-related fear instrument (Pain Related Fear Scale) scores differ between different BMI groups (healthy weight, overweight and obese adults).

5.2 Methods

5.2.1 Study design, participants, setting, criteria and ethics

The exploration in this chapter relies upon the data that was collected in the study in chapter 4. The study design, sampling, participants, settings, recruitment, ethical considerations and exclusion criteria are outlined in section 4.2 of the previous chapter.

5.2.2 Data collection method and measurement instruments

The methods of data collection are outlined in section 4.6 of the previous chapter. The new instrument (PRFS) was developed from a combination of existing instruments which were used to collect data in the quantitative study (chapter four). This means that the data was also employed to explore if the new instrument scores differed between BMI groups.

5.3 Data analysis

Pain-related scores for the new Pain Related Fear Scale were compared across participant BMI groups (healthy, overweight, and obese) using an analysis of variance (ANOVA) with pairwise testing. This was conducted using a Bonferroni test to identify the significance across the different subgroups (i.e. healthy weight and obese etc.).

Further analysis was conducted to determine if the there was an independent relationship between the new instrument score and BMI, accounting for age or gender. Univariate analysis of variance modelling was conducted to explore the effect of potential confounding factors, BMI, age and gender on the association between the new instrument scores and physical activity. This determined if younger obese adults differ in pain-related fear scores when the effects of age and gender within the sample are taken into account.

5.4 Results

5.4.1 Comparison of mean scores between BMI classifications of new 12 item instrument

Having established that the new instrument had adequate validity, a further aim was to explore if pain-related fear scores differ between different BMI classifications (healthy weight, overweight and obese adults). The underweight BMI classification was excluded because participant numbers were too small for meaningful analysis (n= 8) (De Vet et al, 2011). The analysis compared the new instruments mean scores between healthy weight, overweight and obese BMI classifications. Mean scores showed that the obese group had a higher score compared to the overweight and healthy weight groups (seen in table 5.1). An analysis of variance (ANOVA) indicated that mean scores of the new 12 item instrument were significant between BMI classifications.

Table 5.1. New instrument scores in healthy weight, overweight and obese BMI classifications

BMI	Healthy weight	Overweight	Obese	Total	Between groups (P value)
Frequency	93	71	64	236	
Mean	22.3	20.3	29.8	23.6	
SD	11.08	10.80	12.01	11.81	
Median	22.0	21.0	28.5	23.0	
Statistical significance (ANOVA)					0.000
df					3
F					9.727

*SD= Standard Deviation, ANOVA= Analysis Of Variance

The Bonferroni test determined statistical significance of mean scores within the pairings of each BMI classification. The analysis showed that the new instrument scores were significantly higher in obese adults compared to healthy weight adults (P= 0.000), and in obese adults compared with overweight adults (P= 0.000) (statistical significance less P= 0.05). However, mean instrument scores were not statistically significant between the healthy weight and overweight BMI classifications (as seen in table 5.2).

Table 5.2. Statistical significance of new 12 item mean scores differences between each pairing of BMI classification.

Statistical tests	BMI (I)	BMI (J)	Mean difference (I-J)	Std. Error	Significance (P value)	95% CI (Lower bound)	95% CI (Upper bound)
Bonferroni	Healthy weight	Obese	-7.4*	1.820	.000	-12.26	-2.58
	Overweight	Healthy weight	-2.0	1.766	1.000	-6.73	2.66
	Obese	Overweight	9.4*	1.931	.000	4.31	14.60

*Mean difference statistically significant at 0.05.

5.4.2 Analysis to identify if age or gender could be confounding the relationship between BMI and the new instrument scores.

Having established that a higher BMI is associated with increased pain-related fear in younger adults, an ANOVA was employed to determine if age or gender were confounding factors. These characteristics were explored because previously literature has highlighted that fear related barriers to activity may be greater in females versus males and in older versus younger adults (Kumar et al, 2016; Zelle et al, 2016).

Pairwise analysis revealed that the new instrument scores were statistically significant between some male and female participants and age of different BMI classifications (seen in table 5.3). This indicated that gender and age could be a confounding factor between the relationship between BMI and instrument scores. Because of these findings, a comparison was made between BMI vs age and BMI vs gender (De Vet et al, 2011).

Table 5.3. Pairwise comparisons of means between gender and BMI groups

Gender	BMI	BMI comparison group	Mean difference	Statistical significance
Male	Healthy weight	Underweight	-4.619	1.00
		Overweight	2.555	1.00
		Obese	-6.141	0.434
	Overweight	Underweight	-7.174	1.00
		Healthy weight	2.555	1.00
		Obese	-8.696	0.057
	Obese	Underweight	1.522	1.00
		Healthy weight	6.141	0.434
		Overweight	8.696	0.057
Female	Healthy weight	Underweight	6.389	0.922
		Overweight	1.785	1.00
		Obese	-8.148	0.002*
	Overweight	Underweight	4.604	1.00
		Healthy weight	-1.785	1.00
		Obese	-9.932	0.00*
	Obese	Underweight	14.537	0.011
		Healthy weight	8.148	0.002*
		Overweight	9.932	0.00*

*Statistical significance less than 0.05, BMI= Body Mass Index.

Similar to the findings relating to gender, statistically significance differences in new instrument scores were identified between several age categories of participants within different BMI classifications (seen in table 5.4). Having identified significant differences between several groups, further analysis was conducted to establish if these differences interacted with the relationship between BMI and the pain-related fear scores.

Table 5.4. Pairwise comparisons of means between age and BMI groups to establish statistical significance between mean scores

Age	BMI	BMI	Mean difference	Statistical significance
18 to 21 years	Healthy weight	Underweight	4.026	1
		Overweight	3.989	0.472
		Obese	-3.447	1
	Overweight	Underweight	0.048	1
		Healthy weight	-3.989	0.472
		Obese	-7.436	0.047
	Obese	Underweight	7.484	0.657
		Healthy weight	3.447	1
		Overweight	7.436	0.047*
22 to 25 years	Healthy weight	Underweight	-	-
		Overweight	2.456	1
		Obese	-12.611	0.007*
	Overweight	Underweight	-	-
		Healthy weight	-2.456	1
		Obese	-15.067	0.004*
	Obese	Underweight	-	-
		Healthy weight	12.611	0.007*
		Overweight	15.067	0.004*
26 to 29 years	Healthy weight	Underweight	-	-
		Overweight	6.455	1
		Obese	3.955	1
	Overweight	Underweight	-	-
		Healthy weight	-6.455	1
		Obese	-2.500	1
	Obese	Underweight	-	-
		Healthy weight	3..955	1
		Overweight	2.500	1
30 to 33 years	Healthy weight	Underweight	-	-
		Overweight	-	-
		Obese	-	-
	Overweight	Underweight	-	-
		Healthy weight	-	-
		Obese	-9.100	0.216
	Obese	Underweight	-	-
		Healthy weight	-	-
		Overweight	9.100	0.216
34 to 37 years	Healthy weight	Underweight	3.000	1
		Overweight	-17.875	0.749
		Obese	-27.000	0.151
	Overweight	Underweight	20.875	0.440
		Healthy weight	17.875	0.749
		Obese	-9.125	0.869
	Obese	Underweight	30.000	0.078
		Healthy weight	27.000	0.151
		Overweight	9.125	0.869
38 to 41 years	Healthy weight	Underweight	-	-
		Overweight	-8.417	0.944
		Obese	-18.875	0.016*
	Overweight	Underweight	-	-
		Healthy weight	8.417	0.944
		Obese	-10.458	0.478

	Obese	Underweight	-	-
		Healthy weight	18.875	0.016*
		Overweight	10.458	0.478
42 to 45 years	Healthy weight	Underweight	-	-
		Overweight	-	-
		Obese	-	-
	Overweight	Underweight	-	-
		Healthy weight	-	-
		Obese	-7.000	0.461
	Obese	Underweight	-	-
		Healthy weight	-	-
		Overweight	7.000	0.461

*Statistical significance less than 0.05, BMI= Body Mass Index.

Further analysis was conducted to determine if the there was an independent relationship between the new instrument score and BMI, accounting for age or gender. Univariate analysis of variance modelling showed that pain-related fear scores (measured by the new instrument) were statistically significant between BMI groups (F= 9.727, P= 0.000). This remained statistically significant when age and gender were accounted for either independently or collectively (F= 7.776, P= 0.000). This can be seen in table 5.5.

Table 5.5. Tests of Between-Subjects effects for age, gender and BMI on new instrument scores.

	Type 3 sum of squares	Degrees of freedom	F	Statistical significance (P value)
Corrected Model	7091.48	37	1.895	0.003
Intercept	23743.329	1	198.475	0.000
Age	1133.907	6	1.580	0.154
BMI	2787.095	3	7.776	0.000
Gender	50.298	1	0.396	0.530
Age * BMI	2024.122	11	1.538	0.119
Gender * BMI	15.116	3	0.402	0.752
Gender* BMI * Age	3463.077	27	1.048	0.407

*Dependant variable= new instrument scores, BMI= Body Mass Index

5.5 Discussion

The aim of this chapter was to explore if the new instrument (the Pain Related Fear Scale) scores differ between BMI groups (healthy weight, overweight and obese adults). The findings highlighted significantly greater pain related fear scores among younger obese adults compared to younger overweight and healthy weight adults (e.g. obese versus healthy weight; mean 28.8 and 22.3, $F= 9.727$, $P=0.00$) (18 to 45 years old). The new instrument demonstrated good construct validity in that it identified significant increases by at least a score of seven between BMI groups (e.g. difference between obese and overweight, mean 9.4, 95% CI 4.31 to 14.60 and obese compared to healthy weight, mean, 7.4, 95% CI 12.26 to 2.58). These findings are consistent with previous research which has identified that pain-related fear is greater among obese adults compared to none-obese adults (Vincent et al, 2011). The results support previous research suggesting that pain-related fear in obese adults may be associated with, and could enhance prediction of perceived disability and levels of physical activity (Vincent et al, 2011). The exploratory data suggests that the new instrument for the measurement of pain-related fear is consistent with the hypothesis of literature regarding differences between BMI groups (De Vet et al, 2011).

The current findings provide some modest evidence that the conceptual map may be valid for younger obese adults given that it demonstrates a graphic display of the factor dimensions that were used to identify significant differences between BMI groups (figure 4.14). The data strengthens an exploratory rationale to suggest that pain related fear may be a barrier to activity among younger adults, and that these fears may be greater among those with a BMI above $30kg/m^2$ (Vincent et al, 2011; Wingo et al, 2011; Vincent et al, 2010). This could be important in that obese adults aged 18 to 45 years may be at an increased risk of activity avoidance through similar relationships with fear than older adults (Vlaeyen et al, 2012). The results appear to suggest that younger obese adults could experience fearful cognitions that may lead to activity avoidance, resembling the conceptual relationships of the fear avoidance model (Vlaeyen et al, 2012). The findings provide modest support to suggest that pain related fear could be a contributing factor as to why some obese adults may remain inactive for long periods, unable to enact health promoting behaviour change (Mitchie, Atkins and West, 2014).

5.6 Strengths and limitations

The strengths of these exploratory findings are alike those in the quantitative study in chapter four (section 4.11), in that the sample was sufficiently large for complex statistical analysis (Byrne, 2009). These findings highlighted modest differences in pain related fear between younger adults with different BMI classifications. However, there are some limitations because the analysis relied upon data from the quantitative study in chapter four. For example, it is unlikely that the data can be generalised to the larger population of younger adults (aged 18 to 45 years) because of the relatively small sample of obese participants aged between 30 to 45 years, and because of the non-random convenience method of sampling (Stewart, 2007). There is also a limitation in the findings relating to the construct validity of the new instrument because the analysis was conducted using the same population data from chapter four. This is because De Vet et al, (2011) states that validation studies of an instrument for its application in other populations should be conducted with a separate sample. Measurement within a separate sample ensures that the instrument performs equally well within a population that it was not originally developed (De Vet et al, 2011). A further limitation exists in interpretating the power of the seven-point difference found between the BMI classifications (De Vet et al, 2011). This is because there is a dearth of literature that has established the clinical significance of pain related fear scores in populations of younger adults with weight concerns.

5.7 Implications for research and practitioners

The immediate implications of the exploratory findings are that they provide modest evidence that greater pain related fears may be associated with higher BMI, especially when BMI rises above 30kg/m^2. These findings may provide some insight for practitioners and researchers into the fear related experiences of younger adults who are obese. The results may be helpful in developing broader intervention functions for health promotion that tackle fear by increasing perceptions of exercise efficacy (Mitchie, Atkins and West, 2014). The data likely strengthens the construct validity of the new instrument which may provide researchers with a more accurate and standardised measurement of pain-related fear in younger obese populations (De Vet et al, 2011).

5.8 Conclusion

An exploration of the relationship between scores for the new Pain-Related Fear Scale showed that it could identify differences in pain-related fear between BMI groups.

Importantly, these instrument scores were statistically significant between BMI categories when age and gender were accounted for either independently or collectively ($F= 7.776$, $P= 0.000$). These findings could strengthen existing evidence that suggests pain related fear is a barrier to activity among adults aged 18 to 45 years, and that greater fears may be associated with heightened BMI above $30kg/m^2$ (Wingo et al, 2011; Vincent et al, 2011; Rosic et al, 2019). However, further research is needed given the study limitations to confirm and quantify the findings in other populations of adults with weight concerns.

The following chapter will be a general discussion that will place an important emphasis on the primary research studies of this PhD and how they can be interpreted collectively to improve understanding of fear related barriers that prevent younger adults from participating in physical activity. The discussion will also conceptualise the findings of the thesis against popular fear avoidance and behaviour change models to highlight how fear related barriers can be addressed through intervention. Finally, the discussion will highlight the strengths and limitations of this PhD and what implications the findings may have for research, practitioners, and clinicians.

Chapter 6

A General Discussion of the PhD Findings

6.1 Recap of the PhD aims and objectives

The aim of this PhD was to investigate the emotion of fear as a barrier to physical activity in young obese adults. The PhD objectives were as follows:

Research Objectives

1. To explore whether and how fears contribute to the lack of physical activity engagement in young obese adults.
2. To identify existing measures of fear that relate to activity.
3. To use existing tools and if necessary, develop a new tool to estimate levels of fear related to activity in young obese adults and to compare these across body mass index (BMI) classifications.

The following sections outlines how the findings contribute to, and further the current knowledge in the field.

6.2 Key findings of the research

In chapters one and two of this PhD, the literature highlighted that there is currently a growing public health concern relating to obesity and inactivity (Mayo et al, 2019; Fruh, 2017). This is important because Individuals with obesity are at an increased risk of developing comorbid conditions which can be somewhat mitigated through regular activity (Fruh, 2017). However, the literature highlights that adults with obesity face a range of barriers that prevent them from participating in activity (McIntosh, Hunter and Royce, 2016). Chapter three of this PhD explored these barriers in younger obese adults, highlighting that experiences of fear were an important factor in the avoidance of activity. This data provided a framework of the important factors that contribute to younger adults' conceptualisations of fear related barriers. This led to a review of the fear avoidance model, a conceptual model by Vlaeyen and Linton (2000), which was subsequently revised using the findings of this phase of the study (section 3.8.5). The fear that appeared to be most important related to pain. Pain-related fears often manifested from experiences of pain, likely exacerbated perceptions of disability and increased activity avoidance. However, pain-related fear had not been confirmed or quantified in younger obese adults. Chapter four explored and identified that the construct of pain-related fear for younger obese adults could be made up of six factors: fear beliefs, disability, physiological responses/ guarded movements, pain catastrophising, avoidance/ escape and experienced pain. This led to the development of a conceptual map which provided the conceptual underpinning for the measurement of pain-related fear in younger adults aged 18 to 45 years. In order to further investigate levels of pain-related fear, identify if it is worse in obesity compared to other BMI categories, and explore its outcomes, a valid instrument was needed for the purpose of measurement.

Although pain-related fear measures have been developed, these have primarily been for older adults (suffering chronic pain) and have yet to be underpinned by conceptual knowledge. Therefore, in chapter four the validity of these measures and their relationship to the conceptual map was investigated, which led to the development of a new shorter instrument: The Pain-Related Fear Scale. As this had good construct and criterion validity, it was used to measure pain-related fears in the sample of adults aged 18 to 45 years. The findings of chapter four highlighted that in this sample of adults aged 18 to 45 years, pain-related fears were significantly greater in younger obese adults compared to their healthy weight counterparts. It also provided some validation for all but one of the factors within the conceptual map that had been developed and revised in chapter three and four.

This chapter will discuss how the findings from chapters three and four can be interpreted collectively to highlight novel factors that may prevent younger adults from adhering to activity guidelines. Firstly, there will be a discussion of fear related barriers and how they are associated with activity avoidance. Secondly, the discussion will consider other key factors that may contribute to inactivity, particularly among younger adults with a BMI that exceeds 30 kg/m^2. Thirdly, there will be a critically analysis of theoretical concepts to assess whether a new conceptual framework may have greater validity for the measurement of pain-related fear in younger adults. This will include how the conceptual map was developed and revised with the findings from each phase of this PhD (with inspiration from the fear avoidance model) (Vlaeyen and Linton, 2000). The discussion will then evaluate popular behaviour change models to highlight how fear related barriers can be addressed through intervention. Finally, the chapter will highlight the strengths and limitations of this PhD overall and what implications the findings may have for research, practitioners and clinicians.

6.2.1 Comparison between qualitative and quantitative findings

This research included both a qualitative and quantitative study. Largely, the findings from the qualitative study were confirmed and quantified in the quantitative study. An example of this is that participants in the qualitative study reported fears of pain which prevented them from engaging with physical activity. These were confirmed in the quantitative study with scores showing significantly greater pain-related fears among less active groups compared with more active groups. However, there were other key findings from the qualitative study which were not supported with results of the quantitative study. In particular, participants in the qualitative study reported pain as a barrier to physical activity and described it as a factor in the manifestations of fear(s). However, the quantitative study found no statistical significance in pain between those who participated in low activity compared with moderate or high activity, or between obese adults compared to healthy weight adults. These findings will be discussed in greater depth within further sections of this chapter. A summary of the qualitative and quantitative can be seen in table 6.1.

Table 6.1 Summary of findings from the qualitative and quantitative studies on fear in this PhD

Associated factors	Qualitative findings	Quantitative findings
Physical activity	Younger obese adult perceived fear as a barrier to activity that appeared to modify behaviour leading to a partial or complete avoidance of physical activity.	Significantly greater pain-related fears among less active groups compared with more active groups.
Body Mass Index	Younger obese adults experienced several fears that may have provoked activity avoidance.	Significantly greater pain-related fears among younger obese adults compared with younger overweight and healthy weight adults. Modest correlation between instrument scores and BMI.
Age	No association between fear and age could be established within the narrow range 18 to 45 years.	Increasing age may be a predictor for increased pain-related fear (measured by the TSK). Modest correlation between instrument scores and age.
Gender	Both male and female participant's highlighted fear related barriers to activity.	Gender was not a statistically significant predictor of pain-related fear. Weak correlation between pain-related fear and gender.
Perceived disability	Younger obese adults who experienced fear described low self-efficacy and increasing perceptions of disability, specifically related to physical activity.	Younger obese adults had higher perceptions of disability compared to the younger overweight and healthy weight adults.
Pain	Younger obese adults often described pain as a barrier to physical activity and associated the experience with negative emotions such as trauma or frustration.	No statistical significance in pain between those who participated in low activity compared with moderate or high activity, or between obese compared to healthy weight adults.

6.3 Exploring how fear contributes to activity avoidance and inactivity

Objective one of this PhD was addressed through the qualitative study in chapter three. The findings identified several explicit fears that may have contributed to activity avoidance behaviour. This included fears relating to weight stigma, negative evaluation, injury, and pain. While some of these fears have been highlighted by previous research in this age group (Rosic et al, 2019), this PhD provides unique insights into fears relating to pain (Vartanian and Novak, 2011). Previous studies have shown that pain-related fear is associated with declines in physical activity among middle to older aged adults, but has yet to explore the association in younger adults (Verbunt et al, 2005). What is currently known about this association is that pain-related fears manifest and contribute to activity avoidance through two known pathways (Amundsen, Norton and Vlaeyen, 2003).

The first pathway is that fear avoidance manifests from painful experiences that are interpreted as unpleasant and undesirable (Vlaeyen et al, 1995). Pain frequently interferes with cognitive function and because of this, a defensive response is elicited to dampen or extinguish it (Sokolov, 1963). In this instance, individuals become conditioned to minimise pain through a defensive behavioural response (avoidance) (Asmundson and Wright, 2004). This behaviour becomes problematic when avoidance is provoked even when the threat of pain is low (Asmundson, Norton and Vlaeyen, 2004). The defensive behaviour is sometimes beneficial under circumstances where injury has occurred and avoidance allows the damaged tissue to heal (Fordyce et al, 1982). However, in many cases individuals are restricted by patterns of avoidance that become desynchronised from sensory components of pain (Lethem et al, 1983; Asmundson, Norton and Vlaeyen, 2003). Hence, there is often a reduction in health promoting behaviour such as physical activity (Vlaeyen and Linton, 2000). Evidence from the current PhD shows that this pathway may not represent how fear contributes to activity avoidance in younger adults because experiences of pain were found to be largely mild, whilst pain-related fears were found to be severe (Marshall, Schabrun and Knox, 2017).

In the second pathway, fear avoidance is similar in that it is acquired through behavioural conditioning but different in that it does not involve painful experiences. Instead, it is transmitted through verbal and observation learning of fear related stimulus (Martinez-Calderon et al, 2019). These transmissions provide a novel stimulus which provokes catastrophisations resulting in fearful cognitions (Vlaeyen and Linton, 2000). The current

PhD shows that this pathway is likely the primary means in which fear contributes to activity avoidance in younger adults. This is inconsistent with findings in older adults and is novel in that it reflects a need for conceptual reform within existing constructs of pain-related fear (Vincent et al, 2014). Importantly, these findings reject existing ideologies that highlight experiences of pain as key component of fear avoidance for younger obese adults (Vlaeyen et al, 2000).

6.3.1 Exploring whether the relationship between fear(s) and physical activity may be different for younger obese adults compared to younger healthy weight and overweight adults

Objective one of this PhD also sought to explore whether fears contributed to inactivity for younger adults with obesity. The qualitative study in chapter three highlighted that younger obese adults experienced several activity related fears that appeared to contribute to activity avoidance. Notably, fears relating to pain were identified by a large proportion of the sample and from detailed descriptions were deemed the most important fear related barrier. This was a novel finding in that it had not yet been identified within current literature as a barrier to activity in younger adults (Denison et al, 2015). These results may be important for growing trends in inactivity because existing research shows that fear could be a risk factor that worsens avoidance (Wingo et al, 2011; Alquot and Reynolds, 2014; Denison et al, 2015). The findings show that activity avoidance may be exacerbated by weight concerns because obese adults have heightened physical reactions to activity (often causing musculoskeletal pain) (Wingo et al, 2011; Hills et al, 2006). It is also believed that obese adults interpret physical responses (particularly breathlessness and muscle tightness) differently than healthy weight adults, which may provoke greater activity avoidance (Wingo et al, 2011).

The current findings suggest that younger obese adults experienced fear that may have also provoked catastrophic ideations, and increased perceptions of disability. This is important given that these factors are independently associated with inactivity (Donini et al, 2016). The current results are consistent with the findings of older obese adults who have reported greater fears, lower quality of life and reduced physical function compared to their non-obese counterparts (Vincent et al., 2010). This highlights similarities in how experiences of fear contribute to activity avoidance between younger and older adults.

Aside from inactivity, a secondary consequence is that younger obese adults who encounter fear related barriers are likely to experience increases in catastrophisations of pain (Lykouras, 2008).

This PhD provides some modest evidence that catastrophisations of pain could independently impact on the ability to participate in physical activity (Gatineau and Dent, 2011). The qualitative study identified that catastrophisations of pain may worsen motivation and exercise efficacy, which are important facilitators of physical activity for obese adults (McIntosh et al, 2016). The data suggested that if left unmanaged, catastrophisations of pain could interact with several other psychological factors such as negative affectivity, low mood and low self-esteem. These factors are known to promote sedentary behaviour (Vincent et al, 2014; Chwastiak et al, 2011). Examples of this were evident in the qualitative study of this PhD, whereby a small sample of younger obese adults became physically and psychologically disabled by negative cognitions relating to pain.

Arguably, the most notable concept within existing models of fear avoidance is that catastrophisations of pain frequently develop into pain-related fears (Vlaeyen et al, 2012). This is important given that the consequences of pain catastrophisations are detrimental to activity adherence, and that it may be necessary to address them through cognitive intervention (Cooper, Fairburn and Hawker, 2004).

6.3.2 Exploring the relationship between perceived disability, physical activity and its association with pain-related fear.

A further finding of this PhD was that younger adult's perceptions of disability appeared to be positively associated with low levels of physical activity. This was highlighted in the qualitative findings by participants who described feeling disabled by their obesity and because cognitions relating to pain discouraged them from engaging in activity. This is consistent with previous studies conducted with older adults with obesity (Vincent et al, 2014). However, the current findings are unique in that they highlighted increasing perceptions of disability that may have been a result of heightened fears relating to pain. This was identified in the quantitative study using scores from instruments that measured perceived disability (PDI) and pain-related fear (the new 12 item instrument). Notably, the magnitude of this relationship was greater than that of previous studies (*r*= .734 compared to *r*= .420) (Zale et al, 2013). This is likely due to key differences in conceptual understanding of disability between younger and older age adults (previous studies have largely recruited older adults aged 45 years and above) (Zale et al, 2013). For example, older adults have been found to perceive disability largely in relation to physical restrictions, whereas younger adult's interpretations focus more upon psychological and emotional health (Sutin et al, 2015). The current study support this finding and demonstrates that pain-related fear may be an indicator to disability, more so than pain itself (Crombez et al, 1999; Lentz et al, 2010). This is an important discovery given that obesity and mobility disability are already established as risk factors for inactivity in elderly adults (Vincent, Vincent and Lamb, 2010).

A further finding of the qualitative study was that family obligations of younger adults may have contributed to activity avoidance. This was primarily because of concerns about becoming disabled and not being able to provide for the family in the event of an activity related injury. These concerns have previously been identified in middle aged adults with obesity, but this is the first study to identify this in younger obese adults (Tukker, Visscer and Picavet, 2009; Cho and Park, 2017). This is a key finding given that previous research suggests that over 50% of adults remain inactive for extended periods because of barriers related to family obligations (Cho and Park, 2017). With the possibility that this may be a mediating factor in the association between fear and disability, practitioners may want to consider how to mitigate these concerns within interventions. It is likely that practitioners will need to explore family concerns and try to alleviate them on an individual case by case basis (Cooper et al, 2017). These findings provide some modest support for the fear avoidance model through the dynamic relationships between perceptions of pain-related fear, disability and inactivity (Vlaeyen et al, 2012). However, further research is needed to identify additional psychological components that contribute to perceptions of disability and how these impact on physical activity for obese adults.

The quantitative study in chapter four of this PhD provided some evidence to support the associations between perceived disability and reductions in physical activity, as well as with increased BMI (exceeding 30kg/m^2). However, there is some conflicting literature suggesting that relationships between activity, BMI and perceived disability are strongly mediated by presence of pain (Marshall, Schabrun and Knox, 2017). This may not be supported by the current study given that perceptions of disability were greater among obese adults who reported little to no pain. The qualitative data corroborated these findings, highlighting that perceived disability appeared to be exacerbated by negative cognitions of weight and fear, not pain. A rationale for the discrepancy in findings could be that previous research recruited older adults or adults with degenerative musculoskeletal conditions (who often suffer chronic pain) (Wilkie, Tajar and McBeth, 2013). The PhD findings show that associations between perceived disability and activity avoidance in younger adults, are more likely to be strengthened by psychological components related to fear, rather than physical experiences of pain. However, further research is needed to clarify these relationships as the instruments used in the current study did not distinguish between measurements of physical and psychological components of disability (Tait et al, 1987). This PhD provides modest indications to support the proposed factors of existing fear avoidance models, but with the novel addition that there seems to be a bi-directional relationship between activity avoidance and disability (likely mediated by fear) (Vlaeyen and Linton, 2000; Leeuw et al, 2007). This is crucial for practitioners in that perceptions of disability may need to be lessened prior to activity interventions in order to minimise dropout.

6.3.3 Exploring the association between fear and mental ill health and how it may contribute to inactivity

This PhD provided novel findings highlighting that younger adult's fearful cognitions likely triggered activity avoidance. However, this was arguably not the most damaging consequence of fear. The qualitative study in chapter three suggested that younger adults with obesity experienced several instances of psychological distress as result of fear (Marshall, Schabrun and Knox, 2017). This was evident in that participants felt worried and unhappy about the impact fears had on their quality of life, particularly relating to social wellbeing. Notably, this relationship may have been bi-directional in that younger adults experienced psychological distress relating to body image concerns, which often manifested into fear. A limitation of these findings is that it is difficult to quantify because distress, depression nor mental ill health were measured in the quantitative study. However, the quantitative data did show significantly greater catastrophisations and perceptions of disability among younger obese adults compared to younger healthy weight adults. These factors may indicate some worsening of mental ill health given that previous literature has highlighted positive associations between perceived disability and depression (Garbi et al, 2014). This could be concerning for the younger adults with obesity, as poor mental health in this age group has risen significantly in the past decade (Twenge et al, 2019). These findings are important because these factors can independently restrict an individual's ability to enact health promoting behaviours (such as physical activity) (Gatineau and Dent, 2011; NHS Digital, 2017).

This PhD demonstrates that pain-related fears appears to contribute to distress, worsening inactivity. The qualitative study in chapter three demonstrated that fears related to pain may have provoked depressive cognitions, stress, social-isolation and a decline in quality of life. There was some evidence that these relationships were bi-directional in that incidents of acute stress such as painful experiences of exercise, likely exacerbated fearful cognitions which may have provoked activity avoidance (Elsenbruch and Wolf, 2015). However, further research is needed to confirm the associations between pain-related fear, mental ill health and inactivity in younger adults with a range of BMI. Collectively, these findings strengthen the limited literature that proposes a bi-directional relationship between fear and obesity related mental ill health (Okifuji and Hare, 2015). With the current findings, a rationale exists to suggest that these factors create a complex web of barriers which impact upon physical activity adherence (Egan et al., 2013). Practitioners may need to consider the impact of fear and depressive cognitions on physical activity, because it may be that younger adults who are obese do not feel psychologically capable (mediated by fear) or motivated to engage with activity (Luppino et al., 2010). This will possibly limit the success of interventions because desired behaviour change is unlikely to occur without adequate motivation or perceived capability (key components of popular behaviour change models such as the COM-B) (Mitchie, Atkins, and West, 2014). The current PhD reinforces the importance of addressing mental health concerns such as fear, that will likely increase physical activity in younger adults who are obese (McIntosh et al., 2016; Sallinen et al., 2009; Flannery et al., 2018; Ball, Crawford and Owen, 2000). It also serves to strengthen existing conceptions of the sequential relationships between fear related activity avoidance and poor mental health within existing fear avoidance models (Gatineau and Dent, 2011; Vlaeyen and Linton, 2000).

6.4 A conceptual framework map of pain-related fear in younger adults

From the data identified in this PhD, it was evident that younger adults experience fear(s) that are likely to be important for participation in physical activity. The scoping review in chapter two identified activity related fear(s) that largely restricted participation within physical activity (Dikareva et al, 2016; Rosic et al, 2019; Cooper et al, 2017; Vincent et al, 2011). The findings shown in chapter three provided some tentative evidence that activity avoidance is a likely consequence of experiences related to fear. Fear avoidance of activity was also likely to be associated with poor mental health and feelings of negative affectivity. These factors frequently prevented participants from partaking in physical activity. Negative views about self-image were found to reduce motivation and self-esteem. These findings contributed to the development of a conceptual map which represented a revision of the fear avoidance model by Vlaeyen and Linton, (2000), explicitly for younger obese adults. The map visually demonstrates that pain or negative affectivity could lead to catastrophisations which may manifest into fears, provoking activity avoidance and mental health concerns (such as disability and depression).

Investigation in chapter four focused upon fears related to pain as one of the key factors of the conceptual maps. The findings from the quantitative study confirmed and quantified several of the construct factors within the previous revisions of the conceptual map. However, the factor of pain (as measured by the NRS) appeared not to be a key component of pain-related fear in this population of younger adults. With this information, the final conceptual map was refined to represent how younger adults may perceive the construct of pain-related fear. This is particularly useful because it determines the construct and the relationships with its factors that are necessary for the development of a new measurement instrument (De Vet et al, 2011). This is a novel approach within the measurement of pain-related fear given that existing instruments are devoid of conceptual frameworks, lack construct validity and are difficult to interpret for measurement (Lundberg et al, 2011).

In this PhD, there were several factors that were found to contribute to pain-related fear namely disability, catastrophisations of pain, activity avoidance and physiological responses/ guarded movements. The qualitative study of this PhD highlighted that a conceptual map for pain-related fear needed to be both formative and reflective (De Vet et al, 2011). This meant that there was a conceptual factor that formed or caused the construct (left-hand side), whilst several factors manifested from the construct (right hand side) (De Vet et al, 2011). Conceptually, if the factor on the left (pain catastrophizing) increases, it is likely that the construct of pain-related fear increases. If the construct of pain-related fear increases, it is expected that all the factors on the right hand side of the model will increase (De Vet et al, 2011). By observing or measuring these factors there could be an evaluation of the presence and degree of pain-related fear (De Vet et al, 2011).

The final version of the conceptual map that has been developed in this PhD is consistent with several components of the Fear Avoidance Model (Vlaeyen and Linton, 2000). For example, there are some similarities in the sequential relationships between fear and avoidance, fear and disability and pain catastrophizing and fear (Vlaeyen and Linton, 2000). These similarities are important because it suggests that the construct has a foundation within theory through well-established cognitive-behaviour fear avoidance models (Lundberg et al, 2011). However, a comparison of the new and existing conceptual map (seen in figure 6.1 and figure 6.2) reveals several distinct differences, such as the absence of pain and injury. An explanation for this may be that the fear avoidance model was designed with evidence from clinical pain patients, whereas this PhD developed its framework with data from a non-clinical sample (Vlaeyen and Linton, 2000). This is important for clinicians in that it highlights a need to personalise interventions that aim to reduce fear related barriers for younger and older adults (clinical and non-clinical). This is also key it that it determines the measurement theory that can be employed in the development and assessment of further instruments (De Vet et al, 2011; Fayers et al, 1999).

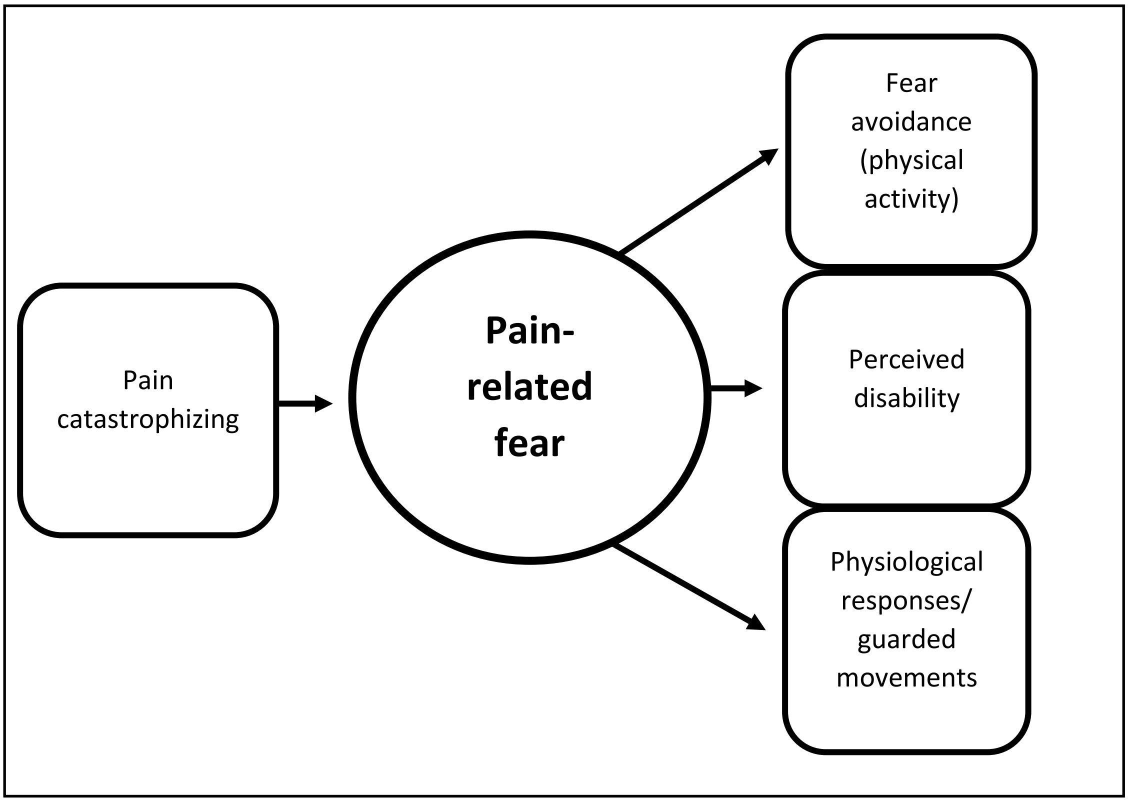


Figure 6.1. Conceptual map of pain-related fear for younger adults.

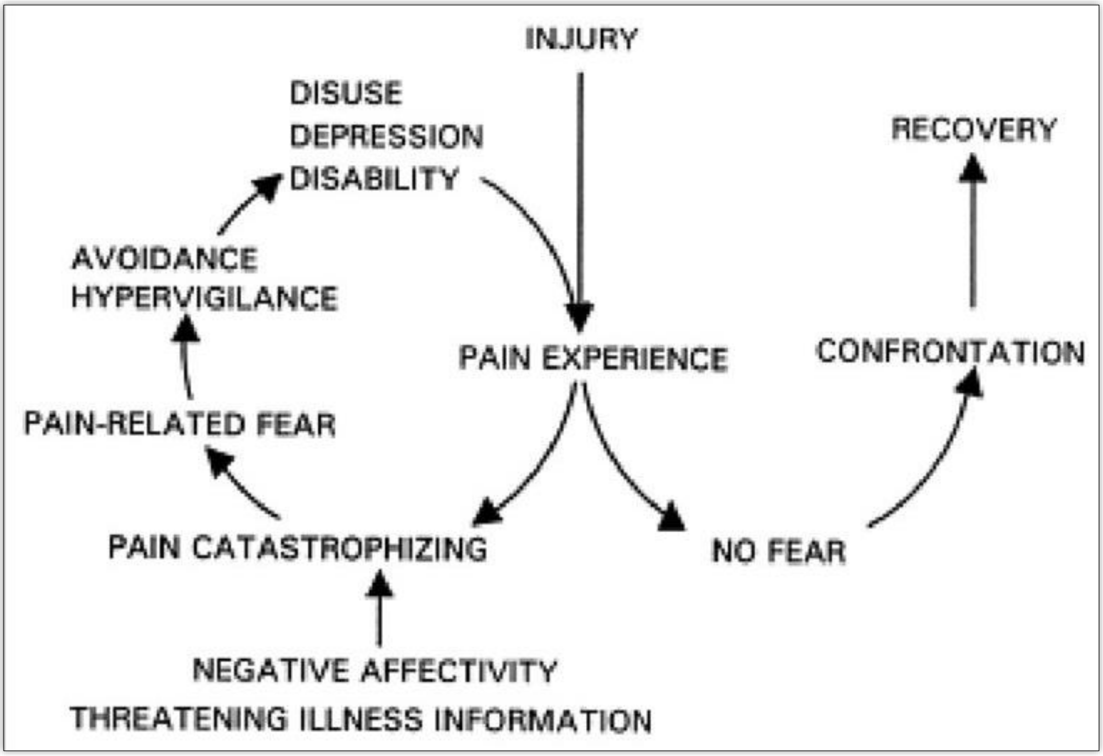


Figure 6.2. Graphic display of the fear-avoidance cycle (Vlaeyen and Linton, 2000)

6.5 Objective 2 and 3 - To identify and use existing measures of fear that relate to activity to develop a new tool to estimate levels of pain-related fear in young obese adults

As discussed earlier in this PhD (section 4.1), several instruments that explore the construct of pain-related fear have already been developed (e.g. the PASS, FPQ, FAPS, FABQ and the TSK) (McCracken et al, 1992). Currently, research suggests that the best available measure is the Pain Anxiety Symptoms Scale (Lundberg et al, 2011). However, existing instruments all fail to represent the construct factors of the conceptual map that indicates how younger adults conceptualised pain-related fear (developed in chapter three and four). This suggests that there would be some concern with the use of the PASS and its construct validity with younger adults, given that it could not capture all of the factors relating to the construct (Lundberg et al, 2011; De Vet et al, 2011). Because existing instruments also lack a universal model that defines the construct, criterion validity between the most popular instruments (used in research) is less than convincing (PASS-*total*: r= 0.45 with PDI-*total*; r= 0.41 with TSK; TSK-*total*: r= 0.44 with PDI-*total*) (Lundberg et al, 2011; McCracken, Zayfert and Gross, 1992; Roelofs et al, 2004). These limitations provided a rational for the development of a new instrument for the measurement of pain-related fear in adults aged 18 to 45 years (De Vet et al, 2011).

The conceptual map above contains four construct factors (fear avoidance, pain catastrophizing, perceived disability and physiological responses/ guarded movements) that were validated in the current PhD. These factors represent the construct of pain-related fear for younger adults but are distinctly different to that of older adults (Lundberg et al, 2011; Roelofs et al, 2004). A comparison of existing constructs to the new conceptual map highlight two key differences that are key to the measurement of pain-related fear (McCracken et al, 1992).

The first key difference is that younger adults within this PhD perceived disability as an important construct factor of pain-related fear. This is a novel discovery as disability has yet to be incorporated in factor models of pain-related fear for older adults (McCracken et al, 1992). In younger adults within this sample, the current findings suggest that disability is related to psychological components more than physical functioning. This is likely associated with the rise in mental ill health among younger adults, but the causal factors have yet to be identified (Hubble and Bolton, 2020). This may also be because younger adults perceive the term disability inclusive of cognitive impairments, whilst research suggests older adults perceive disability exclusively as physical functioning (Kelley-Moore et al, 2006). Explanations aside, several studies reinforce the current findings having also identified relationships between heightened pain-related fear and disability (Wertli et al, 2014; Zale and Ditre, 2015). For example, Werti et al, (2014) highlighted that pain-related fear could predict perceptions of disability in contexts that relate to leisure time activity. The data showed that there was an increased risk of disability with elevated fear avoidance beliefs (odds ratios ranged from 1.05- 95% CI, 1.02- 1.09 to 4.64- 95% CI, 1.57-13.71). Perceived disability has also received further conceptual support in that existing models of fear avoidance feature it as a key component (Vlaeyen and Linton, 2000; Vlaeyen et al, 2012). This is important because it means that the new measurement developed in this PhD can be mapped onto well-established theoretical models of fear avoidance (Lundberg et al, 2011; Vlaeyen and Linton, 2000).

The second key difference within the construct of pain-related fear was that factors of fear and avoidance were undistinguishable for younger adults. Unlike older adults, the findings identified strong correlations between items relating to fear and avoidance. This meant that items within both factors were redundant and likely measuring the same construct (De Vet et al, 2011). This is inconsistent with previous factor models of older aged adults and pain sufferers, whereby fear and avoidance have been validated as distinct factors (Roelofs et al, 2004; McCracken, Zayfert and Gross, 1992). This suggests that younger adults may perceive avoidance as a default response to fear, likely learnt through behavioural conditioning (Krypotos et al, 2015). The current PhD shows that younger adults' likely associate fearful cognitions with avoidance and that the two factors cannot be detached from one another (Janssens, Dupont and Leupoldt, 2018). The findings are supported by previous research showing that older adults have a higher level of emotional regulation giving them greater control over their emotional responses (compared to younger adults) (Demeyer and De Raedt, 2013; Wilson, 2013). These factors may be important for practitioners because it suggests that younger adults with heightened pain-related fears will likely avoid physical activity. This is likely because they may well seek to distance themselves from that in which they fear.

The two distinct factors discussed above partially address objectives two and three of this PhD in identifying that existing measures do not validly measure pain-related fear in younger adults. This is because they lack factor dimensions of disability and fear avoidance that have been highlighted by a qualitative exploratory study in this PhD (Roelofs et al, 2004; McCracken, Zayfert and Gross, 1992). These findings are important because it highlighted the need for a new instrument which was developed in this PhD. The new instrument encompasses the novel factor dimensions and is valid in that it adequately correlates with instruments purported to measure similar constructs (De Vet et al, 2011). It also provides a measurement that meets existing known group expectations, distinguishing between groups that partake in different levels of physical activity, and between different BMI classifications (De Vet et al, 2011).

6.6 Discussing pain as a construct factor of pain-related fear

This PhD identified some discrepancies in the factors that contributed to pain-related fear between its qualitative and quantitative studies. Initially, experiences of pain were identified by the qualitative study as a construct factor of pain-related fear. However, this could not be quantified in the quantitative study, indicating that pain may not be a valid construct factor of pain-related fear for younger adults. There are several reasons that could explain these findings.

Firstly, younger adults may not frequently experience pain that restricts physical activity. This is supported by the quantitative findings that showed pain was not significantly associated with inactivity, BMI or greater fears (Sample mean NRS= 2.4). This finding is inconsistent with previous research that highlights greater BMI and inactivity as strong independent predictors of musculoskeletal pain (Brady et al, 2016; Okifuji and Hare, 2015). However, the absence of pain within constructs of pain-related fear is consistent with the factor models of existing instruments such as the PASS-20 and TSK (McCracken et al, 1992; Bunzli et al, 2015; Vlaeyen and Linton, 2000; Meier et al, 2018). Notably, this absence may not be by conceptual design considering existing instruments have yet to conduct factor analysis with pain as a factor dimension (Lundberg et al, 2011). The absence of pain found within the current sample of younger obese adults is important because it provides some exploratory evidence to dispute claims that pain is caused by obesity specific factors (including genetic predispositions) (Wright et al, 2010; Chin et al, 2020). The absence of chronic pain is also in contrast to previous findings showing associations between chronic pain and obesity in middle to older aged adults (Turk and Wilson, 2010; Cooper et al, 2016; Vincent et al, 2013). Critically, the current quantitative study provides some contradictory evidence to previous claims that musculoskeletal pain is a key factor in the manifestations of activity related fears (Turk and Wilson, 2010; Cooper et al, 2016).

Secondly, the diversity in findings relating to pain may be because the quantitative sample was largely limited to adults under 30 years of age, and with a BMI less than 35kg/m^2 (mean BMI, 33.8kg/m^2). This rationale is supported by research proposing that younger obese are less likely to experience pain that leads to inactivity, particularly those who have only recently become obese (Lorig et al, 2006). Given this limitation, pain could still be important for younger adults who are morbidly obese, but further research is needed to explore these relationships (Ferguson et al, 2013: Janke and Kozak, 2012; Egan, Mahood, and Fenton, 2013; Peacock, Sloan, and Cripps, 2013; McCarthy et al, 2009). This is important for practitioners in that incidences of pain (and its associated factors) may still be a risk factor for inactivity in younger adults, but is likely to be in those with a BMI that exceeds 40kg/m^2 (Okifuji and Hare, 2015; Vincent et al, 2013; Napolitano et al, 2011; Matter, Sinclair, and Hostetler, 2012). These findings also highlight that existing models of fear avoidance that include pain, may not be valid for younger adults, particularly if individuals have a BMI less than 35kg/m^2 (Vlaeyen and Linton, 2000). This provides a rationale to employ the new conceptual map and instrument that was developed in this PhD, when measuring pain-related fears in younger adults.

A third explanation could be that the NRS instrument used in the current PhD was not a valid measurement of pain relating to activity (for younger adults) (Cleland et al, 2008).

This may be because the instrument asked respondents to assign a single number to their current experiences of pain, which could have limitations in contextual differences between rest periods and instances of exercise (Correll, 2007). This rationale aligns with previous criticisms of the NRS in that it over-simplifies pain and does not allow respondents to express a multidimensional experience (leading to a floor or ceiling effect) (Turk and Melzack, 1992). It has also been suggested that the NRS instrument can often be interpreted as asking participants for their present pain intensity at the moment of survey, which is not often completed during periods of physical activity (Correll, 2007). This is important because research suggests that experiences of pain vary when individuals are moving compared to sitting, although in many instances the underlying stimulus remains the same (Williamson and Hoggart, 2004; O'Sullivan et al, 2002). This is a notable limitation of the current study as measurement of current pain was taken at rest (not during physical activity), and so may not represent a valid measure of activity related pain.

A fourth factor could be attributed to the interpretations of the qualitative study data relating to experiences of pain. As with findings from Cooper et al, (2017), obese adult's experiences of pain were closely linked to catastrophisations and fear. This could have meant that the researcher's interpretations of pain may have actually been related to catastrophisations of pain. If perceived incorrectly within the qualitative data, catastrophisations may have played a greater role in the development of fear than pain itself. This is very likely considering that catastrophisations play a fundamental role in pain perception and the tendency of obese adults to magnify sensations of pain (Somers et al, 2009). This explanation has some basis given that the quantitative PhD data showed significantly greater catastrophisations of pain but little to no experience of severe pain in inactive participants. A case could be made that the qualitative study more likely represented younger obese adult's catastrophisations of pain, rather than the nociceptive stimulus of pain (Linton and Shaw, 2011). This could be a limitation of the interpretations made from the qualitative study within this PhD.

Based on the weight of discussions above, it appears that experiences of pain were not an important factor in how younger adults conceptualised pain-related fears. That being said, the sample was limited in that it did not have diversity of obese classifications, particularly as it lacked adults with a BMI that exceeded 40kg/m^2. It is also possible that the discrepancy in construct factors relating to fears of pain in the PhD could be a misinterpretation of qualitative data or an invalid measurement in the quantitative study

(Correll, 2007). The most likely explanation is that initial qualitative findings that were interpreted as pain, may have actually been focused on younger adult's catastrophisations of pain. Together, these limitations provide a rationale for the inconsistency in findings between the qualitative and quantitative studies of the PhD.

6.7 How the findings impact on conceptual models of fear avoidance and behaviour change

The current PhD reveals that younger obese adults experience fears that may trigger activity avoidance, prompt powerful perceptions of disability, and in some cases could exacerbate mental health concerns. These findings are consistent with the fear avoidance beliefs of middle and older aged obese adults (Vincent et al, 2014; Vincent et al, 2010; McPhail, Schippers, and Marshall, 2014). The relationships found in the exploratory data align with the sequential and dynamic relationships of the theoretical fear avoidance model (Vlaeyen and Linton, 2000). In this context, the fear avoidance model conceptualises that individuals avoid activity because of fear (Vlaeyen and Linton, 2000). Fears are said to manifest from experiences of pain, catastrophisations of pain and, or negative affectivity (Vlaeyen and Linton, 2000). However as previously discussed, this PhD demonstrates that relationships between pain and pain-related fears may not be valid for younger adults. That being said, relationships relating to fear, activity avoidance and perceived disability have been confirmed within the exploratory research of this PhD (Vlaeyen and Linton, 2012; Vincent et al, 2014). This shows that younger adult's conceptualisations of pain-related fear may have some basis within existing models, but that they are likely not wholly representative of all the factors (Vlaeyen and Linton, 2000; Leeuw et al, 2007). This is important because there is a rationale to suggest that the instrument developed in this PhD can be mapped onto many of the concepts of the theoretical Fear Avoidance Model (Lundberg et al, 2011; Vlaeyen and Linton, 2000).

The Fear Avoidance Model designed by Vlaeyen and Linton (2000) has a basis within psychological research as it portrays a cycle of undesirable behaviour change toward increased inactivity. This is because psychological components such as fear, may threaten perceptions of capability and motivation. This PhD reinforces evidence that fearful cognitions likely increase perceptions of disability and inactivity which may worsen beliefs about physical capability. The findings also support the premise that fear can worsen motivation because of the associations with depressive cognitions, mental ill health and low self-confidence (Luppino et al, 2010; Gatineau and Dent, 2011). This is important because capability and motivation (as well as opportunity) are key components of well-known behaviour modification frameworks (such as The Behaviour Change Wheel) (Vlaeyen, Crombez and Linton, 2016; Mitchie, Atkins and West, 2014). They are also important factors in why adults who are obese do not adopt active lifestyles (British Psychological Society, 2019). Relevant to behaviour change theory, fear may reduce opportunities for activity as younger obese adults avoid specific exercises (jumping, twisting and running). Consequently, fear related behaviours could result in a decrease in health promoting behaviour. The current findings in relation to fear avoidance means that younger adults who are obese may require a psychological intervention to overcome fears and improve perceptions about their capability to enact health behaviour change, before engagement in activity (Vlaeyen, Crombez, and Linton, 2016; Vlaeyen and Linton, 2000; Vincent et al, 2013). Without an intervention that addresses these factors (and how they interact with other psychological components of behaviour change), it is unlikely that younger obese adults will autonomously participate in physical activity (Cooper et al, 2017). That being said, further research is needed to establish how other barriers interact with fear and contribute to inactivity among younger obese adults.

Intervention functions such as enablement could be employed to reduce perceptions of pain and disability, which have previously been successful in promoting activity adherence (Taylor, Lawton and Conner, 2013). Likewise, intervention functions that promote environmental restructuring (adapted for obese adults) could remove the need to twist, jump, run or climb stairs, which may lessen fears and increase opportunity for physical activity (Cooper et al, 2018). Other intervention functions such as modelling could encourage obese individuals to confront negative cognitions in order to improve motivation and manage avoidance responses (Mitchie, Atkins and West, 2014). This collection of intervention functions is a useful starting point that could improve self-efficacy and reduce the cognitive burden of stress, increasingly the likelihood that obese adults will adhere to physical activity guidelines (Gatineau and Dent, 2011). However, further research is needed to identify the success of these intervention functions when they are employed specifically to target fear related barriers to physical activity.

Table 6.2 provides further examples of how the PhD findings can provide a guide for intervention design. These findings are key because they extend current understanding of the role of fear as a barrier to physical activity, and detail how practitioners can begin to target the consequential behaviour of inactivity through novel intervention. However, this must be interpreted with caution as there is currently a lack of available evidence to suggest that these will be successful in younger adults (Gatineau and Dent, 2011).

Table 6.2. Identifying needs of change using a Theoretical Domain Framework (TDF).

Theoretical component of need (COM-B*)	**Barrier to physical activity**	**Theoretical Domain Framework***	**Intervention functions***
Capability (Physical)	Perceived Pain/ functional limitations	Beliefs about consequences (Experiencing pain, guarded movements)	• Education • Enablement
Capability (Psychological)	Perceived disability	Beliefs about capabilities (Catastrophisation about pain and low self-efficacy)	• Enablement • Education
Opportunity (Physical)	Physical activity environments (Leisure facilities)	Knowledge and skill (Lack of knowledge provokes cognitions of catastrophizing and fear)	• Environmental restructuring • Enablement • Education • Training
Motivation (Reflective)	Emotion of fear	Emotions (Fears of chronic pain.)	• Modelling • Education • Enablement
Motivation (Automatic)	Fear avoidance	Emotions and behavioural regulation (Previous components of psychological conditioning which encourages avoidance behaviour. Automatic response to fear)	• Enablement • Training

*inspired by Mitchie, Atkins and West, (2014).

6.7.1 Critical analysis of behaviour change models in addressing fear related barriers to activity

Some behaviour change interventions have had some short-term success in increasing health promoting behaviour (Baronowsi et al, 2003). However, this research shows that existing models such as the Behaviour Change Wheel may lack specific functions to tackle fear related barriers to activity (Kelly et al, 2016). This is because existing intervention functions such as training and education have largely been ineffective at reducing the growing international trend of inactivity (Baranowski et al, 2003). A rationale for this is that interventions have relied upon stigmatisation and fear-based communication strategies which have been found to be counterproductive, particularly among obese adults (Wansink and Pope, 2015; Baranowski et al, 2003). Similarly, intervention functions designed to enable health promoting behaviour through coercion and incentivisation, have only resulted in short term increases in activity (Cooper et al, 2010). This leaves some uncertainty as to whether intervention strategies outlined in the Behaviour Change Wheel can effectively reduce fear related inactivity (Mitchie, Atkins and West, 2014).

Some research suggests that activity related fears can be overcome with cognitive behavioural strategies (Dalle Grave et al, 2011). For example, cognitive behaviour therapy has had some success in increasing adherence to exercise, particularly for individuals with obesity (Dalle Grave et al, 2011). However, there is a notable absence of cognitive behavioural strategies within the intervention functions of the Behaviour Change Wheel (Mitchie, Atkins and West, 2014). This is problematic considering that cognitive strategies have achieved superior outcomes (compared to other intervention functions such as education) in reducing fear, extinguishing pain behaviour, decreasing catastrophisations, improving perceptions of disability and increasing functional capacity (Fersum et al, 2012). This PhD highlighted that these outcomes could be important for fears relating to pain because younger adults perceive these to be key factors that restrict physical activity participation. Notably, this is not the first time that research has identified gaps between behaviour and application of existing models (Peters and Kok, 2016). Several studies have suggested that there are a lack of suitable functions that can be applied effectively to tackle the complex issues in human psychology, and that existing models create a false impression of simplicity (Peters and Kok, 2016; Peters, 2014; Bartholomew et al, 2016). These concerns are compounded by the aim of existing models to systematise behaviour change science. This is because they neglect variability in individual psychology and rarely consider the complex web of interactions between behaviours (Peters and Kok, 2016). This provides a rationale to reconsider concepts of existing behaviour change frameworks to reflect the interactions between different barriers and include cognitive behavioural intervention functions that target fear related barriers to activity. These novel additions could provide an improved intervention strategy to tackle barriers that are influenced by emotions such as fear (Fersum et al, 2012).

6.8 Summary of discussion

The key discussion points of this chapter demonstrate that younger adults who are obese may perceive pain-related fears as a barrier to physical activity. These fears appear to provoke activity avoidance, perceptions of disability, depressive cognitions and catastrophisations based on pain. This can be conceptualised in part, by using the theoretical cycle of the Fear Avoidance Model (Vlaeyen and Linton, 2000). The existence of these barriers presents obstacles for health promoting behaviour change, because they may place restrictions on perceptions of physical and psychological capability, motivation, and opportunities for activity (Mitchie, Atkins and West, 2014). The new 12 item instrument developed by in this PhD captures the constructs of these barriers and may be used to measure the severity of pain-related fear, avoidance beliefs, perceived disability, physiological responses and catastrophisations of pain.

6.9 Strengths and limitations

There are strengths and limitations to the individual studies conducted within this PhD that have already been outlined within sections 2.8.1, 3.8.6 and 4.11. However, there are key strengths and limitations relating to the PhD as a whole which will now be outlined in this section.

A key strength of the research in this PhD was that it utilised qualitative and quantitative methods to explore, confirm and quantify fear related barriers of physical activity. Both the qualitative and quantitative study designs provided complementary evidence, detailing in depth individual experiences and measurement for the purposes of precision and generalisability (Creswell and Clarke, 2007). The researchers ontological and epistemological view of pragmatism offered a paradigm whereby there was freedom to draw important inferences from both sets of data (quantitative and qualitative) (Creswell, 2015). This was particularly beneficial during the process of developing a new instrument in that the data provided contextually relevant information that improved the construct validity of the measurement (De Vet et al, 2011). However, this may have had some limitations in that it relied upon interpretation and integration of data from qualitative to quantitative methods (Creswell, 2015). These concerns may have been mitigated somewhat in that the PhD did not attempt to triangulate the results, but rather used the data from one method to compliment the findings from another (Tariq and Woodman, 2013).

A further limitation to this PhD is that the data may have been affected by an external bias, such as, social desirability (Althubaiti, 2016). In the current studies, participants were asked about the sensitive topics of weight, age, levels of physical activity and fears, which can provoke inaccurate responses (Farrugia et al, 2010). Social desirability bias may have meant that participants underestimated their BMI activity levels, or under reported their fears (Van De Mortel, 2008). Literature shows that research reliant upon self-reported weight can be problematic given that only 35% of participants will respond accurately (Gorber et al, 2007). One of the greatest concerns relating to this PhD is that over 50% of young adults completing surveys have previously been found to under-report weight (Bowring et al, 2012). However, several studies have concluded that although weight is often incorrectly reported, this does not have a significant impact on the accurate identification of overweight/ obese BMI classification (Bowring et al, 2012; Farrugia et al, 2010). This is an important finding for this PhD as it shows that some of the limitations may have been mitigated with the use of BMI classifications for data analysis (i.e. healthy weight, overweight, obese). Social desirability bias may also have been mitigated with the use of pre-validated instruments, assurances of anonymity, confidentiality and that participation was voluntary (Farrugia et al, 2010; Bowring et al, 2012).

A key limitation was that both studies in this PhD were cross sectional in design. This meant that the data collected only represented a single snapshot in time, and that the results may vary outside of the given context (Levin, 2006). Because of the one-time measurement, it is difficult to derive causal relationships from the finding relating to activity, BMI, disability and fear (Setia, 2016). For example, there is no indication of whether pain-related fears caused inactivity, or if inactivity worsened pain-related fears (Levin, 2006). Equally, it is unclear if the relationships are even causal at all (even though several factors were found to have strong associations) (Levin, 2006). These limitations were somewhat mitigated with findings from the qualitative study that identified associations and the direction of several relationships. This limitation could also be defined as a strength given that the cross sectional design allowed for the studies to be finished within a short time period which was important given the limited resources of the PhD programme of study (Setia, 2016). Limitations aside, the findings from the cross-sectional studies are still useful in generating hypothesis for future research (Levin, 2006).

A further limitation regarding the research design was that both studies which qualified and quantified fears were exploratory, and so the results must be interpreted with caution (Hallingberg et al, 2018). This is specific to the generalizability, as no definitive claim can be made that participants represented the wider population (Brotherton, 2007). Likewise, the findings of the qualitative study may be subject to interpretation and social desirability biases which means that it is unlikely that the results can provide definitive conclusions (Creswell, 2014). Exploratory research was conducted because little was known about the topic area and because the concept of fear related barriers (particularly pain-related fears) needed refining for future research (Hallingberg et al, 2018). In addition, the exploratory nature provided flexibility that allowed for new insights to be formed from the data which helped to develop hypothesis to explain the phenomena of fear as a barrier to physical activity (Kimmelman, Mogil and Dirnagl, 2014). The results of this PhD are valuable in providing an improved understanding of fear related barriers to activity in younger adults. The findings can form the basis of more conclusive research into the variables that are likely to be associated with activity related fears (Cooper et al, 2018).

6.10 Implications for further research

This PhD has several immediate and broader implications for further research.

6.10.1 Immediate implications for research

Firstly, the PhD addressed a gap in the literature identifying pain-related fear as barrier to activity in younger adults. The study provided some modest results regarding associations between pain-related fear, disability, BMI and physical activity. However, these were found in a cross-sectional study design with limited applicability to the general population (Waddell et al, 1992). Longitudinal research is needed to compare the levels of pain-related fear and disability in younger adults, before and after physical activity interventions designed for weight loss (Vincent et al, 2011). This may provide evidence that can identify the direction of relationships between the important variables of the current study and may establish a BMI threshold in which pain-related fear significantly contributes to activity avoidance (Vincent et al, 2011).

A finding of this PhD was that younger adults reported high intensities of pain-related fear, largely in the absence of musculoskeletal pain. This provides a modest rationale for future potential research to explore fear related barriers in adolescents. Exploratory research could identify how, if and why pain-related fears develop in early life. These explorations could highlight the pathways in which avoidance responses to fear become habitual behaviours. This research could probe the important factors in how young people confront and overcome fear related barriers to activity. This may provide an improved understanding of the recovery process of overcoming fears and highlight novel intervention functions that could aid physical activity specialists.

The current PhD outlines a conceptual map of pain-related fear for younger adults aged 18 to 45 years. These findings have yet to be mapped comprehensively onto components of behaviour change theory in order to improve understanding of fear related inactivity (Mitchie, Atkins and West, 2014). However, there is some limitation in that current behaviour change intervention functions may not adequately decrease fears in younger adults (Bombak, 2015). This may be because they do not include functions of psychotherapy or cognitive therapy. Previous research findings reinforce that interventions that do not integrate a component of psychotherapy or cognitive therapy are unlikely to be successful in reducing activity related fear avoidance (Wetherall et al, 2019). The data from the current study could be strengthened with further qualitative research that employs behaviour change diagnosis tools to map fear related barriers onto appropriate intervention functions (COM-B) (Mitchie, Atkins and West, 2014). These tools could identify novel techniques and modes to tackle fear and improve health promotion strategies. Together, the findings may provide additional knowledge to inform the intervention functions needed to bring about the desired change in activity avoidance behaviours (Mitchie, Atkins and West, 2014). The current PhD suggests that training, modelling and environmental restructuring functions may be effective intervention strategies. However, it is unclear from the current PhD if other functions such as incentivisation or persuasion would be successful. Further research is needed to identify useful strategies that will help to construct behaviour change techniques to guide intervention design (Mitchie, Atkins and West, 2014).

Following the development of a new measurement instrument (that has a conceptual underpinning), a longitudinal study is needed to determine the direction of several relationships between fear, BMI and physical activity levels. Further research is also needed to determine whether it may be useful in middle to older aged adults (De Vet et al, 2011). This is because older adults may conceptualise pain-related fear differently compared to younger adults (Lundberg et al, 2011). If validated, the new instrument could identify differences in pain-related fear between younger adults, older adults and BMI classifications. However, it is possible that the construct measured by the new instrument will not be valid for older adults because of differences in conceptualisations of pain-related fear (Hadjstavropoulos et al, 2011). It may be necessary given the lack of instruments with conceptual frameworks, for further research to develop a new instrument for middle to older aged adults. This process would need to begin with research that explores the construct and be repeated with clinical patients of various diseases in which conceptual frameworks may differ (De Vet et al, 2011). Given that physical inactivity is increasing among adolescents and children, research may also want to explore if pain-related fears is a barrier to activity in younger populations (WHO, 2018).

6.10.2 Broader potential implications for research

Having established that pain-related fear may be associated with inactivity, future research could explore the development of a software mobile application that provides exercise specialist with a prompt measurement of pain-related fear. However, further research is needed prior to this in order to assess the reliability, standard error of measurement and development thresholds for measurement (De Vet et al, 2011). That being said, the advantages of having immediate measurement could have a direct impact on the success of exercise interventions adherence (Zijlstra et al, 2005). Research suggests that merely the awareness of fear related barriers has been shown to improve and empower exercise specialists to adopt new practices within their activity programs (Bethancourt et al, 2014). Previous research shows that adaptations to activity interventions based upon fear related barriers can decrease drop out (Somerset and Hoare, 2018). Data from this PhD suggests that adaptations to reduce exercises that include jumping, twisting or running, may result in greater adherence. However, further research is needed to explore how fears impact on specific exercises and vice versa. A mobile software application would also be useful for health promotion practitioners as it would allow them to efficiently identify individuals with severe intensities of fear who may need to be referred to counselling or psychotherapy.

Overall, this PhD provides some modest evidence that fear is a barrier to physical activity for younger adults. Further research would benefit from the identification of all other known fear related barriers to activity. This could be achieved through a systematic review of literature. This would likely highlight further gaps within literature and potentially provide qualitative data that could be used to form conceptual frameworks for older adults and those suffering chronic pain. The qualitative data may also establish how fears interact with other barriers, which could highlight the complex web of relationships that contribute to activity avoidance. A systematic review may be useful to summarise the depth and breadth of current research making the current evidence more accessible for stakeholders, practitioners, and decision makers (Gopalakrishnan and Ganeshkumar, 2013).

6.11 Implications for practitioners, clinicians, and policy

The findings of this PhD provide some immediate implications and several broader potential implications that may be useful for exercise specialists in promoting an improved understanding of fear and its impact on activity avoidance.

6.11.1 Immediate implications for practitioners, clinicians, and policy

The novel findings regarding pain-related fear could help to inform clinicians of the important reasons for intervention drop out among obese adults. An improved understanding of fear related barriers to activity can increase awareness of the cognitive challenges faced by obese adults. This understanding will likely promote compassionate attitudes and create better opportunities for positive contact between obese adults and clinicians (British Psychological Society, 2019). Research has shown that positive contact and increased knowledge of the biopsychosocial complexities associated with obesity, help to decrease weight stigmatisation (Kushner et al, 2014). A focus on decreasing stigma is important because weight bias has recently been highlighted as a contributing factor in intervention avoidance and inactivity among obese adults (McGuigan and Wilkinson, 2014).

The PhD findings may be important for providers of leisure facilities because it highlights a need for future changes in policy and practise. The PhD highlighted several fears that explicitly manifested within leisure facilities, often related to weight stigmatisation. This meant that younger obese adults may have avoided leisure facilities because of negative perceptions of staff and equipment. The current findings suggest that adaptations for induction procedures to emphasise weight sensitively may help to reduce stigma, pain, injury, and fears (Mitchie, Atkins and West, 2014). Further education and training for staff about the risk of fear related barriers may also help to minimise its impact on activity adherence, particularly for adults who are obese. Exercise specialists who provide fitness classes may also consider the findings and exclude specific exercises to make the sessions more appealing to obese adults. This PhD highlights a broader need for both the public and private sector to consider a greater level of personalisation when promoting and facilitating physical activity for adults with weight concerns (Pavey et al, 2011).

6.11.2 Broader potential implications for practitioners, clinicians, and policy

The PhD findings identified that younger obese adults may be limited in their capability to perform physical activity because of a habitual cycle of fear avoidance. The data suggested that fearful cognitions likely restricted younger adult's ability to perform moderate intensity movement, particularly exercises involving twisting, jumping, or running. Because of this, there may be a distinct lack of opportunity for younger obese adults to perform physical activity. The PhD identified that these factors of fear may contribute to a reduction in motivation because they increase perceptions of weight related disability. With this knowledge, practitioners could begin to employ well known behaviour change models (such as the behaviour change wheel) to design and implement future interventions (Glanz and Bishop, 2010; Mitchie, Atkins and West, 2011). It is likely that several intervention functions will be needed to target specific avoidance behaviours associated with fear (Mitchie et al, 2011). However, there is a rationale to suggest that future interventions may be successful given previous accomplishments that have led to increased activity using enablement, persuasion, and training strategies (Mitchie et al, 2010).

Practitioners and clinicians could begin to employ the proposed conceptual map as a framework of pain-related fear to define the problem of fear avoidance (as a barrier to physical activity). Mitchie, Atkins and West (2014) stated that research defining a behavioural problem is key to successful behaviour change. This PhD provides complementary evidence that identifies pain-related fear avoidance behaviour as risk to inactivity. The findings provide modest but insightful links between factors of behaviour change theory and intervention strategies that are likely improve the success of future health promotion initiatives (Kumar et al, 2012).

The findings suggest that it may be beneficial to measure fears related barriers within initial exercise consultations. Measurement will provide a provisional indication as to the severity of individual fear which can be used to design and adapt personalised exercise plans. For example, if individuals score highly in pain-related fear this could highlight a need to minimise exercises that have previously caused pain or injury. Evaluation of fear severity could also establish if individual's need extended exercise inductions in order to minimise catastrophisations of pain. This could be measured through novel pathways such as device applications that provide the specialists with an immediate measurement. However, this may have some limitations in that research has yet to validate the measurement instrument in digital form.

6.12 The novel and original contributions to knowledge of this PhD

There are three key original contributions to knowledge that can be drawn from this PhD. 1) Fears are important in younger obese adults. The range of fears included stigma, pain, embarrassment, falling, injury, leisure facilities and failure. 2) Pain-related fears appeared most important for younger adults with weight concerns. These fears are concerning because they may lead to a detrimental cycle of activity avoidance. These findings have previously been highlighted in elderly adults, but this is the first study to report them as a possible risk factor for inactivity in younger adults (Sallinen et al, 2009; Vincent et al, 2014). This PhD provides some modest evidence of these relationships in that pain-related fears were found to be significantly greater in younger adults with a BMI above 30kg/m^2, and in those who participated in low levels of activity. The PhD provides a conceptual map for the construct of pain-related fear in younger adults. The map identifies relationships relating to fear, activity avoidance and perceived disability which were supported by the exploratory findings of this PhD (Vlaeyen and Linton, 2012; Vincent et al, 2014). These findings provide modest evidence that younger adult's conceptualisations of pain-related fear has some basis within existing models (such as the Fear Avoidance Model) (Vlaeyen and Linton, 2000; Leeuw et al, 2007). However, the current map highlights important differences in how younger adults perceive the construct of pain-related fear. For example, younger adults perceive disability as an important factor which has not previously been identified in older adults (Vincent et al, 2014). Another key difference is that relationships between pain and pain-related fears may not be valid in populations of younger adults. Having highlighted these differences, it is evident that existing instruments may lack construct validity to measure pain-related fear in younger adults, particularly those who are obese. This PhD provided a rationale for the development of a new instrument to validly measure pain-related fears in younger adults. 3) The third original contribution to knowledge is the development of a new instrument (the Pain-Related Fear Scale) which may provide research with a valid measurement of pain-related fear for adults aged 18 to 45 years. The new instrument is 12 items long and has four sub dimensions; fear avoidance, perceived disability, pain catastrophizing and physiological anxiety. It has advantages over other instruments in that it is underpinned by a conceptual framework map, and is less burdensome on participants than combined scales. The Pain-Related Fear Scale has good construct and criterion validity in adults aged 18 to 45 years. An exploration of the relationship between scores for the Pain-Related Fear Scale showed that it can identify modest statistical differences in pain-related fear between physical activity and BMI groups. Collectively, these original contributions to knowledge enhance the current understanding of psychological barriers to physical activity, particularly as it relates to fears of pain in younger obese adults. They also provide novel avenues for research to develop novel interventions to increase activity levels among younger obese adults.

6.13 Conclusion

This PhD has successfully achieved it aim of exploring psychological barriers to physical activity among younger adults, with a specific focus on fear. This was achieved through three studies:

1. A scoping review of fear as a barrier to physical activity
2. A qualitative semi structured interview study to explore the emotion of fear as a barrier to physical activity in adults aged 18 to 45 years who are obese
3. A quantitative cross-sectional study to identify a conceptually underpinned instrument of pain-related fear and explore differences between younger adults with different BMI classifications.

The review of literature highlighted several explicit activity related fears that may be a risk factor for inactivity, particularly among obese adults. It also identified key gaps in knowledge that related to how some fears impact on physical activity for younger obese adults. The qualitative study explored these gaps through an Interpretative Description approach using interviews and thematic analysis (Thorne, 2016). The findings highlighted that younger obese adults find it challenging to meet basic physical activity recommendations because of fear related barriers. Of these fears, pain-related fears appeared most important. This was a key finding in that these fears had consequences in provoking activity avoidance and preventing health promoting behaviour change. Subsequently, a conceptual map was developed to outline important concepts in how younger adults may perceive pain-related fear as a barrier to activity. The studies limitations meant that further research was needed to confirm and quantify pain-related fears as a risk factor for inactivity in a larger sample of younger adults. However, this could only be achieved if a pain-related fear measure was available that mapped onto the conceptual pathway. Investigations into the existing pain-related fear instruments revealed that no single instrument could measure all six factors outlined by the conceptual map developed in the qualitative study. Because of this, three instruments (PASS-20, PDI and NRS) were combined to provide a measurement for the important concepts outlined in the qualitative findings. Following this, a cross-sectional study was designed to explore construct and content validity of pain-related fear in adults between 18 to 45 years of age. This showed that the three instruments had good validity in the study population. The process of validation which included factor analysis, revealed that the construct factor of pain (as measured by the NRS) and several other dimensions/ items were likely not key components of pain-related fear for younger adults. This led to development of a new instrument and the refinement of the conceptual map, originally developed in the qualitative study. The new instrument was called the Pain-Related Fear Scale. It comprises of 12 items and four sub dimensions; fear avoidance, perceived disability, pain catastrophizing and physiological anxiety. The Pain-Related Fear Scale has benefits in that it is conceptually based and is less burdensome on participants. The instrument was tested to have good construct and criterion validity. An exploration of the relationship between scores for the Pain-Related Fear Scale showed that it could identify statistically significant differences between younger obese adults (BMI, $\geq$30kg/m^2), compared to younger healthy weight and overweight adults (BMI, 18.5 to 29.9kg/m^2) (mean scores 29.8 vs 22.3; P= 0.000).

Prior to the research in this PhD, pain-related fear had not been associated with reduced activity participation in this age group, and so this provides for an original contribution to knowledge. The findings may be useful to inform practitioners, public health workers and exercise specialists of novel and potentially more appropriate interventions, in order to increase activity adherence among younger adults with obesity.

7.0 References

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8.0 Appendices

Appendix A – Medline search strategy

(EBSCO*host*)

S1. Explode_ (MH “Obesity+”) (182534)
S2. Explode_ (MH “Overweight+”) (187453)
S3. S1 & S2 (190,138)
S4. Explode_ (MH “Body Weight+”) (416008)
S5. Explode_ (MH “Waist Circumference+”) (8174)
S6. MH_ ("Body Mass Index”) (107782)
S7. MH_ (“adiposity”) (9382)
S8. (“Obese*”) (109943)
S9. (“Fatness”) (3858)
S10. S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8 OR S9 (505126)
S11. Explode_ (MH “Exercise Therapy+”) (41700)
S12. Explode_ (MH “Exercise Movement Techniques+”) (6819)
S13. Explode_ (MH “Exercise+”) (162127)
S14. Explode_ (MH “Activities of Daily Living+”) (62028)
S15. Explode_ (MH “Movement+”) (488221)
S16. MH_ (“Physical Exertion”) OR MH_ (“Physical Fitness”) (77848)
S17. (“Activit*”) (2,908,921)
S18. (“Fitness”) (77118)
S19. S11 OR S12 OR S13 OR S14 OR S15 OR S16 OR S17 OR S18 (3,321,486)
S20. Explode_ (MH “Fear+”) (31251)
S21. Explode_ (MH “Phobic Disorders+”) (10540)
S22. MH_ (“Panic Disorders”) (6542)
S23. MH_ (“Phobia, Social”) (311)
S24. (“Afraid”) (2143)
S25. (“Fright*”) (2421)
S26. (“Concern*”) (517798)
S27. (“Avoidance”) (69593)
S28. (“Negative evaluation”) (750)
S29. (“Threat”) (49,690)
S30. S24 OR S25 OR S26 OR S27 OR S28 OR S29 (633170)
S31. S20 OR S21 OR S22 OR S23 OR S24 OR S25 OR S26 OR S27 OR S28 OR S29 (669,541)
S32. S10 AND S19 (98,536)
S33. S10 AND S30 (15550)
S34. S19 AND S30 (91,666)
S35. S10 AND S19 AND S30 (3,743)
S36. S35 (Limiters - English Language; Human; Age Related: All Adult) (1278)

Appendix B – Sports Discus search strategy

(EBSCO*host*)

S1. Explode_ (DE "OBESITY" OR DE "CANCER & obesity" OR DE "OBESITY in children" OR DE "PRADER-Willi syndrome") (11823)
S2. (DE "OVERWEIGHT persons") (1665)
S3. S1 AND S2 (12897)
S4. Explode_ (DE "BODY weight" OR DE "LEANNESS" OR DE "OBESITY") (19292)
S5. Explode_ (DE "BODY mass index" OR DE "BODY weight) (18544)
S6. (DE "WAIST-hip ratio") (210)
S7. "obese*" (7863)
S8. "Fatness" (671)
S9. S3 OR S4 OR S5 OR S6 OR S7 OR S8 (31211)
S10. Explode_ (DE "EXERCISE" OR DE "ABDOMINAL exercises" OR DE "AEROBIC exercises" OR DE "ANAEROBIC exercises" OR DE "AQUATIC exercises" OR DE "ARM exercises" OR DE "BACK exercises" OR DE "BREATHING exercises" OR DE "BREEMA" OR DE "BUTTOCKS exercises" OR DE "CALISTHENICS" OR DE "CHAIR exercises" OR DE "CHEST exercises" OR DE "CIRCUIT training" OR DE "COMPOUND exercises" OR DE "COOLDOWN" OR DE "DO-in" OR DE "EXERCISE adherence" OR DE "EXERCISE for children" OR DE "EXERCISE for girls" OR DE "EXERCISE for men" OR DE "EXERCISE for middle-aged persons" OR DE "EXERCISE for older people" OR DE "EXERCISE for people with disabilities" OR DE "EXERCISE for women" OR DE "EXERCISE for youth" OR DE "EXERCISE therapy" OR DE "EXERCISE video games" OR DE "FACIAL exercises" OR DE "FALUN gong exercises" OR DE "FOOT exercises" OR DE "GYMNASTICS" OR DE "HAND exercises" OR DE "HATHA yoga" OR DE "HIP exercises" OR DE "ISOKINETIC exercise" OR DE "ISOLATION exercises" OR DE "ISOMETRIC exercise" OR DE "ISOTONIC exercise" OR DE "KNEE exercises" OR DE "LEG exercises" OR DE "LIANGONG" OR DE "METABOLIC equivalent" OR DE "MULAN quan" OR DE "MUSCLE strength" OR DE "PILATES method" OR DE "PLYOMETRICS" OR DE "QI gong" OR DE "REDUCING exercises" OR DE "RUNNING" OR DE "RUNNING -- Social aspects" OR DE "SCHOOL exercises & recreations" OR DE "SEXUAL exercises" OR DE "SHOULDER exercises" OR DE "STRENGTH training" OR DE "STRESS management exercises" OR DE "TAI chi" OR DE "TREADMILL exercise" OR DE "WHEELCHAIR workouts" OR DE "YOGA") (153067)
S11. Explode_ (DE "EXERCISE therapy") (4774)
S12. (DE "MOVEMENT therapy") (141)
S13. (DE "PHYSICAL fitness" OR DE "ANAEROBIC exercises" OR DE "ASTROLOGY & physical fitness" OR DE "BODYBUILDING" OR DE "CARDIOPULMONARY fitness" OR DE "CARDIOVASCULAR fitness" OR DE "CIRCUIT training" OR DE "COMPOUND exercises" OR DE "EXERCISE tolerance" OR DE "ISOLATION exercises" OR DE "LIANGONG" OR DE "MUSCLE strength" OR DE "PERIODIZATION training" OR DE "PHYSICAL fitness for children" OR DE "PHYSICAL fitness for girls" OR DE "PHYSICAL fitness for men" OR DE "PHYSICAL fitness for older people" OR DE "PHYSICAL fitness for people with disabilities" OR DE "PHYSICAL fitness for women" OR DE "PHYSICAL fitness for youth" OR DE "SPORT for all") (106544)
S14. "Activit*" (98213)
S15. "Fitness" (159697)
S16. S10 OR S11 OR S12 OR S13 OR S14 OR S15 (333754)
S17. Explode_ (DE "FEAR" OR DE "PHOBIAS") (1661)
S18. "Panic Disorder" (118)

S19.	“Afraid” (647)
S20.	“Fright*” (317)
S21.	“Concern*” (8484)
S22.	“Avoidance” (3273)
S23.	“Negative evaluation” (95)
S24.	“Threat” (4112)
S25.	“Fear*” (8582)
S26.	S17 OR S18 OR S19 OR S20 OR S21 OR S22 OR S23 OR S24 (24501)
S27.	S9 AND S16 AND S26 (255)
S28.	S27 (Limiters - Language: English) (248)

Appendix C – PEDro search strategy

<u>PEDro (Physiotherapy Evidence Database)</u>

S1. Obes* (2192)
S2. Overweight (1370)
S3. “Body Weight” (2097)
S4. “Waist Circumference” (626)
S5. “Body Mass Index” (1676)
S6. Adiposity (199)
S7. Fatness (36)
S8. Exercise (296)
S9. Movement (65)
S10. Activit* (331)
S11. “Physical Fitness” (2)
S12. “Fitness Training” (11456)
S13. “Strength Training” (8878)
S14. Sports (35)
S15. Fear (404)
S16. “Phobic Disorders” (2)
S17. “Social Phobia” (4)
S18. Afraid (4)
S19. Concern (179)
S20. Avoidance (203)
S21. Threat (18)
S22. “Behaviour modification” (5692)
S23. S1 AND S12 (1649)
S24. S15 AND S12 (97)
S25. S1 AND S8 AND S22 (110)

Appendix D – CINAHL search strategy

CINAHL Complete (Excluding MEDLINE records, through EBSCO*host*).

S1. Exp_(MH "Obesity+") (26564) Limiters - Exclude MEDLINE records
S2. "Overweight" (6399) Limiters - Exclude MEDLINE records
S3. Exp_ (MH "Body Weight+") (40778) Limiters - Exclude MEDLINE records
S4. MesH_ (MH "Waist Circumference") (1381) Limiters - Exclude MEDLINE records
S5. "adiposity" (1090) Limiters - Exclude MEDLINE records
S6. "OBes*" (33972) Limiters - Exclude MEDLINE records
S7. "Fatness" (184) Limiters - Exclude MEDLINE records
S8. S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8
S9. Exp_ (MH "Exercise+") (45303) Limiters - Exclude MEDLINE records
S10. MesH_ (MH "Physical Activity") (17215) Limiters - Exclude MEDLINE records
S11. Exp_ (MH "Therapeutic Exercise+") (23630) Limiters - Exclude MEDLINE records
S12. MesH_ (MH "Movement+") (31821) Limiters - Exclude MEDLINE records
S13. "Physical Exertion" (110) Limiters - Exclude MEDLINE records
S14. MesH_ (MH "Physical Fitness+") (7138) Limiters - Exclude MEDLINE records
S15. "Activit*" (92293) Limiters - Exclude MEDLINE records
S16. S10 OR S11 OR S12 OR S13 OR S14 OR S15 OR S16 (154555)
S17. Exp_ (MH "Fear+") (4534) Limiters - Exclude MEDLINE records
S18. Exp_ (MH "Phobic Disorders+") (1811) Limiters - Exclude MEDLINE records
S19. Mesh_ (MH "Panic Disorder") (708) Limiters - Exclude MEDLINE records
S20. "Phobia" (496) Limiters - Exclude MEDLINE records
S21. "Afraid" (589) Limiters - Exclude MEDLINE records
S22. "Fright*" (447) Limiters - Exclude MEDLINE records
S23. "Conern*" (47585) Limiters - Exclude MEDLINE records
S24. MesH_ (MH "Avoidance (Psychology)") (172) Limiters - Exclude MEDLINE records
S25. "Negative Evaluation" (73) Limiters - Exclude MEDLINE records
S26. "Threat" (4991) Limiters - Exclude MEDLINE records
S27. S18 OR S19 OR S20 OR S21 OR S22 OR S23 OR S24 OR S25 OR S26 OR S27 (59390)
S28. S9 AND S17 AND S28 (474)

Appendix E – Psych Info search strategy

Psych Info (Ovid)

S1. Explode_ Obesity/ 21940
S2. Explode_ Overweight/ 23114
S3. Explode_ Body weight/ 47629
S4. Explode_ Body Mass Index/ or exp Body Size/ 52242
S5. adiposity.mp. 1948
S6. Fatness .mp. 654
S7. Obese .mp. 14740
S8. S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7/ 55814
S9. Explode_ EXERCISE/ 23565
S10. Explode_ AEROBIC EXERCISE/ 1571
S11. Explode_ MOVEMENT THERAPY/ 1045
S12. movement.mp. 97898
S13. Explode_ exp DAILY ACTIVITIES/ or exp "ACTIVITIES OF DAILY LIVING"/ 8709
S14. Explode_ Physical Activity/ 36196
S15. Explode_ PHYSICAL FITNESS/ or fitness.mp. 15961
S16. S9 or S10 or S11 or S12 or S13 or S14 or S15/ 152705
S17. Explode_ FEAR/ 18984
S18. Phobia.mp. or Explode_ PHOBIAS/ 17343
S19. Explode_ Panic Disorder/ 7388
S20. Afraid .mp. 2168
S21. Fright .mp. 622
S22. Concern .mp. 61922
S23. Explode_ AVOIDANCE/ or Explode_ AVOIDANCE CONDITIONING/ 16029
S24. Negative evaluation .mp. 2241
S25. Threat .mp. 31925
S26. Avoidance .mp. 50678
S27. S17 or S18 or S19 or S20 or S21 or S22 or S23 or S24 or S25 or S26/ 177259
S28. S8 and S16 and S27/ 257

Appendix F – Fear related findings identified in the scoping review

Charted results from review of literature using systematic methods.					
Author, Year & Study Location	**Study population**	**BMI/ Mean BMI (Kg/m^2)**	**Study aim(s)/ title**	**Method**	**Key findings**
Farhangi et al, (2016). Iran.	170 participants. Aged 17–45.	BMI 25.0 – 29.9 and ≥30	Weight self-stigma and its association with quality of life and psychological distress	Survey design	➢ Fear of stigma and negative evaluation In conclusion, findings revealed that higher weight stigma denotes higher psychological distress and lower quality of life among overweight and obese women. This also has an impact on the decision to partake in activity.
Chang et al, (2008). USA	22 participants. Aged 18 – 35.	BMI 25.0 – 39.9	Motivators and Barriers to Healthful Eating and Physical Activity among Overweight and Obese Mothers	Focus groups and interviews	➢ Fear of stigma and negative evaluation Going through their daily routines participants felt unattractive, disliked their bodies, and were angry with themselves for not being able to lose weight. Because of low self-esteem and constant worries about how other people would judge their body sizes, many mothers felt depressed and upset and chose to isolate themselves. They did not engage with activity and avoided public spaces.
O'Brien et al, (2017). Ireland.	22 participants. 18- 45 years	BMI 25.0 – 39.9	Influences on physical activity behaviours of overweight and obese women	Interviews	➢ Fear of stigma and negative evaluation Some obese women recalled feeling victimised by others due to their weight, often through prejudicial weight-based stereotyping, which attributed negative characteristics such as laziness, poor willpower or inferiority.

Sand et al, (2017). Norway.	12 participants. Aged 18- 21.	BMI range from 27.0 – 32.9	Motivation and obstacles for weight management	Interviews	➢ Fear of embarrassment, stigma and negative evaluation. Participant described feelings about revealing her body shape in front of her classmates. She felt uncomfortable and almost humiliated and described this as an obstacle for participating in physical activity.
Lewis et al, (2011). Australia	36 participants. Aged 18- 75 (Mean age 44.8)	BMI >30	To investigate obese men's health behaviours	Interviews	➢ Fear of embarrassment, stigma and negative evaluation Men feared embarrassment in gym settings and did not want to put themselves out there to be ridiculed. Addressing the self-blame and stigma associated with obesity is important in developing strategies to improve the health and well-being of obese men.
Denison et al, (2015). UK	13 participants Aged 25 -34.	BMI >40	A qualitative exploration of attitudes and behaviours of obese women.	Interviews	➢ Fear of embarrassment, stigma and negative evaluation Barriers associated with engaging in physical activity and lifestyle interventions included lack of self-confidence, problems with body-image and motivation and societal judgements. These were described as a barrier to activity.
Zabatiero et al, (2015) Australia.	19 participants. (mean age 41.6)	Mean BMI 41.6	Beliefs, Barriers and Facilitators to Physical Activity in Bariatric	Survey design	➢ Fear of embarrassment, stigma and negative evaluation Most participants described concerns about their physical appearance in terms of size and engaging in activity in public. This concern was mostly related to being watched and the perception of being judged by people due to being overweight.
Ashton et al, (2015). Australia.	61 participants. Aged 18-25.	Mean BMI: 25.3 ± 5.1	Young adult males' motivators and perceived barriers towards eating healthily and being active:	focus groups	➢ Fear of embarrassment, stigma and negative evaluation Many young men often felt that doing exercise or going to the gym was associated with feelings of inferiority, inadequacy, lack of self-confidence and feeling self-conscious or fears around embarrassed. Negative stereotypes and the stigma attached to the gym activities were also frequently mentioned.
Thomas et al, (2008). Australia.	76 participants. Aged 16 – 72	BMI >30	A qualitative investigation of dieting, weight loss, and	Interviews.	➢ Fear of embarrassment, stigma, negative evaluation Participants spoke of being emotionally humiliated, embarrassed or daunted when they attempted to exercise alone. Swimming and walking were the two most common forms of exercise

	(mean age 47)		physical exercise, in obese individuals		recommended to participants by health professionals. Whilst many participants felt that swimming would be the ideal exercise for them, most said that they felt ashamed and fearful of embarrassment at going to a place where they would have to bare so much of their body to others.
Dikareva et al, (2016). Canada.	12 participants. (mean age 47)	BMI >25	Exploring Perceptions of Barriers, Facilitators, and Motivators to Physical Activity	Interviews	➢ Fear of embarrassment, stigma, negative evaluation and death as a fear facilitator Participants repeatedly described poor body image and fear of negative evaluation when exercising around others as barriers to PA. These findings are consistent with literature surrounding pervasiveness of body image dissatisfaction among women in Western culture. The data indicated that weight-based stigmatizing experiences have a profound effect on body image dissatisfaction and PA avoidance behaviours.
Wiklund et al (2011). Sweden	18 participants. Aged 29- 62. (mean age 47)	Mean BMI 47 BMI range, 38–68	Physical activity as viewed by adults with severe obesity, awaiting gastric bypass surgery	interviews	➢ Fear of embarrassment, stigma, negative evaluation Not ‘fitting in’ in the groups or at the gym because of excess weight was revealed in this category. Common for most was the feeling of being critically stared at in public. Some participants described different reasons for not being physically active. Many experienced appearing naked, in a bathing suit or in sport clothes as a huge obstacle and therefore the main reason for not performing physical activity.
Baruth et al. (2014). USA	28 Participants. (Mean age 34.3)	Mean BMI 40.4	Perceived barriers to exercise and healthy eating among women from disadvantaged neighbourhoods	focus groups	➢ Fear of embarrassment, stigma and negative evaluation Issues related to body size were frequently mentioned as barriers to exercise. Such barriers were particularly relevant to overweight/obese women. A number of women talked about being the biggest one at the gym and the cruel comments and/or snickers they received while exercising at the gym or in the neighbourhood. The comments came from adults and children alike and deterred them from going to the gym or exercising in their neighbourhood, as they were embarrassed.
Alqout and Reynolds, (2014).	7 participants. Aged 26–43.	BMIs > 40	Experiences of obesity among Saudi Arabian women	interviews	➢ Fear of stigma, embarrassment and infertility Social events had triggered humiliating feelings and were therefore activity was avoided as much as possible. There were several examples of internalised stigma, where the women expressed anxieties about others’ likely reactions to their body shape. Obesity

Saudi Arabia					also had another social dimension in that women experienced it as impeding pregnancy. For two of the older participants, the desire to conceive another child had finally motivated the decision to be active.
Ball et al, (2000). Australia	2,298 adults Aged 18 to 78	BMI >30	To describe perceptions of being 'too fat' as a barrier to physical activity.	Survey design,	➢ Fear of embarrassment Associations were found between being too fat as a barrier and being too shy or feeling too embarrassed to exercise; being too lazy or not motivated; having an injury or disability (males only); and being not the sporty type. Feeling too fat to exercise was a common barrier among the overweight, particularly for women because they feared being embarrassed as a result of their body size.
Ramírez-Vélez et al, (2014). USA	5,663 participants. (Mean age 20)	BMI> 25	The prevalence of barriers for Colombian students engaging in physical activity	Survey design	➢ Fear of injury The most prevalent barriers in overweight individuals were "fear of injury" (87.0%). Data from surveys.
Guess, (2012) UK.	30 participants. (mean age of 40.7)	Mean BMI 33.8	investigation of attitudes towards aerobic and resistance exercise	focus groups and interviews	➢ Fear of injury This group expressed concern with performing resistance exercise, and all but one (who had experience of this activity in a physiotherapy group) were worried about the risk of injury. Participants were fearful about the risk of injury, how to perform the exercise correctly and unwanted muscle development.
Napolitano et al, (2011). USA	280 participants aged 18–65.	BMI >25	Effects of Weight Status and Barriers on Physical Activity Adoption Among Inactive Women	Survey design and interviews	➢ Fear of injury Interestingly, poor health and fear of injury appeared elevated among obese women, relative to normal and overweight women. This meant that participant was not able to adopt activity as much as they hoped,

Wouters et al, (2011). Netherlands	42 participants. (Mean age 38)	mean BMI 47 ± 6	Physical Activity After Surgery for Severe Obesity: The Role of Exercise	Survey design	➢ Fear of injury and embarrassment The negative exercise cognition "fear of injury" at 1 year after surgery was correlated with reduced physical activity 2 years after surgery (p = 0.01), and this cognition was also a significant predictor of less increase in physical activity during the second year after surgery (p = 0.02). Fear of injury may obstruct physical activity.
Sallinen et al, (2009). Finland.	619 participants. Aged 75–81.	BMI >25	Perceived constraints on physical exercise among obese and non-obese older people	Survey design	➢ Fear of injury and falling Data indicated that comorbidities, pain and tiredness together with fear of falling and injury and negative experiences explained a substantial proportion of the increased risk of physical inactivity among older severely obese people.
Somers et al, (2009). USA	106 participants. (Mean age of 58.7).	Mean BMI 34.7	Pain Catastrophizing and Pain-Related Fear in Osteoarthritis Patients	Survey design	➢ Pain-related fear Fears explained a significant proportion of the variance in measures of psychological disability (pr2 = 0.07) and walking at a fast speed (pr2 = 0.05). Pain cognitions, particularly pain catastrophizing, appear to be important variables in understanding pain, disability, and walking at normal, fast, and intermediate speeds.
McPhail et al, (2014). Australia	217 participants. (Mean age 53)	BMI >25	Perceived barriers and facilitators to physical activity among overweight & obese	Survey design	➢ Pain-related fears Numerous themes of fear- and anxiety-related responses centred on a fear of making their musculoskeletal condition(s) worse by undertaking physical activity. Aging-related factors were also prevalent in the responses of a number of patients, including fear of falling due to poor balance.
Vincent et al, (2014). America	49 participants. Aged 60–85.	BMI>30	Resistance Exercise, Disability, and Pain Catastrophizing in Obese Adults	Survey design	➢ Pain-related fears and fears of movement Severely obese persons) demonstrate approximately 30% higher average pain catastrophizing scores compared with that in overweight person. Fear avoidance beliefs were moderately elevated in obese, middle-age individuals compared with those in their non-obese counterparts, and higher kinesiophobia levels were associated with

					higher disability scores in obese persons compared with those in non-obese counterparts
Vincent et al, (2011). America.	192 participants. (Mean age 48.2)	BMI >30 Mean BMI 36.9	Fear of Movement, Quality of Life, and Self-Reported Disability in Obese	Survey design	➢ Fear of movement This fear was found to be higher in obese adults than non-obese adults suffering musculoskeletal pain. Fear of movement in obese patients was primarily related to the somatic focus component of the TSK score. Fear of movement enhanced prediction of self-reported disability with walking on the Oswestry survey and for the overall Oswestry disability score for the obese but not normal weight patients. Importantly, elevated fear of movement occurred in the obese group despite similar pain ratings
Vincent et al (2013). America.	55 participants. Aged 60- 85.	BMI>25	Kinesiophobia and Fear-Avoidance Beliefs in Overweight Older Adults	Survey design	➢ Fear of movement Fear of movement slightly elevated among those with BMI over 30kgm2. This was not significant with a P value of 0.77 over different BMI ranges. Participants who had higher fear scores held elevated fear avoidance beliefs around activity.
Vincent et al, (2010). America	278 Participants. (Mean age 28.7)	BMI ≥40	Morbid Obesity Is Associated with Fear of Movement and Lower Quality of Life	survey design	➢ Fear of movement Fears were elevated in morbidly obese adults with knee pain-related diagnoses compared with non-obese counterparts. Importantly, elevated fear of movement occurred despite the morbidly obese group reporting the lowest knee pain ratings. Fear of movement may also be related to deterioration in the quality of life (QOL) over the long term in this obese population.
Capodaglio et al, (2010). Italy.	Review of obese adults	BMI >30	Disabling obesity: from determinants to practical care	Narrative review.	➢ Fear of movement Weight stigma related to body weight and embarrassment of being unable to get into exercise equipment can also deter the obese from participating in programs. To help overcome fear of movement due to pain, exercise may need to be supervised initially and periodically thereafter to help ensure that activity is performed at the appropriate training stimulus and not compromised because of fear.
Byoung-Jin Jeon, (2013). Korea	351 participants. Aged 60 plus.	BMI >30	The Effects of Obesity on Fall Efficacy in Elderly People	survey design	➢ Fear of falling The data found that obesity reduces activity in the elderly and increases the fear of falling. The results of the present study indicate that the BMI does have a direct causal effect on fall efficacy. The fear of falling is defined as low perceived self-efficacy or low sense

					of assurance at avoiding a fall, and fall efficacy is determined by measuring this fear.
Rosic et al, (2019) UK.	63 participants. Aged 18 – 49.	BMI over 30 (mean BMI 42.1)	fear of falling in obese women age under 50 years	Survey design	➢ Fear of falling study confirmed fear of falling Is present in obese women under 50 years of age. Fear of falling association with low levels of physical activity.
Bruce et al, (2002). Australia	1,500 participants. Aged 70-85	BMI >25	To examine whether FOF is probable cause of reduced activity participation	Survey design	➢ Fear of falling This is common in older adults and is independently associated with reduced levels of participation in recreational PA. It is also associated with high BMI. Anxiety and/or fear of falling need to be considered for anyone experiencing a fall or presenting with a balance/gait disorder—an important consideration given that fear of falling does not necessarily need to result from an actual fall.
Deshpande et al (2008) USA	848 participants. Aged ≥65 years. (mean age 75.9)	Mean BMI 26.49	To identify psychological, physical function parameters that are specifically associated with activity restriction	Survey design	➢ Fear of falling Psychological and physical factors are independently associated with FOF. A higher but not significant risk of FOF reported with increased BMI. In elderly population, activity restriction associated with FOF is an independent predictor of decline in physical function. A significant association reported between higher BMI and increased activity restriction.
Larsson and Mattsson (2001). Sweden	57 participants. (Mean age 44yrs).	Mean BMI 37	Perceived disability and observed functional limitations in obese women	Survey design	➢ Fear of falling Obese women stated that they dreaded falling over as they felt clumsy, got nasty comments and were stared at in public when they were trying to stand up. Obese women reported fear of falling due to a fear of feeling clumsy and being mocked and stared at if they fell. This resulted in activity avoidance whereby there may be a risk of falling.
Neri et al (2017).	226 participants.	BMI >25	Association between obesity, risk of falls and fear	Survey design	➢ Fear of falling

Brazil.	(mean age 68)		of falling in older women.		Fear of falling is associated with obesity in older women and can be explained by lower limb muscle weakness. Also, may increase risks of falls.
Wingo, et al (2011). USA	21 participants. (Mean age 48.57).	Mean BMI 40.63	Fear of physical response to exercise among overweight and obese adults	focus groups	➢ Fear of weight related risk factors and pain-related fears. Participants in each group stated that this overreaction to physical responses stems, in part, from a fear of weight-related risk factors. Many participants reported that knowing they were at an increased risk for heart attack and stroke due to their weight made them more aware of physical responses during and after exercise. The discussions of these focus group members indicated that fear of pain is often as much of a barrier as pain itself for adults who are overweight or obese.
Cooper et al, (2017). UK	18 Participants. Aged 29-71.	BMI ≥25-46.	Perceptions of adults with overweight/obesity and chronic musculoskeletal pain.	Interviews.	➢ Fear of weight causing more damage. Overweight/obesity contributed to fear and catastrophizing, which resulted in avoidance of exercise. Participants' perception that extra pressure caused by their weight further damaged joints contributed to fear and catastrophizing.
Kodjebacheva et al, (2015). USA	1427 participants (Mean age 55).	Mean BMI: 29	Fear of Crime and Higher Body Mass Index	Survey design	➢ Fear of crime Fear of crime was positively associated with depressive symptoms. Fear of crime was not directly associated with moderate or vigorous exercise. Fear of crime was directly associated with higher BMI. Fear of crime was associated with depressive symptoms, which in turn were associated with reduced exercise and subsequently higher BMI.
Phelan et al (2014). USA	4,687 participants. (Mean age 23.9)	BMI>25	The Adverse Effect of Weight Stigma on the Well-Being of Medical Students with	Survey design.	➢ Fear of becoming fat This fear was strongly associated with all of the stress vulnerability factors. Compared to underweight/normal-weight students, overweight/obese students reported significantly worse overall health, body esteem, and loneliness, and were more likely to report using alcohol or drugs to cope with stress.

			Overweight or Obesity		
Tod and Lacey, (2004). UK	16 participants. Aged 33 – 58.	BMI >25	Overweight and obesity: Helping clients to take action	interviews	➢ Fear of death and embarrassment as a facilitator Triggers to action Embarrassment and humiliation. Most participants described feeling embarrassed or humiliated because of their weight. Embarrassment and humiliation associated with certain events or situations were reported to facilitate action to lose weight. Having a child who had recently started school heightened any embarrassment people felt about being overweight.
Alvarado et al (2015). Barbados, West Indies.	17 participants. Aged 25 – 35 years (mean age 30)	BMI > 25. Mean BMI of 33.	Barriers and facilitators to physical activity amongst overweight and obese women	Interview and meetings.	➢ Fear of missing out Guilt around missing classes and fear of missing out were both reported to be strong motivations for consistent attendance. On a small island, several women explained that it was very likely that one would run into someone from an exercise group on the street, making social pressure more tangible.

Appendix G – Interview schedule

Exploring Concerns around Activity for Adults Aged 18 -45 Years with Weight Problems

Lead Researcher: Oliver Hamer. E: Hamero@edgehill.ac.uk T: 01695654314 (Ext. 6314)

1) **Preamble:** Thank you for kindly agreeing to talk to me about your concerns with activity. Interviewer introduces himself, his role and what the PhD entails. The interviewer will explain what is hoped to be learnt by the research and its impact in real life situations.

2) **Opening- Explanation of Interview, participant, estimated time of interview, what will happen to the data and participant rights**

    Purpose - The interview is to find out your concerns that may cause you to avoid activity. I am interested in the interpretations of these concerns from the point of view of an adult with weight problems.
    Time Line - The interview is estimated to last anywhere between 30- 90 minutes. Once concluded the interview will be transcribed for analysis.
    Confidentiality - The results will be reported as part of my PhD but you will not be identified in any way. Everything you disclose within the interview will be completely confidential, other than anything that may incriminate you or the researcher. This interview will be recorded.

3) **Background and demographic information**

    - Could you please confirm that you have read the information sheet and have given informed consent?
    - Can you please confirm your height?
    - Can you please confirm your weight?
    - Can you please confirm your age?
    - Do you have diabetes, heart disease or osteoarthritis?
    - Do you use any assistive devices?

4) **Establishing Rapport**

    Could you please start by telling me about your daily routines, how do you start your day and how does it typically end up?

5) **Main Body - Thinking back to the last few days, weeks and months…**

    - Could you please tell me if any, what activities you engage in such as shopping, taking the stairs, gardening, walking, or group exercise classes?

Prompt: how often and the duration of activity you take part in on an average week

- Could you please tell me if you enjoy these activities and what helps you to take part in them?
- Could you please tell me any activities that you do not do and why this may be?

- Could you tell me if you have had any concerns that may have stopped you or restricted you taking part in these activities or any activities?

    - *Prompt:* Have you ever hurt yourself or felt uncomfortable?
        - Does injury restrict you or cause you concern?
        - Are you concerned about feeling embarrassed?
        - Do you feel concerned about breathing difficulties?
        - Is pain a factor in your decision to partake in activity?
        - Are there any situations you feel silly or stupid when partaking activity
        - Do you think activity increases your risk of injury?
        - What are the consequences for you if you were to get injured during activity?

- Could you please tell me under what circumstances activity is most concerning for you?

- Could you please tell me where you perceive your concerns originates from and what it means for your experiences of activity?

- Could you please tell me if you would like to increase your activity levels and what you think is your biggest barrier to achieving this?

- Finally, is there anything else you would like to add on the topics that we have discussed?

Prompts:

In your response you talked about…………(led by participants response) could you expand on that point please?

Prompt may follow any of the questions above.

Thank you for your participation in this study, there is a debriefing form that holds all my details should you wish to follow up on this interview and add anything at a later date.

Appendix H – Ethical approval letter

Edge Hill University

Dear Oliver,

Thank you for submitting your research ethics application *'To Explore the Emotion of Fear as a Barrier to Physical Activity in Young Adults Who Are Obese'* (FOHS 202) to the Faculty of Health & Social Care Research Ethics Committee.

I have pleasure in informing you that the Committee recommended that your study is granted Faculty of Health & Social Care research ethics approval, subject to the following conditions:

1. Ethical approval covers only the original study for which it is sought. If the study is extended, changed, and / or further use of samples or data is needed the Committee Administrator, Daniel Brown, must be contacted for advice as to whether additional ethical approval is required.

2. (NHS studies only) NHS Research governance processes must be adhered to. An application must be made to the HRA for approval for the research to be conducted in the NHS. All NHS R&D departments (in Trusts where data is being collected) will also need to be approached for Trust permission to proceed.

3. If the project requires HRA approval and/or NHS ethical approval, please forward evidence of the approval(s) to Daniel Brown (browdan@edgehill.ac.uk) before commencing the study

4. The Principle Investigator is responsible for ensuring that all data are stored and ultimately disposed of securely in accordance with the Data Protection Act (1998) and as detailed within the approved proposal.

5. The Principle Investigator is responsible for ensuring that an annual monitoring form and an end of study form, where appropriate, is sent to the Committee Administrator (browdan@edgehill.ac.uk). The form will be sent to you at the appropriate time by the Committee Administrator.

6. Ethical approval for this research will expire on 01/09/2018. Any extensions to this date will require additional approval from the committee.

The study documentation that has been reviewed and approved is detailed below:

<doc title>	**<version no & date>**
Phase 1 FREC Ethics RESUBMISSION	**V2, 04/04/2018**

Professor Mary O'Brien

Chair of Faculty of Health & Social Care Research Ethics Committee
Edge Hill University

St Helens
Road
Ormskirk
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Appendix I - Participant information sheet, informed consent form and debriefing sheet

Participant Information Sheet

Edge Hill University

Study title: What are the concerns around activity for adults aged 18 -45 years with weight problems.

An Invitation to participate

You are invited to participate in a research study. This study is in partial fulfilment for a PhD at Edge Hill University and this participant information sheet is to inform you of what it means to be part of this research.

After reading this information sheet you may want to ask further questions. The email address of the lead researcher is at the end of this information sheet. Please do not hesitate to make contact if you are unsure of what your participation involves. If you agree to participate in the research project, you will be asked to sign the declaration consent form and return to the researcher before taking part in this study. Before giving your signature for informed consent please make sure you fully understood all the information provided.

What is the purpose of the study?

To explore the concerns around activity for adults aged 18 -45 years with weight problems.

Many concerns exist as to why partaking in physical activity is often difficult. Concerns that relate to activity engagement have recently been explored but not in younger adults. This project wants to explore if the concerns raised by younger adults are something that can be categorised as a barrier to activity. Many concerns are experienced differently by individuals and needs to be explored in the context of activity avoidance. This project seeks to recall your past experiences and what your concerns may be.

Why have I been asked to take part in the study?

You have been invited to take part in this study because you are between 18 and 45 years of age and feel that you have weight problems. Research shows that various concerns prevent activity engagement but we want to understand more.

What do I have to do as part of this study?

The study will require you to participate in a telephone, skype or face to face interview, lasting anywhere between 30-90 minutes. The interview will begin with an initial directed question and then further questions will be guided by your responses. The types of areas that will be covered by the questions are daily activity, movement, barriers to activity, falling or injury and concerns around activity. Any data collected will be kept in accordance with Edge Hill University Policy with reference to confidentiality and anonymity.

Do I have to take part?

No. It is up to you to make a decision on whether you take part in this study or not. If you do agree to be a participant then we will ask for you to give informed consent.

What are the possible benefits of taking part?

It is unlikely that you will experience any direct benefit from taking part in this study. However, the information gained from the study will be used to assist weight management practitioners.

What are the potential risks of taking part in the study?

There are no additional risks through participating in this study. If you do get upset in the interviews you can talk to us about it or later you can speak with your GP or you could contact the Samaritans on 08457 909090.

Will my taking part in the study be kept confidential?

Yes, any information about you that is shared as part of this study will be anonymous. Your demographic information will be removed from all transcripts so that you cannot be recognized from the information. All information about you will be handled in confidence. Privacy, confidentiality and anonymity will be guaranteed in accordance with Edge Hill University policy.

What will happen if I want to withdraw from the study?

You have the right to withdraw up to one week after signing the consent form. Your data will be destroyed following your withdrawal.

Once consent is given you will then be asked to provide a unique identity pseudonym, which you will need to keep throughout your involvement in the research. You can write this pseudonym on your debriefing sheet, but please keep this name somewhere safe where you can have access to it, as this will be the needed should you wish to withdraw.

Who is organising and funding the research?

The research is being organized by the lead researcher at Edge Hill University and funded by Edge Hill University.

Who has reviewed the study?

This study has been reviewed and approved by Edge Hill Faculty of Health and Social Care research ethics committee, date of approval.

What if there is a problem?

If you are concerned at any point about any aspect of this study, you should ask to speak to the lead researcher who will do their best to answer your questions. Alternatively if you would like to speak to anyone outside of the research team please contact the Associate Director of Research: Professor Clare Austin, Edge Hill University, Faculty of Health and Social Care. Contact Email: Clare.Austin@edgehill.ac.uk.

What will happen to the results of the study?

Participants who take part in this study will be provided with a debriefing sheet, this will expand on the studies aims and give contact details for follow up comments or contributions you wish to make. Once all the data has been collected and analysed, it will be used or shared as partial fulfilment of a PhD, meetings, conference papers, presentations, teaching materials, educational projects, and publications or to inform future projects. You will remain anonymous throughout any sharing or presentation of the data. Any information written about you will be kept anonymous through the use of coding and in accordance with the Data Protection Act 1998. Any additional notes, transcriptions or paperwork will be kept in accordance to the Universities policies.

<u>Who can I contact for further information?</u>

For further information regarding the study you can contact:

Thank you for your time

Oliver Hamer
PhD Student, MA, PGCE, BSc
Faculty of Health and Social Care
Edge Hill University
St Helens Road
Ormskirk
L39 4QP
E: Hamero@edgehill.ac.uk
Supervisors:

Supervisory team contacts:
Paola Dey (Director of studies) Paola.Dey@edgehill.ac.uk
Derek Larkin Derek.Larkin@edgehill.ac.uk
Nicola Relph Nicola.Relph@edgehill.ac.uk

Thank you for taking the time to read this information.

Appendix I continued

Signposting Agencies for Participant

Study title: What are the concerns around activity for adults aged 18 -45 with weight problems

If you feel distress or upset from partaking in this interview please do not hesitate to contact your GP or one of the following agencies for support

Samaritans
(Mental health support)
Phone: 08457909090
Email: Jo@samaritans.org
Website: www.samaritans .org

Anxiety UK
(Mental health support)
Phone: 08444775774
Website: www.anxietyuk.org.uk

Lead Researcher - Oliver Hamer
PhD Student, MA, PGCE, BSc
Faculty of Health and Social Care
Edge Hill University
E: Hamero@edgehill.ac.uk
T: (01695) 654314 – Ext. 6314

Thank you for taking the time to participate in this research.

Appendix I continued

Edge Hill University

Participant Consent Form

Study title: What are the concerns around activity for adults aged 18 -45 years with weight problems

Please initial each box

This purpose of this consent form is to check that you are aware of your rights, understand what will be required of you and agree to take part in the study.

1. I confirm that I have read and understood the Participant Information Sheet (version 1.0) for the above study.
2. I have had the opportunity to consider the information, ask questions about the research and have had these answered satisfactorily.
3. I agree to take part in the research and understand that my participation is voluntary.
4. I understand that I have the right to leave the interview, without giving reasons for this, at any time during the interview
5. I understand I have the right to withdraw my data up to one week after signing this consent form.
6. I am satisfied that the information I provide will be treated confidentially by the researcher.
7. I agree for the interview to be audio recorded.
8. I agree that anonymised quotations and data from the interview can be shared and used to inform a PhD study, meetings, conference papers, presentations, teaching, educational projects, and publications or to inform future projects. I understand that my quotations will be used anonymously.
9. I understand that relevant anonymised data collected during the study may be looked at by the lead researcher, individuals from Edge Hill University and regulatory authorities for audit purposes where it is relevant to me taking part in the research. I give permission for them to have access to this data.
10. I understand that other researchers, including the lead researcher, may use the anonymised data to inform other research.

Participant's Signature………………………**Print Name**…………………………
Date..

Researcher's Signature…………………**Print Name**…………………………….

Date …..

Appendix I continued

Edge Hill University

Attachment Sheet

Study title: What are the concerns around activity for adults aged 18 -45 years with weight problems

Following your involvement in this research the data will be analysed and summarised in a write up. If you would like to receive a summary of the research findings please supply your email address below. A summary of the findings will likely be disseminated if you so wish to receive one in January 2019.

Email Address

………

Thank you for taking the time to participate in this research.

Appendix I continued

Participant Debriefing Sheet

Study Title: What are the concerns around activity for adults aged 18 -45 years with weight problems

Thank you for your participation within this research.

The data you have provided for this research will prove beneficial within the health sector to inform interventions for weight management.

The findings from this study will help practitioners to better understand the concerns that individuals outside of healthy weight experience when attempting to engage in physical activity.

Your Data and Your Rights

Your anonymity will be preserved throughout this study: there will be nothing in data files or reports that will identify you in any way. Your consent forms, which contain your name and your signature will be stored in a locked filing cabinet and will be held in accordance with The Data Protection Act (1998) and Edge Hills ethics policies. The data collected may be presented in academic forums such as assignments, teaching, academic conferences, or research papers etc, but all data will be anonymized.

You have the right to withdraw your data from our study at any time up to one week after the date you consented.

In order to anonymize your data please write a participant pseudonym here, do not tell anyone, and keep this name with you when participating with the research. ……...

Contact information :

The Lead researcher in this study is Oliver Hamer Should you need to contact me at any point, the details are below:

E: Hamero@edgehill.ac.uk T: 01695654314 (Ext. 6314)

If you would like to contact anyone other than the lead researcher please contact Prof Paola Dey, the Director of studies on: Paola.Dey@edgehill.ac.uk
If you are contacting to request that your data be withdrawn from our study, please do so within one week of your interview, and include your participant pseudonym in your message.

Appendix I continued

Edge Hill University

Screening Information Sheet

Study title: What are the concerns around activity for adults aged 18 -45 years with weight problems

Please fill in the information below to the best of your ability;

1. Can you confirm by putting an X in the box that your age is between 18 to 45 ☐ years?

2. Please can you state your height

3. Please can you state your weight

4. Please can you indicate your gender

5. Do you have any physical condition un-related to weight that affects movement such as degenerative muscle conditions, artificial joints or amputations?

Thank you for taking the time to complete this information.

Appendix J – Ethical approval for quantitative phase

19th July 2019

Dear Oliver,

Thank you for submitting your research ethics application '*Exploring pain-related fear measurement instruments in younger adults*' (FOHS 202) to the Faculty of Health & Social Care Research Ethics Committee.

I have pleasure in informing you that the Committee recommended that your study is granted Faculty of Health & Social Care research ethics approval, subject to the following conditions:

1. Ethical approval covers only the original study for which it is sought. If the study is extended, changed, and / or further use of samples or data is needed the Committee Administrator, Daniel Brown, must be contacted for advice as to whether additional ethical approval is required.

2. (NHS studies only) NHS Research governance processes must be adhered to. An application must be made to the HRA for approval for the research to be conducted in the NHS. All NHS R&D departments (in Trusts where data is being collected) will also need to be approached for Trust permission to proceed.

3. If the project requires HRA approval and/or NHS ethical approval, please forward evidence of the approval(s) to Daniel Brown (browdan@edgehill.ac.uk) before commencing the study

4. The Principle Investigator is responsible for ensuring that all data are stored and ultimately disposed of securely in accordance with the Data Protection Act (1998) and as detailed within the approved proposal.

5. The Principle Investigator is responsible for ensuring that an annual monitoring form and an end of study form, where appropriate, is sent to the Committee Administrator (browdan@edgehill.ac.uk). The form will be sent to you at the appropriate time by the Committee Administrator.

6. Ethical approval for this research will expire on 30/06/2020. Any extensions to this date will require additional approval from the committee.

The study documentation that has been reviewed and approved is detailed below:

<doc title>	**<version no & date>**
Phase 2 FREC resubmission	**V2, 01/07/2019**

Risk assessment	**V2, 01/07/2019**
Email/ Letter to Organisations for Access to Participants	**V2, 01/07/2019**
Email, Edge Hill University Students and Staff	**V2, 01/07/2019**
Participant Information Sheet	**V2, 01/07/2019**
Demographic &questionnaire pack	**V2, 01/07/2019**
Monthly Ethical Checklist	**V2, 01/07/2019**
Data Management Plan	**V2, 01/07/2019**
Poster/ leaflet for recruitment	**V2, 01/07/2019**
Pain Anxiety Symptoms Scale – 20 (PASS-20)	**n/a**
Tampa Scale of Kinesiophobia (TSK)	**n/a**
Pain Disability Index (PDI)	**n/a**
Pain Numeric Rating Scale (NRS)	**n/a**

Yours sincerely

Professor Mary O'Brien

Chair of Faculty of Health & Social Care Research Ethics Committee
Edge Hill University
St Helens
Road
Ormskirk
Lancashire
L39 4QP
obrienm@edgehill.ac.uk

Appendix K – Risk assessment and data management

Risk assessment- Title: Measuring activity-related fear of pain in younger adults.

Risk	**Risk Probability** **Low/ Medium/ High**	**Impact if risk occurs**	**Outcome**
Lone working in the studies data collection and analysis	Low	Emotional/ psychological harm to researcher	There is a low risk of lone working. The risks of collecting data alone will be mitigated with a buddy system that will be implemented with on the supervisory team. The buddy and the lead researcher will report to one another to confirm the safety of all parties, prior and following data collection. If there is a vulnerability or intimidation felt by the researcher throughout the project there will be a consultation of the supervisors and possibly the counselling therapy services at Edge Hill University
Damage to the natural environment, from the research	Low	Excess emission from using personal transport could impact on global health	There is a low risk to the natural environment as the researcher will make provisions to use public transport as much as possible to minimize vehicle emissions. The research does not require the use of the environment which would cause any damage.
Threat of abuse (physical or verbal) form participants	Low	Physical or psychological harm to researcher, long term injury or illness.	If a threat of abuse is present at any point during data collection the researcher will immediately cease the collection and document and report the incident to the director of studies. If the researcher feels any adverse effects from the threat he will seek the counselling services at Edge Hill University.
Health & safety issues	Low	Injury or illness for participants and researcher. Loss of earnings and health.	A low risk, all health and safety risk assessments will be reviewed for the data collection environments. Any health and safety incidents will be reported and may require immediate action. Injury to participants and the researcher will be documented and reported to Edge hill University but occurrence is unlikely.

Causing harm to participants through sensitive matters such as weight and fear	Low	Potential to harm mental health. Impact on the development of mental health disorders	Low risk as the data collection process will be a questionnaire. If the researcher believes harm has been caused then the researcher would signpost to GP, University services and participants given the option to terminate the data collection and leave the setting immediately. This would be likely to be psychological concerns following data collection. The researcher will report any concerns with the research team.
Breaching confidentiality	Low	Indemnity claims, identify theft and the studies data becoming unusable	Low risk, but would result in immediate action, the data management plan will be followed closely to attempt to avoid any occurrence of a breach in confidentially.
Trauma resulting from psychological harm to researcher.	Low	Poor mental health, loss of earnings, sickness leave from employment, failure to meet project management deadlines.	There is a low risk of harm to researcher due to the topic of pain-related fear and physical activity not being relevant to the researcher. The researcher will consult the supervisory team and seek the support of Edge Hill counselling services if this occurs.
Situations in which could compromise the integrity of the researcher or the university	Low	Bringing the University into disrepute. Failure to achieve PhD. Loss of funding.	The risk of this is low as the researcher will have planned ahead and consulted the supervisors on precautions to take. The data collection will be in a public place with other people within a close vicinity to assist with safeguarding policy.
Emotional well-being	Low	Reduction in quality of life of participants. Negative effect on mental health.	There would be low risk to the emotional well-being of potential participants, if this were to happen It would be reported to the supervisory team. The lead researcher will signpost to GP and other agencies.
Taking advantage of vulnerable adults	Low	Damage the reputation of the researcher and the University. Criminal	Vulnerable adults will not be part of the population for this particular research project; my target group does not target venerable adults.

		investigation. Ceasing of study and employment.	
Data management, potential breaches of confidentiality, such as storing identifiable information	Low	Unable to use the data within the study. Potential indemnity claims. Financial loss. Termination of PhD. Criminal investigations, implication’s in law and liability claims.	The researcher will follow correct ethical processes in order to maintain confidentiality and anonymity. Minimal information will be needed, Such as age, gender etc. Any breach must be reported immediately the supervisors and in accordance with University policy.

Appendix L - Email/ Letter to Organisations for Access to Participants

Edge Hill University

Oliver Hamer
PhD Student, MA, PGCE, BSc
Faculty of Health and Social Care
Edge Hill University
St Helens Road
Ormskirk
L39 4QP
E: Hamero@edgehill.ac.uk
T: (01695) 654314 – Ext. 6314

Dear Sir/ Madam,

I am currently leading a PhD research project at Edge Hill University considering adults who encounter barriers to partaking in physical activity. I am looking to survey younger adults (aged 18-45 years) about the concerns they have when partaking in physical activity. I am particularly interested in fears that relate to physical activity and how they may lead to activity avoidance. If you feel that anyone within your organisation would be interested in completing a short questionnaire (will take no longer than 15 minutes to complete) I would be happy to discuss this further with them.

If you feel this project is something your organisation/ group would be happy to participate in, then I will be happy to contact you. I would be happy to call or meet with you at your convenience.

Thank you for your time

Oliver Hamer
PhD Student, MA, PGCE, BSc
Faculty of Health and Social Care
Edge Hill University
St Helens Road
Ormskirk
L39 4QP
E: Hamero@edgehill.ac.uk

Appendix M - Email, Edge Hill University Students and Staff

Oliver Hamer
PhD Student, MA, PGCE, BSc
Faculty of Health and Social Care
Edge Hill University
St Helens Road
Ormskirk
L39 4QP
E: Hamero@edgehill.ac.uk
T: (01695) 654314 – Ext. 6314

Dear Student/ Staff

I am currently conducting a PhD project within Edge Hill University that hopes to identify barriers to physical activity.

I am conducting some research that intends to highlight the concerns younger adults experience when partaking in physical activity.

Subsequently, I am looking for adults aged 18-45 years old who would be happy to complete a short questionnaire that measures several factors that relate to activity avoidance.

The questionnaires will take approximately 10 to 15 minutes to complete and consist of around 60 questions.

With the assistance from participants I am hoping the findings will have a positive impact on intervention strategies in the management of weight.

Please see the attached information sheet or contact me via email for further details on the project.

Thank you for your time

Oliver Hamer
PhD Student, MA, PGCE, BSc
Faculty of Health and Social Care
Edge Hill University
St Helens Road
Ormskirk
L39 4QP
E: Hamero@edgehill.ac.uk

Appendix N – Participant Information Sheet

Study title: Measuring activity-related fear of pain in younger adults

An Invitation to participate

Regular physical activity is important to maintain health. Previous research has found that fears about injury, joint and muscle pain may stop younger adults from partaking in physical activity. However, these concerns have yet to be measured in large samples or using appropriate questionnaires. This research aims to measure these concerns and explore if pain-related fear scores differ between groups who are active and those who are inactive. The questionnaire will ask you about your worries surrounding pain, weight and levels of physical activity. If any of the questions cause you concern or upset, you may withdraw at any time.

By conducting the research, we hope to share important information about fear related avoidance of activity (specifically pain-related fears) to professionals involved in weight management and health promotion. It is also hoped that the findings can help drive further research into ways of increasing physical activity in younger adults, particularly those who are overweight. This study is in partial fulfilment for my PhD at Edge Hill University and this participant information sheet is to inform you of what it means to be part of this research. After reading this information sheet you may want to ask further questions. My email address is at the end of this information sheet.

Because this research focuses on younger adults, if you are not between the age of 18 and 45 years you are ineligible to participate. The questionnaire will take between 10 to 15 minutes to complete. **Your consent will be implied if you complete and return the questionnaire pack.**

Please note that you have the right to withdraw at any point during the completion of the questionnaires. If you choose to withdraw it will hold no consequences. **Once you have submitted the questionnaire pack back to the lead researcher (following completion), you will be unable to withdraw your data from the study**. This is because the questionnaire is anonymous and does not contain any identifiable information.

All information about you will be handled in confidence. Privacy, confidentiality and anonymity will be guaranteed in accordance with Edge Hill University policy. Once all the data has been collected and analysed, it will be used or shared as partial fulfilment of my PhD, meetings, conference papers, presentations, teaching materials, educational projects, and publications. The data will also be deposited into the university repository to inform future research. This study has been reviewed and approved by Edge Hill Faculty of Health and Social Care research ethics committee, date of approval- 19th July 2019. If you are concerned at any point about any aspect of this study, you should ask to speak me and I will do my best to answer your questions. Alternatively, if you would like to speak to someone outside the research team, please contact the Associate Director of Research: Professor Clare Austin, Edge Hill University, Faculty of Health and Social Care. Contact Email: Clare.Austin@edgehill.ac.uk. If you participate in this research and would like to receive a summary of the research findings, please contact the lead researcher via email stating that you would like a copy of the report and your contact details. A summary of the findings will likely be disseminated if you so wish to receive one in June 2020.

For further information regarding the study you can contact me on:

Oliver Hamer. Faculty of Health and Social Care, Edge Hill University, Ormskirk, L39 4QP**.** E: Hamero@edgehill.ac.uk**. Thank you for taking the time to read this information.**

Appendix N Attachment - General Data Protection Regulation

Edge Hill University

Study title: Measuring activity-related fear of pain in younger adults.

General Data Protection Regulation

Information about how we handle your data is described in the participant information sheet you have been given about the study. The following is additional information, including our Privacy Notice and the lawful basis for processing your data.

Privacy Notice

At Edge Hill, we are committed to respecting and protecting your personal information. To find ways in which we use your data or information, please see edgehill.ac.uk/about/legal/privacy.

Lawful basis for processing data

Academic research is conducted in the public interest for current and future generations, so **the lawful basis for research data collection is that of a necessary 'public task'**, so the collection of data is 'necessary for the performance of a task (research) carried out for reasons of public interest'

Complaints

If you wish to raise a complaint on how we have handled your personal data, you can contact our Data Protection Officer (dataprotection@edgehill.ac.uk) who will investigate the matter. If you are not satisfied with our response or believe we are processing your personal data in a way that is not lawful you can complain to the Information Commissioner's Office (ICO).

If you feel distress or upset from partaking in this study, please do not hesitate to contact your GP or one of the following agencies for support.

Samaritans
(Mental health support)
Phone: 08457909090
Email: Jo@samaritans.org

Anxiety UK
(Mental health support)
Phone: 08444775774
Website: www.anxietyuk.org.uk

Alternatively, if you are a student at Edge Hill University you can contact the wellbeing team on;

Email: studentwellbeing@edgehill.ac.uk
Phone: 01695 650988
Or by visiting the Catalyst Helpdesk.

Thank you for taking the time to read this information

Appendix O - Demographic & measurement Instrument pack

Study number:
Cohort (researcher use):

Study title: Measuring activity-related fear of pain in younger adults.

1. Please record your age by selecting one of the options below. Please only tick **one.**

18-21 years old	
22-25 years old	
26-29 years old	
30-33 years old	
34-37 years old	
38-41 years old	
42-45 years old	

2. Please select the option for how you identify. Tick **one** box?

Male Female Other, please write

____

3. Please state your height in either of the boxes below.

Feet Inches

Centimeters

4. Please state your weight in either of the boxes below.

Stones Pounds

Kilograms

5. Do you have any physical problems which may affect your balance or ability to take part in physical activity? Please tick **one** box.

No	
Yes	

Please turn over.

6. What is your current employment status? Please tick **one** of the boxes below.

Employed full time (40 or more hours per week)	☐
Employed part time (up to 39 hours per week)	☐
Unemployed and currently looking for work	☐
Unemployed and not currently looking for work	☐
Student	☐
Homemaker	☐
Self-employed	☐
Other	☐

Please note that your consent will be implied if you complete and return the questionnaire pack.

.

Study number:

Please turn over.

Pain Anxiety Symptoms Scale – 20 (PASS-20)

The following set of questions are interested in how you respond to pain. We would like to know what you do and what you think about when in pain. Please use the rating scale below to indicate how often you engage in each of the following thoughts or activities.

Please circle one number from; <u>0 (NEVER)</u> to <u>5</u> <u>(ALWAYS)</u>

7. I can't think straight when in pain	0	1	2	3	4	5
8. During painful episodes it is difficult for me to think of anything besides the pain	0	1	2	3	4	5
9. When I hurt I think about pain constantly	0	1	2	3	4	5
10. I find it hard to concentrate when I hurt	0	1	2	3	4	5
11. I worry when I am in pain	0	1	2	3	4	5
12. I go immediately to bed when I feel severe pain	0	1	2	3	4	5
13. I will stop any activity as soon as I sense pain coming on	0	1	2	3	4	5
14. As soon as pain comes on I take medication to reduce it	0	1	2	3	4	5
15. I avoid important activities when I hurt	0	1	2	3	4	5
16. I try to avoid activities that cause pain	0	1	2	3	4	5
17. I think that if my pain gets too severe it, will never decrease	0	1	2	3	4	5
18. When I feel pain, I am afraid that something terrible will happen	0	1	2	3	4	5
19. When I feel pain, I think I might be seriously ill	0	1	2	3	4	5
20. Pain sensations are terrifying	0	1	2	3	4	5
21. When pain comes on strong I think that I might become paralyzed or more disabled	0	1	2	3	4	5
22. I begin trembling when engaged in activity that increases pain	0	1	2	3	4	5
23. Pain seems to cause my heart to pound or race	0	1	2	3	4	5
24. When I sense pain, I feel dizzy or faint	0	1	2	3	4	5
25. Pain makes me nauseous	0	1	2	3	4	5
26. I find it difficult to calm my body down after periods of pain	0	1	2	3	4	5

Study number:

Please turn over.

Tampa Scale of Kinesiophobia (TSK)

The following set of questions are interested in how you may perceive injuries and pain.
Please circle one number that best describes how you feel about each statement;

1 = strongly disagree, 2 = disagree, 3 = agree, 4 = strongly agree

27. I'm afraid that I might injury myself if I exercise	1	2	3	4
28. If I were to try to overcome it, my pain would increase	1	2	3	4
29. My body is telling me I have something dangerously wrong	1	2	3	4
30. My pain would probably be relieved if I were to exercise	1	2	3	4
31. People aren't taking my medical condition seriously enough	1	2	3	4
32. My accident has put my body at risk for the rest of my life	1	2	3	4
33. Pain always means I have injured my body	1	2	3	4
34. Just because something aggravates my pain does not mean it is dangerous	1	2	3	4
35. I am afraid that I might injure myself accidentally	1	2	3	4
36. Simply being careful that I do not make any unnecessary movements is the safest thing I can do to prevent my pain from worsening	1	2	3	4
37. I wouldn't have this much pain if there weren't something potentially dangerous going on in my body	1	2	3	4
38. Although my condition is painful, I would be better off if I were physically active	1	2	3	4
39. Pain lets me know when to stop exercising so that I don't injure myself	1	2	3	4
40. It's really not safe for a person with a condition like mine to be physically active	1	2	3	4
41. I can't do all the things normal people do because it's too easy for me to get injured	1	2	3	4
42. Even though something is causing me a lot of pain, I don't think it's actually dangerous	1	2	3	4
43. No one should have to exercise when he/she is in pain	1	2	3	4

Please turn over.

Study number:

Pain Disability Index (PDI)

The following set of questions are interested in which aspects of your life (if any) are disrupted by pain. In other words, we would like to know how much pain is preventing you from doing what you would normally do or from doing it as well as you normally would.

Respond to each category indicating the overall impact of pain in your life, not just when pain is at its worst. For each of the 7 categories of life activity listed, **please circle the number on the scale that describes the level of disability you typically experience.**

A score of 0 means no disability at all, and a score of 10 signifies that all of the activities in which you would normally be involved have been totally disrupted or prevented by your pain.

44. **Family/Home Responsibilities**: This category refers to activities of the home or family. It includes chores or duties performed around the house (e.g. yard work) and errands or favours for other family members (e.g. driving the children to school).

No Disability 0__. 1__. 2__. 3__. 4__. 5__. 6__. 7 __. 8__. 9__. 10__. Worst Disability

45. **Recreation:** This disability includes hobbies, sports, and other similar leisure time activities.

No Disability 0__. 1__. 2__. 3__. 4__. 5__. 6__. 7 __. 8__. 9__. 10__. Worst Disability

46. **Social Activity**: This category refers to activities, which involve participation with friends and
acquaintances other than family members. It includes parties, theatre, concerts, dining out, and other social functions.

No Disability 0__. 1__. 2__. 3__. 4__. 5__. 6__. 7 __. 8__. 9__. 10__. Worst Disability

47. **Occupation:** This category refers to activities that are part of or directly related to one's job.
This includes non-paying jobs as well, such as that of a housewife or volunteer.

No Disability 0__. 1__. 2__. 3__. 4__. 5__. 6__. 7 __. 8__. 9__. 10__. Worst Disability

48. **Sexual Behaviour**: This category refers to the frequency and quality of one's sex life.

No Disability 0__. 1__. 2__. 3__. 4__. 5__. 6__. 7 __. 8__. 9__. 10__. Worst Disability

49. **Self-Care**: This category includes activities, which involve personal maintenance and independent daily living (e.g. taking a shower, driving, getting dressed, etc.)

No Disability 0__. 1__. 2__. 3__. 4__. 5__. 6__. 7 __. 8__. 9__. 10__. Worst Disability

50. **Life-Support Activities**: This category refers to basic life supporting behaviours such as eating, sleeping and breathing.

No Disability 0__. 1__. 2__. 3__. 4__. 5__. 6__. 7 __. 8__. 9__. 10__. Worst Disability

Please turn over.

Study number:

Pain Numeric Rating Scale (NRS)

The following question is interested in how you perceive the intensity of (if any) pain you may have experienced within the past **24 hours.**

51. Please **circle** the number that best represents the average intensity of your pain in the past 24 hours on a 0-to-10 scale, where 0 = No pain and 10 = Pain as intense as you can imagine.

0 1 2 3 4 5 6 7 8 9 10

International Physical Activity Questionnaire (IPAQ-L7S)

The following set of questions are interested in finding out about the kinds of physical activities that you do as part of your everyday life. The questions will ask you about the time you spent being physically active in the last 7 days. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the vigorous activities that you did in the last 7 days. Vigorous physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think only about those physical activities that you did for at least 10 minutes (or more) at a time.

52. During the last 7 days, on how many days did you do vigorous physical activities like heavy lifting, digging, aerobics, or fast bicycling?

_____ days per week

No vigorous physical activities. Skip to question 54

53. How much time did you usually spend doing vigorous physical activities on one of those days?

_____ hours per day _____ minutes per day

Don’t know/ Not sure

Study number:

Please turn over.

Think about all the moderate activities that you did in the last 7 days. Moderate activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

54. During the last 7 days, on how many days did you do moderate physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.
    _____ days per week

    No moderate physical activities. Skip to question 56

55. How much time did you usually spend doing moderate physical activities on one of those days?
    _____ hours per day _____ minutes per day

    Don't know/ Not sure

Think about the time you spent walking in the last 7 days. This includes at work and at home, walking to travel from place to place, and any other walking that you have done solely for recreation, sport, exercise, or leisure.

56. During the last 7 days, on how many days did you walk for at least 10 minutes at a time?
    _____ days per week

    No walking. Skip to question 58

57. How much time did you usually spend walking on one of those days?
    _____ hours per day _____ minutes per day

    Don't know/ Not sure

The last question is about the time you spent sitting on weekdays during the last 7 days. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

58. During the last 7 days, how much time did you spend sitting on a week day?
    _____ hours per day _____ minutes per day

    Don't know/ Not sure

Please turn over.

Study number:

This is the end of the questionnaire.

We would like to sincerely thank you for completing this questionnaire. The information you have provided will help us to understand more about the barriers to physical activity. If you would like a copy of the final report, please email the lead researcher on Hamero@edgehill.ac.uk stating that you would like a copy of the report and your contact details.

If you are not in the presence of the lead researcher, please return the questionnaire pack with all questions completed back to the lead researcher via the pre-paid stamped addressed envelope. Please check that you have completed every question.

Appendix P – BMI and physical activity computed variables

ID	BMI	BMI Categories	Physical activity levels
1	21.4	Healthy weight	High
2	31.6	Obese	High
3	25.4	Overweight	High
4	22.3	Healthy weight	High
5	22.1	Healthy weight	High
6	23.5	Healthy weight	Moderate
7	36.1	Obese	Moderate
8	29.1	Overweight	High
9	21.2	Healthy weight	Moderate
10	25.5	Overweight	High
11	30.9	Obese	Low
12	39.5	Obese	High
13	41	Obese	Moderate
14	26.6	Overweight	High
15	24.2	Healthy weight	Moderate
16	23.6	Healthy weight	High
17	29.9	Obese	High
18	20.1	Healthy weight	High
19	25.4	Overweight	High
20	29.3	Overweight	High
21	23.5	Healthy weight	Low
22	27.2	Overweight	High
23	34.3	Obese	High
24	31.2	Obese	High
25	28.5	Overweight	High
26	35.5	Obese	Moderate
27	32.3	Obese	High
28	28.2	Overweight	High
29	34	Obese	High
30	31.6	Obese	High
31	28.9	Overweight	High
32	31.4	Obese	Moderate
33	18.4	Underweight	High
34	26.1	Overweight	High
35	24	Healthy weight	High
36	27.2	Overweight	Low
37	29.9	Overweight	High
38	29.4	Overweight	High
39	23.2	Healthy weight	High
40	20.5	Healthy weight	High
41	28.7	Overweight	High
42	26.8	Overweight	High

43	20.9	Healthy weight	High
44	26.1	Overweight	High
45	26.4	Overweight	High
46	29.6	Overweight	Moderate
47	25.4	Overweight	Moderate
48	30.7	Obese	High
49	23.5	Healthy weight	Moderate
50	26	Overweight	Moderate
51	21.6	Healthy weight	High
52	21.3	Healthy weight	High
53	25.6	Overweight	High
54	21.8	Healthy weight	High
55	23.5	Healthy weight	Moderate
56	18.7	Healthy weight	High
57	27	Overweight	High
58	27.7	Overweight	Low
59	29	Overweight	Moderate
60	32.5	Obese	Low
61	26.6	Overweight	High
62	22.7	Healthy weight	Low
63	20.8	Healthy weight	Low
64	21.7	Healthy weight	Low
65	19.9	Healthy weight	High
66	19	Healthy weight	Moderate
67	23.5	Healthy weight	High
68	20.6	Healthy weight	High
69	23.2	Healthy weight	Moderate
70	21.9	Healthy weight	High
71	24.5	Healthy weight	Moderate
72	20.4	Healthy weight	High
73	22.3	Healthy weight	High
74	28.3	Overweight	High
75	19.8	Healthy weight	High
76	33.8	Obese	Moderate
77	27.5	Overweight	High
78	18.6	Healthy weight	High
79	25	Overweight	Low
80	22.5	Healthy weight	High
81	18.3	Underweight	Moderate
82	24.4	Healthy weight	Low
83	22.5	Healthy weight	Moderate
84	32.6	Obese	Moderate
85	31.8	Obese	Moderate
86	28.9	Overweight	High
87	33.6	Obese	High
88	29.2	Overweight	Low

89	25.3	Overweight	Moderate
90	23.1	Healthy weight	High
91	30.1	Obese	Moderate
92	21.7	Healthy weight	Low
93	17.6	Underweight	Moderate
94	25.1	Overweight	Moderate
95	26.2	Overweight	Low
96	26	Overweight	Moderate
97	19.8	Healthy weight	High
98	32.8	Obese	Moderate
99	21.7	Healthy weight	Moderate
100	19.4	Healthy weight	Moderate
101	24	Healthy weight	High
102	23.2	Healthy weight	Moderate
103	21.5	Healthy weight	Low
104	30.5	Obese	Moderate
105	31.2	Obese	High
106	28.4	Overweight	High
107	37.8	Obese	Moderate
108	22	Healthy weight	Low
109	21.8	Healthy weight	Low
110	29.3	Overweight	Moderate
111	29.4	Overweight	Low
112	19.1	Healthy weight	Moderate
113	20.4	Healthy weight	Moderate
114	17.5	Underweight	Low
115	18.5	Healthy weight	High
116	24.6	Healthy weight	High
117	18.9	Healthy weight	Low
118	26.6	Overweight	Moderate
119	21.6	Healthy weight	High
120	26.6	Overweight	Moderate
121	23.3	Healthy weight	Moderate
122	19.6	Healthy weight	Moderate
123	23.3	Healthy weight	Moderate
124	27.3	Overweight	High
125	20.6	Healthy weight	Moderate
126	18.3	Underweight	Low
127	30.1	Obese	Moderate
128	21	Healthy weight	Moderate
129	21.3	Healthy weight	High
130	21.8	Healthy weight	High
131	27	Overweight	Moderate
132	41.6	Obese	High
133	42.4	Obese	Moderate
134	22	Healthy weight	Low

135	19.3	Healthy weight	Low
136	33.9	Obese	Low
137	37.9	Obese	Low
138	21.6	Healthy weight	Low
139	19.5	Healthy weight	Low
140	21	Healthy weight	High
141	27.3	Overweight	Moderate
142	25.6	Overweight	High
143	25.8	Overweight	Moderate
144	23.8	Healthy weight	Moderate
145	22	Healthy weight	High
146	35.5	Obese	Moderate
147	26.2	Overweight	High
148	26.2	Overweight	Low
149	21.8	Healthy weight	Moderate
150	32.2	Obese	Low
151	20.3	Healthy weight	Moderate
152	34.9	Obese	Moderate
153	23.2	Healthy weight	Moderate
154	22.8	Healthy weight	Low
155	29.1	Overweight	Moderate
156	30.6	Obese	Moderate
157	27.3	Overweight	Low
158	20	Healthy weight	Moderate
159	20.2	Healthy weight	High
160	28.1	Overweight	Moderate
161	28.9	Overweight	Moderate
162	38.7	Obese	Low
163	31.6	Obese	High
164	20.7	Healthy weight	Moderate
165	23.9	Healthy weight	Moderate
166	32.1	Obese	Moderate
167	33.1	Obese	Low
168	26.1	Overweight	Low
169	20.9	Healthy weight	Moderate
170	20.5	Healthy weight	High
171	28.4	Overweight	High
172	37.3	Obese	Moderate
173	36	Obese	Low
174	22.5	Healthy weight	High
175	37.9	Obese	Moderate
176	28	Overweight	High
177	22.8	Healthy weight	Low
178	30.1	Obese	Low
179	18.2	Underweight	High
180	24.4	Healthy weight	High

181	23.8	Healthy weight	Moderate
182	20.7	Healthy weight	Low
183	20.6	Healthy weight	High
184	19	Healthy weight	Moderate
185	33.2	Obese	High
186	16.2	Underweight	Moderate
187	26.7	Overweight	Moderate
188	24.8	Healthy weight	Moderate
189	23.9	Healthy weight	High
190	19.3	Healthy weight	Moderate
191	28.3	Overweight	Low
192	28.7	Overweight	Low
193	37.7	Obese	Low
194	20.5	Healthy weight	Low
195	39.6	Obese	Low
196	19.3	Healthy weight	Moderate
197	25.9	Overweight	Moderate
198	30.8	Obese	High
199	20.9	Healthy weight	High
200	18.1	Underweight	High
201	18.9	Healthy weight	High
202	34.6	Obese	High
203	35.7	Obese	Low
204	32.7	Obese	Moderate
205	24.4	Healthy weight	High
206	35.3	Obese	Moderate
207	30.9	Obese	Moderate
208	33.9	Obese	Moderate
209	30.2	Obese	Low
210	32.6	Obese	Low
211	31.8	Obese	Low
212	26.2	Overweight	Moderate
213	30.7	Obese	Moderate
214	34.2	Obese	Low
215	32.2	Obese	Low
216	27.2	Overweight	Moderate
217	28.2	Overweight	High
218	24.5	Healthy weight	Moderate
219	34	Obese	Moderate
220	27.8	Overweight	High
221	26.9	Overweight	Moderate
222	29.4	Overweight	Moderate
223	29.8	Overweight	High
224	28.9	Overweight	Low
225	33.6	Obese	Moderate
226	30.9	Obese	Moderate

227	20.6	Healthy weight	Moderate
228	37.1	Obese	Moderate
229	25.4	Overweight	Low
230	27.3	Overweight	Moderate
231	25.7	Overweight	Moderate
232	25.6	Overweight	Moderate
233	36.2	Obese	Low
234	32.4	Obese	Low
235	27.7	Overweight	Moderate
236	35.5	Obese	Low

Appendix Q – SPSS cycles of regression imputations relating to missing IPAQ-L7S items one to six

Participant	Missing item	50th cycle imputation	Pooled mean imputation, used in data set (following 50 cycles of imputation)
12	4	4.28	0.9
22	4, 6	1.57, 3.16	1.04, 2.96
26	4, 6	1.44, 1.69	0.68, 2.77
30	4	1.25	0.79
36	2, 4	2.2, 2.56	0.88, 0.88
46	6	1.79	3.42
47	2, 4	0.87, 2.92	0.86, 0.89
57	4, 6	2.13, 1.91	0.95, 2.93
58	6	1.89	2.99
60	6	4.78	3.21
62	6	1.95	2.36
63	4	1.13	1.03
64	6	3.7	2.94
68	4	0.88	1.06
69	6	1.76	2.99
70	4	5.1	0.87
78	4	2.41	0.92
79	2, 4	0.72, 0.99	1.01, 1.07
80	6	2.61	3.33
83	2, 6	1.34, 2.54	1.04, 3.82
88	4, 6	3.16, 3.56	0.85, 3.32
92	2	1.81	0.80
93	2	1.45	1.08
101	4, 6	1.69, 1.80	0.83, 2.87
103	4, 6	3.08, 1.43	3.42, 0.73
108	4	0.87	0.99
109	2, 4	1.28, 1.38	1.07, 0.84
134	6	1.84	3.35
135	6	2.66	2.92
141	2	0.77	0.93
154	4, 6	2.75, 3.58	1.24, 3.23
155	6	3.99	3.28
161	4, 6	1.92, 2.74	3.19, 3.36
164	4, 6	1.5, 1.59	0.86, 3.55
168	6	2.53	2.56
181	6	3.66	2.69
186	6	1.7	3.41
193	4	6.14	0.95
194	6	1.87	3.05
195	6	2.55	3.42
197	6	3.52	2.88
204	4, 6	1.53, 2.3	0.85, 2.92
230	6	3.88	2.92
235	1, 2, 3, 4	1.96, 1.06, 2.04, 2.38	1.74, 0.93, 2.23, 1.07

Appendix R – Data editing, mean substitution.

The IPAQ-L7S does not have subscale dimensions and so missing values were substituted with a mean item score from the available sample. Following the imputation process, the 44 participants were categorised into low, moderate or high activity groups. Using this method 19 participants were categorised in the low activity group, 17 in the moderate activity group and 8 in the high activity group.

Table demonstrating the participant activity groups with mean substitution method.

	Activity group	N	Percent %
Physical activity levels	Low Moderate High	19 17 8	43.2 38.6 18.2

Following the mean substitution method of imputation, a comparison of activity levels was carried out between the groups with missing IPAQ-L7S data and those without missing data. The tests showed that those with missing IPAQ-L7S data had substantially greater percentage of low levels of activity than those who did not have missing data (P=0.000).

Mean substitution was not employed as the imputation method for the dataset because the regression method has deemed a more reliable method (De Vet et al, 2011).

Table demonstrating the comparison of activity groups following the mean substitution method and the remainder of the sample if missing data cases were deleted.

Method	Physical activity group	N	Percent %
Mean substitution method	Low Moderate High	19 17 8	43.2 38.6 18.2
Sample with missing cases deleted	Low Moderate High	35 76 81	18.2 39.6 42.2

Appendix S - Comparison of means and activity levels after imputations

Following imputation using several methods, observations were made to determine differences in physical activity levels. Imputation using the mean substitution and regression method resulted in approximately 40% of participants with missing data being categorised as partaking in low levels of activity. This was notably higher than the 18.2% of participants without missing data. Notably, the methods differed in that higher percentages of high levels of activity were observed when employing the regression method.

Table demonstrating the comparison of activity levels following imputation from several methods

Method	Physical activity group	N	Percent %
Regression method	Low Moderate High	18 11 15	40.9 25.0 34.1
Mean substitution method	Low Moderate High	19 17 8	43.2 38.6 18.2
Case deletion method	Low Moderate High	35 76 81	18.2 39.6 42.2

Upon further investigation, higher mean scores were observed among most IPAQ-L7S items in the group with missing data. This finding suggests that those with missing IPAQ-L7S data reported (on average) greater levels of activity. The regression method of imputation resulted in a greater percentage of the missing data group being categorised in higher activity groups compared to the mean substitution method. This shows that the regression method imputed values that likely reflected the truer activity levels of those with missing IPAQ-L7S data.

Table demonstrating the comparison of mean IPAQ-L7S item scores of low, moderate and high activity groups in those with and without missing IPAQ-L7S data.

	Activity Levels	Stat	IPAQ Item 1	IPAQ item 2	IPAQ item 3	IPAQ item 4	IPAQ item 5	IPAQ item 6
Participants without missing IPAQ-L7S data	Low	Mean	0.1	0.9	0.2	0.8	3.0	0.8
		N	35	4	35	6	35	34
		SD	.43	.49	.54	.68	1.83	1.75
		Median	.0	1.0	.0	1.0	3.0	0.5
	Moderate	Mean	0.7	1.1	1.3	1.0	5.8	1.6
		N	76	31	76	44	76	76
		SD	1.09	.57	1.62	.46	1.45	1.71
		Median	.0	1.0	1.0	1.0	6.0	1.0
	High	Mean	2.9	1.9	3.2	2.3	6.4	2.4
		N	81	75	81	72	81	81
		SD	1.38	1.13	1.99	2.31	1.41	2.30
		Median	3.0	2.0	3.0	1.7	7.0	1.5
	Total	*Mean*	*1.5*	*1.7*	*1.9*	*1.8*	*5.5*	*1.8*
		N	*192*	*110*	*192*	*122*	*192*	*191*
		SD	*1.64*	*1.06*	*2.02*	*1.91*	*1.94*	*2.06*
		Median	*1.0*	*1.5*	*2.0*	*1.0*	*7.0*	*1.0*
Participants with missing IPAQ-L7S data	Low	Mean	0.7	1.0	1.0	1.4	5.3	1.7
		N	18	7	18	10	18	18
		SD	1.01	.52	1.11	.92	1.50	1.42
		Median	.0	1.2	1.0	1.0	5.5	1.8
	Moderate	Mean	1.3	1.1	2.5	2.2	6.3	3.9
		N	11	7	11	8	11	11
		SD	1.20	.40	2.29	1.69	1.56	5.08
		Median	1.9	1.0	2.0	1.7	7.0	2.5
	High	Mean	3.4	1.7	3.9	2.2	6.8	3.0
		N	15	15	15	15	15	15
		SD	1.59	.88	2.54	1.33	.35	2.78
		Median	3.0	1.5	3.0	2.1	7.	2.3
	Total	*Mean*	*1.8*	*1.4*	*2.4*	*2.0*	*6.1*	*2.7*
		N	*44*	*29*	*44*	*33*	*44*	*44*
		SD	*1.75*	*.76*	*2.32*	*1.33*	*1.39*	*3.18*
		Median	*2.0*	*1.0*	*2.0*	*1.5*	*7.0*	*1.9*

*SD= Standard Deviation

End of thesis