EXPLORING THE RELATIONSHIP BETWEEN FEAR OF FALLING AND PHYSICAL ACTIVITY IN OBESE WOMEN UNDER 50 YEARS OF AGE

By

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ABSTRACT

Despite widespread promotion of the benefits of regular activity, uptake by obese adults, particularly women, remains low. There is limited research on the physical barriers to exercise in younger obese adults, yet studies in elderly women suggested a relationship between obesity, fear of falling (FOF) and activity participation. It is feasible that FOF might be a problem in younger obese women and a subsequent barrier to activity participation.

The aim of this thesis was to explore the phenomenon of FOF in obese women under 50 years of age and to develop a conceptual framework to explain its relationship to activity participation. An exploratory mixed methods approach was used. An initial study of 12 obese women used semi-structured interviews to elicit original knowledge of concerns they had about falling when active, which was analysed using a thematic approach. Eight participants reported FOF and there were suggestions that FOF led to activity avoidance. Younger participants and those more active were less likely to report problems. The results were used to develop a conceptual framework of FOF which informed the design of a larger study to measure the relationship between FOF and activity level in obese women.

A review of FOF instruments to identify those appropriate for use in a further study of obese women was completed. Sixty-three participants completed self-reported questionnaires that measured different constructs of FOF, notably, falls-efficacy, feared consequences of falling and activity avoidance. Statistical analysis confirmed FOF to be an independent predictor of current low activity, irrespective of age, BMI or depression. These findings shed light on an important issue which could be used to inform the design of interventions to promote activity in overweight women. The development of such interventions that target FOF in obesity warrants further investigation.

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Abbreviations

ABC	Activities-specific Balance Confidence Scale
ABC-6	Activities-specific Balance Confidence short version
ABC-S	Simplified ABC scale
ABC-UK	Anglicised ABC
ADL	Activities of Daily Living
aFES	Amended Falls-efficacy Scale
ANOVA	Analysis of Variance
BAQ	Baecke Activity Questionnaire
BMI	Body Mass Index
CHD	Coronary Heart Disease
CINAHL	Cumulative Index to Nursing and Allied Health Literature
CoF	Consequences of Falling Scale
CoF-LFI	Loss of functional independence – CoF scale
CoF-DI	Damage to identity – subscale of CoF
CONFbal	Confidence in maintaining balance Scale
COPD	Chronic Obstructive Pulmonary Disease
CRD	Centre for Reviews and Dissemination
DALYS	Disability adjusted life years
DARE	Database of Abstracts of Reviews of Effects
DH	Department of Health
DM	Type 2 Diabetes
DSM-IV	Diagnostic and Statistical Manual of Mental Disorders
ELHT	East Lancashire Hospitals NHS Trust
FES	Falls-Efficacy Scale
FES-I	International Falls-Efficacy Scale
FES-S	Falls-efficacy scale –short version
FES-UK	Anglicised Falls-Efficacy Scale
FFABQ	Fear of Falling Avoidance Behaviour Questionnaire
FFQ	Fear of falling Questionnaire
FHI	Falls Handicap Index
FOF	Fear of falling
FSQ	Functional Status Questionnaire

GAD	General Anxiety Disorder
GADS	Goldberg Anxiety and Depression Scale
GAD-7	General Anxiety Disorder-7
GCP	Good Clinical Practice
GDS-30	Geriatric Depression Scale- 30
GPAQ	Global Physical Activity Questionnaire
HADS	Hospital Anxiety and Depression Scale
HADS-A	HADS –anxiety subscale
HADS-D	HADS-depression subscale
HAMA Scale	Hamilton Anxiety Rating Scale
HDAS	NHS Evidence Healthcare Database Advanced Search
IADL	Instrumental Activities of Daily Living
ICC	Intra-class Correlation Coefficients
ICF	International Classification of Functioning, Disability, and Health
ICON-FES	Iconographic Falls-efficacy Scale
IPA	Interpretative phenomenological analysis
IPAQ-SF	International Physical Activity Questionnaire – short form
IQR	Interquartile Range
K	Cohen’s Kappa coefficient
LCFT	Lancashire Care Foundation Trust
MES	Mobility Efficacy Scale
METS	Metabolic Equivalent units
MFES	Modified Falls-Efficacy Scale
MS	Multiple sclerosis
MSAFFE	Modified Survey of Activities and Fear of falling in the elderly
MSK	Musculoskeletal
NHS	National Health Service
NZ-PAQ-SF	New Zealand Physical Activity Questionnaire-Short Form
PHQ	Patient Health Questionnaire
PHQ-9	Brief Patient Health Questionnaire Mood Scale
PROFANE	Prevention of falls Network Europe
PROSPERO	Prospective Register of Systematic Reviews
QOL	Quality-of-life
REC	Research Ethics Committee

rFES	Revised Falls-efficacy Scale
SAFFE	Survey of activities and fear of falling in the elderly
SCT	Social Cognitive Theory
SD	Standard Deviation
SEM	Standard Error of Measurement
SET	Self-Efficacy Theory
Short FES-I	Short International Falls-efficacy Scale
STEMH	Science, Technology, Engineering, Medicine and Health
TUGT	Timed Up and Go Test
UICFFM	University of Illinois at Chicago Fear of Falling Measure
UCLAN	University of Central Lancashire
VAS-FOF	Visual analogue scale – fear of falling
WC	Waist circumference
7-DR	Baecke Activity Questionnaire, Stanford-7 day recall

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CHAPTER ONE: INTRODUCTION

"Lack of activity destroys the good condition of every human being, while movement and methodical physical exercise save it and preserve it".

Plato (cited in King and King 2010, p. 402)

Knowledge about the risks of obesity and the benefits of lifestyle interventions to manage it are widely accepted, yet despite efforts to increase activity levels through mass social marketing and local service provision, uptake remains low. Past research has focused mainly on the behavioural/motivational elements of non-participation in activity by overweight individuals, and less so on the possible physical causes. To date, there is little published research on the physical problems obesity presents for people when engaging in activity. This chapter briefly summarises the background issues of obesity and its relationship with physical activity.

1.1 Epidemiology of Obesity

Obesity is one of the fastest growing public health problems in England today with over half the population now classed as either overweight or obese (HSE 2012; Foresight, 2007). Once thought to be a self-inflicted condition of overindulgence, obesity is now commonly acknowledged as a chronic relapsing medical condition in its own right with a multifaceted, complex aetiology including environmental and lifestyle factors (WHO, 2000).

The prevalence of obesity in England has almost doubled in the past 20 years with 24% of men and 25% of women now classified as obese, defined as a Body Mass Index (BMI) > $30kg/m^2$. This rapid increase is not limited to Western Countries but has been reported worldwide with recent figures estimating that just over 200 million adult men and just under 300 million adult women are obese (Finucane et al, 2011). In the 1980s the rise in obesity started developing in many high-income countries. More recently, there is evidence to indicate that many of the lower income countries are also experiencing increased rates in obesity (Swinburn et al, 2011). However, the absence of representative data from many countries has made it difficult to estimate exact trends (Wang et al, 2006). The health problems of obesity are well documented and include over 45 different co-morbidities, the major ones being Coronary Heart Disease (CHD), Type 2 Diabetes (DM) and certain cancers (Guh et al, 2009). In 2010, overweight and obesity were estimated to cause 3.4 million deaths, 3.9% of life years lost and 3.8% of disability adjusted life years (DALYS) worldwide (Marie et al, 2014). Not surprisingly this has led to obesity becoming a global health issue.

1.2 Lifestyle Interventions to Treat Obesity

Due to the complexity of obesity there is a lack of known effective interventions that lead to long-term weight loss and maintenance, and in the same vein, a long-term sustained change in health and behaviour in obese individuals (Jebb and Steer, 2007, Thomas et al, 2010). In 2003, the Health Development Agency (Mulvihill et al, 2003) looked into the evidence-base for treatment of obesity and the reported reliable though limited evidence of effective treatment for overweight or obese adults. It concluded a combination of lifestyle interventions as being most effective, notably dietary, physical activity and behavioural change (NICE, 2006). The past 15 years has seen no significant developments to improve the effectiveness of lifestyle weight management interventions as the results of weight loss interventions continue to remain modest (Franz et al 2007, Douketis et al, 2005). There have been several systematic reviews of lifestyle interventions for obesity, which report between 5-10% weight losses following individual or combination interventions of diet, exercise and behavioural programmes delivered over a 6 to12 month period (Fogelholm et al, 2000; McTigue et al, 2003; Mastellos et al, 2014; Shaw et al, 2006). Most studies reported were randomised controlled clinical trials, which often signify good robust evidence. However, these designs may have their own limitations in the evaluation of the management of obesity. Many studies reviewed had high intervention dropout rates, which is often observed in practice. Many studies excluded missing data from the analysis which may lead to misleading results. In addition, the majority of published research was of short-term interventions, often between 6 and 12 months, although three reviews included longer-term studies (Franz et al, 2007, Douketis et al, 2005; Curioni and Lourenco, 2005). Short-term findings do not reflect the nature of a chronic, long-term condition and can miss weight regain which is common (Ulen et al, 2008). Franz et al (2007) completed a systematic review and meta-analysis of 80 weight loss trials that lasted up to 48 months in length. A combined diet and exercise intervention was the most effective treatment compared with diet alone or activity alone. However, the weight loss was modest (mean = 8% initial weight loss) at 6 months, with evidence of weight regain (mean = 4% initial weight loss) at 48 months (Franz et al, 2007). Douketis et al, (2005) found similar results in a systematic review of longer-term weight loss interventions in which lifestyle interventions resulted in modest weight losses of <5kg measured 2-4 years after intervention (Douketis et al, 2005). Another review of lifestyle interventions reported that single item interventions such as physical activity or diet alone were more effective at achieving the target behaviour, while a combination of diet and physical activity achieved more weight loss (Sweet and Fortier, 2010). In-depth telephone interviews of 142 obese adults aged 19 to 75 years of age to explore their attitudes about current weight loss practices, found most participants strongly supported non-commercial interventions that focused on healthy lifestyle changes rather than weight loss (Thomas et al, 2010). There was less support for invasive surgical interventions, those interventions perceived too stigmatising (media campaigns), or commercially motivated and promoting weight loss. This suggests obese individuals' value support from lifestyle programmes, despite the modest weight changes seen. Weight loss maintenance is as important as weight loss as a measure of success in the treatment of obesity as weight regain in common (Ulen et al, 2008). Maintaining regular activity in addition to adherence to dietary changes can help to prevent weight regain (Wing and Phelan, 2005).

1.3 Physical Activity and Obesity

1.3.1 Health Benefits and Current UK National Guidelines

As seen above, increasing physical activity is widely accepted as one of the key components in the management of obesity (Erlichman et al, 2002). The health benefits of regular physical activity are widely documented, and are irrespective of BMI or whether individuals achieve weight loss (Mulvihill and Quigley, 2003; Warburton et al, 2006; Brown et al, 2006; Borodulin et al, 2005; Leitzmann et al, 2007). There appears to be a linear relationship between physical activity and health status with proven health benefits that include the primary and secondary prevention of chronic diseases such as CHD, DM, cancer, obesity, hypertension, depression, and osteoporosis (Warburton et al, 2006). In addition, regular activity improves health-related quality-of-life by enhancing psychological wellbeing and improving physical functioning in those with poor health (Macera et al, 2003; Ratey and Loehr, 2011; Warburton et al, 2006). As previously stated the health benefits of regular activity are independent of an individual's weight. There is growing evidence to support this, with low levels of cardiovascular fitness being a stronger predictor of cardiovascular disease and all-cause mortality than BMI (Jakicic and Otto, 2005). Katzmarzyk et al (2003) summarised the relationships from available studies on activity, obesity, and mortality, and concluded that physical inactivity is independently associated with a higher risk of premature death. Similarly, excess adiposity was related to higher mortality rates, independent of activity levels. A more recent systematic review by Katzmarzyk and Lear (2012) looked at the effectiveness of physical activity in reducing chronic disease risk factors in obese adults. Their results showed an overall modest reduction of risk factors in obese individuals. However, in many of the studies reviewed, it was difficult to determine the effect of activity, independent of other factors such as weight loss.

The terms 'exercise' and 'physical activity' are often used interchangeably, but their differences are noteworthy. 'Physical activity' is any bodily movement produced by skeletal muscles that results in energy expenditure (Caspersen et al, 1985), and includes activities such as walking, stair climbing, cycling and swimming. 'Exercise' is a subset of physical activity and is more structured, planned, with repetitive bodily movements that someone purposely engages in, in order to improve or maintain physical fitness or health, such as aerobic classes, running, swimming laps or weight lifting (Waumsley et al, 2011).

In 2010 the UK Physical Activity recommendations were updated to include a life-course-approach. This update subsequently included specific guidelines for different age groups, from early years to older people and guidance on reducing sedentary behaviour (Department of Health, 2011). Adults aged between 19 and 64 should aim to do at least 150 minutes of moderately intense activities over a week or 75 minutes of vigorous activities or a combination of both moderate and vigorous activities, within the same time-frame (Bull et al, 2010). These activities can be accumulated from sessions of at least 10 minutes and additional activities to improve muscle strength are encouraged to be undertaken on at least 2 days a week. Regular physical activity is also recommended to maintain weight loss and prevent weight regain, which is common (Ulen et al, 2008). NICE Guidance CG36 (2006) recommend that in order to prevent obesity, most people should be advised that they may need to do 45 to 60 minutes of moderate-intensity activity a day, particularly if they do not reduce their energy intake. People who have been obese and have lost weight should be advised that they may need to do 60 to 90 minutes of activity a day to avoid regaining weight (NICE, 2006).

1.3.2 Physical Inactivity in Obese Adults

Inactivity affects more people in England than the combined number of people who smoke (20%), misuse alcohol (6-9%) or who are obese (24%) (Chief Medical Officer, DH, 2011). In 2012, the Health Survey for England reported 67% of men and 55% of women aged 16 and over met the recommendations for aerobic activity, and 26% of women and 19% of men were classed as inactive (Health Survey for England, 2012). The proportion meeting these guidelines generally decreased in age, for both sexes and there was a clear association between BMI and meeting the guidelines for aerobic activity. Seventy-five percent of men who were not overweight or obese met the guidelines, compared with 71% of overweight men and 59% of obese men. Similarly, in women, 64% who were not overweight or obese met the guidelines, compared with 58% of overweight women and 48% of obese women.

It would appear with the statistics provided that if less overweight and obese adults achieved the daily physical activity recommendations than those who were lean, there would be a probability that even less would achieve the higher levels of activity needed to lose weight or maintain weight that has been lost (Health Survey for England, 2007). In addition to a lower proportion meeting physical activity recommendations, obese adults have a lower cardiovascular fitness than those who are not obese (Young et al, 2009; Health Survey for England, 2008; Bish et al, 2007). Other studies have shown that obese individuals are less likely to be physically active, as a study in the United States reported obese adults spend 21 minutes less per day engaged in moderate or vigorous intensity activities compared with normal weight adults (Davis et al, 2006). An Australian observational study of 2,200 adolescents aged 9-16 years found a significantly lower level of moderate to vigorous activity participation in obese participants compared to non-obese, which was mainly attributed to less participation in team sports activities (Olds et al, 2011).

With this said, being obese is clearly associated with reduced likelihood of a person's participation in physical activity, including leisure time activity (Trost et al, 2002). However, the causal pathway as to whether low activity is a cause or a consequence, or both, of obesity, remains unclear (Ekelund et al, 2008; Peterson et al, 2004). There have been a number of longitudinal and prospective studies looking for associations between sedentary behaviour and body mass index (BMI) (Hu et al, 2003; Bak et al, 2003; Mortensen et al, 2006). However, many of these have used self-reported measures of physical activity, which reduces the reliability of the measure due to recall bias. From previous physical activity surveys it is also known that adults often over-estimate their actual levels of activity (Health Survey for England, 2008).

Despite widespread promotion and acknowledgement of the benefits of regular physical activity and the introduction of interventions to enable individuals to become more active (Department of Health, 2008 & 2011), there is little evidence to suggest that there has been an increase in the uptake of physical activity (Health Survey for England, 2012) in England, particularly among those who are obese, which suggests that there are additional barriers to activity in this group, which have, as yet, not been addressed.

There is clear evidence that regular exercise in overweight and obese adults can help reduce weight in addition to other health benefits. This finding was reinforced by Shaw et al in 2006, who undertook a review of randomised controlled trials. These trials measured weight change using one or more physical activity intervention in overweight or obese adults with less than 15% loss to follow up (Shaw et al, 2006). The 43 studies examined included 3,476 participants. The author's conclusions support the use of exercise as a weight loss intervention, particularly when combined with dietary change. In 2010, Sweet and Fortier analysed together the results of 35 reviews and meta-analyses of single and multiple interventions of physical activity, and dietary behaviour. They concluded that single interventions were more successful at achieving increases in physical activity but multiple interventions were more successful at achieving weight loss (Sweet and Fortier, 2010). These results highlight the importance of planning an intervention based on the desired outcomes. The need for high levels of physical activity to maintain body weight has been confirmed by many studies (Jeffery et al, 2003). Catenacci et al looked at the physical activity patterns of successful weight losers and how much they were required to do to maintain their weight loss (Catenacci et al, 2011). The results identified that weight loss maintainers have to spend significantly more time each day in structured activity than either overweight or obese controls and also tend to do more than the normal weight, never overweight controls. Evidence suggests that weight loss and maintenance are regulated by the total energy expenditure of the activity, rather than from the intensity of activity (Jakicic et al, 2003). The health benefits of physical activity far outweigh those of weight loss, though its inclusion is one of the best predictors of long term weight loss success (Dalle Grave et al, 2010).

1.3.3 Problems Obese Adults face in undertaking physical activity

The reasons why adults, particularly those who are overweight, do not partake in physical activity remain largely unexplored (Jewson et al, 2008), but from the limited research published, it is reported that overweight and obese women perceive exercise to be more difficult than their lean counterparts (Ball et al, 2000; Brock et al, 2009). This self-reported perception can be supported by more objective data collected during walking tests performed under laboratory conditions (Mattsson et al, 1997). This data also shows obese women walk more slowly and exert more effort when walking compared to lean controls. Furthermore, they experience other difficulties when walking such as increased pain and soreness from chaffing due to excess gluteal fat around the abdomen and legs. Other studies looking at the performance of middle-aged women, found obesity to affect gait, walking patterns and reduce walking speeds (Sowers et al, 2006; Sternfeld et al, 2002; La Roche et al, 2011; Mignardot et al, 2013). It is clear from the low uptake of physical activity figures, taken form the Health Survey of England, 2012, that the current guidelines and initiatives to encourage overweight individuals to be more active are only moderately effective. With this said, further effective and proactive investigations are required to explore the potential reasons for these current outcomes.

1.3.4 Reasons why Obese Adults are not physically active

The association between physical activity and obesity are age and gender related, with women and older age groups more likely to be inactive and less physically fit (Ball et al, 2000; Chen & Mao, 2006; Poortinga, 2006; Ansari & Lovell, 2009; Kruger et al, 2005). There have been a limited number of qualitative studies looking at the barriers to physical activity in overweight groups, but these often focus around the psychosocial factors influenced by motivation or cognition such as body image, self-consciousness, weight perception, current level of activity, being too shy or embarrassed to exercise, being too lazy, not being the sporty type and social support (Atlantis et al, 2008; Ball et al, 2000; Chang et al, 2008; Jewson et al, 2008; Rye et al, 2009).

There are few published studies looking at the physical restrictions of obesity, particularly in younger adults, and how these might affect an individual's ability to be physically active. In 2007, a cross-sectional survey investigated why older people were reluctant to be active. The reported reasons for non-participation included a lack of interest, shortness of breath, joint pain, a dislike of going out alone in the evenings, a perceived lack of fitness and lack of energy (Crombie et al, 2004).

Fear of falling (henceforth FOF) is a complex chronic condition mainly reported in the elderly (Legters et al, 2002; Jung, 2008; Harding and Gardner, 2008), and was originally thought to occur following a fall (Murphy and Issacs, 1982). It has since been found to occur without a previous fall and characterised by anxiety or concern that an individual will fall (Harding and Gardner, 2008). Since the identification of FOF, several authors have attempted to define it, but no consensus on a standardised definition has so far been reached. Loss of confidence in an individual's balance abilities, low confidence at being able to avoid a fall or being afraid or concerned of falling, are some concepts used (Legters et al, 2002). FOF has more recently been seen associated with other health conditions such as Parkinson's disease, strokes, lower limb amputees and chronic obstructive pulmonary disease (Hellstrom et al, 2009; Niisson et al, 2010).

Studies in the elderly have found activity restrictions and FOF are strong predictors of non-participation in physical and social activities, regardless of whether they have had a previous fall or not (Cummings et al, 2000; Howland, 1993). Fear of falling in the elderly is a widely-researched area and has been found to have many independently associated factors such as previous falls, balance and mobility problems, anxiety, depression, sedentary lifestyle, and obesity (Austin et al, 2007; Bruce et al, 2002; Howland et al, 1993). Fear of falling is more commonly reported in elderly women than men and often mediated by impairments of balance and mobility (Austin et al, 2007). It often leads to a reduction in both social and activity participation and in some cases can result in activity avoidance (Bruce et al, 2002; Zijlstra et al, 2007a). Similarities are seen between elderly individuals at risk of falling or with FOF and adults who are obese. Restricted activities, poor postural control, and impaired mobility caused by abdominal adiposity, can increase the risk of falling in obese subjects (Corbeil et al, 2001; Hue et al, 2007; Singh et al, 2009). The risk of falling and poor mobility are increased by reduced activity in obese individuals (Koster et al, 2008). Therefore, with this highlighted it is reasonable to suggest FOF might be an issue in younger obese individuals.

In the elderly, FOF, and subsequent avoidance of physical activity, can lead to adverse health consequences such as functional decline, restriction in social participation, isolation, decreased quality-of-life and increased risk of falling (Deshpande et al, 2008; Kempen et al, 2009). FOF is a serious health condition that can affect an individual both physically and psychologically. Treatments include both educational and physical training, which help to build the confidence, improve balance and activity levels of those afflicted with this debilitating condition (Zijlstra et al, 2007b).

1.4 Chapter Summary

Obesity is widely acknowledged as a significant global public health concern affecting over 500 million adults worldwide. It is a chronic condition with a multifaceted complex aetiology and known to cause serious health problems. Regular physical activity is recognised as a key component in the treatment of obesity, and has significant physical and psychological health benefits regardless of weight loss. Encouraging obese adults to move and improve adherence to exercise is a challenge, particularly as their activity requirements for health are over and above those recommended for normal weight adults in the UK (NICE 2006; Dalle Grave et al, 2010). Obese adults tend to be less active than those not obese, especially women, though research into the reasons for this have tended to focus more on psychological concerns around motivation and less on physical barriers. Studies in the elderly have suggested activity restrictions and FOF lead to reduced activity participation, particularly in women, exacerbated by obesity. FOF and reduced activity leads to poor health outcomes. Additionally, these poor health outcomes impact on the social life of individuals, potentially creating social withdrawal and isolation. With this highlighted, obesity causes physical restrictions that could affect balance and activity participation in younger adults. These findings suggest that it is plausible to explore further the relationship between obesity, activity restrictions, and activity participation in younger obese adults, with particular reference to the issues of balance and FOF.

CHAPTER 2: THE RELATIONSHIP BETWEEN OBESITY, FEAR OF FALLING AND ACTIVITY PARTICIPATION: A SCOPING REVIEW

2.1 Background

Previous research has suggested a relationship between obesity, fearing of falling (FOF) and activity participation in the elderly (Austin et al, 2007; Bruce et al, 2002; Sallinen et al, 2009). However, it was not known whether there were are any similar studies conducted in younger adults. FOF was first described by Bhala et al (1982) as a phenomenon in elderly people of "a phobic reaction to standing or walking" and soon after classified as a "post-fall syndrome" (Murphy and Isaacs 1982 p. 265). A number of definitions of FOF have since been developed describing an individual's loss of confidence in their balance abilities or a "fearful anticipation of a fall" (Jung et al 2008, p.215). Tinetti and Powell (1993) defined FOF as "a lasting concern about falling that can lead to an individual avoiding activities that he/she remains capable of performing" (Tinetti et al 1993, p.36), and other authors have followed with various definitions around the concept of anxiety about falling.

A preliminary search for existing reviews on FOF and obesity was conducted in the Cochrane Database of Systematic Reviews and the International Prospective Register of Systematic Reviews (PROSPERO) database, but none were found to have been published. This lack of previous relevant reviews and limited knowledge on the research topic helped to justify undertaking a scoping review of the literature as described by Arksey and O'Malley (2005). A scoping review can be defined as:

> "aiming to map rapidly the key concepts underpinning a research area and the main sources and types of evidence available, and can be undertaken as stand-alone projects in their own right, especially where an area is complex or has not been reviewed comprehensively before".
>
> (Arksey and O'Malley 2005, p.5)

The scoping review framework consists of a number of stages. These stages include identifying the research question, identifying relevant studies, study selection, charting and collating the data, summarising the findings and reporting the results. However, the use of an additional parallel 'consultation exercise' to inform and validate findings was not included in this review, because of available resources. Scoping reviews are essentially exploratory and differ from a systematic review in that they tend to focus less on a specific area of interest and more at mapping or addressing a broader topic of interest, regardless of the study design of the research.

A scoping review was chosen as a comprehensive method of reviewing the literature around FOF, activity restrictions, obesity and activity participation. This was appropriate for this topic area, as it enables the broad examination of the level, range and nature of the research activity, and identifies any gaps in the published research, in a relatively short space of time. However, it is important to note that although scoping reviews focus more on the breadth than the depth of available research, the heterogeneity of study designs included mean they do not include a formal quality assessment of each study as part of their remit. This is not to say that the review process lacks methodological rigour because the framework used shares similarities with a systematic review, in that the methods used are explicit and conducted in a rigorous and transparent way to increase the reliability of the results (Arksey and O'Malley, 2005).

2.2 Scoping Review Objectives

The objectives of this scoping review are to examine literature on FOF, obesity, activity restrictions in order to:

1) Explore what is known in the literature on FOF (and other related concepts) and activity in obese populations.

2) Identify the gaps in the literature in relation to younger obese adults.

In this way, the scoping review provides information not just on what is known about FOF and activity in younger obese adults, but a rationale for further investigation of this topic.

2.3 Methods

2.3.1 Selection Criteria

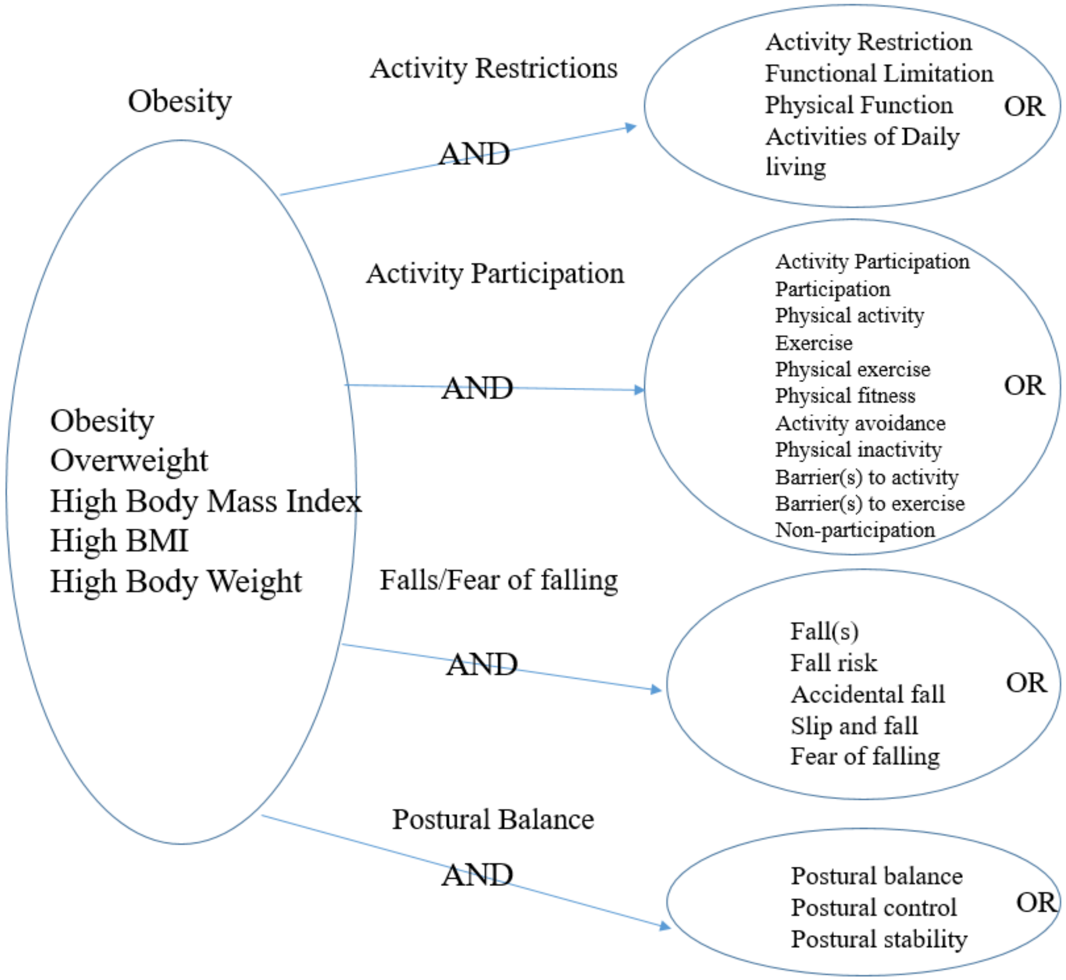
The characteristics of study participants in this review included adolescents and adults of both genders. Studies in adolescents were included as previous findings had suggested postural balance problems in teenagers, which might be relevant to this research (Goulding et al, 2003). Studies including healthy or overweight subjects with associated minor medical complaints such as general aches and pains, mild anxiety or depression were included. However, studies of population samples with unrelated medical conditions that might themselves be associated with FOF such as post-stroke, endocrine conditions, poor cognitive function, lower limb fractures, respiratory diseases, pregnancy, and eating disorders were excluded. Similarly, other medical conditions that were specifically relevant to elderly populations such as sarcopenia, frailty or severe degeneration were also excluded.

Published studies on obesity were included if they related to the review objectives including the concepts of FOF, balance, activity restrictions and activity participation. ‘Balance’ can be defined as “a process that maintains the centre of gravity within the body’s support base and requires constant modifications that are provided by muscular activity and joint positioning”, whereas ‘postural control’ is “any act of maintaining, achieving or restoring balance in any static or dynamic posture” (Greve et al 2007, p.717). There were no limitations on study type or setting whether acute, primary healthcare or in the community, and no limitation on culture or geographical locations of any participants or study. All sources of published literature such as peer reviewed research papers, systematic reviews and meta-analyses were included. Dissertations or conference papers that had not been peer-reviewed were not included.

2.3.2 Search Strategy

A comprehensive 3-step search strategy was developed as part of the scoping review. Initially the 2 databases MEDLINE and Cumulative Index to Nursing and Allied Health Literature (CINAHL) were searched using a few general search terms relevant to the review objectives, such as ‘fear of falling’, ‘obesity’, ‘activity restrictions’ and ‘activity participation’. Secondly, some of the relevant paper titles and abstracts retrieved were then examined to find key search terms, including keywords and subject headings, which could be used to search all the selected databases, in order to ensure a broader search of literature. These key search terms were then organised in order to reflect the review objectives or key concepts (Figure 2.1). For instance, keywords and subject headings for ‘obesity’ were used together with those for each of the key concepts, ‘activity restrictions’, ‘activity participation’, ‘falls and fear of falling’, and ‘postural balance’, using the Boolean operators ‘AND’ across the key concepts, and ‘OR’ to connect

Figure 2.1: Key concepts for the Scoping Review of Obesity, Fear of Falling and Activity Participation



keywords and subject headings within a key concept. In addition, the truncation symbol (*) was used to capture all endings of specific keywords. The results of each search were then combined together using the operator 'OR' to eliminate possible duplicate papers. An initial pilot search resulted in a number of studies being identified that included either pregnant women or individuals with eating disorders such as anorexia nervosa or bulimia nervosa, all of which were not relevant to this research. The use of the Boolean indicator 'NOT' in the search strategy enabled the exclusion of studies of pregnant women and eating disorders from the review.

The five health related bibliographic databases selected as those likely to contain papers relevant to the research topic were CINAHL, Allied and Complementary Medicine (AMED), MEDLINE and PsycINFO, accessed via the platform EBSCOhost, and EMBASE accessed via OvidSP. The Cochrane library systematic review database was also searched. The search was limited to peer reviewed articles published between 1982 (as this was the year FOF was first described) and March 2010. Papers were limited to those published in English only, as there were limited resources and time available to translate material. The search was also restricted by age to adolescents aged 13 to 18 years and adults aged 18 to 19 years or older, depending on the database searched. Finally, the reference lists of any identified reviews or key papers identified by the search were searched for additional studies.

An example of the search strategy used for searching the MEDLINE database is shown in Table 2.1, a search history of each interface can be found in Appendix A1, p231. The titles and abstracts of all identified papers were screened by the research student, once against the selection criteria and then for relevance to the research topic or key areas of interest, notably obesity and balance, obesity and FOF or falls, obesity and activity participation and obesity and activity restrictions.

2.3.3 Charting the Data

Full text papers of selected abstracts were reviewed and checked again against the selection criteria and for relevance to the research topic. The final selection of papers were then collated and summarised using a 'charting' framework described by Arksey and O'Malley (2005). Data relevant to the review objectives were extracted from each

Table 2.1: Search Strategy for MEDLINE EBSCOhost (1982- 2010)

1	OBESITY OR OVERWEIGHT OR "BODY MASS INDEX OR high BMI OR high body weight. ti,ab.
2	activity restriction* OR functional limitation* OR physical function* OR activit* of daily living OR ADL*.ti,ab.
3	1 AND 2
4	Activity participation OR participation OR physical activit* OR EXERCISE OR PHYSICAL EXERCISE OR PHYSICAL FITNESS OR activity avoidance OR physical inactivity OR barrier* to activity OR barrier* to exercise OR non-participation .ti,ab.
5	1 AND 4
6	3 OR 5
7	FALLS OR FALLING OR fall* risk OR ACCIDENTAL FALL OR SLIP AND FALL OR fear of fall*.ti,ab.
8	1 AND 7
9	6 OR 8
10	POSTURAL BALANCE OR postural control OR postural stability.ti,ab.
11	1 AND 10
12	9 OR 11
13	PREGNANCY OR ANOREXIA NERVOSA OR ANOREXIA OR BULIMIA NERVOSA OR BULIMIA.ti,ab.
14	12 NOT 13
	Limiters: Published date: 1982-2010; Human; English language; Age Related: Adolescent: 13-18 years; All Adult: 19+ years.

NB: MESH terms are highlighted in capital letters.

paper and 'charted' into topic areas using a template or data charting form (Appendix A2, p233). Charting is a technique for recording key items of information about each study using a consistent 'descriptive-analytical' method, whereby standard information about each study is collected and recorded using a common analytical framework (Arksey and O'Malley, 2005). Charting tables were used to record the data extracted in a consistent manner to enable comparisons across different study types, in order to identify any contradictory evidence and to identify any potential gaps. The data charting forms included the headings for the author, year and country, study type, sample size, and participant characteristics (for example, gender, age), study objective(s), concepts or topic area covered, and key findings.

2.3.4 Collating and Summarising

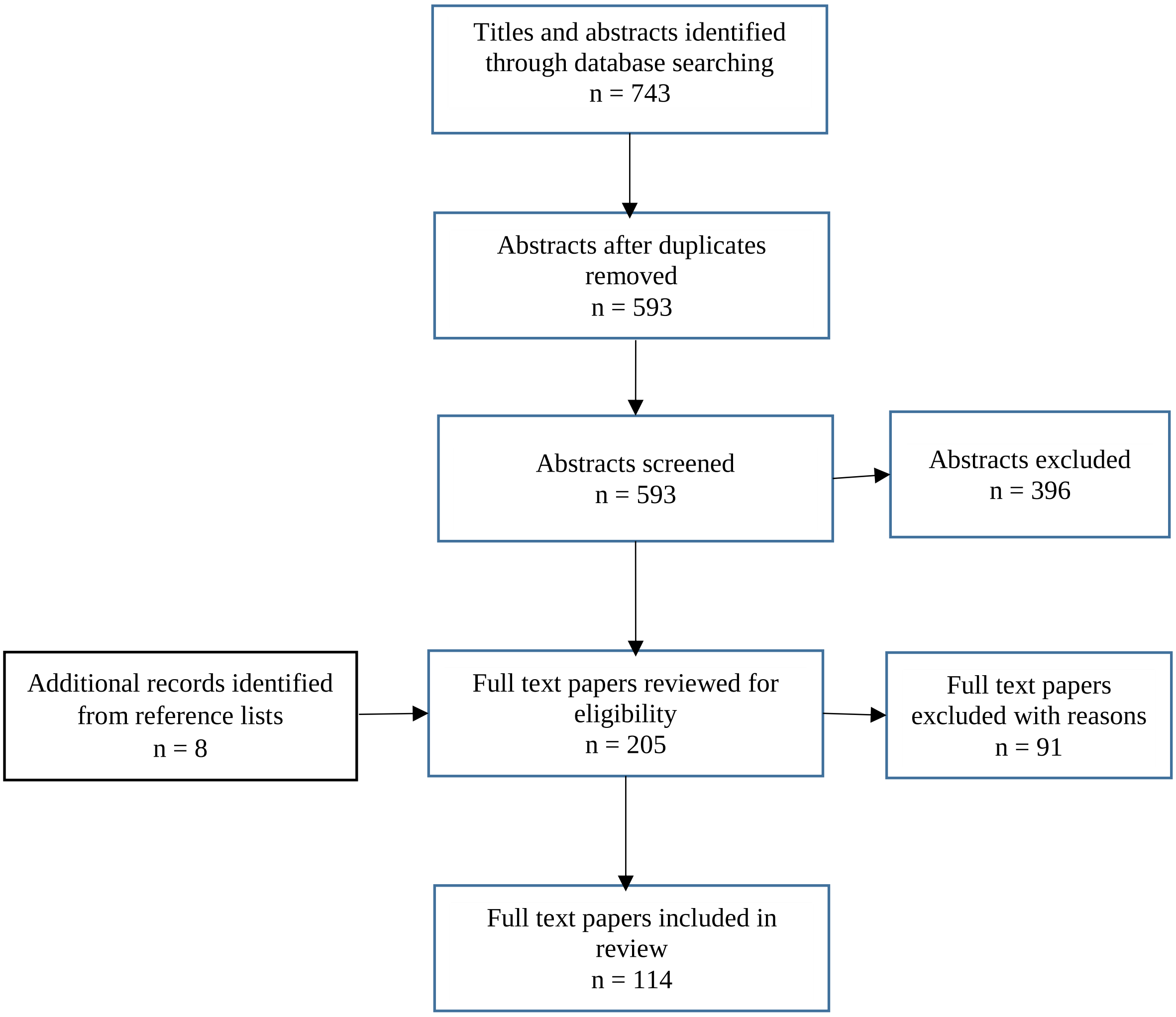
The identified papers were organised into similar areas, and from these 4 key themes emerged. A number of papers referred to activity restrictions found in obese populations and how they affected activity participation, which became the first key area or theme. Papers were organised into age groups in order to clarify where the majority of research has been and to identify gaps, particularly in younger populations, which was an objective of the review. All papers referring to FOF and obesity became another theme and again highlighted any gaps in younger populations. There were many papers looking at balance, falls and falling in obesity which was relevant as these are key factors of FOF in the literature on elderly populations, and thus became another theme. Finally, a number of papers referred to physical activity and obesity which were not related to activity restrictions formed the final theme. These were thought relevant as they include possible predictors or barriers to activity that might be important to inform future research looking at activity participation in obese populations. Some of the key themes were sub-divided where there were a number of papers relating to a specific area related to the theme, e.g. risk of injuries in obese individuals who have poor balance or fall, which might be pertinent to why an individual might have FOF. In some cases, a paper was charted in more than one topic area, particularly if it was a review.

The charting approach of a scoping review enables the presentation of an overview of all reviewed material, though as previously highlighted, it does not include a robust quality assessment as in a systematic review. Charting data from studies also helps structure the narrative discussion of the key findings, by firstly presenting a basic numerical analysis of the numbers, size, nature and settings of all studies in the review. Secondly, it allows you to identify dominant areas of research, possible contradictory evidence in a specific area and significant gaps. Consequently, results of this scoping review helped summarise relevant literature, which in turn led to the development of the aims and objectives of this thesis.

2.4 Results

An initial search of all the selected databases resulted in 743 articles being identified. After removing duplicates, 593 titles and abstracts were screened by the author for relevancy against the review objectives. (Figure 2.2). In total, 396 papers were excluded from the review. The main reasons for exclusion were due to non-relevance to the areas of interest, for example, balance or falls in elderly (not FOF) without reference to obesity, obesity and physical activity guidelines, or the treatment of obesity, and studies specific to elderly populations and age-related illnesses. Unrelated topics, for example, fall used in other contexts to falling over, as in a ‘fall in blood pressure’, duplicate papers previously missed, and studies in populations with specific non-relevant medical conditions, were also excluded.

Figure 2.2: Flow chart



Full texts of the remaining 197 papers were reviewed together with eight more papers identified from reference lists. A further 91 papers were omitted with reasons for exclusion presented in Table 2.2. The main reasons for excluding papers were that they were studies on activity restrictions, functional limitations, balance or falls in non-obese populations or studies reporting on physical activity and obesity, which were not relevant to the research topic (Table 2.2).

Table 2.2: Summary of Reasons for the Rejection of Selected Full Text Papers

Reasons for Rejection	Number of papers
Irrelevant studies in non-obese elderly or younger populations, or do not report data relevant to obesity e.g., functional limitations, balance, falls, FOF, activity	22
Papers on obesity and or physical activity not relevant to research topic, e.g. models or measures of activity or interventions, goals of weight loss, benefits of activity, tv watching, risks to health, mortality	19
Factors specific to elderly populations, e.g., sarcopenia, dementia, assisted living	12
Irrelevant papers on injury and/or disability	9
Dissertations	6
Irrelevant biomechanical studies not related to obesity	4
Inclusion of other chronic conditions e.g. severe arthritis, respiratory, knee pain	5
Barriers of activity to non-obese populations	7
Development of FOF tools or measurement properties	4
Same study but different journal	3

One hundred and fourteen papers were identified from the search results, including 6 review papers. The key information for each paper was charted and organised into 4 key areas or themes, based on the review objectives: These 4 key areas were:

1) The link between obesity, activity restrictions and activity participation.
2) The link between FOF, obesity and activity participation.
3) The link between poor balance/falls and obesity, which could possibly explain or lead to a FOF.
4) The link between obesity and reduced activity participation not related to activity restriction, which might highlight other important barriers to activity participation that need to be considered in future research.

The data charting forms of relevant papers for each key area were arranged in date order. These included subdivisions of different population types or topics within each key area, with some papers reporting on more than one of the 4 key areas. Table 2.3 provides a brief overview of the identified areas of interest and number of papers for each area, whereas Table 2.4 (p 32) provides brief summaries of all the findings. The original detailed data charting forms of all the papers can be found in Appendix A2, p 233.

Table 2.3: Identified areas relating to Activity Restrictions, Fear of falling and Activity Participation in Obese Adults

	Area of interest	Population	Topic within area	Number of papers
1	Obesity, activity restrictions and activity participation	Obese elderly Obese elderly women Young, middle-aged obese adults All ages	Non-specific activity restrictions Walking or mobility problems and obesity	28 7 15 12
2	Fear of falling, activity participation and obesity	Elderly Young obese adults	Reduced participation or Activity avoidance	7 3
3	Obesity and balance or falls	Obese elderly Obese adults Obese adolescents All ages	Increased risk of trips and falls Increased risk of injuries	4 19 3 4
4	Obesity and physical activity not related to activity restrictions	All ages	Barriers to and predictors of activity participation	17

NB: Some papers included more than one area of interest or topic and so were counted more than once.

2.5 Findings

2.5.1 Obesity, Activity Restrictions and Activity Participation

i) Non-specific Activity Restrictions

Sixty-two of the identified papers referred to activity restrictions or functional limitations in obese adults and the effect on activity participation. The majority of these papers (n=37) described cross-sectional cohort studies and 43 were carried out in elderly populations (≥55 years of age), including one review of functional limitations in the elderly obese (Jensen and Hsiao, 2010). Fifteen papers reported on physical functioning in younger and middle-aged obese adults, including three reviews, two of which were on the biomechanics of adiposity and functional limitations (Wearing et al, 2006; Hills et al, 2001) and one on functional limitations and occupational issues in obese adults (Capodaglio et al, 2010). Full details of the extracted key information for each paper can be found in the data charting form in Appendix A2 Table A2.1, p.233.

Activity restrictions and functional limitations are commonly reported in relation to performance of everyday activities. Functional limitations can be defined as the,

> "inability to perform a task or obligation of usual roles and typical daily activities as the result of impairment, which can be defined as: Any loss or abnormality of anatomic, physiologic, or psychologic structure or function".
>
> (Guccione 1991, p. 503)

However, activity restriction can be defined as "having difficulty performing activities alone, requiring help or not being able to do any one of several activities of daily living" (ADL) (Jagger, Spiers, and Arthur 2005, p. 278). ADLs are defined as everyday routine tasks that generally involve functional mobility and personal care such as bathing, dressing, toileting, and meal preparation, whereas instrumental activities of daily living (IADL) are daily tasks that enable an individual to live independently in the community, such of shopping, housework, preparing meals, using the telephone and managing money (Brown et al, 2014).

Elderly Populations

Thirty-five studies have reported on the associations of obesity with increased activity restrictions or functional limitations in elderly populations (Visser et al, 1998; Han et al, 1998; Ferraro and Booth, 1999; Tsuritani et al, 2002; Sternfeld et al, 2002; Larrieu et al, 2004; Houston et al, 2005; Jinks et al, 2006; Lidstone et al, 2006; Alley and Chang, 2007; Lang et al, 2007; Bish et al, 2007; Kostka and Bogus, 2007; Chen and Guo, 2008; Lang et al, 2008; Reibe et al, 2009; Walter et al, 2009; Woo et al, 2009; Stenholm et al, 2010; Jensen and Hsiao, 2010; Capodaglio et al, 2010). Activity restrictions reported in this older cohort include: climbing stairs, increased pain, upper body function, reduced walking speed, poor balance, poor mobility, limited ADL and IADL (Coakley, 1998; Han et al, 1998; Apovian et al, 2002; Aoyagi et al, 2002; Sternfeld et al, 2002; Sharkey et al, 2006; Kim et al, 2008; Gadalla, 2010). Findings suggest that older obese adults have significantly higher functional limitations than their lean counterparts; this risk of restriction increases with increasing body mass index and/or waist circumference (Di Francesco et al, 2005; Houston et al, 2005; Sharkey et al, 2006; Simoes et al, 2006; Woo et al, 2007; Chen and Guo, 2008; Gadalla, 2010). Twenty-one of the studies identified were of cross-sectional design and so the causal direction of whether obesity was a cause or consequence of activity restrictions was not always clear (Friedman et al, 2001; Aoyagi et al, 2002; Davison et al, 2002; Larrieu et al, 2004; Simoes et al, 2006; Woo et al, 2007; Chen and Guo, 2008). However, a number of prospective studies were able to show that obesity or increasing weight predicted the onset of functional limitations, reduced ADL, reduced balance, walking speed, reduced mobility and knee pain (LaCroix et al, 1993; Launer et al, 1994; Coakley et al, 1998; Houston et al, 2005; Sharkey et al, 2006; Jinks et al, 2006; Walter et al, 2009).

The literature suggests that gender plays a role in activity restrictions as elderly obese women are more susceptible to activity restrictions than elderly obese men (Friedmann et al, 2001; Jensen and Friedmann, 2002; Himes et al, 2000; Larrieu et al, 2004). They perceive that they have greater disabilities, believe exercise to be more difficult and are more likely to report activity restrictions than men (Himes, 2000; Jensen and Friedmann, 2002; Davison et al, 2002; Larrieu et al, 2004; Chen and Gou, 2008; Valentine et al, 2009; Reibe et al, 2009; Gadalla, 2010). In a study of 134 elderly sedentary adults, Valentine et al (2009) reported a gender difference in the relationship between body fat, aerobic fitness, balance and gait. A marked decrease in performance in women was observed on balance and gait tasks, in comparison to men. This suggests that the women were affected more by changes in 'body' composition than men.

Ten studies looked at the association of obesity with lower levels of physical activity and poor physical function in the elderly (Di Francesco et al, 2005; La Croix et al, 1994; Van Gool et al, 2005; Lang et al, 2007; Brach et al, 2004a; Kim et al, 2008; Simoes et al, 2006; Kostka and Bogus, 2007; Koster et al, 2007; Reibe et al, 2009). Simoes et al (2006) reported findings from a telephone survey of over 3000 adults, aged 60 years and above, that ADL and IADL dependence increased with BMI and low levels of physical activity, whilst other studies in the elderly showed regular activity to be protective against the development of activity restrictions (La Croix et al, 1993; Sternfeld et al, 2002; Larsson et al, 2004; Kim et al, 2008; Koster et al, 2008). Di Francesco et al (2005) found leisure-time physical activity to be inversely associated with body fat, BMI and reported disability, in a study of 85 elderly men aged 68 to 79 years old. Another cross-sectional study, of 3,075 well-functioning 70 to 79 year olds, revealed that those who participated in moderate intensity exercise for 20 to 30 minutes on most days of the week had better physical function than those who were inactive, irrespective of weight (Brach et al, 2004a). Similarly, Lang et al (2007) in a national prospective study of 10,209, 50 to 69 year old subjects, found physical activity (that is, active on 3 or more days of the week) to be protective of impaired physical functioning, regardless of BMI.

A prospective study looking at higher exercise adherence in 134 obese elders with knee arthritis reported associations with improved walking and reduced self-reported disability (Van Gool et al, 2005). This suggests a relationship between obesity, activity restrictions and physical activity, though causal pathways have not been established. Interestingly, Brach and colleagues (2004b) undertook a 14-year prospective study to explore the relationship between obesity and physical function in 171 community dwelling elderly women (mean age 74 years), using the Functional Status Questionnaire (FSQ) and gait speed to assess physical function. Using regression analysis, the findings revealed that physical activity level not BMI was an independent predictor of physical function in elderly populations (FSQ: adjusted $R^2 = 0.09$, $F = 4.68$, $P < 0.001$, gait speed: adjusted $R^2 = 18.0$, $F = 9.41$, $P < 0.0001$).

Younger or Middle-aged Populations

Ten studies reporting on activity restrictions in obese middle-aged adults have published similar findings to those studies in the elderly, whereby poor physical function is associated with increasing body weight and inactivity (Han et al, 1998; Coakley et al, 1998; Larsson and Mattson et al, 2001a and b; Tsuritani et al, 2002; Feraro et al, 2002; Sternfeld et al, 2002; Kuh et al, 2005; Stenholm et al, 2007a; Lang et al, 2007).

Fifteen studies were identified that looked at functional limitations and activity restrictions in middle-aged and younger obese adults, though many did not specify what the limitations were. In a population-based study of US adults aged 20 years and over, Bish et al (2007) identified that approximately 30% of overweight and obese adults reported some degree of activity restriction and that the restriction increased with increasing BMI. This study also reported that overweight women with activity restrictions were less likely to attain physical activity recommendations compared to those without activity restrictions (Bish et al, 2007). A number of studies in younger populations reported associations between obesity and poor physical functioning, including musculoskeletal conditions such as osteoarthritis and pain, which could lead to limited activity (Lusky et al, 1996; Han et al, 1998; Larrsson and Mattsson, 2001a; Tsuritani et al, 2002; Ferraro et al, 2002; Swallen et al, 2005; Lidstone, 2006; Wearing et al, 2006; Tukker et al, 2009). Lusky et al (1996) reported associations of overweight and obesity with joint conditions of the hip, ankle and knee in a 110,000 17 year old Israeli males. In another study, Ferraro and Booth (1999) found obesity to be associated with functional limitations of all ages, with the suggestion that effects of some limitations are greater in the young or middle-aged. A more recent review by Capodaglio and colleagues (2010) of the functional limitations experienced by obese individuals in occupational work, summarised the physiological and biomechanical causes of these limitations, though they were specific to the workplace. The limitations included reduced walking speed, reduced speed of movement and a reduced range of motion, often leading to early onset of degenerative conditions of the musculoskeletal system (Capodaglio et al, 2010). In a small comparative study of 57 obese women with a mean age of 44 years and 22 non-obese women of similar age who underwent a series of functional tests to ascertain the type of physical difficulties they experienced (Larsson and Mattson, 2001). The limitations reported by the obese women were found to be difficulties in reaching, balancing, squatting, kneeling and rising from low furniture, stepping onto high steps, stair climbing, and carrying grocery bags (Larsson & Mattson, 2001a). Additionally, they walked more slowly and experienced more pain and exertion, than the normal weight women in the non-obese group. This study highlighted that the obese women perceived themselves to have greater functional limitations than was observed and measured (Larsson & Mattson, 2001b), which subsequently might result in a barrier to activity participation.

ii) Obesity and Walking/Mobility

Twelve papers reported on the walking and mobility difficulties associated with obesity (Table 2.4, p 32). Four studies included younger obese populations, though the rest were in the middle-aged or elderly. More details of each paper can be found in the data charting form in Appendix A2 Table A2.1 p 242. Obese subjects have been observed walking significantly slower, taking shorter steps and strides than non-obese counterparts, possibly in order to maintain better body balance and reduce movement around the knee (Stenholm et al, 2007a and b; Tukker et al, 2008; Lai et al, 2008; Colne et al, 2008; Woo et al, 2009). They are also reported to have significantly greater stride widths, possibly due to excess adipose tissue inside their thighs (Spyropolous, 1991), and exhibit longer stance times and less time in the swing phase, perhaps, in order to generate an adequately powerful push-off force (Lai et al, 2008). Other studies have found that central adiposity, measured by waist circumference and independent of levels of either lean or fat mass, is associated with decreased walking speed and increased likelihood of self-reported functional limitation in middle-aged and older obese adults (Visser et al, 1998; Sternfeld et al, 2002). The mechanism for this is not known but it is suggested that abdominal fat distribution increases both the onset of pathology of disease, and its impact on functional limitations (Sternfeld et al, 2002). Obese individuals are reported to sway more than non-obese individuals, which again may make them prone to losing balance and falling (Hue et al, 2007). A review of the biomechanics of restricted movement in obesity indicates that obesity is associated with reduced muscular strength, impaired postural control and altered limb mechanics during walking (Wearing et al, 2006), which can lead to pain, injury or increased restriction in mobility. However, what is less clear is the exact cause of these effects. Previous suggestive causes of restricted mobility in obesity include, increased body mass, physical inactivity, altered limb anthropometry or a metabolic disturbance due to adiposity (La Croix et al, 1993; Visser et al, 1998; Mendes de Leon et al, 2006; Koster et al, 2007; Houston et al, 2009). The reported inefficiencies in movement may be improved with appropriate interventions. These include resistance weight training, specific balance training, balance and posture and aerobic exercise to improve gait (Maffiuletti et al, 2005; Hills et al, 2002). Interestingly, the reported gait patterns of younger obese individuals are similar to those described in studies of elderly individuals who have a FOF (Bernard et al, 2003; Spyropoulos et al, 1991).

2.5.2 Fear of Falling, Activity Participation and Obesity

Elderly Populations

One possible reason for activity restrictions in the obese elderly could be FOF. This review identified 7 papers reporting on FOF, activity restriction and obesity in elderly adults, which included five cross-sectional studies and two prospective studies. However, it must be emphasised that this was not intended to be a review of all studies relating to FOF and activity participation, only those relevant to the field of research (obesity). A summary of the findings can be seen in Table 2.4, p.32. The full details of all the selected papers can be found in the data charting forms in Appendix A2 Table A2.2, p 245.

Austin et al (2007) conducted a 3-year longitudinal study to determine predictors of incident and persistent FOF in 1,282 community dwelling women aged 70 to 85 years.

At baseline 418 (33%) participants reported FOF which was found to be associated with a number of independent variables, including impaired balance, mobility and obesity, which increased to 46% after 3 years. Very few participants reported a reduction in FOF over the 3-year period and obesity was found to predict a new onset FOF. Similarly, another cross-sectional study of 619 community dwelling elderly people (aged 75-81 years) compared the physical activity levels of those obese and non-obese. The results showed variables including FOF, discomfort whilst exercising, feelings of insecurity when exercising outdoors and a lack of interest whilst exercising, to be moderately correlated with obesity and physical inactivity (Sallinen et al, 2009). Bruce et al (2002) explored whether FOF was a probable cause of reduced physical activity level in 1,500 older women using self-reporting and performance based measures. Both FOF and obesity were found to be independent factors associated with low levels of physical activity (Bruce et al, 2002). While a further study of 920 moderately-to-severely disabled community dwelling women aged 65 years and older, reported obesity to be negatively associated with walking outside, regardless of level of disablement, this was not seen in the case of FOF, suggesting like other authors of FOF in the elderly, that FOF does not predict activity independent of walking ability (Simonsick et al, 1999; Tinetti et al, 1994). Deshpande et al (2008a and b) found a significant association between higher BMI and increased activity restriction (Deshpande et al 2008b) and a higher but not significant risk of fear of falling with increased BMI (Deshpande 2008a). The latter was also observed by Andresen et al (2006).

Younger Obese Adults

Three papers were identified which report on issues relating to fear of falling in younger adults. Details of these papers can be found in the charting data form found in Appendix A2, Table A2.2, p 246.

A small study of 8 obese and 8 non-obese younger adults (students or university staff) suggested that fear of falling, measured using the Falls-Efficacy Scale-International (FES-I), was slightly higher in obese people (Dey et al, 2007). Apart from the study size, a major limitation of this study was the scale used, which was originally designed for use in elderly populations. In another small observational study of 57 obese women (mean age = 44 years), Larsson and Mattson reported a number of obese women who commented that they dreaded falling over because they felt clumsy, got nasty comments, and were stared at in public (Larsson and Mattson, 2001b). Therefore, it is feasible that a FOF may be a problem in younger obese adults, possibly due to a fear of looking foolish or receiving negative attention. In 2001, Deitel (2001) reported on a study of 1,549 pre-bariatric surgery obese patients (mean BMI = 44.8 kg/m^2), that the everyday problems they faced were often overlooked. Sixteen percent of the participants reported walking downstairs backwards as they could not see the lower stairs because of their truncal obesity and were afraid of falling (Deitel, 2001).

2.5.3 Balance, Falls and Obesity

The findings of 26 papers identified related to the topic of balance and falling in obese subjects and are presented in more detail in the data charting form found in Appendix A2, Table A2.3, p 247. Additional adipose tissue and body weight is reported to reduce the body's ability to maintain balance, presumably because of the added constraints exerted by the excess weight on balance control (Corbeil et al, 2001; Jadelis et al, 2001; Hue et al, 2007). It has also been shown that obese persons walk more slowly with a greater stride width and that they spend more time in the double-support phase, possibly in an attempt to maintain balance (Lai et al, 2008).

All Age Populations

At all ages, obese individuals are reported to have impaired balance control compared to those of normal weight (Jadelis et al, 2001; Manckoundia et al, 2007; Corbeil et al, 2001; Gauchard et al, 2003; Maffiuletti et al, 2005; Greve et al, 2007; Hue et al, 2007; Teasdale et al, 2007; Matrangola and Madigan, 2009; Singh et al, 2009; Menegoni et al, 2009; Bernard et al, 2003; Goulding et al, 2003; Colne et al, 2008). Suggested causes for this reduction in stability include biomechanical constraints caused by excess body weight which can be further exacerbated by reduced muscular strength or reduced muscle mass. Furthermore, abnormal distribution of body fat, particularly around the abdomen, interference with the interaction between muscles and joints and changes to foot function, can all lead to poor stability in obese individuals (Jadelis et al 2001; Corbeil et al, 2001; Gravante et al, 2003; Menegoni et al, 2009; Blaszczyk et al, 2009). Strong associations between weight and postural stability have been reported, whereby overweight subjects are observed as having a larger postural sway and swaying at a faster speed than normal weight individuals. This finding is reported to have an impact on the overweight subjects leading to a potential reduction in stability. (Corbeil et al, 2001; Hue et al, 2007; Singh et al, 2009). Interestingly, Davis et al (2009) reported observations in a small cohort of overweight and obese firefighters, whereby the obese subjects (with an assumed level of fitness) were able to compensate their stance when their postural systems were compromised by reducing their postural sway, this strategy improved their stance, thus helping to avoid potential slips or falls.

Reduced physical activity, regardless of previous activity status and BMI, can significantly affect postural balance and muscular strength, thus meaning inactive obese individuals are increasingly prone to poor postural balance, reduced aerobic fitness and muscle weakness (Rolland et al, 2004; Duvigneaud et al, 2008; Bulbulian, 2000). Jadelis et al (2001) reported an association between obesity and reduced strength in a group of 480 men and women aged 65 years and over, resulting in those obese being weaker than those of normal weight. With this said, overweight individuals, especially those who are sedentary, have been reported to be more prone to poor balance. Research advocates that larger muscular forces are needed to maintain control during postural instability. This could also explain why women who are less active, that is, less physically fit with poorer muscle development, are more susceptible to poor balance, as they do not have the core strength to maintain an upright posture. With this said, less active women's postural stability appears to be more affected by additional weight gain than that of men (Manckoundia et al, 2007), with differences in body fat distribution between the sexes being another suggested reason for poor balance control in women (Menegoni et al, 2009). Another prospective cohort study in 2,956 middle-aged men and women, reported subjects with poor balance more likely to be overweight and/or inactive (Kuh et al, 2005). Interventions including weight loss and/or increased strength gained through activity in obese subjects can lead to improvements in postural balance. However, many of the studies identified had small sample sizes, which in turn can affect the significance or reliability of the results (Maffiuletti et al, 2005; Teasdale et al, 2007; Matrangola and Madigan, 2009; Colne et al, 2001; Handrigan et al, 2010a).

In an intervention trial of 16 normal weight controls, 14 obese men (BMI 30-40Kg/m^2), and 14 morbidly obese men (BMI >40 kg/m^2) weight loss following a reduced calorie diet resulted in improvements in postural balance, whereby the extent of improvement was directly related to the amount of weight loss (Teasdale et al, 2007). Similarly, Handrigan and colleagues (2010) conducted a controlled intervention study to monitor the effect of changes in body mass on relative strength and balance control on a group of normal weight (BMI<25kg/m²), obese (BMI = 30-39.9 kg/m²) and very obese (BMI = >40kg/m²) Caucasian males. The obese group lost an average of 12% of their initial body weight by dietary modification and the very obese group lost an average of 45% of their initial weight by bariatric surgery over a 12-month period. In addition, the obese and very obese groups reduced their muscular strength by an average of 10% and 33% respectively. The noted weight losses improved balance control in the obese and very obese groups on average by 12% and 27% respectively (measured with speed of centre of foot pressure). These findings suggest that individual weight loss is more effective at improving balance control than increasing or maintaining muscular strength (Handrigan, 2010a). Matrangola and Madigan (2009) compared the relative effects of a weight loss intervention and strength training on balance recovery in 9 obese men and found both to improve balance recovery using an ankle strategy. Interestingly, Blazczyk et al (2009) reported from observations in a group of 100 obese and 33 normal weight controls aged 18 to 53 years that the biomechanical constraints imposed by an increase in body weight lead to adaptions of balance control in obese individuals. However, Handrigan et al (2010b) opposed these claims as contrary to their findings and strongly disagreed with the concept that obese individuals can preserve their balance.

Nine observational studies suggested postural balance problems could be a possible cause of falls and fall-related injuries in obese adults (Jadelis et al, 2001; Bernard et al, 2003; Finkelstein et al, 2007; Fjeldstad et al, 2008; Hue et al, 2007; Corbeil et al, 2001; Singh et al, 2009). Obese individuals, particularly those with abnormal body fat distribution, are reported to be at higher risk of falling (Corbeil et al, 2001). Falling is seen more in those who are inactive as balance requires muscle strength and flexibility, which are maintained by regular physical activity (Corbeil et al, 2001; Fjeldstad et al, 2008; Hue et al, 2007; Singh et al, 2009). Though many studies report that obesity can lead to increased falling, very few actually report the prevalence or incidence of falling in obese subjects, particularly in younger adults. Fjeldstad et al (2008) reported the prevalence of falling in 116 obese and normal weight middle-aged and elderly subjects, (>50 years) using a single-item self-reported measure of whether they had fallen over in the past year. Twenty-seven percent of obese subjects had fallen compared to 15% normal weight subjects, and 32% (obese) compared to 14% (normal weight) had stumbled, which again was ascertained by self-reported measures.

ii) Risk of Injury in Obese Adults

A subcategory of papers relating to the associations of obesity with poor balance and falls with specific reference to injuries was found. Four papers reported on the increased risk of injury associated with obesity in relation to poor balance, trips or falls (Table 2.4, p.32). More details of these studies can be found in the data charting form in Appendix A2, Table A2.3 p 253.

Obese individuals, particularly if unfit, are more likely to experience an accident or be injured, particularly during activity, which could lead to reduced or avoidance of activity participation (Finkelstein et al, 2007; Gauchard et al, 2003; Xiang et al, 2005; Matter et al, 2007). Finkelstein et al reviewed the characteristics of 42,304 adult injuries and found a clear association between BMI and the probability of suffering an injury, with obese individuals up to 45% more likely to sustain an injury by falling or partaking in sports than normal weight individuals (Finkelstein et al, 2007). Common injuries sustained were related to falls, sprains/strains, lower extremity fractures and joint dislocations (Matter et al, 2007; Finkelstein et al, 2007). An 18-month prospective study of 397 overweight adults reported 46% had at least one injury or illness with 32% reporting at least one injury related to exercise, though only 7% were attributed to exercise alone (Janney and Jakicic, 2010).

2.5.4 Obesity and Physical Activity, not related to activity restrictions

All Age Populations

Seven papers reported associations between obesity and physical activity, not related to activity restrictions, with references to gender, increasing BMI and possible motivating factors (Table 2.4, p 32). More details about the individual studies can be found in the data charting form in Appendix A2 Table A2.4, p 254.

National and population-based health surveys report obese adults to be less active than non-obese adults and that women engage in less leisure-time activities than men, suggesting that obesity affects activity participation (Davis et al, 2006; Young et al, 2009; Health Survey for England, 2008; Bish et al, 2007). Studies in elderly populations report that obese individuals spend less time engaged in physical activity compared to non-obese individuals and that the risk of being less active increases with increasing BMI (Jenkins and Fultz, 2008; Sallinen et al, 2009). Segar et al (2006), undertook a small cross-sectional study to investigate the motives for physical activity in 59 middle-aged women. They found body-shape motives to have a negative effect on activity participation as compared with non-body shape motives, although BMI was not seen to be associated with physical activity motives or participation. Social interaction or regular participation in organisations or groups were reported as other motivators to activity in overweight women (Jewson et al, 2008; Felton et al, 1994). Another small study of 12 obese teenage boys and girls found many to avoid activity participation despite understanding the link between obesity and reduced activity, although the reasons given were related to traumatic experiences of activity, or sport participation at an earlier age (Trout and Graber, 2009).

The concept of sedentary behaviour is gaining interest among researchers looking to increase activity levels in obese populations, though it is quite different to physical activity (Biddle et al, 2010). Sedentary behaviour refers to low levels of movement and time spent sitting. This has been linked with the time spent watching television, using a computer or other 'screened' devices. A review of the evidence found sedentary behaviour to be associated with age, gender, weight status, occupation, and elements of the physical environment, though independent of levels of physical activity (Biddle et al, 2010). Furthermore, the relationship between various sedentary behaviours, and physical activity in obese adults at this time remained largely unexplored, and offered no evidence to the contrary in this review that sedentary behaviour is linked with balance or FOF.

ii) Barriers and Predictors to Activity Participation

Ten papers reported on various barriers or predictors of activity in overweight or obese populations (Table 2.4, p 32). More detailed information of each study can be found in Appendix A2 Table A2.4, p 255. Research looking at the reasons for reduced participation in obese adults has focused more on cognitive and motivational factors with less reported about the physical difficulties experienced when active. A number of papers in the literature reported common barriers to activity participation in obese individuals which included, body dissatisfaction, embarrassment, shyness, not motivated, having an injury, perceived lack of time or cost, and being 'lazy' (Rosenburger et al, 2006; Genkinger et al, 2006; Faith et al, 2002; Jewson et al, 2008; Rye et al, 2009; Atlantis et al, 2008; Ball et al, 2000; Thomas et al, 2008).

A previously reported observational study by Larsson and Mattson (2001) looked at the functional limitations of obesity in a group of middle-aged women and stated that some women reported that they dreaded falling over in case they got stared at, or got nasty comments (Larsson and Mattson, 2001a). Feelings of embarrassment, discomfort or weight criticism from members of the public, were commonly reported barriers to activity in obese individuals, particularly in women (Ball et al, 2000; Hills and Byrne, 2004; Thomas et al, 2008; Faith et al, 2002). Although not directly related to FOF and obesity, if falling over leads to embarrassment in an obese individual, it may suggest that avoiding falling over, this, in turn, might become important or paramount to that person, and so indirectly be linked to and potentially perpetuate a FOF.

Table 2.4: Identified Areas in review of literature of Obesity and FOF, Balance, Activity Restrictions and Activity Participation

Area	Population	Main findings	Authors
1.Obesity, activity restrictions and activity participation	Obese elderly	Obesity linked to functional limitations/activity restrictions and/or disability	Launer et al, 1994; Visser et al, 1998; Ferraro and Booth, 1999; Tsu Sternfeld et al, 2002; Larrieu et al, 2004; Houston et al, 2005; Jinks et al, 2006; Lidstone et al, 2006; Alley and Chang, 2007; Lang et al, 2007; Bish et al, 2007; Kostka and Bogus, 2007; Chen and Guo, 2008; Lang et al, 2008; Reibe et al, 2009; Walter et al, 2009; Stenholm et al, 2010; Woo et al, 2009; Jensen and Hsiao, 2010; Capodaglio, 2010.
		Association of obesity with poorer physical function and increased pain	Coakley et al, 1998; Apovian et al, 2002; Aoyagi et al, 2007; Newton et al, 2009.
		Functional limitations more likely in elderly women and obese elderly women	Himes, 2000; Jensen and Friedmann, 2002; Davison et al, 2002; Larrieu et al, 2004; Chen and Gou, 2008; Valentine et al, 2009; Reibe et al, 2009; Gadalla, 2010.
		Regular activity in elderly reduces activity restrictions/functional limitations	Brach et al, 2004a; Larsson et al, 2004; Kim et al, 2008.
		Relationship between physical activity, obesity and functional limitation/activity restriction	Sternfeld et al, 2002; Di Francesco et al, 2005; Van Gool et al, 2005; Simoes et al, 2006; Sharkey et al, 2006.
	Obese elderly women	Obese women who were physically active had better physical function than those inactive	Larrsson, 2004; Brach et al, 2004b; Kim et al, 2008; Koster et al, 2008.
		Obesity linked to functional limitations/illness, impaired quality-of-life, disability and perception of disability	Ferraro and Booth, 1999; Ferraro et al, 2002; Tsuritani et al, 2002; Sternfeld et al, 2002; Lidstone et al, 2006; Lang et al, 2007; Bish et al, 2007; Capodaglio et al, 2010. .

Area	Population	Main findings	Authors
	Middle aged/young obese adults	Obesity linked with functional limitations/activity restrictions	Han et al, 1998; Coakley et al, 1998; Ferraro and Booth, 1999; Larsson and Mattsson, 2001a and b; Hills et al, 2002; Tsuritani et al, 2002; Kuh et al, 2005; Swallen et al, 2005; Lidstone et al, 2006; Lang et al, 2007; Bish et al, 2007; Capodaglio et al, 2010.
		Obesity linked with muscular skeletal problems conditions including arthritis and pain	Lusky et al, 1996; Larrsson and Mattsson, 2001a; Tsuritani et al, 2002; Wearing et al, 2006; Rolland et al, 2007; Tukker et al, 2009.
		Physical activity is protective of impaired physical function	Sternfeld et al, 2002; Lang et al, 2007; Koster et al, 2008.
Walking and mobility problems	In all ages	Obese walk slower with limitations	Spyropoulos et al, 1991; Sternfeld et al, 2002; Stenholm et al, 2007a and b; Tukker et al, 2008; Lai et al, 2008; Colne et al, 2008; Woo et al, 2009.
		Obese have mobility limitations	LaCroix et al, 1993; Visser et al, 1998; Hills et al, 2002; Mendes de Leon, 2006; Koster et al, 2007; Houston et al, 2009
2.Fear of Falling, activity participation and obesity	In elderly	BMI associated with new onset FOF	Austin et al, 2007
		FOF and obesity linked to reduced activity participation	Sallinen et al, 2009..Bruce 2002
		FOF increased with higher BMI but not statistically significant	Deshpande et al 2008a, Andresen 2004
	In young obese adults	Small sample of obese and non-obese adults, obese had higher FES score than non-obese	Dey et al, 2007.
		1 observational study showed obese women reported FOF as get mocked or stared at.	Larsson and Mattsson, 2001.
		Obese reported walking downstairs backwards because they feared falling.	Dietel, 2001.

Area	Population	Main findings	Authors
3.Balance or falls and obesity	Obese elderly	Obesity associated with reduced muscular strength, increasing likelihood of poor balance.	Means et al, 2000; Jadelis et al, 2001.
		High risk of failing balance test in obese females and those with low health perception	Manckoundia et al, 2007.
		obesity associated with increased risk of falling	Torgesson et al, 1993; Corbeil et al, 2001; Gauchard et al, 2003; Hue et al, 2007; Fjeldstad et al, 2008; Singh et al, 2009.
	Obese adults	Obesity associated with poor balance	Kuh et al, 2005; Greve et al, 2007; Hue et al, 2007; Singh et al, 2009; Menegoni et al, 2009.
		Weight loss/balance training improves balance and reduces falls	Maffililetti et al, 2005; Teasdale et al, 2007; Greve et al, 2007; Singh et al, 2009; Matrangola and Madigan, 2009.
		Biomechanics of obesity affect balance and therefore functioning	Bertocco et al, 2002; Gravante et al, 2003; Blaszczyk et al, 2009; Handrigan et al, 2010.
	Obese adolescents	Obesity leads to poor balance	Bernard et al, 2003; Goulding et al, 2003.
		Weight loss improves balance	Colne et al, 2008.
Increased risk of injuries	All ages	Obesity associated with increased risk of injuries	Gauchard et al, 2003; Xiang et al, 2005; Wearing, 2006; Finkelstein et al, 2007; Matter et al, 2007; Janney and Jakicic, 2010.
		Obesity associated with increased risk of injuries related to falls	Finkelstein et al, 2007; Matter et al, 2007.
		Obesity associated with increased risk of injuries related to musculoskeletal conditions	Finkelstein et al, 2007; Matter et al, 2007; Janney and Jakicic, 2010.

Area	Population	Main findings	Authors
4.Obesity and physical activity participation, not related to activity restrictions. Barriers and predictors to activity participation	All ages	Obesity associated with activity participation and gender Baseline BMI and activity status in younger women affects activity change Sedentary behaviour in obese adults associated with age, gender, occupation, weight status, and elements of the physical environment, though independent of physical activity Psychological barriers to activity include: social embarrassment, shyness, lazy, not motivated, body image dissatisfaction, lack of support/willpower, overweight perception, negative attitude towards sport Physical barriers to activity include: injury, disability, physical restrictions due to weight, pain, low fitness and chaffing	Hill and Byrne, 2004; Segar et al, 2006; Jenkins and Fultz, 2008; Sallinen et al, 2009. Nitz and Choy, 2007. Biddle et al, 2010. Felton et al, 1994; Ball et al, 2000; Faith et al, 2002; Hills and Byrne, 2004; Rosenburg et al, 2006; Atlantis et al, 2008; Thomas et al, 2008; Rye et al, 2009; Trout and Graber, 2009; Dalle Grave et al, 2011. Ball et al, 2000; Hills and Byrne, 2004; Thomas et al, 2008; Dalle, Grave et al, 2011.

2.6 Discussion

The key findings of this scoping review show evidence of a relationship between obesity, activity restrictions, and activity participation in middle-aged and elderly people (Reibe et al, 2009; Simoes et al, 2006). Obese elderly individuals have significantly more activity restrictions than their lean counterparts and the risk of these restrictions increases with increasing weight and reduced activity (Sternfeld et al, 2002). Additionally, gender appears to play a role, as elderly obese women are more likely to report activity restrictions than obese men and be less physically active than men; they also find exercise harder than their lean counterparts (Friedman et al, 2001; Himes et al, 2000). Despite a substantial number of studies reporting associations between obesity and activity restrictions in younger obese populations, few specify the types and effects of restrictions reported and whether they might relate to balance problems or a possible fear of falling (FOF) (Hills et al, 2002; Lang et al, 2007; Koster et al, 2008). One study reported a number of obese women to have concerns of falling due to a 'fear-of-feeling-clumsy', being mocked, or stared at if they fell (Larsson and Mattson, 2001a). Furthermore, regular activity has been shown to be protective against the onset of activity restrictions in elderly obese subjects (Brach et al, 2004a and b; Kim et al, 2008). Although, a few studies did speculate that activity restrictions could lead to a reduction in physical activity in younger obese populations, none showed a definitive association (Jung, 2008; Kempen et al, 2009).

Another key finding of the literature review reports evidence of a relationship between obesity, FOF, and activity participation in elderly populations (Bruce et al, 2002; Austin et al, 2007; Sallinen et al, 2009), which has not been fully investigated in younger obese populations. Of the three papers identified for reporting FOF in younger obese populations, two reported comments from small samples of obese individuals who expressed concerns of falling over (Deitel, 2001; Larrson and Mattson, 2001). However, these findings did not refer to the possible causes of, or the context of the identified concerns of falling. A preliminary comparative study of 16 relatively active younger adults revealed differences in activity restrictions and balance confidence between obese and non-obese individuals (Dey et al, 2007), however, the differences were small and the findings could only be considered tentative. Except for this small primary study, FOF has not been studied in younger obese populations and thus no associated factors or long-term consequences are known.

The predisposing factors of FOF in the elderly are widely documented and include, previous falls, poor balance and mobility, activity restrictions, low activity, age, anxiety, and depression (Legters, 2002; Scheffer et al, 2008; Jung, 2008; Harding and Gardner, 2009), which interestingly have all been associated with obesity in all-aged adults (Fjeldstad et al, 2008; Singh et al, 2009, Jadelis et al, 2001, Colne et al, 2008). Furthermore, FOF is reported more frequently in elderly women compared to men (Bruce et al, 2002; Suzuki et al, 2002; Austin et al, 2007; Ziljstra et al, 2007b), and has been associated with activity restrictions and poor physical functioning in community based middle-aged and elderly populations (Lachman et al, 1998; Howland et al, 1998; Murphy et al, 2002; Suzuki et al, 2002; Wilson et al, 2005; Martin, Hart et al, 2005; Andresen et al, 2006; Deshpande et al, 2008a and b; Jung, 2008; Kempen et al, 2009). Individuals who restrict their activity because of a FOF are more likely to have poor or worse functional limitations than those with FOF alone (Kempen et al 2009; Deshpande et al 2008; Wilson et al 2005). Moreover, the consequences of reduced functional limitations due to FOF can lead to devastating effects on an individual's quality-of-life as they are reported to affect psychological as well as physical health, and if left untreated could lead to social withdrawal or isolation (Howland et al, 1993; Arfken et al, 1994; Lachman, 1998; Cummings et al, 2000; Legters, 2002; Jung, 2008).

Fear of falling is common in adults aged 60 years or above. The reported prevalence varies widely between 12 to 92%, depending on whether the individuals are living independently or are in care, and with or without a history of falling (Legters et al, 2002; Lachman et al, 1998; Howland et al, 1993; Scheffer et al, 2008). Another reason for the variation in the reported prevalence of FOF could be due to the definition used. There are several different definitions of FOF reported in the literature and likewise, a variety of tools used to measure these differing definitions (Legters et al, 2002; Jung, 2008). There appears to be no consensus among researchers on a standard definition of FOF. Therefore, some confusion exists regarding the best method of defining and measuring it, which consequently makes comparing studies using different measurement tools problematic (Jorstad et al, 2005).

Fear of falling is independently associated with sedentary behaviour in elderly women, even after controlling for use of walking aids and obesity (Bruce et al, 2002). Regular exercise is known to reduce a FOF in older people, particularly those activities that improve lower limb strength, balance, endurance, and stability; consequently, leading to a reduction in falls and improved confidence in ability to do activities (Hadjistravropoulos et al, 2007; Jung, 2008). Exercises that improve balance control, physical function, walking speed and ankle strength are found reduce falling and associated FOF (Jung, 2008). In addition, regular activity is known to improve mood including depression, which as reported above, has also been associated with FOF (Jung, 2008). What seems clear from the evidence is that low levels of physical activity are key factors, both in the cause and outcome of FOF.

Obesity in all-ages is known to affect postural balance and mobility, particularly in those less active (Corbeil et al, 2001; Kuh et al, 2005). This is reported to lead to an increased risk of falling and injuries in obese adults, however, many studies do not report the actual prevalence of falling (Gauchard et al, 2003; Wearing et al, 2006; Koster et al, 2007; Hue et al, 2007; Manckoundia et al, 2007; Fjeldstad et al, 2008; Houston et al, 2009; Singh et al, 2009). Poor balance, mobility and previous falls are common characteristics found in both obese subjects and elderly individuals with a FOF. It is therefore, feasible to suggest that a FOF might be an issue in some obese adults. Furthermore, regular activity is reported to improve balance, muscular strength, mobility, and reduce falls in obese populations (Teasdale et al, 2007; Matrangola and Madigan, 2009); these benefits can also lead to a reduction of FOF in the elderly (Ziljstra et al, 2007b).

There are few studies looking into the physical barriers of exercise in obese populations. Obese women are frequently reported to be less active than non-obese women and obese men (Ball et al, 2000; Thomas et al, 2008; Dalle, Grave et al, 2011; Health Survey for England, 2012). One study looking at the functional limitations of obesity in younger obese women reported that they dreaded falling over due to embarrassment, which although, not directly linked to falling, might suggest a reason to be concerned about falling and subsequent reduction in activity participation (Larrson and Mattson, 2001).

Fear of falling is a strong predictor of reduced, non-participation, avoidance in physical and social activities in elderly populations (Cummings et al, 2000, Howland et al, 1993; Vellas et al, 1987; Tinetti et al, 1990). Both FOF and obesity have been found to be independently associated with low levels of physical activity (Bruce et al, 2002), and obesity; these have been discovered to predict a new onset of FOF in elderly subjects

(Austin et al, 2007). This together with the knowledge that obese individuals tend to be less active as compared to those not-obese, that inactivity impairs their postural balance and increases their risk of falling (Corbeil et al, 2001; Jadelis et al, 2001), all add to the proposal that a FOF might be an issue in younger obese adults, and thus a possible cause of reduced activity. Furthermore, with this said, relationships between a FOF, reduced activity with both anxiety, and depression, have been reported in older populations (Harding and Gardner, 2009; Jung, 2008; Legters, 2008; Van Haastregt et al, 2008). These, interestingly, highlight similarities to the limited findings in younger obese populations of associations between obesity, reduced activity and depression (Stella, 2005).

The findings of this review highlight gaps in the literature around the specific types of activity restrictions associated with obesity and their relationship with reduced activity participation, and whether they are associated with poor balance, falling or FOF. Few studies have reported the prevalence of falling in obese populations and whether this might lead to a FOF in younger obese populations. Fear of falling is a multifaceted phenomenon, found mainly in the elderly. It can have devastating effects on the health of individuals ranging from reduced participation and activity avoidance to deteriorating health and quality-of-life. This review highlights similarities between FOF in the elderly and the effects of obesity on activity participation, including associated factors such as poor balance, increased risk of falling, low activity anxiety, and depression. These similarities suggest that a FOF might be an issue in younger obese populations and a possible reason for reduced activity; even though possible predisposing factors and the long-term consequences of FOF in younger populations are unknown. Further research is needed to clarify the specific activity restrictions reported by younger obese populations, particularly those around balance and falls, and also the prevalence of falls in this population. An exploratory study looking at whether a FOF might be an issue in younger obese populations is also recommended. This includes possible contributory factors of previous falls or poor balance and any associations with activity participation. The known associations of FOF, physical activity, and obesity together with awareness of the serious consequences of FOF if left untreated, justifies the exploration of FOF as a phenomenon in younger obese adults.

2.7 Limitations of the Review

The purpose of this scoping review was to provide a rationale for investigating FOF in younger obese adults. It was not intended to be a full review on FOF and so only included papers pertinent to a link between obesity, activity restrictions, fear of falling and physical activity. The limitations of the review process included that only one researcher screened the papers and that the search was limited to English language, which, in turn, meant that both could lead to relevant studies being missed. Scoping reviews provide a method for extracting and mapping areas of research from a variety of study types in a relatively short space of time, thus providing a descriptive or narrative account of the available research. However, it can generate a lot of data covering more the ‘breadth’ than ‘depth’ of research available and does not appraise the quality of evidence for each study reported in a detailed manner. This makes it difficult to make decisions about the ‘weight’ of evidence around a particular research area. Although scoping reviews are designed to identify gaps where no research has been conducted, they do not identify gaps where the research might be of poor quality.

2.8 Implications for Future Research

The majority of studies identified in the review were cross-sectional and so the direction of the putative causal pathway could not be established between FOF, activity restrictions and the associated variables.

Considering the widely reported consequences of FOF and the potential devastating effects it can have on the lives of older people, there is surprisingly very little published research on a FOF in younger obese adults. Research into reasons for non-participation of obese adults has mainly focused on psychological barriers around motivation. There have been limited studies on the activity restrictions of obesity in young and middle-aged adults. Most studies fail to report what the restrictions are (Hills et al, 2001) or their impact on the health of obese adults. There is a lack of obesity specific instruments to measure activity restrictions (Larsson and Mattson, 2001b) and it is not known whether the tools used to measure FOF in elderly are suitable for use in younger, obese adults.

2.9 Conclusions

Findings of the scoping review revealed evidence of a relationship between FOF, obesity and activity participation in elderly populations and the similarities between elderly obese adults with FOF and younger obese adults with activity restrictions. Findings from three small observational studies suggest FOF might be an issue in younger, obese populations, however, there have been no large scale or prospective studies in younger obese adults. The results of this review provide some evidence that FOF could be a potential issue in younger obese adults and might have an impact on activity providing a rationale for this thesis and consequently helping to develop the research.

2.10 Research Aims and Objectives

Results of the scoping literature review provided evidence of a relationship between obesity, FOF and physical activity in older women, whereby a FOF increased with increasing weight and reduced activity (Bruce et al, 2002; Austin et al, 2007; Wijlhuizen et al, 2007; Jung, 2008). FOF was more likely to be reported by older women than men who also tend to be less active (Vellas et al, 1997; Bruce et al, 2002; Zijlstra et al, 2007b; Scheffer et al, 2008; Jung, 2008; Kempen et al, 2009). Limited research suggested FOF might be a problem in younger obese adults and could be a reason for reduced activity participation.

The overarching research question for this PhD was ‘what prevents obese adults from participating in physical activities?’. Subsequent findings from the literature review suggested that a FOF, which leads to reduced activity and activity avoidance in elderly obese individuals, could be a novel factor in younger obese adults. No previous studies have looked at FOF in younger obese adults (under 50 years old) and the possibility that it might be linked to reduced activity participation. Studies in the elderly found FOF to be higher in obese women than in obese men, which suggests a gender difference and that FOF could be a factor as to why obese women are less physically active than obese men (Austin et al, 2007; Bruce et al, 2002). For this reason, the research focused on obese women only.

i) Aims

The aims of this thesis is twofold:

1) To investigate fear of falling (FOF) as a phenomenon in young obese women.

2) To develop a conceptual framework to help inform the developmental future lifestyle interventions to treat obesity.

ii) Objectives

This thesis attempts to answer the question:

Is a fear of falling an issue in younger obese women? And, if so, what is the relationship between fear of falling and physical activity in younger obese women?'.

The specific objectives of the thesis were to:

1) Ascertain whether fear of falling is an issue in obese women under 50 years of age.

2) To quantify fear of falling and its components in younger obese women and assess its relationship with activity.

3) To develop a conceptual framework of fear of falling in obese women.

2.11 Chapter Summary

The research for this thesis was original in that there was no previous published literature on FOF in younger obese adults, and therefore the research questions were primarily exploratory. The thesis is composed of three sequential phases of research:

1) A qualitative exploration of concerns about falling in obese women under 50 years of age and how this affects activity restrictions and activity participation.

2) A review of tools used to measure balance/fear of falling suitable to use in young obese adults.

3) A quantitative exploration of fear of falling and relationship with physical activity levels in obese women under 50 years of age.

The methodological rationale for this will be discussed in the next chapter.

CHAPTER 3: METHODOLOGICAL FRAMEWORK

3.1 Introduction

The aims and objectives of this thesis advocate the use of exploratory research methodology as FOF has not previously been established in young obese adults and the research questions were open to change as a result of the revelation of new data or insights throughout the research. The aims and objectives of the research were to explore the research questions with varying levels of depth and provide initial data on the nature of FOF in obese women under 50 years of age. Exploratory research does not intend to provide final and conclusive evidence of a particular problem, but instead offer new information in order to determine a better understanding of the problem and forms the basis of more conclusive research (Singh, 2007). Appropriate research designs were required to achieve the objectives of this thesis.

3.2 Rationale for Research Methodology

The chosen research methodology uses multiple methods or 'multi-methods', that is both qualitative and quantitative methods in an exploratory sequential design, whereby the results of the first, qualitative study are used to inform the design of the second, quantitative study. "Multiple methods are used in a research program when a series of projects are interrelated within a broad topic and designed to solve an overall research problem" (Morse 2003, p. 196)

The first research question was to explore whether FOF might be a problem in young obese women before proceeding to a research study to explore how common this problem was and whether there was a relationship with physical activity levels. As little was known about this phenomenon, the best research method to answer the first question was considered to be a qualitative study in a small number of subjects to elicit if there was FOF in this population and possible related factors. This would lead to hypothesis generation and help develop a preliminary conceptual framework of FOF specifically in this population to guide further quantitative research. This framework was used to inform a review of suitable FOF instruments to use in the second exploratory quantitative research study of levels of FOF and its relationship with physical activity. The findings of this study further informed the framework.

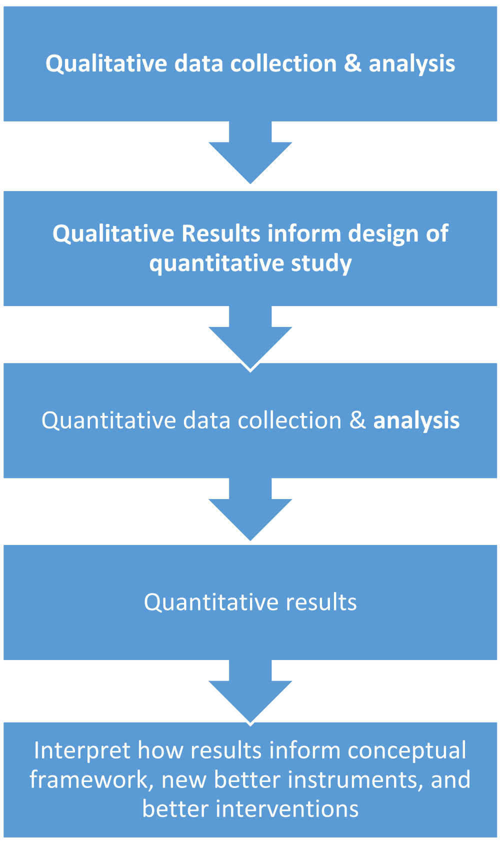
The underlying rationale of using multi-methods in this research is that neither quantitative nor qualitative methods are adequate in themselves to capture sufficient insight and information about the specific situation. A combination of methods provides a better understanding of a research topic than either approach alone which has complementary strengths of both approaches and reduces the limitations of either single design (Creswell et al, 2004; Larkin et al, 2014). Multiple method designs are increasingly used in health service research as they help address and understand the numerous complexities in healthcare ensuring the perspectives of both service users and providers are captured (Esteves and Pastor, 2004;O'Caithain et al, 2007). The need for best practice within healthcare settings has seen a growing acceptance of qualitative and social science used alongside clinical studies to ensure a better understanding of numerous health problems (Creswell et al, 2011; Plano Clark, 2010). Multi-methods design, like mixed methods design uses a combination of qualitative and quantitative methods. However there are significant differences in their design. Multi-methods design involves qualitative and quantitative projects that are completed separately and then the results are used together to form essential components of one research program (Morse, 2003). Conversely, mixed methods research involves the collection or analysis of qualitative and/or quantitative data in a single study in which the data are collected concurrently or sequentially and the data are integrated at one or more stages in the process of the research (Tashakkori and Teddlie, 2003).

3.3 Multiple-methods Research Design

The research questions are fundamental in the design of the multi-method research, reflecting the pragmatic foundations for conducting multiple methods research where the concept of 'what works best' applies (Creswell, 2003). There are many multiple methods designs available, but what is clear is the research questions guide the design, not vice versa, so each design or prototype is adaptable.

The multiple methods design that best answered the research aims in this thesis was a basic two phase exploratory sequential method adapted from the model as described by Creswell (Creswell, 2003: Figure 3.1).The qualitative component of the research was implemented first to enable an exploration of FOF as a phenomenon in a group of obese women and identify key factors from the individuals' perspective. Results of the qualitative analysis were then used to help inform the development of a conceptual framework and design of a subsequent quantitative study to measure FOF and other factors that emerged and test associations between them. Interpretation of the quantitative results can then be made to confirm how they have improved the qualitative results and hence the conceptual framework that can guide the development of future interventions. A sequential exploratory design is ideal for the exploration of new phenomena, where there is little already known about the subject being studied (Creswell and Plano Clarke, 2007). This design was therefore appropriate to this research as there was little known about the subject of FOF in younger, obese adults and there was no guiding framework or theory available. The study design is driven by the research aims and objectives and sought to capture the complexity of FOF and better understand its relationship with activity from obese women's perspective, by gathering and analysing qualitative and quantitative data. As previously stated, the qualitative component helped identify specific elements of FOF, enabling the development of a conceptual framework, whilst the quantitative component helped quantify those elements considered most important and tested associations between them.

Figure 3.1: Basic Multi-Methods – Exploratory Sequential Design



SOURCE: Adapted from model by Creswell (2003).

3.4 Strengths and Weaknesses of Multiple Method Designs

As social phenomena such as FOF are complex, different kinds of methods are needed to better understand their complexities. As all methods of data collection have limitations, a strength of using a multi-methods design is it neutralises some of the disadvantages of each method whilst the advantages of each complement each other (Esteves and Pastor, 2004). Another strength is that it enables the researcher to address a range of confirmatory and exploratory questions using a range of methods at the same time. Although the design emphasises a qualitative aspect, inclusion of a quantitative component can make it more acceptable to quantitatively biased audiences and the same can be said about the quantitative aspect and qualitatively biased audiences.

A major drawback in multi-methods research is that it is resource and labour intensive, involving multiple stages of data collection and analysis. Another disadvantage is the need for the researcher to be proficient in both quantitative and qualitative methods, drawing on a wide variety of skills. The abundance of literature on multiple and mixed methods research lacks consistency in the terminology and descriptions used leading to confusion (Sandelowski, 2003; Larkin et al, 2014).

3.5 Chapter Summary

The research aims and objectives highlighted the requirement for exploratory research methods and were central in guiding the design of these methods. As there was little previously known about FOF in obese adults, a qualitative study was essential to gain a deeper level of understanding from the perspective of the individuals, and to develop a construct of this phenomena. One disadvantage of qualitative research is that by itself it is not possible to quantify or make quantifiable predictions, which can lead to lower credibility than that of quantitative research. Multi-methods research enables a combination of the strengths of both qualitative and quantitative research to produce a more complete picture of the phenomena and provide stronger evidence of the findings through convergence and corroboration of the results. The best research design to answer the research aims and objectives was a sequential exploratory multi-methods design, where results from an initial qualitative study are used to inform the design of a subsequent quantitative study, which in turn is used to test out or confirm the results of the qualitative study, consolidating the research findings.

CHAPTER 4: QUALITATIVE STUDY TO EXPLORE CONCERNS ABOUT FALLING IN OBESE WOMEN AND HOW THIS AFFECTS ACTIVITY RESTRICTIONS AND ACTIVITY PARTICIPATION

4.1 Introduction

Previous research outlined in Chapter 2 suggests that a fear of falling (FOF) could be a problem in younger obese adults, though no evidence exists to support this proposal. If FOF was found to be an issue in obese women it could have implications on treatment and lifestyle interventions in obesity. The purpose of this study was primarily to explore the activity restrictions or physical difficulties reported by a group of young obese women under 50 years of age, with particular reference to any issues they might have relating to balance or fear of falling, and whether these might affect activity participation. However, other factors than activity restrictions might be equally or more important to obese women in affecting their activity participation, such as pain, discomfort, self-image, stigma of obesity or perhaps just not enjoying being active. Activity participation and restrictions were specifically chosen for this research as the literature review (Chapter 2) reported a relationship between these, obesity and FOF in studies of older people, which suggests the possibility of similar findings in younger populations (Bruce et al, 2002; Austin et al, 2007; Sallinen et al, 2009). The literature also suggested a lack of studies on the specific activity restrictions reported by younger, obese populations, which could lead to the development of other original research in this population if FOF was not found to be an issue.

4.2 Aim of Qualitative Study

The overall aim of this qualitative study was to explore the experiences and concerns around falling in young obese women and its impact on activity restriction and participation in physical activity.

4.3 Method

4.3.1 Methodology

The overall research used a sequential exploratory multi-methods approach and this study formed the qualitative strand. Consequently, the methodology chosen was a ‘fundamental’ qualitative descriptive study using a simple thematic analysis to interpret the data (Sandelowski, 2000; Attride-Sterling, 2001). Thematic analysis was chosen as the preferred method for analysis of this study as an in-depth analysis and interpretation of the participant's experiences and their meanings using a specific theory or epistemological position such as phenomenology or grounded theory was not necessary.

Although less interpretive than the other theories mentioned, this methodology can be applied across a range of theoretical and epistemological approaches. It is more interpretive than a quantitative description and enables the interviewer to explore the participant's responses, and in doing so gains clarification, and verification of the data. The thematic network analysis used as described by Attride-Sterling (2001) is a realist or essentialist method, as opposed to constructionist or conceptualist method which focuses more on acknowledging the way individuals make meaning of their experiences, and is used in some specific theoretical approaches as mentioned above.

4.3.2 Study Population

This study focused on younger obese adults, defined as being less than 50 years old. The reason for this being that the vast majority of published studies include participants who are over 60 years old, and although there are a few studies looking at FOF in adults over 50 (Andresen et al, 2006; Martin et al, 2005), there appears to be a gap in the research literature with little or no work on obese adults under 50 years old. Obese women were chosen as the study cohort as women are both less likely to be physically active and, in the elderly, are more likely to report FOF than men (HSE 2008; Vellas et al, 1997), thus suggesting a gender difference.

4.3.3 Inclusion Criteria

Women from the local area of East Lancashire (an area of diverse ethnicity) attending community weight management services aged between 18 and 50 years old and with a BMI between 30 and 50kg/m^2 were included in the study. If English was not the first language of a participant wishing to take part in the study, interpreters available through NHS East Lancashire Community Services would be contacted and arrangements made to verbally translate the participant information sheets/consent forms, interview questions and responses.

4.3.4 Exclusion Criteria

Women with physical conditions unrelated to their weight that could affect their mobility or functional status, such as joint replacements, lower limb amputations, complications of DM, degenerative muscular or neurological conditions, were excluded from the study. Physical conditions related to weight that were included in the study were osteoarthritis, joint aches, lower back ache, and general body pain. The study did not include any participants who were unable to consent for themselves through physical or mental incapacity.

4.3.5 Research Governance and Ethics

Ethical approval was first sought and gained from Greater Manchester West NHS Research Ethics Committee (Appendix B1, p 258) and the University of Central Lancashire. NHS Trust Research and Development governance approval was obtained. The study was conducted in compliance with the Research Governance Framework for Health and Social Care and Good Clinical Practice (GCP). In addition, it complied with both the University's and relevant NHS Trusts' Health and Safety policies and practices, including a full risk assessment. The study was conducted in accordance with approvals from NHS East Lancashire and East Lancashire Hospitals NHS Healthcare Trust Research Governance. The researcher adhered to the University of Central Lancashire's code of conduct for research.

Subject to the requirements of the Data Protection Act 1998, and the Freedom of Information Act 2000, all information collected about a participant during an investigation is confidential unless otherwise agreed in advance. The researcher was a registered health professional and NHS worker and so worked under a professional code of conduct, and within the ethical framework set out by the Caldicott principles.

All participants were identified by health development practitioners and community dietitians' delivering NHS lifestyle services. These professionals had access to identifiable client information from their registers and databases, as per the workplace policies and procedures. The healthcare professionals had undergone prior training from the researcher about the proposed study. They were instructed on how to identify and approach the potential study participants, and taught how to explain the patient information sheets. They used BMI to help identify suitable participants; to maintain confidentiality and adhere to the data protection act, the BMI was not shared with members of the research team. The names and contact details of the willing participants were passed onto the researcher in person, who then made contact to explain more about the study. Only after approval to be interviewed, gaining written consent from the participants, did the researcher then measure participants' height and weight.

The individual participant details, that is, name, address, telephone number, age, were coded and kept as a hard copy along with the signed consent forms in a separate file, and in a locked drawer in an NHS office. These records were accessible only to the research team and the research and development departments.

The researcher was responsible for collecting, recording and the storage of the data. A clear audit trail was in place and a reflective diary kept throughout the study. Procedures were in place to ensure the integrity and confidentiality of data during collection, processing and storage. These included: the use of coding and storing all personal data separate to the interview transcripts, storing data on NHS secure personal drives or in locked office drawers, minimising the number of staff with access to identifiable data, anonymising interview recordings and removing all identifiable data prior to having them transcribed. Once the transcripts had been verified by the participants, all coded personal data was safely destroyed as was no longer needed. All primary data collected will be securely stored for at least five years as per the University of Central Lancashire's Code of Conduct for Research.

The participants were informed that they were able to withdraw from the study at any point before the transcribed interview had been checked by the participant and returned to the researcher. After this time, all personal details linked by code to the anonymous transcript would be destroyed, making it impossible to identify the participants' data, and thus unable to withdraw. This would not jeopardise their care/support from the health service.

There were no potential physical or medical risks to participants taking part in the study, nor any intentional distressing or intrusive questions asked. However, as FOF as a construct has previously been related to anxiety or depression, the participants were given written contact details in the information sheet of an NHS service manager who would act on and follow up any concerns the participants might have after the interview (Appendix B2, p 261). Each participant was informed that they may need to remain in the study for about 3 to 6 months, which included the time taken for the interview, a transcript to be written, the transcript to be posted to the participant to verify and any modifications returned to the researcher.

4.3.6 Selection and Recruitment

A purposive sampling strategy was used to recruit between 12 to 15 participants. This type of sampling strategy was used to ensure that the objectives of the study were met by selecting a group of individuals with similar characteristics and experiences, which would be representative of younger overweight women living in East Lancashire. It was also used because it was achievable within the allocated time and budget. The sample study was made up of overweight women who were identified by health development practitioners and community dietitians because of their attendance at the weight management services in East Lancashire. The sampling strategy used enabled suitable participants to be identified by staff using the specific inclusion and exclusion criteria. Each participant was given a patient information sheet by either a health development practitioner who delivered weight management group sessions or a community dietitian. A brief explanation about the study and a 7-day consideration period to take part in the study was given to the participants (Appendix B2, p 261). If they chose to take part, their name and contact details were passed to the researcher, who then contacted them to reaffirm details of the study and answer questions. A suitable interview time was then agreed where each participant signed a consent form prior to the interview. BMI measurements and a brief medical and weight history were taken. Recruitment continued until data saturation was reached.

4.3.7 Data Collection

All interviews were carried out in an NHS primary care centre and conducted in a private consulting room, affording confidentiality and privacy. To address the study aim, the interviews were semi-structured to enable an exploration of the activity restrictions the participants reported, which in turn helped to elicit information about balance, falling, fear of falling, and activity participation. The data was collected by digital audio recording. Additionally, field notes were taken to provide context and a reflective diary was kept. At the beginning of the interview process, the interviewees were asked to give a brief history about their weight gains and losses, a short medical history including the use of any assistive devices and information about their activity levels (Box 4.1).

Participant recordings were transcribed ad verbatim soon after the interview and the transcripts were sent to the participants for verification (Appendix B3, p 270). Data analysis took place concurrently during the study and the interview schedule was modified to highlight any new issues that were identified during the analysis. For instance, the original interview schedule did not ask specifically about balance or falling unless it was first raised by the participant, although a prompt question was included near the end of the schedule for the eventuality that falling was not raised by the participant (Box 4.1, question 8). One of the first two interviewees did not raise any issues about falling and as such the prompt question was used. On further discussion with the supervisory team, it was decided to include the prompt question as a more explicit question raising concerns about falling for the remainder of the study. Recruitment continued until no more original information was reported by the participants and data saturation was presumed.

Box 4.1: Semi-structured Interview Schedule

1. *Could you tell me a little bit about your daily routine, perhaps describe a typical day of what you do from waking up at the start of your day to going to bed at the end?*

2. *Since being overweight, have you changed the way you do activities? If so, in what way have you changed?*

3. *Are there any activities you currently don't do but would like to try? What is stopping you?*

4. *How do you feel your size and the physical restrictions you have mentioned today, affect your ability to be physically active?*

5. *Do you regularly partake in physical activity i.e. walking, home based activity or attending exercise classes or a gym? If so, what, for how long, and how much do you do each week?*

6. *What would you like to be available for someone else in your situation?*

7. *Whilst doing any of the activities you have mentioned, do you have any concerns? And if so, what are they?*

8. *Do you ever avoid an activity because you think you might fall or lose your balance?*

9. *Is there anything else you think I should know to understand your condition?*

4.3.8 Data Analysis

The data were analysed using a thematic network process as described by Attride-Sterling (2001), which is a method of deriving themes from textual data at different levels and illustrating it in an organised way. The themes were identified using a semantic or explicit approach, whereby the researcher was not looking beyond what was said by the participants but organised the data to show and summarise emerging patterns (Braun and Clarke 2006). Thematic analysis is a search for themes that emerge as being important to the description of the phenomenon (Fereday and Muir-Cochrane, 2006). The process involves the identification of themes through careful reading and re-reading of the text, this looks for patterns within the data, and identifies the emerging themes, which then become the categories for analysis. First, the text from each transcript was dissected into segments and highlighted using the MAXQDA software package (version 10 Schonfelder 2011) and labelled with a code depicting what each segment or phrase was describing. The codes relevant to the study objectives were then listed and the segments from the text of each code were re-read several times until common, prominent, underlying themes emerged, and then extracted to form the basic themes. The identified basic themes were then assembled together into larger categories or 'organising' themes, which subsequently were looked at together to determine a global theme.

4.3.9 Identifying Fear of falling

Although, there have been several attempts to define FOF, no consensus has been reached on a standardised definition. There are many definitions including, 'Post-fall syndrome' (Legters et al, 2002; Jung, 2008), 'a fearful anticipation of a fall' (Murphy and Issacs, 1982), 'a lasting concern about falling that can lead to an individual avoiding activities that he/she remains capable of performing' (Silverton and Tideiksaar, 1989), 'a lasting concern about falling that can lead to an individual avoiding activities that he/she remains capable of performing' (Tinetti et al,1993, p36), 'a person's loss of confidence in their ability to maintain balance' (Tinetti et al, 1988; Maki et al, 1991), 'a general concept that describes low-falls related efficacy and being afraid of falling' (Cummings et al 2000), and 'not afraid, but worried/concerned about falling' (Tennstedt et al, 1998). Other authors describe FOF as more of a symptom rather than a diagnosis and is characterised by high levels of anxiety related to walking or a fear of falling (Vellas et al, 1997; Arfken et al, 1994). Most definitions fall into two categories, one that focuses on the level of 'fear', 'worry' or 'concern' itself of falling and the other on the loss of confidence when doing certain activities caused by FOF (Jung, 2008). These differences often reflect the phrasing of different tools used to measure the different constructs of a FOF, though some authors have reported these terms being used interchangeably (Jorstad et al, 2005). In this study participants who reported concerns about falling using terms such as ‘frightened’, ‘fear’ or ‘worried’ about falling over were recorded as having possible FOF.

4.3.10 Reflexivity

Coming from a clinical and positivist background, this study was the researcher’s first experience of undertaking qualitative research. Hence, the researcher was new to the idea of defining and declaring her epistemological and ontological positions, such as pragmatism and looking for the best solution in a practical way, in relation to the research. The researcher had worked as a clinician in the NHS for over 20 years, and at least 10 of those years as a specialist dietitian working in weight management, thus bringing a significant amount of experience and ability to talk to overweight and obese clients to gain an understanding of ‘their world’ through the filters that had been developed from her own personal beliefs and background. Throughout the data collection and analysis, a reflective diary was kept to document, reflect, discuss what the interviewer was thinking, how they thought it was affecting the participants, the nature and quality of the data and how they would analyse and eventually present it. These reflections were discussed in supervisory team meetings, which enabled the academic, professional, and personal interpretations of the interviews to be shared.

4.4 Results

The interviews took place between July 2011 and February 2012. Seventeen potential participants were identified, two changed their minds, one cancelled due to personal reasons and one was not contactable, resulting in 13 being interviewed. The interviews took between 15 minutes 56 seconds and 100 minutes 45 seconds (median 32 minutes 5 seconds) to complete. One interview was later removed from the analysis as the participant did not fit the age criteria. However, the data was kept to compare with the findings. The women were aged between 22 and 49 years old (mean = 37 years of age SD=2.75) and their BMI varied from between 28.8 and 49 kg/m^2 (mean =39.5 kg/m^2 SD=1.81). One participant had a BMI below 30kg/m^2 because they had lost weight through bariatric surgery and was interviewed about the problems they had with activity restrictions, falling and concerns of falling when obese. Seven women had a chronic condition associated with obesity, two used assistive devices, six said they were moderately to highly active and six reported low or no activity. Over half had been overweight since childhood or adolescence (Table 4.1). No major changes to the interview transcripts were requested by the women following verification.

Table 4.1: Socio-demographic, Anthropometric and Clinical Characteristics of the Participants

Characteristics	Number
Age in years	
20-30	3
30-40	3
40-50	6
BMI Range	
28-34.9kg/m2	4
35-39.9kg/m2	4
40-50.0kg/m2	4
Ethnicity	
White Caucasian	9
South Asian	2
Black British	1
Weight History	
Since childhood/ teenager	7
Increase following fall/illness or event	2
Increase after marriage/pregnancy	3
Occupation	
College student	2
Housewife	8
Employed	2
Chronic conditions	
Type 2 Diabetes	1
Hypertension	1
COPD	1
Arthritis/ joint pains	4
Anxiety and/or depression	3
Assistive Devices	
Walks with stick	2
Self-reported Activity	
Sedentary	6
Moderately active	6

Common reasons for activity restrictions reported by the participants were: increased shortness of breath, poor strength in lower limbs, problems with lower back, poor mobility, being slower/taking longer to walk or perform other activities, increased exhaustion, difficulty walking up and down stairs, pains and aches in joints, increased difficulties when using certain exercise equipment, problems with balance and falls (Table 4.2).

The reported issues around activity restrictions, balance and falling reported by participants are shown in Table 4.2. The participants are listed in age groups and not in order of interview. To determine whether a FOF might be an issue in any of the participants for the purpose of this study, a FOF was acknowledged if a participant reported that they had a ‘concern’, ‘fear’, were ‘afraid’, ‘frightened’, ‘worried’ or felt ‘anxiety’ about falling over whilst active. Eight of the participants reported a FOF, whether this was to do with balance problems, previous falls, embarrassment or avoiding certain activities in order to prevent it (Table 4.3). Five reported previous falls and three had sustained knee injuries from falling. Nine participants reported avoiding certain activities to prevent falling, though one of these reported not having a FOF. Three of the four participants who reported that they did not have a FOF were relatively active and under 40 years of age. Conversely, most of those participants who were not very active expressed a FOF, particularly if they were over 40 years of age. One participant who did not report a FOF was over 40 years old and inactive. The older age group of participants (six) reported more activity restrictions than the younger groups, particularly around the issue of joint pains, though, with this said, three had sustained a knee injury from previously falling.

Table 4.2: Reported issues relating to Activity Restrictions and Falls in 12 Obese Women under 50 years of age

PARTICIPANT AGE RANGE	ACTIVITY RESTRICTIONS	PREVIOUSLY FALLEN	FALLS RELATED INJURY	BALANCE ISSUES	FEAR OF FALLING	ACTIVITY	BMI Kg/m²
20-30	Knee and back pain, short of breath, mobility, stair climbing, lifting, tired	Yes	No	None reported	Yes, avoided activities to prevent embarrassment and being unable to get up	Recently restarted walking/cycling	49
20-30	Aching legs, short of breath	No	No	Sometimes has to grab hold as feels like going to fall. Dizzy	No	Dances	48
20-30	Sore feet, knee/lower back, short of breath, stand from kneeling	Yes	No	Trips over feet/clumsy, shaky, cannot balance on 1 leg	No	Fitness games/walks	47.5
30-40	Slower, more effort involving lifting/carrying, tired	No	No	No problems as very active	No	Dances/Wii	34
30-40	Tired, short of breath, bending down, balance, harder doing tasks – improved since more active	No	No	None reported	Yes, when on treadmill so avoids	Fairly active	35
30-40	Slower, short of breath, weak ankle, poor balance	No	No	Falls over feet/clumsy but not fallen	Yes, avoids cycling/skating FOF increased with age	Walks dog – short distance, low activity	36.6
40-50	Joints ache, short of breath, difficulty on stairs, getting up from kneeling	Yes	Yes, knees	Ankles give way, cannot balance on 1 foot	Yes, when exercising so avoids fast activities	Recently restarted exercises in WMP	39.7
40-50	Foot and knee pain, short of breath, tired, increased falling, can't kneel, carrying bags and stairs	Yes, frequently falls	Yes, knee injury	Does not know why falls	Yes, fear of harm and embarrassment, avoids activities on cross-trainer	Walks dog	42.4
40-50	Knee and back pain, short of breath, can't do as much, mobility, stairs	No	No	Feels unsteady due to weight, reported feeling light headed	No, but avoids activities that would affect balance	Limited	34.6
40-50	Back ache, bending, difficulty on stairs, tired, reduced strength	No	No	None reported	Yes, in shower and slipping when walking, avoids many activities	Limited – not active	39.3
40-50 Post bariatric surgery	Aches and pains in knees, ankles, hips and back. Sit to stand, poor balance, walks slower	Yes	Yes, knee injury	Struggled with balance, used to get dizzy a lot when overweight	Yes, pre bariatric surgery - pain, confidence and embarrassment, avoided activities	Not prior to surgery	28.8
40-50	Joint pain, short of breath, dizzy, stairs, getting up from kneeling	No	No	When on small trampolines	Yes, avoids activities	Activity reduced	38.6

4.4.1 Thematic Analysis

The transcribed text was divided into segments and coded, then refined to form 11 basic emerging themes (Table 4.3). The basic themes described both physical (previous falls, injuries, and psychological), anxiety and depression issues reported by the participants, which related to their experiences or belief about their ability to be active whilst overweight (Appendix B5 & B6, p 275-281). The basic themes relating to balance and falls were then collected together and arranged into five groups which shared larger emerging themes about balance or falling when active. Subsequently, these defined the five organising themes, which are:

1) Poor perceived balance

2) Previous falls

3) Falls self-efficacy

4) The consequences of falling

5) Emotions

(Refer to the information presented in Figure 4.2 and Table 4.4)

The organising themes were then re-looked at with the context of the original text and from this a single global theme of FOF and the impact on activity participation was considered (Figure 4.1). A sample of transcripts were reviewed by a member of the research team with qualitative research expertise to check and verify the coding, in order to reduce researcher bias and help increase the credibility of the data.

Table 4.3: Emergence of Basic Themes about Balance or Falls whilst Active

CODES	BASIC THEME
Falls due to clumsy feet Trips over feet Clumsy	Clumsy/trip
Feel unsteady as weight distributed differently Felt unsteady on stairs Feel unsteady whilst active Poor balance Feel dizzy/light-headed	Feel unsteady
Often feel like going to fall Think will fall on exercise equipment Think will fall while active Concerns of falling when active Concerns of falling again during activity	Feel likely to fall whilst active
Previous fall Fall on stairs Fall more when overweight Concerns of falling again during activity Fall in front of others Fall when exercising Ankle/knee give way when active causing fall	Previous fall(s)
Concern of injury if fall Concern of pain if fall Injured when fallen Reduce or slow down activity as fear of injury/ pain	Falls related injury/pain
Concerned not able to get up from fall Couldn’t get up following a fall	Not able to get up following a fall
Avoid activity as reduced belief can do without falling Believe weight and age make falling more likely Believe will fall on exercise equipment Reduced confidence as injured knee	Reduced confidence in participation
Concern of looking foolish in front of others if fall over whilst active Embarrassment of falling over outside Embarrassment at falling worse than pain from injury Being stared at following a fall outside	Social embarrassment/look foolish when fall
Avoiding/avoided activities due to fear Avoided exercise equipment for fear of falling Low mood leads to activity avoidance Reduce or slow down activity as fear of injury/pain	Reduced/avoidance of activities
Anxiety/panic about slipping/falling when active Anxiety depression increase risk of falling	Emotions increase risk of falling
Low mood leads to activity avoidance	Emotions lead to activity avoidance

Table 4.4: Themes Relating to Fear of Falling and Impact on Activity Participation

BASIC THEME	ORGANISING THEME
Clumsy/trip Feel unsteady	Poor Perceived Balance
Feel likely to fall whilst active Previous fall(s) Reduced confidence in participation	Falls self-efficacy
Previous fall (s) Falls-related injury/pain	Previous Fall(s)
Not able to get up Social embarrassment/look foolish/feel judged Reduced/avoidance of activities Falls-related injury/pain	Consequences of Falling
Emotions increase risk of falling Emotions lead to activity avoidance	Emotions

4.4.2 Organising Themes

1) Poor Perceived Balance

Eight of the participants raised concerns about feeling unsteady or dizzy when active or expressed a worry about losing their balance, or being clumsy. Feeling dizzy was recorded when the participant specifically expressed feeling dizzy, light-headed or having vertigo. Feeling unsteady was recorded when this term or 'wobbly', shaky' or 'unstable' were used by the participant. Although, most linked these with concerns when they felt that they were likely to fall, this relationship was not observed in all participants. These concerns appeared to be reported more by older participants (40 to 50 years of age) than by younger participants, regardless of their BMI. Participants reported that these concerns had an impact on undertaking of activities.

"You do sometimes have to grab hold of something because you feel like you are going to fall over, but I have never actually fallen over." Participant 2

"I am so clumsy. I just walk into things and am always falling over." Participant 6

"I knew I couldn't do it because you have to be able to balance to do things like that, I didn't really have any proper balance at the time [when bigger], I felt a bit like a Weeble very wobbly…." Participant 7

"I am quite fearful of riding bikes. I think I would struggle to keep balance on a bike." Participant 8

"Well, if your balance has gone out of the window or you are frightened of falling over, I think sometimes it is just the fear of falling will knock your balance off, sometimes thinking something is going to happen, you try, overcorrection sometimes will throw you off balance sometimes if you have to think about these things it just stops you doing them basically." Participant 7

2) Falls Self-Efficacy

Falls self-efficacy has been defined as 'perceived self-confidence at avoiding falls during essential, relatively non-hazardous activities' (Tinetti & Powell, 1993:36). A number of participants described a reduction in confidence or belief in their ability to perform activities without losing balance or falling. This reduced falls self-efficacy was often linked to a previous fall (or falls) or related injury and led to avoidance of activities in order to prevent falling.

"I am always a bit scared I am going to fall; I have been falling quite a while… it's (when I have) been doing some exercise or walking, I will probably fall on (the) road or something." Participant 9

"... of course it [walking machine] has a safety strap and I thought 'I don't need a safety strap just walk' and of course I took a tumble from it but now I can't. The fear now is that I am going to fall…." Participant 10

"I am quite fearful of riding bikes …. I think I would struggle to keep balance on a bike, I don't know if I would or not because I have not tried but I am fearful of the roads as well and I think I would fall off… ." Participant 8

3) Previous falls

Five out of the 12 participants reported having fallen previously. Participants related falling over with being overweight. Four of these five participants reported an ongoing impact on future activities because of concerns about falling (consequences of falling). These participants felt that they were more likely to fall again, which resulted in them being less confident about their ability to undertake activities because they felt they could not stop themselves falling (falls self-efficacy). They were also concerned that falling would lead to injury or pain (consequences of falling). These concerns were greater in older, less active participants.

"I have always been big and always fallen over." Participant 6

"But suddenly if I am walking or playing my ankle just gives way, so I have been falling quite a while." Participant 9

"You slip and fall a lot more and you are frightened of slipping and falling a lot more [...] you purposely slow everything down so you know exactly what is happening, you are thinking, 'right I have got to stand up straight, I have got to do this, I have got to do that,' whereas normally you would just get on and do it but the amount of effort you have to put into planning when you are overweight… ." Participant 7

Three of the five previous fallers had sustained an injury from falling and this in all cases led to a fear of falling again. Their main concern was that the injury had left them vulnerable to falling again during activity. All those injured were over 40 years of age.

"I went (down) on my knee. I smashed my knee to bits." Participant 7

"I am always a bit scared I am going to fall; I have been falling quite a while it's has been doing some exercise or walking, I will probably fall on (the) road or something." Participant 9

So during exercise or when you are out and about you might fall? (Interviewer)

"Yes, I have hurt my knees a couple of times." Participant 9

4) Consequences of Falling

Many participants highlighted the potential consequences of falling whether they had actually experienced these outcomes or whether they were concerned that they might occur on activity. These consequences included: not being able to get up, social embarrassment, risk of injury or pain, reduced confidence in further participation and avoidance of further activities.

As expected, some participants were concerned about fall-related injury or pain either because of their own experiences, as described above, or because they perceived that they would be injured or in pain if they fell.

"… Yes, the effort, how much you are going to hurt after it, if you fall over or something like that, how you are going to hurt more than you would normally, things like that." Participant 7

"Well, it's [fear of falling] a lot of things… about getting up because I couldn't get up, … the other thing you hear about so many people who have a simple fall and they break a hip or they break their wrist and I think I will be even worse off if that happens so I won't do them." Participant 10

Another major concern about the consequence of falling to emerge from the data was that the participants felt foolish or would feel embarrassed, particularly if they fell in front of other people and some had concerns that they would not be able to get up. These concerns did not differ across age groups.

"We were in where the shops are and it is carpeted, it is not a slippery floor […] one leg went one way and one leg went the other and everyone was looking at me… ." Participant 10

"It's making yourself look like an idiot if you fall over […] it took about four people to help me up. I kept saying 'no leave me alone, leave me and I will get up in my own time'. I couldn't actually get up by myself at all. *I don't know why I was even saying it. I couldn't feel a thing at the time; I couldn't feel a thing except embarrassment."* Participant 7

Some participants reported how their concerns about the consequences of falling had led to a reduction in confidence to partake in activities or an avoidance of exercise or leisure-time activities. Their comments reflected a fear, an inability, an inadequacy and a fear of looking like a 'fool' or 'idiot'.

"… of course it [walking machine] has a safety strap and I thought 'I don't need a safety strap just walk' and of course I took a tumble from it but now I can't. The fear now is that I am going to fall… ." Participant 10

"Quite a while ago…. I was asked if I wanted to come here to do chair exercises and even chair exercises, I can't do that with my knees." Participant 7

"I did avoid the Zumba … because I thought I can't do them. I've got 2 left feet and I'm going to look like a right numpty [colloquial for 'idiot' or 'fool'] *and I'm going to fall on my face."* Participant 1

"I avoid stuff like ice-skating; I wouldn't put myself forward for stuff like that because I think I would be a bit…. But I think that is my age as well because you get a bit more fearful." Participant 8

5) Emotions

A number of the participants reported having anxiety and/or depression (Table 4.1) or feeling 'down' or 'panicky'. In some participants, anxiety and depression was felt to be a possible contributor to their falls or concerns about falling.

"I have had a few dizzy spells when I have been doing my exercise classes so I have had to sit out. I think, 'oh god I'm going to pass out', but I mean with my anxiety and depression I have passed out at home before then and fell down the stairs…." Participant 1

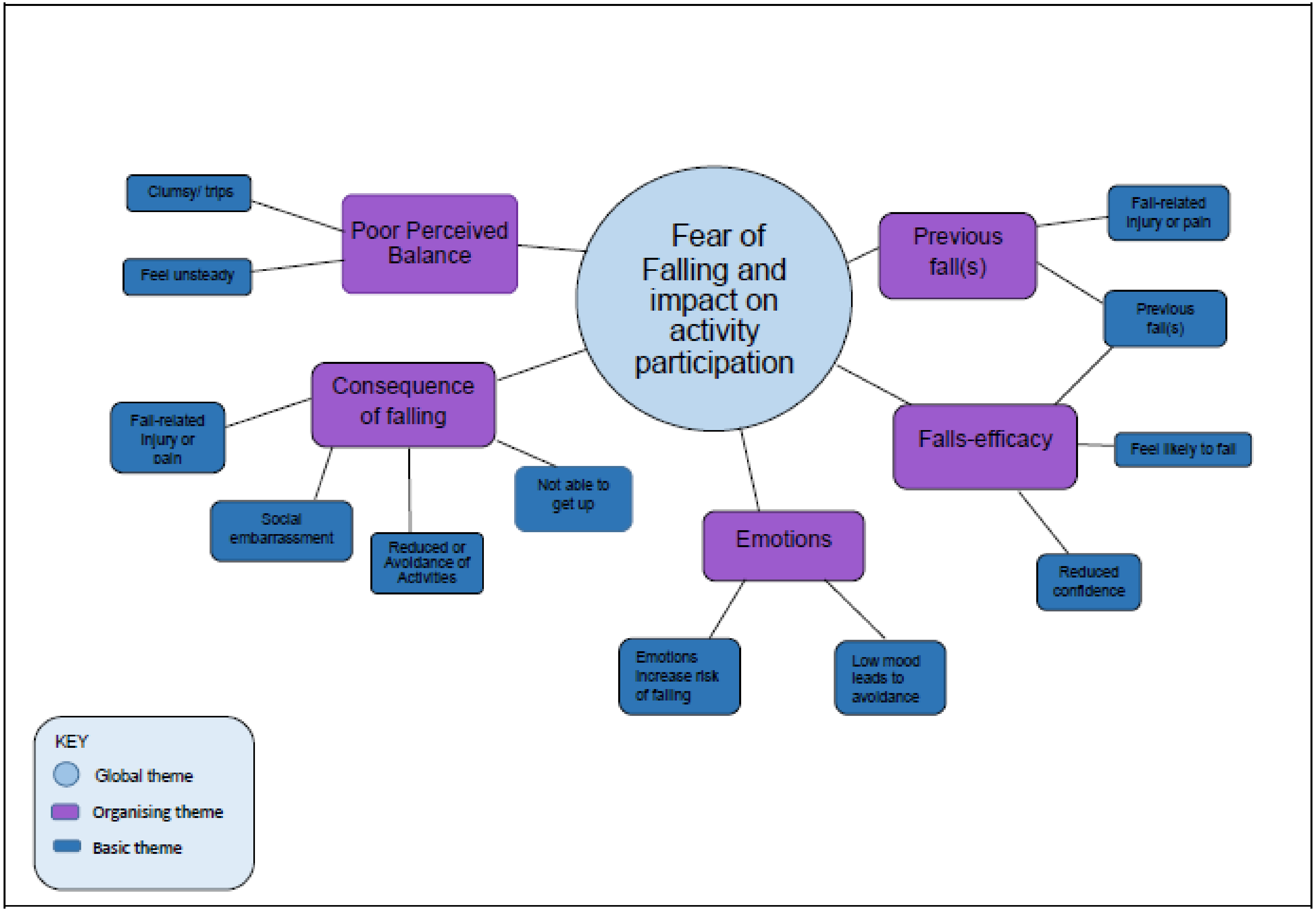
Others reported anxiety directly related to a concern about falling: **Is there anything you fear might happen when you are moving? (Interviewer)**

"... slipping. I nearly slipped, luckily I had my stick. I panicked. That was just walking. It felt like slipping on ice but it wasn't ice, it was a nice day. It (leg) just went a bit weak, but that panicked me." Participant 12

Though not directly related to falls, a few participants reported that their depression or low mood could sometimes lead to reduced activity participation or activity avoidance. This is worth noting as a possible contributory factor to FOF in young obese populations, as anxiety and depression is found in literature on FOF in elderly populations and known to often be associated with exhaustion, which in turn could affect an individual's perception of their ability to be active (Kressig et al, 2001; Legters 2002; Jung, 2008).

"*…not so much physical, I think it is more mental with people that suffer from depression and anxiety, you don't always feel like getting up and doing things. Sometimes you feel like you don't want to get out of bed some days and you think I am not getting up today, what's the point? It's going to be the same day as yesterday, there is nothing ever new, you know and you do go on a downward spiral…… ."* Participant 2

Figure 4.1: Thematic Map of Fear of Falling in Obesity



4.5 Discussion

All 12 participants reported some of the physical difficulties obese women experience during activities. The effect of these physical or activity restrictions of obesity on the participant's ability to be active highlight already researched factors such as difficulties performing, reduced confidence, embarrassment and reduced participation (Sternfeld et al, 2001; Hills et al, 2002; Larrson and Mattson, 2001). The reported activity restrictions again reinforced the findings of previous studies, although the majority of these had been in older obese groups (Hills et al, 2002; Wearing et al, 2006; Bish et al, 2007).

Exploration of some of the balance and falls issues reported by participants, whereby they described 'being concerned', 'scared', 'frightened', 'worried' or 'fearful' about falling whilst active, could be interpreted as FOF. The majority of participants reported having FOF giving various reasons for this such as poor balance, previous falls or falls related injuries, social embarrassment, reduced confidence in their ability to be active without falling, fear of pain, anxiety or depression. As a result of FOF some participants reported that it led to reduced participation or activity avoidance. Fear about falling were more likely in those participants over 40 years of age and those less active, but was not found to be linked to increasing BMI (between 30-50kg/m^2). This study, as far as the researcher knows, is the first to report specifically that some younger obese women have problems relating to balance, falls and a fear of falling whilst undergoing activity.

Poor balance was reported subjectively by participants and was not a true measure of their actual balance ability. However, 'perceived' balance has been previously shown to be associated with objective measures of 'actual' balance, suggesting that some individual's ability to accurately rate their own falls risk is good (Maki et al, 1991; Delbaere et al, 2010). A number of studies have reported differences between patient's perceived balance and actual balance performances and possible explanations for these (Myers et al, 1996; Andersson et al, 2009; Delbaere et al, 2010). Bandura's efficacy framework suggests that perceived capability is more predictive of behaviour, that is, the activities an individual is likely to engage in, rather than actual physical ability (Bandura, 1982; Myers et al, 1996). However, actual performance achievements do strongly influence efficacy expectations and thus if an individual successfully maintains balance during a specific activity, this will raise their expectations and self-efficacy, though conversely the opposite is also true, where lowered self-efficacy or expectations occur as a result of an individual repeatedly failing at an activity or losing their balance (Bandura, 1982). Some authors report past experience is not the only factor influencing an individual's self-efficacy or perceived balance, and it is widely known there are previous fallers who do not report FOF and likewise non-fallers who do report FOF (Wilson et al, 2005; Jung, 2008; Harding and Gardner, 2009). Other circumstances involving a fall might be more important than the fall itself. For instance, whether an individual could get up, the need for assistance, the use of a walking aid or the social embarrassment that is anticipated following a fall could all influence an individual's perception of their ability to maintain balance (Tinetti et al, 1990).

Fear of falling has been explored as a possible exaggerated or 'irrational' fear leading to unnecessary avoidance of activities, physical deconditioning and subsequent poor health and quality-of-life (Bhala et al, 1982; Cumming, 2000; Yardley and Smith, 2002; Li et al, 2003). Findings of a prospective study of 500 community dwelling adults, aged between 70 to 90 years old, in whom both the physiological and perceived falls risk were measured, showed that perceived and physiological falls risk are both independent predictors of future falls (Delbaere et al, 2010). The participants were divided into 4 subgroups based on their psychological profiles (vigorous, anxious, stoic, and aware). Although the majority of participants in the 'vigorous' and 'aware' subgroups had similar perceived and physiological falls risks, almost a third either over or underestimated their risk of falling. Those participants in the 'anxious' group had a low physiological risk of falling but a high perceived falls risk influenced by psychological factors, such as depression, anxiety, and higher levels of self-rated disability. The 'stoic' group rated their perceived falls risk lower than objective measures, though their higher activity levels and lower perception of falls risk acted to protect them from future falls as they fell less than the 'aware' group. This study highlighted the disparities between perceived and actual falls risk being mainly due to psychological factors, and suggests the need for the inclusion of both subjective and objective measures when assessing falls risk or balance.

The few older (40 to 50 years of age) inactive participants reported more restrictions and balance or falls issues than the younger, more active and sometimes heavier participants, suggesting current activity status may play a pivotal role. This reinforces what is in the literature as balance problems are reported less in individuals who are more active (Brach et al, 2004; Maffililetti et al, 2005) or who have undergone strength training (Matrangola and Madigan, 2009). Therefore, in these cases, a FOF may be independently associated with low levels of physical activity (Bruce et al, 2002). The data also suggest that falling and balance issues may increase in frequency with age, as does FOF, even in this younger group. The literature shows a positive correlation between BMI and increased postural instability (Greve et al, 2007), and that balance issues are common in obese adults, particularly if they are older and female (Larsson and Mattsson, 2001a; Manckoundia et al, 2007). However, the study showed that falling and balance did not appear to be related to increasing BMI, though this could be due to all the participants already having a BMI above 30 kg/m^2 and the possible confounding effect of activity, as many of the participants were already engaged in regular activity, which might prevent or reduce FOF.

There is limited research looking into understanding the barriers to physical activity women might have, and how these might change across a woman's lifespan (King et al, 2000). Ansari and Lovell (2009) undertook a survey of 100 underactive women, 25 to 35 years of age, in a shopping centre to find out the barriers to being active. The sample was split into two groups of younger (20 to 27 years of age) and older (28 to 35 years of age) women. The results showed that the older group had more perceived barriers to activity than the younger group, though the biggest barrier for both groups appeared to be parenthood, which was not influenced by age, but by other factors including the number of children they had, free time available, disposable income, and family commitments. Interestingly, these results reflected what was reported in this qualitative study as a few of the participants under 30 years of age talked about barriers to activity around having children, cost of activities, and time. Furthermore, the participants over 40 years of age spoke more about their inability to do activities that they used to do because they had gained weight. A number of the participants said this despite not actually having tried to do the activities, suggesting age might affect their perception of being able to be active. A recent article comparing the perceived benefits and barriers to exercise in groups of obese and non-obese women aged over 50 years of age (Leone and Ward, 2013), revealed that the most common theme within the barriers constructs in the obese group was weight related barriers, both physical (e.g. shortness of breath, physical discomfort) and emotional (e.g. discomfort with appearance or how others perceived them whilst exercising), which closely reflected the findings of our study. Overall, the obese group was less likely to report enjoying exercise than the non-obese group and found their weight made exercise difficult.

Obesity alone is a barrier to physical activity as it presents several unique challenges to the obese individual, both physically and psychologically (Atlantis et al, 2008). Although the main objectives of the study were to explore the physical restrictions of obesity, and the impact they might have on the participant's ability to be physically active; the majority of the participants chose also to disclose their experiences/feelings of being obese, specifically about feeling embarrassed and being watched during activity. The analysis shows that the social embarrassment some participants reported, if or when they fell over, and how this added to their fear or concerns of falling, affected their participation in activity. However, the majority of participants also conveyed that they experienced embarrassment whilst participating in activity infront of others, even without falling, which might also affect their activity participation. In a population based study of 2,298 Australian adults, the most common barriers to activity reported by overweight individuals were, being too fat, shy or embarrassed, lazy, or not motivated (Ball et al, 2000). Interestingly, a number of participants in this qualitative study, particularly the women under 40, used terms such as 'too lazy' or 'can't be bothered' to describe reasons why they were not active.

Another cross-sectional self-report study in 280 inactive women concluded common barriers to activity were feeling too overweight, self-conscious, minor aches and pains and a lack of self-discipline (Napolitano et al, 2011). Body image dissatisfaction was a main reason for not engaging in physical activity, as reported by groups of obese adults interviewed by Dalle Grave et al (2010). The body image dissatisfaction included feeling ashamed, observed, judged, and mocked due to their weight. Similarly, some participants in the qualitative study reported feeling watched, judged or embarrassed when active and were consequently concerned that they would look foolish. Ironically, the most physically appropriate activities often recommended for obese individuals include swimming and walking, which may only exacerbate any embarrassment the obese individuals already experience whilst exercising, especially whilst alone (Thomas et al, 2008; Biddle et al, 2008).

Current research suggests that older individuals who are regularly active, irrespective of their BMI, are less likely to have physical restrictions and balance or falls issues than those who are inactive (Lang et al, 2007). The results of the study suggest this might also be the case in younger obese women though other factors such as age might also play a part. Some of the participants in the older age range (40 to 50 years of age) who had fallen had a fear of falling or previous injury consequently felt that these had contributed to their weight gain and their subsequent physical restrictions and inactivity. Previous research had ascertained a relationship between age and FOF in elderly groups (Jung, 2008).

Overall, the majority of participants reported some kind of fear of falling, whether to avoid injury, embarrassment, or due to a lack of confidence to remain upright whilst active, which suggest that this might be an issue in younger obese women. These findings indicate that the relationship between activity, fear of falling s and age in obese adults warrants further investigation.

4.6 Development of a proposed Conceptual Framework

The findings from the thematic analysis and demographic information of participants, e.g., activity status, age, previous injury, mental health from the qualitative study, together with results of the literature review (Chapter 2) were used to develop a conceptual framework of FOF in young obese women (under 50 years old).

Jabareen (2009) defined a conceptual framework as a network of interlinked concepts that together provide a comprehensive understanding of a phenomenon or phenomena. Similarly, Miles and Huberman (1994) defined it as a visual or written product, one that 'explains, either graphically or in narrative form, the main things to be studied-the key factors, concepts, or variables-and the presumed relationships among them' (Miles and Huberman, 1994 p18). A conceptual framework is a model of a tentative theory of a phenomenon to be investigated. It includes what is already known about the area of interest and a proposal of what is going on and why (understanding) rather than a theoretical explanation (Jabareen, 2009). The function of a conceptual framework to is to help inform the design of future research by identifying research variables and clarifying the relationship between these variables (McGaghie et al, 2001).

Fear of falling is a complex phenomenon mainly reported in the elderly. It lacks a universal definition, resulting in a number of different constructs developed from studies in the elderly, notably, falls-self efficacy, balance confidence, feared consequences of falling on activity participation, and activity avoidance (Jorstad et al, 2005; Jung, 2008). A previous review of the literature found there to be limited knowledge of a FOF in younger obese women, though evidence from studies in the elderly suggested an association between obesity and FOF. The proposed conceptual framework included key themes identified from the previous qualitative study analysis and observations made of the study participants. The key organising themes included well known features of FOF such as poor perceived balance, previous falls, falls self-efficacy, consequences of falling such as reduced or avoidance of activity, social embarrassment and emotions such as anxiety, and depression. These factors are also known to be common in obese individuals and were highlighted in the previous literature review as possible reasons for reduced activity participation (Fjeldstad et al, 2008; Greve et al, 2007; Janny and Jakicic, 2010; Thomas et al, 2008; Puhl and Heuer, 2009).

Narrative data from the semi-structured interviews suggested relationships between increasing age, activity status and a FOF. These associations cannot be measured in qualitative studies. However, similar associations were found in the literature review from cross-sectional studies in the elderly (Suzuki et al, 2002; Bruce et al, 2002; Zijlstra et al, 2007a), which supported their inclusion in the framework.

The consequences of a FOF which leads to reduced activity and subsequent poor physical and psychological health are widely reported in the elderly (Legters et al, 2002; Scheffer et al, 2008). Anxiety and depression were included in the framework as they have been associated with FOF in the elderly and obese individuals who do not engage in lifestyle changes, particularly women (Hassan et al, 2003; Doll et al, 2000; Zhao et al, 2009). Obesity is widely known to be associated with poor mental health, specifically anxiety and depression (Jorm et al, 2002). Reasons for this include, associations of obesity with physical health problems, lower levels of activity and stigmatisation, that are known to increase levels of depression (Carnacho et al, 1991). In a large US state telephone survey, Strine et al (2007) found that adults with a diagnosis of depression or anxiety were significantly more likely than those without, to be physically inactive or obese. Obesity has been associated with an increased risk of depression, panic disorder or agoraphobia, particularly among women (Zhao et al, 2009; Jorm et al, 2003; Anderson et al, 2006). Jorm et al (2003) suggested that obesity is not always directly associated with anxiety and depression and that if other risk factors such as physical health are controlled the association disappears. This indicates that it is the physical health of obese individuals which affects mental health, and obesity is only a mediating factor (Jorm et al, 2003).

Recent research has found that there are a number of relationships between fear of falling, anxiety, depression and activity restriction in a group of community dwelling adults over 55 years old (Painter et al, 2012), one of which is that anxiety and depression predict activity restriction in the presence of a FOF. Some of the study participants in the exploratory study reported either having a clinical diagnosis of depression or feeling depressed, and some additionally reported having anxiety, particularly around feeling self-conscious when active, though this was not a specific question asked.

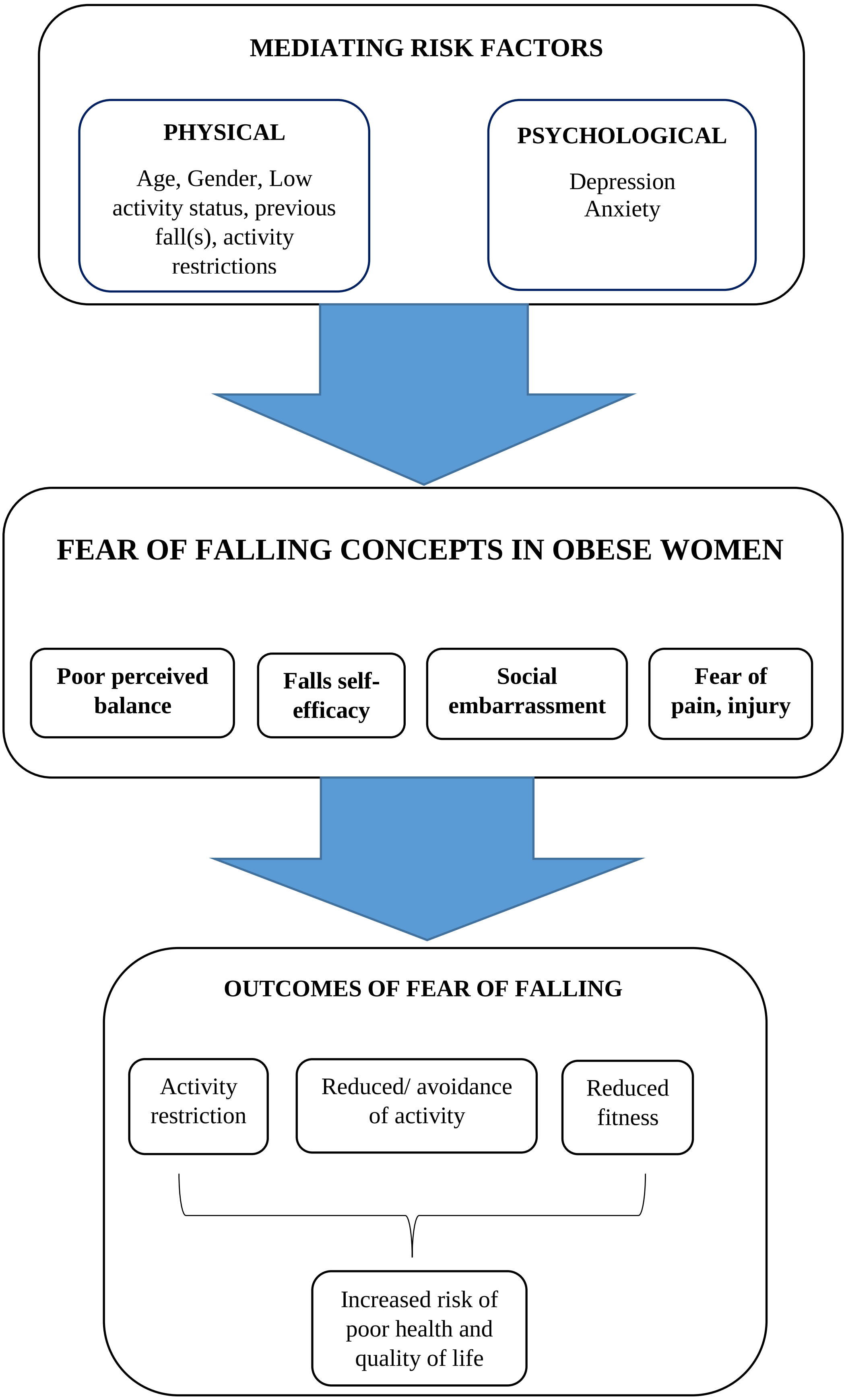
The framework was an arrangement of the key concepts of a FOF in obese women, including both physical and psychological factors that were proposed to influence FOF and the outcomes and consequences of this phenomenon (Figure 4.2). Activity restrictions have been found to be associated with FOF in many studies in the elderly (Lachman et al, 1998; Bruce et al, 2002; Legters, 2002). However, most were cross-sectional and so the direction of cause could not always be established (Kempden et al, 2009). Prospective studies by Deshpande et al (2009) and Andresen et al (2006) found a FOF to both be a cause of, and a result of activity restrictions. Thus activity restrictions were included in the proposed framework and both as a potential contributory factors or outcomes of a FOF in young obese women.

The proposed conceptual framework showed the relationship between a FOF, activity participation and obesity, including 4 key concepts of FOF, contributory factors and potential outcomes. The 4 organising themes from the qualitative study findings formed the key concepts of a FOF to be, poor perceived balance, falls self-efficacy, the two perceived consequences of falling, fear of pain/injury and social embarrassment.

Mediating factors from the qualitative study findings that could affect FOF in obese populations included age, activity restrictions, low activity status, previous falls, anxiety and depression. These factors along with gender and BMI are also known to influence FOF in elderly populations (Legters, 2002; Bruce et al, 2002; Zijlstra et al,2007b; Austin et al, 2007).

The outcomes of FOF reported by some young obese female participants included activity reduction or avoidance. Again these factors are known to be consequences of FOF in elderly populations, in addition to reduced fitness and activity restrictions (Scheffer et al, 2008; Kempen et al, 2009; Deshpande et al, 2008b). However, in the long-term, untreated FOF is known to lead to both poor physical and psychological health, social isolation, withdrawal and subsequently a poor quality-of-life in elderly individuals (Arfken et al, 1994; Lachman et al, 1998; Cummings et al, 2000; Suzuki et al, 2002; Legters, 2008; Jung et al, 2009). There are many similarities between inactive elderly individuals with activity restrictions and a FOF and some of the younger inactive obese participants who also reported activity restrictions and a FOF. Therefore, it seems feasible to suggest that the long-term outcomes of FOF, if left untreated in this younger, obese cohort might be similar.

Figure 4.2: Conceptual framework of Fear of Falling and its relationship with activity restriction and participation in obese women



4.7 Study Limitations

Qualitative research has a number of limitations that were reflected in this study. Participant numbers were small as data collection, analysis and interpretation unavoidably take a long time. The results can be influenced by the researcher's personal bias and idiosyncrasies, and cannot be generalised to other populations or settings.

Conducting semi-structured interviews requires careful planning as although the interviews follow a general framework, the direction of the interview cannot always be predicted as it allows for flexibility and exploration of any useful information as it emerges. The researcher had experience interviewing participants in a clinical setting to elicit dietary habits and negotiate goal setting, however this only helped to build up rapport and making the participants feel at ease. The researcher was aware of the issues of interviewer bias whilst conducting the interviews (Lees, 2011), recording and analysing the data, however the researcher found the first few interviews difficult as asking direct questions about falling or FOF was not thought appropriate as it was a leading question and might introduce bias. This made it harder to elicit useful information about falling, balance or FOF and it also became apparent that the participants were attending lifestyle interventions and already fairly active.

The researcher kept a reflective diary and interview notes throughout the data collection and reported the findings to the supervisory team. At this point the interview questions were amended to ask the participants explicitly about concerns of falling which helped elicit more relevant information and help keep participants on topic. Analysing the data using a thematic analysis was also challenging as the researcher came from a positivist background and found it difficult to interpret the findings based on their own judgement. Semi-structured interviews, data analysis and interpretation were conducted by one researcher which could lead to observational bias. However, a member of the supervisory team with experience of qualitative methods, reviewed a number of the transcripts and checked the coding of the text and emerging themes. The data analysis was subsequently discussed in supervisory team meetings to help reduce bias and improve credibility.

The original interview schedule did not include a direct question about FOF unless the participant did not raise the issue of FOF without prompting, as it was thought to be too leading. However, after the first two interviews, whereby neither participant raised the issue of FOF (therefore the interviewer had to use the FOF prompt question "Do you ever avoid any activities because you think you might fall?”), the interview schedule was amended to include the same question about FOF for the remainder of the study. This did not affect the quality or consistency of the interviews.

Participants were identified by health development practitioners delivering weight management group sessions and community dietitians delivering one-to-one weight management sessions. A representative sample of the local female population was required to preferably include a range of ages (18 to 49 years), BMI, ethnic groups, and activity levels as these were factors that could affect activity restrictions and balance and so inclusion of these were preferable to begin to explore possible associations. A purposive sampling strategy was used which is a non-random method and relies on the judgement of the researcher to select a sample of participants who have similar characteristics that are of interest. This type of sampling is recommended for use in qualitative research as it enables a wide range of sampling techniques to be used, and provides justification to make generalisations of the population being studied, even though these are theoretical, analytical or logical in nature. The disadvantage of this sampling method is that it is prone to researcher bias and is subjective in nature, so it can be difficult to convince others of the sample selected.

After the first few participants were interviewed it became apparent that they were all attending the weight management group sessions run by health development practitioners, which included regular physical activity sessions, and all the participants thus far reported being regularly active. This was not representative of the local overweight population as not all overweight patients are regularly active and if participants continued to be selected from these groups, it could inadvertently have affected the results. This was not to say similar participants were stopped from partaking in the study, but the recruiting practitioners were then asked to identify some less active or inactive participants accessing local services regardless of any other factors including age. All the weight management services included women of all ages. Participants identified from community dietitians tended to be less active and so together with the participants accessing the weight management groups, a more representative sample of clients attending local weight management services were obtained. The study sample included a proportionately higher number of women aged between 40 to 50 years old. Local synthetic estimates suggest that prevalence of obesity in East Lancashire is similar to the national average figure of ~24.8% (Public Health England 2011). However, the exact prevalence according to sex or age range is not known. National data of obesity reports an increase of obesity with age in women: 12.8% in 16 to 24 year olds, 19.9% in 25 to 34 year olds, 25.2% in 35-44 year olds, and 28.9% in 45 to 54 year olds (Health Survey of England 2011-13). Higher prevalence of obesity in women aged 40 to 50 years helps justify the higher proportion of this age group in the study population. However, other reasons not explored such as employment commitments, time available, motivation, family commitments, or other barriers might also explain the disproportion between age groups. More participants from the older age group might have been more willing to take part if they had more time available due to being less likely to have young families or work commitments. Bias might have inadvertently been created if participants in the older age group were more willing to take part as they perhaps had more interest, time or experience of the research topic, or less work or family commitments than some of the younger participants.

The older (>30 years of age) and less active participants reported more balance and fall issues and FOF than the younger, more active, and often heavier participants, suggesting age and activity play a part. The basic analysis did not explore in-depth why this might be, and whether the length of time an individual has been overweight, or physical changes to do with weight could have contributed. The finding that was least expected was that increasing BMI did not appear to affect balance and falls in this group of (obese) women, but whether this was related to the individual's current activity level was not explored. Also, as these women were already classified as being obese (BMI>30 kg/m²) maybe the range of BMIs (34-50 kg /m²) was not wide enough to show a change in balance and falls issues.

Another limitation of the study was that the participants were only asked about their current activity levels in a general way and so the results were not quantified using a specific measurement tool to determine those who were for example, 'inactive', 'low activity', 'moderately active' etc. As it became apparent current activity levels might influence balance/fear of falling, using a tool to compare different levels of activity with balance/fear of falling would have helped to establish a stronger link, though it was still a small sample of participants.

4.8 Chapter summary

This study achieved its original objectives of exploring the activity restrictions experienced by younger obese women and established that there were reported balance/falls issues in some of them. Although, there were no apparent differences between the BMI ranges, there were differences seen across the age groups and particularly in those who were not regularly active. The majority of participants reported concerns about falling related to a number of factors including, previous falls, pain or injury, low falls self-efficacy, age, poor balance and low activity, which suggests that there might be an issue in obese women under 50. There was some suggestion that FOF leads to activity avoidance, particularly in relation to embarrassment, feeling foolish, and reduced falls self-efficacy in this cohort of women.

A conceptual framework of Fear of Falling in young obese women and its relationship to activity participation was developed using the results of the study together with findings in the literature review. These developments warrant further investigation using a quantitative study to explore the levels of FOF in young obese women and the relationship between FOF and activity participation. Fear of falling measures are needed to be able to conduct the next study. However, it was not clear from the literature whether there were validated assessment tools to measure balance and fear of falling in the younger obese population.

CHAPTER 5: A REVIEW OF TOOLS TO MEASURE BALANCE OR FEAR OF FALLING SUITABLE TO USE IN YOUNGER OBESE ADULTS

5.1 Introduction

Findings of the previous qualitative exploratory study suggested FOF might be an issue in younger obese women and identified key components that might contribute. These results enabled the development of a conceptual framework and highlighted key factors that might affect FOF such as age, previous fall, and activity level. Further exploration involving a larger, quantitative study of FOF and these key factors is necessary to provide further evidence of FOF in his group and explore the relationship between FOF and activity participation. Appropriate FOF measurement tools are needed for a quantitative study. As the majority of literature is in elderly populations, it is not known whether the tools used to measure FOF were designed for or have been validated in obese or younger adults. Therefore, it is recommended that a review of FOF measures be undertaken to elucidate whether any are suitable for use in the study population, in order to help inform a future quantitative study. This chapter will identify self-reported FOF tools available for use in community based populations and examine their validity. Those tools considered most appropriate for use in the next study will be selected and justification for this choice given.

5.2 Background

'Fear of falling' is a commonly investigated fall-related psychological construct but as previously reported is a complex, not easily defined condition which has resulted in the development of a range of psychometric tools measuring different constructs associated with this phenomenon (Kendrick et al, 2012). Psychometrics involves the theory and measurement of observed psychological phenomena and unobserved concepts such as fear, anxiety, depression, knowledge, abilities, attitudes and beliefs of individuals using a variety of different instruments and procedures (Brewerton and Milward, 2001; chapter 6, p87).

Early FOF studies used single item questions with a dichotomous response, asking individuals whether or not they were afraid of falling (Tinetti et al, 1990) or asking them to 'rate' their FOF on a continuum or visual analogue scale. A visual analogue scale

(VAS) consists of a line, where the ends of the line represent the extreme limits of subjective phenomena (Wewers et al, 1990). The VAS is useful for measuring a variety of subjective phenomena and provides a convenient, easy, and rapidly administered measurement strategy (Scheffer, 2011). The main disadvantages of using these simple single-item tools is that they cannot discriminate between different levels of fear and do not assess concerns about different activities (Legters, 2002; Tinetti et al, 1990). Furthermore, they cannot differentiate what aspects of falling are feared, and are unable to distinguish between perceived risks of falling and the feared consequences of falling (Howland et al, 1993; Lachman et al, 1998; Yardley et al, 2005; Moore and Ellis, 2012).

In light of its increasing complexity, more recently developed multi-item measures of FOF are used to assess the level of fear or concern an individual has about falling. Unlike the single item measures, the multi-item tools can differentiate between varying levels of fear across a number of different situations (Howland et al, 1993). These FOF tools can be broadly divided into those measuring five related but separate falls–related psychological constructs: ‘Fear of falling’ (the degree or level of fear or concern a person has about falling); ‘Falls self-efficacy’ or ‘falls-efficacy’ (a person belief in their ability to avoid falling during activity); ‘balance confidence’ (the ability of an individual to engage in everyday functional tasks without losing their balance), and more recently the ‘feared consequences of falling’ on participation and ‘avoidance behaviour’ or ‘activity avoidance’ (Jorstad et al, 2005; Legters, 2002; Landers et al, 2011). Other less common constructs include perceived control over falling and perceived ability to manage falls (Moore and Ellis, 2008).

Tinetti and colleagues (1990) were the first to attempt to quantify FOF by creating the term ‘falls self-efficacy’, defined as a low fall-related self–efficacy for avoiding falls while performing common daily activities. It is derived from Bandura’s Self-Efficacy Theory (SET), a construct from Social Cognitive Theory (SCT) to assess changes achieved in fearful and avoidant behaviour (Bandura, 1977). Self-efficacy is defined as an individual’s perception about being able to perform a specific behaviour and Bandura suggested ‘one’s cognitive appraisals either hinder or facilitate an individual’s decision to engage in a particular activity’ (Bandura, 1977). Self-efficacy is thought to facilitate knowledge and behaviour, as knowledge alone is not enough to motivate behaviour. It also helps explain why people’s behaviour differs despite having the same knowledge or ability. For instance, a person with high self-efficacy in balance (falls self-efficacy) might engage in riskier activities such as standing on a chair, whilst a person with low falls self-efficacy might limit or avoid hazardous activities altogether. Bandura also noted that measurements of self-efficacy are only generalisable to similar situations, so must be situation specific. Originally, Tinetti and other researchers used the terms FOF and falls–efficacy interchangeably, which resulted in confusion as tools measuring either FOF or falls-efficacy were being used as though the same. Since the development of the first falls-efficacy instrument, the ‘Falls Efficacy Scale’ (FES), several authors have demonstrated that FOF and falls-efficacy are two related but separate constructs and as such should be used separately (Li et al, 2002; Tinetti et al, 1994). However, many studies since have not followed this recommendation.

Balance confidence, like falls self-efficacy, is a cognitive construct involving beliefs and self-appraisal and refers to an individual’s self-assurance in being able to keep their balance whilst performing common daily activities. It is a situation specific form of self-efficacy that relates to perceived balance ability as opposed to actual balance ability (Powell and Myers, 1995).

The proposed conceptual framework has similarities to other FOF constructs seen in elderly populations in that issues around balance, falls-efficacy, social embarrassment, previous falls, low activity and avoidance behaviour were all identified. A critical review of the evidence on the existing FOF instruments will help form the decision as to whether there are one or more existing FOF instruments which could be used in a future study of FOF in young, obese women, or else highlight the need to develop a new tool.

5.3 Purpose of the Review

To be able to establish whether FOF is an issue in young obese adults, the identified key concepts of FOF in the conceptual framework need to be measured using valid and reliable tools. There are a number of different instruments available to measure FOF, however it was not known whether any had been specifically designed for or used in young obese adults. In order to determine whether any of the available instruments are applicable for use in young, obese adults, a review of the reliability and validity of those tools currently available was necessary. The objectives of the review were:

1.To identify questionnaire-based instruments used to assess fear of falling and balance confidence developed in community dwelling adults.

2. To map components of the identified instruments onto the conceptual framework

3 To assess the reliability and validity of those identified tools.

4. To choose the tool(s) most appropriate for use in a further study in obese young adults.

5.3.1 Originality of the Review

Prior to this review, the DARE (Database of Abstracts of Reviews of Effects), Prospero and Cochrane databases were searched to ensure no similar review had been completed or registered. There are a few published reviews of instruments designed to measure FOF and their measurement properties, though most have been assessed for use in older people or those with specific medical conditions (Jorstad et al, 2005; Greenberg, 2012; Visschedijk et al, 2010; Oliveira et al, 2013). Prior to this time, no-one had published a conceptual framework or construct of FOF in obese individuals or identified appropriate tools to measure the key concepts of such a framework.

5.4 Methods

The review was performed in a systematic manner using a protocol based on recommended guidelines from De Vet et al (2011) and the Centre for Reviews and Dissemination at the University of York (2009).

5.4.1 Selection Criteria

The purpose of this study was to review the published research literature on the measurement of FOF in community based adults. Studies using non-performance-based questionnaire based measures, in which the majority of participants were adults or adolescents (defined as the period between the onset of puberty and adulthood starting at 11 years and finishing at 20 years), were included. Studies in adolescents were included in the criteria as there were known publications on measuring balance in teenagers that might have been applicable (Bernard et al, 2003; Colne et al, 2008). The search was limited to peer-reviewed papers published in English and between the years 1982-2013, as 1982 was the year FOF was first described.

The results of the review were to be used to inform the final quantitative study in this thesis, looking at the relationship of FOF in obese women with differing ages and levels of activity. This study was performed in a community setting, therefore equipment based measures that are time consuming and/or have to be performed in a laboratory setting or with specific equipment unavailable to most healthcare professionals were not included. The types of instruments included in this review were non-performance based questionnaires only. This was because if any instruments were found to be appropriate, they would be more applicable for use by a wide range of healthcare professionals, especially where time, space, and resources are limited. Also, most staff working in this area will not have undergone appropriate training to use performance based measures and there are additional issues around health and safety.

5.4.2 Study Design

Studies were included if they reported on the development of or reliability or validity of a questionnaire-based instrument designed to measure balance or FOF in community dwelling adults. Tools that were designed for people with a specific medical condition that might affect the validity of the results, for example, Parkinson's disease, stroke, or those who have undergone a lower limb amputation were excluded. However, tools that were developed or validated in a common chronic condition often caused by weight gain and reported in overweight individuals such as back pain, osteoarthritis were included. Exclusions applied to other physical conditions not caused by weight gain such as rheumatoid arthritis, sporting or accidental injuries. Studies using instruments validated in any other language but English were excluded as they were not generalisable to a future study using participants from the United Kingdom. Where relevant systematic reviews were identified, the original studies were assessed for eligibility and included individually.

5.4.3 Reliability and Validity

The key measurement properties of the self-reported instruments identified in this review were reliability and validity, which are both essential before an instrument can be ideally used in both research and clinical settings (Jorstad et al, 2005; Schellingerhout et al, 2012). Reliability is defined as "the degree to which the measurement is free from measurement error" (Mokkink et al, 2010 p. 743) and refers to the internal consistency or reproducibility (external consistency) of an instrument. Internal consistency measures to what extent all items in the tool, or sub-scale of a tool, are consistent or related and therefore measure aspects of a single construct. Internal consistency is based on a single administration of a tool to a group of individuals. The test consists of averaging all the correlations in every combination of items within a scale, or subscale, to produce an average inter-item correlation between 0 and 1 (0 = no reliability and 1 = perfect reliability). These correlations can also be calculated using other methods including Cronbach's alpha (for multi-item measures), Kuder-Richardson (for dichotomous item measures) and split-halves, though they all produce similar results. An acceptable score is between 0.7 and 0.9, with >= 0.8 signifying good and ≥0.9 excellent reliability (De Vet et al, 2011 p83). Item total correlations are the correlations between each item and the total scale score and are acceptable between 0.2 and 0.7 (De Vet et al, 2011 p. 81), though preferably at least 0.4. The drawback of internal consistency as a single-time measure of reliability is that is does not take into account daily or observer variations of participants.

The reproducibility or external consistency of an instrument administered on 2 or more occasions can be assessed using test-retest reliability, inter-rater reliability or intra-rater reliability respectively. Test-retest is used to determine the stability of an instrument given to the same individual at 2 different points in time under similar circumstances. Inter-rater reliability is a measure of the level of agreement between 2 or more observers of the same individual at the same time. Intra-rater reliability is the observations made by the same observer on 2 or more occasions. Intraclass correlation coefficients measure the agreement between test scores for continuous data. In general, the strength of agreement (correlation coefficient) is defined as poor (<0.5), moderate (0.70-0.80) and substantial (>0.9) (Jorstad et al, 2005; De Vet et al, 2011 p120). Cohen's Kappa coefficients (K) are used with ordinal or categorical data to indicate the level of observed agreement greater than that due to chance where a value of 1.0 represents perfect agreement. In general, the strength of agreement has been defined as excellent when K ≥0.75 and poor when K <0.4 (De Vet et al, 2011 p121). A limitation of reliability is that it does not provide evidence of what is being measured, only that the instrument is consistent or repeatable.

Validity is defined as 'the degree to which an instrument truly measures the construct(s) it purports to measure' (Mokkink et al, 2010 p743). Validity is a unitary construct and refers to the outcome of validity testing or 'validation', which is the process whereby inferences are made about individuals based on their scores of a particular instrument. Validating a scale or instrument is a process to determine the degree of confidence placed on the inferences made about certain individuals, based on their scores of the instrument.

That is to say the instrument can be shown to be valid with a criterion group of people, within a particular context (Streiner et al, 2014). Furthermore, if the scale is to be used with different populations or in different circumstances, the results from the original validation process may not apply. Establishing validity is an ongoing process and cannot be done with a single study. The validity of an instrument emerges slowly, as evidence from various studies gradually accumulates (Wellington and Szczerbinski, 2007).

There are several types of validity testing or 'validation' referred to in the literature, and generally it has been divided into 3 main distinguishable types, which are content, criterion and construct validity (De Vet et al 2011 p. 150). Content validity looks at the extent to which an instrument accurately measures all the aspects of the construct it was designed to measure. This process is done by evaluating the items in the instrument and their relationship to the construct and not based on scores of the instrument. Content validation includes the opinions of experts and patients, as to whether the items of an instrument measure the construct for which they were intended.

Criterion validation is defined as "the degree to which the score of a measurement instrument are an adequate reflection of a gold standard" (Mokkink et al, 2010 p. 743), and implies it can only be assessed when a gold standard or criterion is available. Previous, frequently used and acceptable instruments are often considered 'gold standard' and can be compared with the scores of newer instruments to help determine their criterion validation. Criterion validity can be divided into, notably: concurrent and predictive validity. Concurrent validity measures how well a new instrument compares to a well-established 'gold standard' or outcome, which may be a previously validated instrument when this measure maybe for the same or related construct, measured at the same time. Predictive validation differs from concurrent validation as it examines whether the new instrument predicts an outcome in the future (De Vet et al, 2011 p. 159). In both cases, the validity of the test is measured using correlational or linear regression. There are no agreed standards on coefficient values as these would vary depending on the hypothesised relationship (Jorstad et al, 2005).

Many instruments used in clinical psychology to measure fields such as attitudes, beliefs or emotions are difficult to evaluate as there is often a lack of objective criterion to compare scores with. Content validation is insufficient by itself as it provides no evidence of inferences made from test scores. This difficulty can be overcome by the use of construct validation which uses a framework of hypothesis testing. This framework is based on knowledge already known about the construct of interest. Construct validity refers to whether you can draw inferences about instrument scores related to the construct being measured. It is often used when there is no 'gold standard' available to test the validity of an instrument and can be assessed via methods such as known-groups analysis and also convergent and divergent validation, if similar tools are available. Correlations between instruments are expected to be high if all instruments claim to measure the same construct, and are frequently calculated using 'Spearman Rank Correlation Coefficient Convergent' validity tests that constructs that are expected to be related, are in fact related, whilst divergent or discriminant validity tests that constructs that should not be related, are indeed not related. Other ways to demonstrate construct validity include formulating a hypothesis based on the research literature, then test whether the particular measure can accurately discriminate between the higher and lower scores on the construct, for example, are FOF scores higher in fallers compared to non-fallers (Moore and Ellis, 2012).

In recent years, there has been a move to revise the conceptualisation of construct validation to include all forms of validity testing and thus provide one 'unifying concept for all validity evidence' (American Educational Research Association, American Psychological Association & National Council on Measurement in Education, 1999). This means that all validity would encompass hypothesis testing and no longer be constrained by the limitations of individual validation methods. Reliability and validity are related, where reliability is necessary but not a sufficient condition of validity. If a test is unreliable it cannot be valid as it does not measure consistently. However, a reliable test is not necessarily valid if it does not measure what it was designed for (Wellington and Szczerbinski, 2007).

5.4.4 Search Strategy

The research student conducted a computerised search of the following databases: Cochrane Library, MEDLINE (1982 to June 2013), EMBASE (1982 to June 2013), Cumulative Index to Nursing and Allied Health Literature (CINAHL 1982 to June 2013), PsycINFO (1982 to June 2013), AMED (Allied and Complementary Medicine 1985 to June 2013) and Prospero website. NHS Evidence Healthcare Database Advanced Search

(HDAS) was used to search Medline, Embase, Ahmed, PsycINFO and CINAHL. The search was limited to studies published in English which, although may introduce language bias, was unavoidable due to limited time and resources for translation.

5.4.5 Search terms for Electronic Databases

A combination of search terms designed to retrieve studies on measurement properties and fear of falling or balance tools were used in each database. Keywords for the search included already known constructs and domains from the new conceptual framework such as: '*fear of falling', 'fear', 'afraid', 'falls', 'falls self-efficacy', 'postural stability', 'activity avoidance', 'behaviour avoidance'* and the names of some of the known tools. The search strategies were customised to each database and a 'search diary' maintained detailing the keywords, search terms, filters (e.g. dates, languages, ages etc.) and search results of each database viewed (Appendix C1, p 282). Titles and abstracts of studies considered for retrieval were recorded on a spreadsheet, and subsequent inclusion and exclusion decisions were also recorded. Any changes to the protocol were noted and an amended version number given. Prior to the review, a pilot search was conducted on the first few databases with the intention of identifying a selection of 14 key papers in the search results that were known to fit the criteria (Appendix C2, p 287). These papers were the 'gold standard' and if found in the results, this would indicate the search strategy was identifying relevant papers. If none or few of these papers were found in the search results, the search terms or filters would be modified using additional relevant terms.

5.4.6 Searching Other Sources

In addition to searching electronic databases, and to minimise publication bias, published research was also obtained by scanning reference lists of both primary papers and existing reviews identified in the search. In addition, the Cochrane and Prospero databases were searched to check for any unpublished, current reviews that had been registered. Three experts in the field of FOF, obtained from author lists of identified papers, were contacted and replied to requests for any additional sources of research that might be useful for the review.

5.4.7 Study Selection Process

Prior to screening the selected abstracts, the selection process was piloted by applying the inclusion criteria to a sample of papers to ensure that they could be reliably interpreted.

The research student scanned the titles of all identified papers to exclude obvious irrelevant studies before obtaining the selected paper abstracts. All remaining identified abstracts were then screened by two reviewers independently (the research student and the Director of Studies) to determine studies to be included in the review using a selection proforma (Appendix C3, p 288). This identified studies that looked to meet the inclusion criteria or required the full text article to enable selection. Full texts of the selected studies were then examined by the research student for eligibility in the review (Appendix C4, p 300). The selection form included: published language, the participant characteristics, inclusion criteria, the FOF domain measured, type of instrument, whether to include in the review and if not, the reason for rejection.

5.4.8 Data Synthesis

This review of ‘self-reported tools’ was primarily twofold:

1) To identify self-reported tools that measure FOF and balance in community dwelling adults.
2) To assess whether the self-reported tools are valid and reliable to be used to assess the different domains of FOF, as previously proposed in a conceptual framework for a future study of young obese women.

If no instruments were found to be appropriate for use in young obese populations, a narrative approach would be taken to analyse each identified instrument and a comparison made of what construct of FOF it purports to measure against the domains of the conceptual framework. A selection of the most appropriate tool or tools for use in a further quantitative study of obese women would then be made, based on the similarities to the framework and the activities or items the tool measured.

5.5 Results

5.5.1 Identification and Screening of Papers

The search strategy resulted in a total of 15,388 hits from all the databases which were all initially screened by the research student to exclude any obvious irrelevant papers or duplications. The majority of papers were excluded as either not being relevant to FOF or they did not meet the eligibility criteria. Papers not relevant included those about FOF with specific medical conditions such as poor visibility, muscular sclerosis, paraplegia, respiratory problems (e.g. hypocapnia, COPD), post-stroke, Parkinson’s disease, or others including surgical procedures, such as hip replacements, amputations or repaired fractures. Papers that did not meet the eligibility criteria did not include measurement properties of FOF tools, reported on tools used for non-English speakers, or included performance-based tools only.

One hundred and eighty-six articles were selected based on their title as potentially relevant to screen for eligibility against the inclusion criteria (Figure 5.1). The abstracts of these 186 articles were evaluated against the inclusion criteria independently by two reviewers and then discussion and consensus agreed on those selected for full text evaluation. Studies using performance based tools, those not reporting measurement properties and those not relating to falls made up the majority of papers that were excluded (Table 5.1). Other reasons for exclusion included duplicate papers; abstracts of dissertations; tools in different languages and non-community based population. One hundred and thirty-three abstracts were excluded and a table kept of all abstracts reviewed with the reason for either inclusion or rejection recorded (Appendix C3, p 288). Thirteen papers were identified from other sources, resulting in a total of 199 abstracts reviewed against the inclusion criteria. Of the 13 papers identified from other sources, 5 were found from comparing the results with another systematic review of the psychological outcomes of falling (Jorstad et al, 2005; Appendix C4, p 300), 7 from FOF other reviews, manuals and books and one was found by a member of the supervisory team.

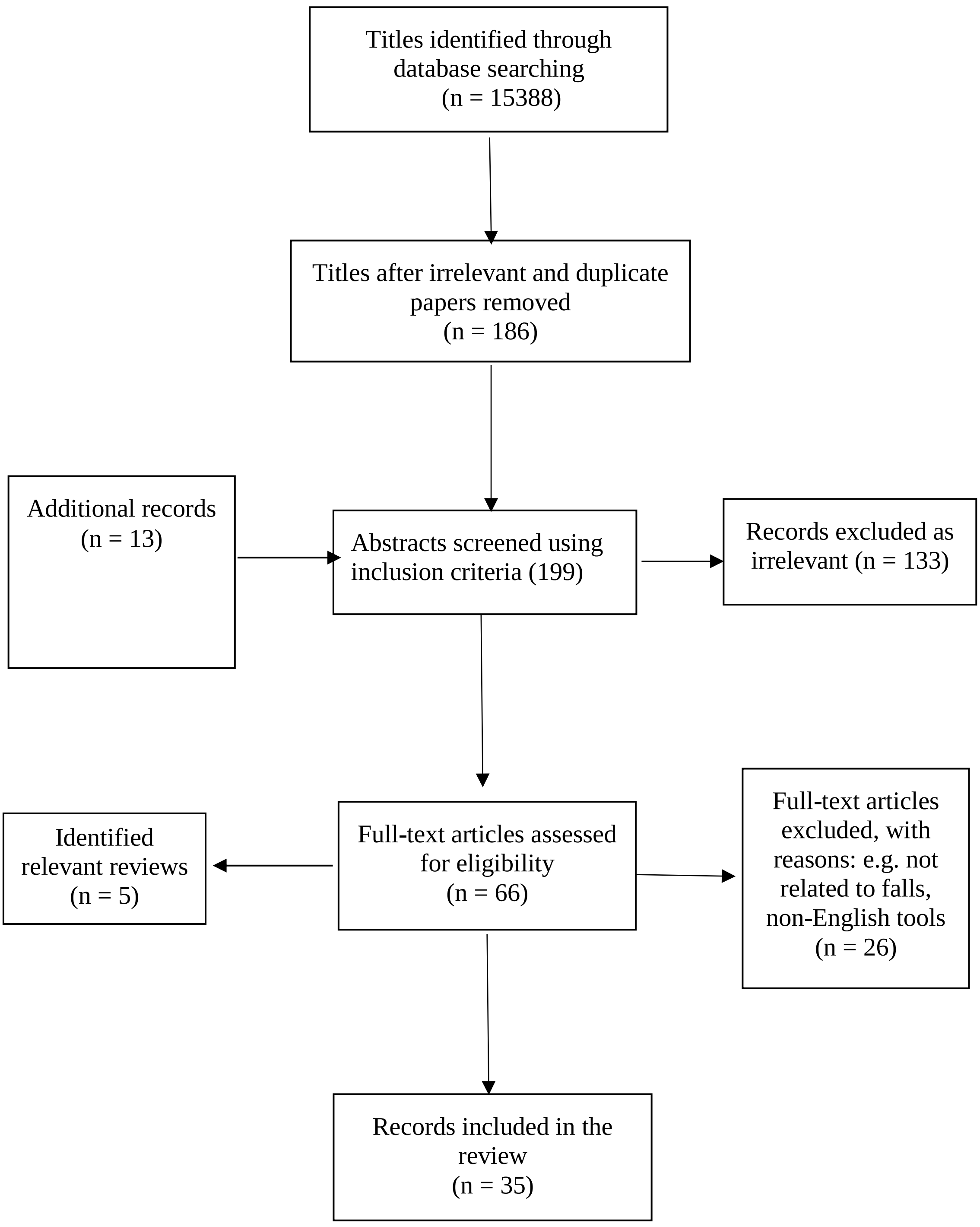
Table 5.1: Summary of the Reasons for the Rejection of Selected Abstracts

Reason for Rejection	Number of papers
Performance based instrument	106
Does not include properties of tools	11
Not falls related	8
Different language	2
Dissertation abstract	2
Duplicate paper	3
Not community based population	1
Total	133

5.5.2 Eligibility and Inclusion of Papers

In total 66 full text papers were retrieved for full review, 53 were identified from searching electronic databases and 13 from other sources (Figure 5.1). All identified papers were assessed for eligibility by the research student, who then discussed the decision making process with another team member (the Director of Studies) to increase the reliability of the decision process, and reduce the risk of errors.

Figure 5.1: Flow Chart of Study Selection Process for Review of Self-report Fear of Falling Measurement Tools



Twenty-eight papers were excluded from the review (Table 5.2). Reasons for the exclusion were mainly due to the instruments not relating to falling (e.g. fear of pain when exercising or anxiety about exercising) or the instruments being performance based (Appendix C5, p 303). Five reviews of FOF instruments were identified in the search but not included in the review process.

Table 5.2: Reasons for the Rejection of Studies from the selection of Full Text Papers

Reasons for exclusion	Number of papers rejected
No measurement properties reported	2
Measurement not related to falling	10
Tool not in English	3
Population not community dwelling adults	3
Performance based instrument	7
Unpublished Dissertation	1

In total 35 relevant papers were identified which included 18 multi-item and 6 single item measures that met the inclusion criteria (Appendix C6, p 309). Each measure was recorded by the construct it reported to measure (Table 5.3).

5.5.3 Identified Instrument Populations

All of the 18 multi-item and 6 single-item FOF instruments were designed for use in elderly populations (Table 5.3). None of the selected instruments had been designed to be used in younger populations or specifically for obese individuals. Similarly, there were no studies identified that reported using these tools in younger or obese populations. This suggested that any measurement properties reported would be relevant only to their study population, that they were designed for use in and therefore not relevant for the study population of younger, obese women. However, instruments that are found to be reliable and/or valid in a specific population implies that some value can be accredited as a worthy tool, although cannot be relied upon in another unrelated population.

Table 5.3: Instrument Characteristics of identified Fear of Falling Measures

INSTRUMENT	PRIMARY REFERENCES	POPULATION MEASURED	CONSTRUCT MEASURED	ITEMS	ITEM RESPONSE SCALE
Falls efficacy Scale (FES)	Tinetti et al, 1990; Powell and Myers, 1995; Myers et al, 1996; Hauer et al, 2011	CLS	Fall-related efficacy	10	10-point numerical rating (range 1-10)
Revised FES (rFES)	Tinetti et al, 1994; Hill et al, 1996; Lachman et al, 1998	CLS	Fall-related efficacy	10	11-point numerical rating (range 0-10)
Iconographic FES (Icon-FES) long and short versions	Delbaere et al, 2011	CLS	Fall-related efficacy	30 and 10	4-point scale of concern
FES- International (FES-I) long and short versions	Yardley et al, 2005; Boyd and Stevens, 2009; Kempen et al, 2008; Kempen et al, 2007; Hauer et al, 2011; Delbaere et al, 2010.	CLS	Fall-related efficacy	16, 7	4-point scale of concern
Modified Falls Efficacy Scale (MFES)	Hill et al, 1996; Cameron et al, 2000; Chamberlin et al, 2005	CLS	Fall-related efficacy	14	11-point numerical rating (range 0-10)
FES- United Kingdom version (FES-UK)	Parry et al, 2001	CLS	Fall-related efficacy	10	10-point numerical rating (range 0-10)
Activities specific Balance Confidence Scale (ABC) long and short versions (ABC-6)	Powell & Myers, 1995 Li et al, 2002 Myers et al, 1996; Peretz et al, 2006; Talley et al, 2008	CLS	Balance Confidence, fall-related efficacy	16, 6	101-point numerical rating (range 0-100)
ABC- United Kingdom version (ABC-UK)	Parry et al, 2001	CLS	Balance Confidence	16	10-point numerical rating in multiples of 10%
Simplified ABC (ABC-S)	Filiatrault et al, 2007	CLS	Balance confidence	15	10-point Likert type rating scale (range 1-10)
CONFbal scale	Simpson et al, 1998; Simpson et al, 2009	CLS	Balance confidence	10	3-point Likert (range 1-3)
Survey of Activities and Fear of falling in the elderly (SAFFE)	Lachman et al, 1998; Hotchkiss et al, 2004; Talley et al, 2008	CLS	Fear of falling, activity restriction	11	4-point Likert (range 0-3)
University of Illinois at Chicago Fear of Falling Measure (UICFFM)	Velozo & Peterson, 2001	CLS	Fear of falling	16	3-point Likert (range 1-3)

INSTRUMENT	PRIMARY REFERENCES	POPULATION MEASURED	CONSTRUCT MEASURED	ITEMS	ITEM RESPONSE SCALE
Fear of Falling Questionnaire (FFQ)	Dayhoff et al, 1994	CLS	Fear of falling	21	5-point Likert type scale
Mobility Efficacy Scale (MES)	Lusardi et al, 1997	CLS	Fear of falling	10	4-point numerical rating (range 1-4)
Fear of Falling Avoidance Behaviour Questionnaire (FFABQ)	Landers et al, 2011	CLS	Activity avoidance, activity restriction	14	5-point ordinal (range 0-4)
Modified SAFFE (MSAFFE)	Yardley and Smith,2002; Delbaere et al 2004	CLS	Activity avoidance	17	3-point Likert (range 1-3)
Consequences of Falling Scale (CoF)	Yardley and Smith, 2002	CLS	Feared consequences of falling	12	4-point Likert (range 1-4)
Falls Handicap Inventory (FHI)	Rai et al, 1995	Outpatient post-fallers	Previous falls, falls related handicaps	18	3-point Likert
"Are you afraid of falling?"	Tinetti et al, 1990	CLS	Fear of falling	1	Dichotomous yes/no
"Are you afraid of falling?"	Hauer et al, 2011	CLS	Fear of falling	1	4-point Likert
"Has fear of falling made you avoid any activities?"	Tinetti et al, 1990; Myers et al, 1996	CLS	Activity avoidance	1	Dichotomous yes/no
"How afraid are you that you will fall (and hurt yourself) in the coming year?"	Howland et al, 1993; Lachman et al, 1998	CLS	Fear of falling	1	4-point numerical rating (range1-4)
"Are you afraid of falling?"	Tinetti et al, 1990; McAuley et al, 1997	CLS	Fear of falling	1	5-point Likert
Visual Analogue Scale – FOF	Scheffer et al, 2010	CLS	Fear of falling	1	10cm numeric scale
CLS- Community-living seniors					

5.6 Identified Tools and their Measurement Properties

The reliability and validity of all identified instruments are summarised in Table 5.4 and the general findings are discussed. Reliability, measured using Cronbach's alpha, item total correlation, mean inter-item correlation and intraclass correlation coefficient were recorded. However, none of the studies reported inter-rater or intra-rater reliability.

At this point in time, none of the identified FOF instruments had been reported to be valid or reliable for use in young obese adults and no instrument was found to include all elements of the construct of FOF in younger, obese women. Consequently, there remained three courses of action:

1) To develop a new FOF tool specific to the obese population.
2) To use one or more already developed and tested tools that measure elements of the proposed construct of FOF in obese adults in a future quantitative study.
3) Or to measure the reliability and conduct validation testing of some of the identified instruments in a population of younger obese adults.

The first option, though possibly the more appropriate course of action would take considerable time and resources beyond the timeframe of this research. Furthermore, there are numerous FOF tools available, which despite their differences have already had a lot of expert time and resources invested into their development. Developing yet another tool may not be the most economical solution, or at least not until more time is given to exploring the suitability of those tools already available for use in the research population. The third option, to measure the reliability and conduct validity tests of identified measures for use in obese populations was not considered worthwhile until the measures had at least been trialled in this population to further assess their suitability. The second option, to choose from the tools already available as to those that best reflect the proposed elements of FOF in obese women under 50 years old was taken.

Before selecting possible contender tools for use in a further study, those tools found to be either too burdensome to complete (SAFFE), not relevant to younger populations (Icon-FES, MES), not previously used as a self-completing questionnaire (UICFFM), or having little or insufficient information about them to enable a full assessment (FFQ) were excluded. In addition, those with insufficient reliability or only content or face validity were also excluded (4 single-item measures).

Table 5.4: Reported Reliability and Validity of identified Fear of Falling Instruments						
		RELIABILITY				**VALIDITY**
INSTRUMENT	**NO**	**INTERNAL CONSISTENCY** **Cronbach's α**	**NO**	**RETEST**	**REPRODUCIBILITY** **Test- retest Coefficient**	
FES	60(25) 56 (31) 60(20) 284 (9)	0.90 (25) 0.89 (9) Mean inter-item correlation =0.45 (9)	18	4-7 days	R=0.71 (31)	Content (31) Concurrent (20,25,31) Convergent (20,25) Construct (20,25)
rFES	179(10) 1,103(32) 270(15)		21	1 week	ICC=0.88 (10)	Convergent (15,32)
Icon-FES Long version (LV) Short version (SV)	250 (6)	0.96 (6) Mean inter-item correlations 0.45 (0.20-0.72) (6) 0.87 (6)	50	1 week	ICC=0.90, 95% CI= 0.83-0.94.(6)	Concurrent (6)
FES-1 LV SV	704(34) 193(13) 178(14) 284(9) 500(5)	0.96 (34) 0.96 (13) 0.97 (14) 0.92 (9) Mean inter-item correlations =0.55 (34) Mean inter-item correlations =0.64 (13) Mean inter-item correlations =0.65 (14) Mean inter-item correlation =0.43 (9) 0.79 (5) 0.63 (5) 0.92 (13) Mean inter-item correlation =0.63 (13) 0.63 (5) 0.84 (9) Mean inter-item correlation =0.43 (9)	704	1 week	ICC=0.96 (34) ICC=0.82 (13) ICC=0.83 (13) FES-I long vs FES-I short rho=0.97 (13)	Content (34) Concurrent (9,13,13) Discriminative (34) Convergent (5) Predictive (5) Construct (9,34)

		RELIABILITY				VALIDITY
INSTRUMENT	**NO**	**INTERNAL CONSISTENCY** **Cronbach's α**	**NO**	**RETEST**	**REPRODUCIBILITY** **Test- retest Coefficient**	
MFES	179 (10) 131) (2) 95 (3)	0.95 (10)	21(10)	1 week	ICC=0.93 (10)	Discriminative (10) Construct (2,3)
FES-UK	193(23)	0.97 (23)	60(23)	1 week	ICC=0.58(23)	Construct (23)
ABC – 16-item (LV) ABC-6 (SV)	60(25) 60 (20) 256(17) 157(24) 272(30) 27(21) 157(24)	0.96 (25) 0.87 (17) 0.95 (30) Healthy α= 0.83 HLGD α=0.90 PD α=0.91 (24) Healthy α=0.86, HLGD α=0.81 PD α=0.90 (24)	21(25)	2 weeks	R=0.92, p<0.001 (25) Healthy ICC=0.78 HLGD ICC=0.88 PD ICC=0.83 (24)	Content (25) Concurrent (20,25,30) Convergent (11,17,20,21,25) Discriminative (24,25) Construct (20,21,24,25) Discriminative (24)
ABC-UK	193(23)	0.98 (23)	60(23)	1 week	ICC=0.89 (23)	Construct (23)
ABC-S	197(8)	Reliability index =0.86 (8)				Convergent (8)
CONFbal scale	45(29) 153(28)	0.91 (29)	45(29)	1 week	ICC=0.96 (29)	Concurrent (28) Convergent (29)
SAFFE	272(30) 270(15) 118(11) 225(7)	0.82 (30) 0.91 (15)			ABC Scale R=-0.65 (p<0.001) (30)	Content (15) Convergent (11,15,17) Concurrent (7,15, 30) Criterion (15)
UICFFM	106(33)	0.93 (33)				Construct (33)
FFQ	168(4)	0.81 (4)	30	3 weeks	R=0.57 (p<0.01) (4)	Construct (4)
MES	92(18)	0.82 (18)				Convergent Or concurrent? (18)
FFABQ	61(16)		61	1 week	ICC=0.81 (16)	Content (16) Convergent (16) Construct (16)

		RELIABILITY				VALIDITY
INSTRUMENT	**NO**	**INTERNAL CONSISTENCY** **Cronbach's α**	**NO**	**RETEST**	**REPRODUCIBILITY** **Test- retest Coefficient**	
MSAFFE	224(35) 225(7)	0.91-0.92 (35)	166(35)	6 months	rho=0.75 (35)	Concurrent (7)
CoF	224(35)	CoF-LFI=0.94 CoF-DI=0.86 (35)	166(35)	6 months	CoF-LFI (rho)=0.61 CoF-DI(rho) =0.64 (35)	Concurrent (35)
FHI	28(26)	0.82	13	48 hours	R= 0.96 (26)	Convergent (26)
"Are you afraid of falling?" (Y/N)	18(31)			4-7 days	K=0.66 (31)	
"Are you afraid of falling?" (5 point Likert response)	58 (19)					Concurrent (19)
"Are you afraid of falling?" (4 point Likert response)	284 (9)					Concurrent (9)
"Has fear of falling made you avoid any activities?" (Y/N)	18(31)			4-7 days	K=0.36 (31)	Discriminative (25)
"How afraid are you that you will fall (and hurt yourself) in the coming year?" (4 point numerical)	270(15)					Convergent (15) Concurrent (15)
Visual Analogue Scale – Fear of falling (VAS-FOF)	440(27)		440	1 week	R=0.56, p=0.01 (27)	Concurrent (27) Concurrent (22)

Note: HLGD= higher level gait disorders; PD= Parkinson's disease; R=Pearson's Correlation coefficient; α=alpha; K= Cohen's kappa correlation coefficient; ICC=intraclass correlation; rho, rs= Spearman correlation coefficient; 1) Boyd and Stevens, 2009; 2) Cameron et al, 2000 ; 3) Chamberlin et al, 2005; 4)Dayhoff, 1994; 5) Delbaere et al, 2010; 6) Delbaere et al, 2011; 7) Delbaere et al, 2004: 8) Filiatrault et al, 2007; 9) Hauer et al, 2011; 10) Hill et al, 1996; 11) Hotchkiss et al, 2004; 12) Howland et al, 1993; 13) Kempen et al, 2008; 14) Kempen et al, 2007; 15) Lachman et al, 1998; 16) Landers et al, 2011; 17) Li et al, 2002; 18) Lusardi et al, 1997; 19) McAuley et al, 1997; 20) Myers et al, 1996; 21) Myers et al, 1998; 22) Ozcan et al, 2005; 23) Parry et al, 2001; 24) Peretz et al, 2006; 25) Powell and Myers, 1995; 26) Rai et al, 1995; 27) Scheffer et al, 2011; 28) Simpson et al, 2009; 29) Simpson et al, 1998; 30) Talley et al, 2008; 31) Tinetti et al, 1990; 32) Tinetti et al, 1994; 33) Velozo et al, 2001; 34) Yardley et al, 2005; 35) Yardley et al, 2002.

5.7 Mapping of Identified Tools against the Conceptual Framework

The remaining 15 tools, including 13 multi-item tools and 2 single-item tools were then mapped against the proposed concepts of FOF and obesity for eligibility of inclusion in a further study (Table 5.5). The concept of 'Fear of Falling' was not proposed as a 'domain' on the conceptual framework. Nonetheless, as there have been numerous different constructs relating to FOF developed, often used interchangeably, all identified instruments were subsequently reviewed for suitability based on their item content, regardless of what they reported to measure. The single item measures of FOF were not mapped against any of the proposed concepts as many authors have reported their inability to distinguish between different levels of fear, or of fear elicited during different specific activities, as well as their poor reported measurement properties (Jorstad et al, 2008; Scheffer et al, 2008; Legters et al, 2002). Therefore, with this highlighted it limited their usefulness in a future study. Several of the multi-item tools were found to be possible contenders for inclusion in the next study. However, a final selection was made based on the reported reliability and validity, item content, length of questionnaire, and if the questionnaire complimented others used to measure different constructs.

Table 5.5: Identified Instruments to measure Construct of Fear of Falling in Young Obese Women

Concept	Identified measures
Poor perceived balance	ABC (S & L) ABC-UK, ABC-S, CONFbal
Falls self-efficacy	FES, rFES, FES-I, MFES, FES-UK
Social embarrassment	CoF
Fear of pain/injury	CoF, FHI
OUTCOME	
Activity restriction	CoF, FFABQ
Reduced/activity avoidance	FFABQ, MSAFFE
Reduced fitness	

Reliability and validity of Identified Instruments

The reliability and validity of the remaining instruments were summarised in a similar way to Jorstad et al (2005) in an attempt to quantify the strength of evidence and thus help in the selection process of suitable tools (Table 5.6). The results of each study reporting reliability or validity were rated according to the findings. This was a twofold process including firstly, the strength and statistical significance of correlations of reported relationships for validity, and secondly whether proposed hypotheses about the relationships with measurement instruments assessing related constructs are successively consistent with the results. However, the evidence of measurement properties was not weighted in terms of quality of the studies which varied enormously in size, populations, and the analyses of instruments used.

From Table 5.6, it was clear that the FES-UK, ABC-UK and CONFBal had insufficient validity (weak) compared with the other instruments and FFABQ and FHI which had unreliable results as the sample sizes of the single reporting studies were relatively small (61 and 28 respectively). Despite these short-comings, the evidence presented was used together with other properties of the instrument, such as what they reported to measure, and how the items included in the questionnaires reflected the reported activities of obese women in the previous qualitative study. Each instrument was then screened to check that the items reflected the 'domains' in the proposed construct and were relevant to use with the intended younger study population.

Table 5.6: Summary of Reliability and Validity of Reviewed Measures

Measure	Number of studies	Number of participants	Reliability	Validity
FES	4	56-284	++/+++	++
rFES	3	270-1,103	++	++
FES-I- SV & LV	5	178-704	++/+++	++/+++
MFES	3	95-179	++	++
FES-UK	1	193	++	+
ABC-SV & LV	7	27-272	++/+++	++
ABC-UK	1	193	++	+
ABC-S	1	197	++	++
CONFBal	2	45-153	+++	+
FFABQ	1	61	++	++
MSAFFE	2	224-225	++	++
CoF	1	224	++	++
FHI	1	28	++	++

0 = no results reported
\+ = weak evidence
++ = adequate evidence
+++ = good evidence

5.8 Instruments selected for Quantitative Study to explore the relationship between FOF and Activity Participation in Obese Women

As no identified single tool measured all of the concepts of the proposed framework, the 13 identified instruments that matched one or more 'domains' of the conceptual framework were examined to assess their appropriateness for inclusion in the future quantitative study exploring the relationship between FOF and activity participation in younger obese women. The study was to include a self-reported questionnaire, including the measurement of other relevant variables such as anxiety, depression, falls and activity levels as well as the different components of FOF proposed for obese adults. Consideration was given to the recruitment of study participants and time taken to complete the self-reporting measures. Minimising the number of questions to as few as necessary, with the minimum overlap of similar questions, was thought to reduce the participant's commitment time and help with the recruitment process, quality of responses and reduce participant fatigue.

1) Falls-Efficacy

Falls-efficacy was identified as a key concept as it reflected the basic themes from the qualitative study of the participant's perception of being able to perform certain activities without falling (since being overweight). Notably, their reduced ability or belief in their ability and/or confidence in/when performing certain activities; and for those who had fallen before, their concerns about falling again during an activity.

The main contender tools to measure falls-efficacy were the FES-I or MFES. The original FES and revised FES (same as the FES except the scoring is reversed) both had adequate measurement properties but the activities included were not as similar to those reported by obese women, in the previous qualitative study, as those of the FES-I and MFES. The MFES was chosen as the most appropriate tool to measure falls-efficacy because the activities reflected more those typically reported in the previous study than those of the FES-I. Getting in and out of bed, using public transport, and using steps outside the house were frequently mentioned, these are found in the MFES, in addition to other activities such as getting dressed, taking a bath or shower, cleaning, and shopping, which were included in both tools. Furthermore, a previous preliminary study used the FES-I to compare FOF in a small sample of healthy obese adults matched with age, gender, and height with a control sample of normal weight subjects. The results showed FES-I scores to be higher in the obese subjects compared to the normal weight subjects and the absolute difference between the groups small compared with studies in the elderly (Dey et al 2007). The authors suggested that the FES-I might not fully capture the types of activities seen in younger obese adults and more sensitive measures of falls-efficacy were needed to explore concerns of falling in obese populations. This was not a criticism of the FES-I, as like many other FOF tools, it was developed for use in elderly populations and found to have excellent measurement properties, though it had not been validated for use in younger or obese individuals. The reliability and validity of the MFES in elderly subjects were not as good as those of the FES-I, though still commendable. The MFES is also slightly shorter than the FES-I and although it did not include social activities found in the FES-I, the other FOF tools (CoF and MSAFFE) selected did include similar social activities, which together complemented each other.

2) Poor Perceived Balance

Poor perceived balance was another key concept of the conceptual framework and reflected findings from the qualitative study that some participants reported perceived symptoms of poor balance such as feeling unsteady, dizzy spells, feeling ‘wobbly’ or their ankles/knees might give way whilst performing certain activities, thus making them feel that they were going to fall. The tools identified to measure perceived poor balance or balance confidence were shown to share similarities with those tools measuring falls-efficacy because both measured an individual’s concern about falling whilst performing specific activities or a confidence that they can perform similar activities without losing their balance. The four self-reported balance confidence tools identified in the review (ABC, ABC-UK, ABC-S, CONFbal) were remarkably similar to the measurements of falls-efficacy and the literature supports this with the frequent use of balance confidence instruments to also measure falls-efficacy (Jorstad et al, 2005). Many of the falls-efficacy and balance confidence instruments have similar questions relating to confidence whilst performing daily activities such as reaching, bending, going-up or down stairs, walking, and a number of activities outside too.

The identified ABC and CONFbal tools all measured confidence in performing specific activities without losing balance. Some of the items were similar in both measures, for example, walking up and down slopes, picking up items from floor. Other activities included the use of walking aids or handrails, reaching, and outdoor or social activities. Both these measures reflected elements of the falls-efficacy and poor perceived balance domains in the conceptual framework, but these were considered too similar to the falls-efficacy measures to clearly define as separate measures. Therefore, it was decided not to include one of the identified measures of balance confidence in the quantitative study.

3) Activity Avoidance

The MSAFFE was chosen as a relevant tool to measure activity avoidance due to its concern about falling because it reflected in a similar way the issues that were raised in the qualitative study. It is a self-completing, shorter version of the original SAFFE which is renowned for being very long and arduous to complete (Jung, 2008). The other multi-item measure of activity avoidance, the FFABQ, was not chosen to be used for the quantitative study, as already mentioned, as the measurement properties were based on one small study and it was originally intended to be used together with performance-based measures (Landers et al, 2011).

4) Activity Restriction, Fear of Pain or Injury, and Social Embarrassment

The CoF was selected as a tool to measure the concepts of fear of injury or pain, activity restriction and social embarrassment. It is made up of two subscales, loss of functional independence and damage to identity. Both of these scales reflected findings from the qualitative study of participants' reporting concerns about being injured, activity restrictions, having difficulties getting up or being embarrassed or feeling foolish if they were to fall.

Other identified tools developed to measure the construct of activity restriction included the FFABQ and SAFFE, which as mentioned above, both also measure activity avoidance due to FOF. However, these tools were excluded as contenders due to insufficient evidence of reliability and validity in the case of FFABQ, and being too time-consuming to complete and analyse in the case of SAFFE. Although not identified in the review, Murphy et al (2002) also reported measuring activity restrictions associated with FOF in elderly people using a combination of single item questions of both FOF and activity avoidance, together with self-reported and performance-based measures of activities of daily living (ADLs) (Murphy et al, 2002).

The items of the CoF scales were more comparable to both the findings from the qualitative study and the proposed concepts than other tools identified. Yardley et al (2005) previously used the MSAFFE together with the CoF in a prospective study and showed correlations between the common feared consequences of falling and activity avoidance, suggesting that the perceived consequences predicted activity avoidance. Both of these tools were chosen because they included items that were the closest out of all the other identified tools to those concerns of falling reported by obese women (Table 5.7 & 5.8).

At this time the researcher believed that the 3 tools selected (MFES, CoF, MSAFFE) best reflected the key concepts of FOF identified in the proposed framework. This consequently contributed towards a final concise and comprehensible questionnaire, with minimum overlap of questions.

The findings of this review helped further development of the conceptual framework as it enabled the comparisons of the proposed concepts of the framework with similar ones used in elderly populations and identified tools to measure these concepts. These tools were then assessed for suitability in younger, obese populations based on the items or activities they measured, their reliability and validity, and findings from the qualitative study. Those tools selected as most suitable for use in younger, obese women could then be used to measure the concepts and their relationships with other relevant variables in a further quantitative study. The results of this review also highlighted that none of the identified tools measured all elements of the framework and that no suitable tools were identified to measure some of the concepts, such as perceived balance or poor fitness. A reason for this might be because all the tools were designed for elderly populations and not ideal or specific enough for obese populations.

5.9 Review Limitations

This review had several limitations. Firstly, it was a review of self-reporting FOF tools for use in community based populations, which was carried out in a systematic way. However, it was not a systematic review that is considered of higher methodological quality for reviewing papers, but as such takes is more resource intensive to complete.

The review of FOF instruments, although done systematically using a protocol, did not follow the all the recommended guidelines for a systematic review in that not all the abstracts were assessed by two independent reviewers (CRD 2009), nor was the final selection of papers not the extraction of data done by two reviewers, thus introducing possible bias.

The initial search resulted in over 15,000 hits which suggests that the search terms used were not precise enough. The design of a search strategy needed to be highly sensitive so as to retrieve as many potentially relevant studies as possible, but conversely retrieving too many results in hours spent trawling through headings and abstracts and there is the risk of overlooking relevant papers. The search strategy did not specify self-reported measures which is reflected in the results (Section 5.5.1, p 89 and Table 5.1, p 90) as one of the main reasons for the rejection of papers was due to them being performance based instruments. The search strategy did not specify to include studies of community based populations only. At the time it was not known how many papers in total would be retrieved, although all papers from the 'gold standard' list were identified in searches of the first two databases selected. The comparison of these results with an earlier review by Jorstad et al (2005) revealed that the majority of papers selected by Jorstad and colleagues also fitted this reviews inclusion criteria, and had already been identified in the results of this review. However, five other papers identified by Jorstad et al that fitted this review's criteria, had not been identified, suggesting a flaw in the search strategy (Appendix C4 p 300).

Several other potentially relevant papers were identified from other sources, which again might suggest an imprecise search strategy. Another possible explanation and limitation is that only one researcher scanned the title lists of the 15,388 hits from all electronic databases, which could have led to selection bias and errors, for example, missing relevant papers. The search strategy was made quite broad to ensure all relevant papers were captured. However, on reflection, the search strategy used was too broad and not specific enough, resulting in thousands of hits, many of which were not relevant and were time consuming to check. If the review was to be repeated, the search strategy would include more specific search terms on questionnaire based tools or instruments only, and exclude all performance based instruments and tools not related to falls or falling.

Limitations of the Review Findings

Closer inspection of the reported reliability and validity of the identified instruments shows enormous variation in sample sizes, populations, study settings, wording of questionnaires and statistical analyses making it difficult to reach meaningful conclusions (Visschedijk et al 2010). There is no agreement on a 'gold standard' measure of FOF. Furthermore, those tools often recommended as such are frequently criticised for their limitations, which further undermines the reported validity of some of these tools (Powell and Myers, 1995; Lusardi et al, 1997; Parry et al, 2001; Yardley et al, 2005). There were discrepancies in the reporting of validity testing whereby some authors differed in the way they interpreted or measured a type of validation, failed to identify the type of validity being tested, or provided insufficient details of the methodology to be able to clarify or replicate the study (Hotchkiss et al, 2004; Powers and Myers, 1995; Lachman et al, 1998; Jorstad et al, 2005; Moore and Ellis, 2012). For instance, when comparing the same or similar instruments some authors confused concurrent with convergent validation (Powers and Myers, 1995; Hotchkiss et al, 2004), and others confused convergent validation with the more recent reconceptualisation of construct validity (Jorstad et al, 2005; Moore and Ellis, 2012).

Not surprisingly the original falls-efficacy and balance confidence instruments, the FES and ABC, are shown to have more evidence of reliability and validity than many of the newer tools (with the exception of the FES-I). This could be due to them being available for longer and both being used more frequently as criterion or comparable tools in validation studies. The FES-I is the most widely used falls-efficacy instrument and has been repeatedly reported to have good reliability and construct validity in elderly populations (Greenberg et al, 2008; Kempen et al, 2008).

Following this review, further studies are recommended to establish clear and agreed criteria to enable the direct comparison of the measurement properties of all instruments, which would help provide a more comprehensive evaluation. Furthermore, as mentioned above, progress towards a consensus on the definition of FOF and its various constructs is also recommended, although ProFaNE (Prevention of falls Network Europe) has already attempted to reach a consensus on the construct of falls-efficacy (Lamb et al, 2005).

5.10 Chapter Summary

The results of this review highlighted the lack of self-reporting FOF instruments available that had been validated for use in young obese adults. It also raised concerns of the lack of a standardisation of FOF, its constructs, use of tools and evaluation of measurement properties. Thirteen of the 24 tools identified measured one or more concept of the proposed conceptual framework, though none measured all of the concepts. Three instruments were selected to measure the majority of components of the framework, notably: falls-efficacy, fear of pain or injury, social embarrassment, activity restriction, and activity avoidance. These findings helped to further develop the conceptual framework and inform the design of a further study to measure some of the concepts and associated factors of FOF in young obese women. This further study could help to support findings from the initial qualitative study that FOF is an issue in obese women and associated with reduced activity participation.

CHAPTER 6: A QUANTITATIVE EXPLORATORY STUDY TO MEASURE FEAR OF FALLING AND RELATIONSHIP WITH PHYSICAL ACTIVITY LEVELS IN YOUNGER OBESE WOMEN.

6.1 Introduction

Chapter four presented the methods and findings of an exploratory qualitative study of activity restrictions in younger obese women. This study suggests FOF might be an issue in younger obese women. The majority of participants reported some concern about falling which they linked to a number of factors such as previous falls or injury, embarrassment, and balance issues. In addition, several participants reported avoiding activities as a result of this fear. Interestingly, the qualitative study in younger obese women suggested that age and levels of regular activity may be contributory factors related to a FOF, as more women over 40 and those with low levels of activity reported a FOF, regardless of their BMI.

These findings together with evidence from the literature led to the development of a conceptual framework of FOF in obese women, which illustrates the relationship between FOF and activity participation, and other influencing factors. To quantify falls and FOF in younger obese women, increase our understanding of relationships between FOF and other factors such as age and BMI, and explore if FOF affects participation in activity, a further larger quantitative study is necessary.

Before conducting a further study, it was necessary to identify suitable FOF tools for use in obese, younger populations that also matched the key concepts of the developed framework. Chapter five reviewed all published self-report balance and FOF instruments. Three FOF measures (MFES, CoF and MSAFFE) were selected as those most appropriate to measure the key concepts and for use in younger, obese populations. These tools, together with validated measures of physical activity, anxiety and depression, previously used in obese populations will be used to further explore FOF and its relationship with physical activity levels in obese women under 50 years of age.

6.2 Purpose of Study

1) To measure the self-reported incidence of falls and fear of falling in a group of younger obese women.
2) To explore the relationship between fear of falling and other factors such as anxiety, depression, age and BMI.
3)To explore the relationship between fear of falling and levels of physical activity in younger obese women.

6.3 Methods

6.3.1 Study Design

This was a cross-sectional exploratory study targeting women under 50 years of age attending NHS weight management services across East Lancashire. As part of these services patients routinely have their height measured and are weighed regularly. Each recruiting member of staff was competent in measuring the height and weight of patients as part of their job role and had undergone prior training on the study and how to identify and recruit participants. The study used self-administered questionnaires to measure baseline characteristics: activity levels, anxiety, depression, incidence of falls and FOF. The questionnaire was developed using a combination of single item and multi-item questionnaires which were organised into a number of sections of a 7-paged, single-sided document.

Women aged between 18 and 50 years old with a BMI equal to or above 30 kg/m^2 and able to read and understand the questionnaire were invited to participate in the study. Participants suffering from a physical disability not related to their weight, such as degenerative neuromuscular conditions, limb amputations, those in a wheelchair or reliant on a walking aid were excluded from the study, as these factors were likely to affect their balance and therefore influence the results.

6.3.2 Participant Recruitment

Women who met the inclusion criteria were recruited from those who attended East Lancashire Hospitals NHS Trust (ELHT) dietetic services and Lancashire Care Foundation Trust (LCFT) Hyndburn weight management services during the recruitment period of 6 months. The sampling method used was non-probability sampling as it involved recruiting participants as they attended particular healthcare services, and on those approached agreeing to take part. This type of non-probability sampling method where participants are recruited based on those easiest to access is considered convenience sampling (Teddlie and Yu, 2007). A disadvantage of using a convenience sample is that they may not be representative of the target population and thus the researcher may not be able to make generalisations to the target population. Those attending these services may differ in their characteristics from those who attend different services or do not attend services. Therefore, it is unclear to what extent a convenience sample, regardless of its size, actually represents the population to which the findings are being generalised, and because the characteristics of the target population are unknown, the extent of this bias is unknown (Punch et al, 2003). Although ideal, probability or random sampling is not always used as it can be extremely difficult to do, time consuming and expensive (Dancey et al, 2012). It would also necessitate a sampling frame of the target population, which was not accessible for the purpose of this research. Many social science studies use convenience samples, for example, of patients, students, paid volunteers, members of friendship groups or organisations. Studies with such samples are useful primarily for documenting that a particular phenomenon or characteristic occurs within a given group, or conversely, demonstrating that not all members of a particular group have a particular trait. Such studies are also useful in preliminary or exploratory research, or for detecting relationships among different phenomena. The advantages of using a convenience sampling method are that it is easy to carry out, and the relative time and cost of attaining convenience samples are small in comparison to probability sampling techniques (Teddlie and Yu, 2007).

Participants who fitted the eligibility criteria were invited to take part in the study by an ELHT dietitian or a health development practitioner who delivered local weight management interventions in NHS premises, across East Lancashire. Each participant was given a brief explanation about the study from the practitioner and received a cover letter explaining the purpose of the study and an information sheet about the study (Appendix D2, p 314). If they were happy to proceed the practitioner asked permission to record their current height and weight on the top of the anonymised numbered questionnaire. The questionnaire was then given to the participant to complete with a prepaid addressed envelope. The participant was given the choice to return the completed questionnaire in the sealed envelope directly to the practitioner, or alternatively to complete it at their leisure and return the questionnaire by post. The return of the questionnaire by either route was taken as an implied consent. No further information was required and so no identifiable information was recorded or kept.

6.3.3 Research Governance and Ethics

Approval to complete the study was given by NRES sub-committee in North East York – Research Ethics Committee number 14/NE/0064. Subsequently, ethical permission was sought and granted from the University of Central Lancashire Ethics Committee for Science, Technology, Engineering, Medicine and Health (STEMH), reference Number: STEMH 200 and was approved by both of the Research Governance Departments at East Lancashire Healthcare NHS Trust and Lancashire Care Foundation Trust.

The researcher was a registered health professional and NHS worker and as such works under professional codes of conduct and within the ethical framework set out by the Caldicott principles. The researcher was also a dietitian working in East Lancashire Hospitals NHS Trust. The study did not conflict with her duties as a dietitian or health care professional.

As employees of NHS Trusts, the researcher, dietitians and health development practitioners were bound to follow the Trusts' Research Governance Policy, Information Governance Code of Confidentiality Policy and Information Management and Technology Security Policy. In addition the researcher, as a research student from the University of Central Lancashire, was bound to follow the University Code of Conduct for Research. The researcher was responsible for coding, collating and analysing the data. A clear audit trail was in place.

Confidentiality

Subject to the requirements of the Data Protection Act (1998) and Freedom of Information Act (2000), all information collected about a participant during a study is confidential, unless otherwise agreed in advance. Each potential participant was given an information sheet (Appendix D2, p 314) and fully informed of the purpose and nature of the study, what the study involved, the benefits, risks and burdens and their right to take part or withdraw from the study at any time up until the anonymised questionnaire was returned. After this point it was impossible to identify the participant's questionnaire as no identifiable data was kept linking them to the coded questionnaire. Participants were also informed that all data would be treated confidentially. No written consent was sought as no identifiable data was taken or recorded and no questions of a sensitive nature were intended to be asked.

There were no potential physical or medical risks to participants as the study involved completing validated questionnaires that did not ask any intentionally distressing or intrusive questions. If for any reason, a participant was to become upset or unhappy as a result of taking part in the study, the researcher or dietetic service manager were available as a first port of call. As no identifiable data was kept it was not possible to link any diagnosed anxiety or depression back to the individual participant. The participant information leaflet specified this and that, if concerned following completion of the questionnaire, the participant was advised to contact either the researcher or the dietetic service manager for advice. Additionally, the participant was advised, as necessary, to speak to their general practitioner or practice nurse to ensure that any related issues were dealt with correctly.

All the questionnaires were coded and anonymous and no identifiable data was recorded. Each participant was allocated an anonymous questionnaire number but as no identifiable data was kept, it was not possible to link the questionnaires back to individual participants. Each participant was asked to complete a short self-administered questionnaire about fear of falling, anxiety, depression and their current physical activity level. The recruiting staff stored the completed questionnaires in a locked filing cabinet in an NHS office until the researcher took receipt of them. The participants were informed that only the researcher would open the sealed envelopes in which the questionnaire was contained and that they will not know who has completed them.

The completed coded questionnaires were collected by the researcher and kept as a hard copy in a separate file, set aside in a locked drawer in an NHS office, accessible only to the research team and the Research and Development Departments. After this the questionnaires were securely transferred to the University of Central Lancashire where they were stored in a locked filing cabinet in the student office. All primary data collected is securely stored for at least 5 years as per the University of Central Lancashire's code of conduct for research.

Steps were in place to safely collect and store confidential data by anonymising using codes and inputting data onto a password secure database at the University. No identifiable data was to be kept and it was not possible to link the questionnaires back to the participants. The participants were informed that it would be impossible to withdraw from the study once they returned their questionnaires as they would not be identifiable.

6.3.4 Measurement Instruments

The study questionnaire was designed to include a number of different sections. It consisted of 3 FOF tools, these were identified and selected from the previous review of FOF instruments that measured different constructs, which were proposed in the conceptual framework. In addition, several questions were included to record relevant participant characteristics as were multi-item questionnaires to measure activity level, anxiety and depression in obese populations.

i) Measures of BMI and Age

Height, weight and BMI were recorded using calibrated equipment and NHS Trust protocols by the recruiting practitioners. As part of the study questionnaire, participants were asked to provide their age not in years but as one of six groups: under 25 years, 25 to 29 years, 30 to 34 years, 35 to 39 years, 40 to 44 years and 45 to 49 years. This was done to help retain the anonymity of the participants and provide reassurance that they would not be identifiable.

ii) Measure of Physical Activity.

Given the nature of the study, a readily accessible questionnaire-based measure of physical activity was required as resources were not available to undertake objective measures, such as the use of accelerometers, heart-rate monitors, or double-labelled water technique (Jakicic et al, 2010; Warner et al, 2012; Fogelholm et al, 2006). Activity diaries, such as the Stanford 7-day recall (7-DR) were excluded as an option for this study as they have to be completed over a 7-day period which involves heavy participant burden as well as the time and resources needed to reduce the data to analysable form (Richardson et al, 2011; Paffenbarger et al, 1993). Likewise, due to the constraints of time and resources interview-based methods were not feasible and so a self-report questionnaire measure was chosen.

The advantages of using a self-report questionnaire are that they are relatively easy to administer and analyse and are less time-consuming to complete compared to either objective or interview-based measures (Prince et al, 2008). Though objective measures of physical activity are often thought to be 'gold standard' measures, they do not capture all activities such as water-based or low intensity activities (e.g. tai chi and yoga) or those with low acceleration (e.g. cycling), and are susceptible to high attrition rates or device failures (Warner et al, 2012). However, interview based methods often report lower activity than self-completed questionnaires, possibly due to the interviewer being able to clarify meaning of the questions asked and thus reduce misinterpretations and misreporting activity (Kim et al, 2007; Hallal et al, 2012; Bandeira et al, 2015)

Another disadvantage of using self-report questionnaires is that, historically, many self-report activity measures lack good reliability or validity, especially when compared with objective measures (Wolin et al, 2008; Prince et al, 2008). This is due to their reliance on a participant's ability to accurately recall their physical activity (Ainsworth et al, 1993; Washburn et al, 1986; Shephard, 2003). However, it has been argued that comparisons of self-reported activity time data with time estimates from objective measures such as accelerometry, are not strictly valid. The reason for this is because they measure different underlying constructs of activity which might explain their lower validity compared to objective measures (Wooden, 2014).

Obese populations have been reported to frequently overestimate the amount of vigorous physical activity they partake in when using self-report questionnaires compared with objective measures, and often misclassify the intensity of activities (Lichman et al, 1992; Warner et al, 2012; Slentz et al, 2005). However, some researchers report the converse to be true (Buchowski et al, 1999). They note that the classifications of activity intensities are often based on non-obese participants and that additional adipose tissue affects an obese individual's ability to partake, thus giving the perception of increased effort and therefore intensity (Fogelholm et al, 2006; Slentz et al, 2005). Furthermore, evidence from randomised controlled trials suggests measures of intensity are not paramount in promoting increased activity in overweight populations and that the amount of physical activity is more important than intensity in promoting long term weight loss (Jakicic et al, 2002; Slentz et al, 2005; Bond et al, 2009).

There are currently no obesity-specific physical activity questionnaires and the need for valid and reliable measures of physical activity in obese individuals has previously been acknowledged (Harvey et al, 2001; Richardson et al, 2011). The self-reported physical activity questionnaires known to be used in overweight populations include the International Physical Activity Questionnaire (IPAQ), Global Physical Activity Questionnaire (GPAQ), Baecke Activity Questionnaire (BAQ) and New Zealand Physical Activity Questionnaire-Short Form (NZ PAQ-SF) (Baecke et al, 1982; Hillsdon, 2009; Bull et al, 2009; Richardson et al, 2011). All these tools have reported reasonable validity and reliability in normal population studies, though most are recommended as interview-based tools.

The IPAQ was chosen for use in this study as it is readily available, has low participant burden and is quick and easy to use. Furthermore, it is increasingly reported to be used to measure physical activity in overweight or obese populations (You et al, 2008; Tehard et al, 2005; Gomez et al, 2009; Hopping et al, 2010; Stavropoulos-kalinoglou et al, 2010; Quinn et al, 2008; Egeland et al, 2008; Leroux et al, 2012; Kharche et al, 2014; Jakicic et al, 2010; Elliott et al, 2014; Bond et al, 2009) and is recommended as a self-report measure of physical activity in weight management interventions (Richardson et al, 2011).

The IPAQ provides a standardised instrument to obtain comparable estimates of physical activity for populations between 15-69 years of age (IPAQ, 2005). Long (27-item) and short (7-item) versions of the instrument are available and have been reported by a number of authors to have acceptable measurement properties, and satisfactory reliability and validity in healthy populations compared to objective measures of activity (Craig et al, 2003; Hagstromer et al, 2006; Wolin et al, 2008; Kutze et al, 2008; Ekelund et al, 2006; Fogelholm et al, 2006; Dinger et al, 2006; Sjostrom et al, 2006; Kim et al, 2007; Warner et al, 2012). The short form (IPAQ-SF) is often preferred by many researchers because it has been reported to have equivalent psychometric properties to the long form despite being one-third of the length and taking less time to complete thereby having a low participant burden (Wolin et al, 2008 Warner et al, 2012; Craig et al, 2003; Tehard et al, 2005). This was important for the study as the participant questionnaire was made up of a number of multi-item questionnaires measuring FOF and other variables, which covered 7 pages. So, consequently the shorter valid measure (IPAQ-SF) was chosen for this study to help reduce the time taken to complete and consequently burden to the participants.

Studies using the IPAQ in overweight populations have reported mixed reviews on the measurement properties of IPAQ with a few suggesting less accuracy among obese individuals (Tehard et al, 2005; Barreto da Canha, 2013; Egeland et al, 2008; Warner et al, 2012). The IPAQ-SF was selected as the physical activity measure for this study because it has demonstrated fair reliability and validity in obese populations, particularly between those subjects who are moderately active and those relatively inactive (Lee et al 2011). As the purpose of the study was not to record accurate measures of energy expenditure in obese subjects but more to classify subjects as either being moderately active or relatively inactive, it was considered appropriate.

The IPAQ-SF accesses a 7-day recall of domain-specific physical activity which include: vigorous intensity activity, moderate intensity activity, walking for at least 10 minutes at one time, and hours spent sitting and/or lying down (excluding sleeping) per day. The results are then used to calculate the energy costs of activity as the metabolic equivalent of task (MET). IPAQ guidelines are used to classify respondents according to activity type and MET into high, moderate or low physical activity levels. Individuals are classified as being physically inactive if they do not attain the levels of moderate or high physical activity (IPAQ, 2005).

iii) Measure of Anxiety and Depression

There are a number of self-report measures used to assess anxiety and depression that have been used in obese populations. The more commonly used self-report measures being: the Hospital Anxiety and Depression Scale (HADS), the Goldberg Anxiety and Depression Scale (GADS), the General Anxiety Disorder-7 (GAD-7) and the Brief Patient Health Questionnaire Mood Scale (PHQ-9) (Zigmond and Snaith, 1983; Goldberg et al, 1988; Spitzer et al, 2006; Cameron et al, 2008).

Both subscales (HAD-A and HAD-D) of the HADS have been shown to have good reliability, sensitivity and specificity and validity in healthy populations (Hermann, 1997; Andersen et al, 2010). The HADS has been frequently used as a measure of anxiety and depression in obesity studies (Bjerkeset et al, 2007; Andersen et al, 2010; Brumpton et al, 2013). HADS has been considered to be well suited for detecting mood disorders among the obese, and has shown good responsiveness to change in morbidly obese patients undergoing bariatric surgery (Karlsson et al 2007; Andersen et al, 2010; Dahl et al, 2012). Other studies report HADS to be reliable and valid in both community and hospital-based obese populations (Lopez-Alvarenga et al, 2002; Andersen et al, 2010; Pokrajac-Bulian et al, 2010; Brumpton et al, 2013). Unlike the HADS, although used in obese populations, there are no studies exploring the validity and reliability of the other measures in obese populations.

Therefore, the HADS was chosen for use in this study as a valid and reliable self-rating scale that measures anxiety and depression in community settings (Bjelland et al, 2002). The researcher had experience of using the HADS with obese patients in clinical practice and it was also recommended to her by other researchers working in the field of FOF. Prior to beginning the study, permission and a license to administer this scale were sought and purchased. The HADS was designed to briefly assess general symptoms of anxiety and depression in the physically ill and carefully distinguishes between the concepts of anxiety and depression (Zigmond and Snaith, 1983). It consists of 14 items divided into two subscales with seven items assessing anxiety (HADS-A) and seven assessing depression (HADS-D). Participants are asked to rate their anxiety and depression symptoms for each item using a four-point scale (from 0 (not present) to 3 (considerable)). Standard cut-off scores are used with HADS-A and HADS-D to classify minimal (0–7), mild (8–10), and moderate to severe (≥11) levels of depression. A lower score represents better mental health (Bjelland et al, 2002).

iv) Self-reported history of Falls Incidence

A main aim of this study was to measure the number of participants who had previously fallen, which was done using a single-item question "During the past year, how often have you fallen over? (Never, once, twice or more)". This question had previously been used in other FOF studies to measure incidence of falls (Wolf et al, 2001; Yardley and Smith, 2002; Parry et al, 2013). Self-reported or subjective, retrospective measures of previous falls are known to be less accurate than prospective measures such as using a falls diary, and are susceptible to under-reporting and recall bias (Mackenzie et al, 2006; Garcia et al, 2015). A falls diary would have put more burden on the participants and more administrative burden on the staff recruiting participants. It was felt that this would affect the recruitment to the study. Though self-report measures of previous falls are shown to be fair to moderately valid in recalling numbers of falls (Mackenzie et al, 2006), this was not essential to the study as the main purpose of this tool was to ascertain the number of previous fallers and non-fallers.

v) Fear of Falling Instruments

Three FOF measurement instruments chosen for use in the study were selected from tools identified in the previous review of self-report FOF measurements (Chapter 5). However, all the identified measures had previously only been used in elderly populations and none had been reported being used in obese adults or those under the age of 50 years. The instruments were chosen based on the items they measured, how well they mapped onto the conceptual framework, and their practicality as relatively short self-report tools.

1) Modified Falls-Efficacy Scale (MFES)

The MFES is designed to be completed by an individual or administered by a professional and aims to determine how confidently clients feel they are able to undertake a range of activities without falling (Hill et al, 2010). It consists of 14 items, including the original 10 from the FES and an additional four activities performed outside the home: using public transport, crossing roads, light gardening or hanging out washing, and using front or rear steps. It asks individuals to rate their confidence in doing each activity without falling on a visual analogue 10-point scale where 0 means ‘not confident at all’, 5 means ‘fairly confident’ and 10 means ‘completely confident’. The MFES also includes clear instructions about how to rate items when an individual does not perform that activity (Hill et al 2010). The overall MFES score is calculated by averaging the scores for all items, to give a score between 0 and 10. Unlike the original FES, the scoring is reversed where higher scores reflect higher falls efficacy and those lower FOF. An average score of below 8 indicates FOF and 8 or above indicates more confidence in performing activities without falling (Hill et al, 1996). Permission to use this tool was received from the author.

2) Consequence of Falling Scale (CoF)

The CoF scale was developed to measure the perception of 12 possible consequences of falling, ‘I think that if I fall over I will…’ and asks for the participant’s opinion from a choice of 4 responses numbered 1 to 4, 1 being disagree strongly with the statement and

4 being agree strongly with the statement (Yardley and Smith, 2002). All responses are added together and higher scores denote greater concerns of the consequence of falling. The questionnaire consists of 12 items made up of two subscales: the Loss of Functional Independence (CoF-LFI) and Damage to Identity (CoF-DI). The CoF-LFI assesses being active, losing independence, becoming disabled, severely injured, helpless, and unable to cope, whilst the CoF-DI measures difficulty getting up, causing a nuisance, losing confidence, embarrassment, pain and feeling foolish (Yardley and Smith, 2002). Permission to use this tool was received from the author.

3) Modified Survey of Activities and Fear of Falling in the Elderly Scale (MSAFFE)

The MSAFFE is a modified, self-administered version of the SAFFE scale that was developed to assess the role of fear of falling in activity avoidance in older people (Yardley and Smith, 2002). The 17 items that quantify the extent an activity would be avoided due to FOF are rated on a 3-point Likert scale (1 = 'never avoid', 2 = 'sometimes avoid', 3 = 'always avoid'). All scores are collated to produce a total score that ranges from 17 to 51 and higher scores denote greater avoidance. Permission to use this tool was gained from the authors.

6.3.5 Sample Size

One of the main objectives of the study was to report the level of fear of falling in obese younger women. Therefore, the sample size was calculated based on studies reporting on the mean MFES in elderly populations (Hill et al, 1996; O'Halloran et al, 2010). The MFES was used as this was the multi-item measure chosen to cover the concept of falls-efficacy and falls-efficacy which was the dominant construct underpinning FOF in the study. Two studies were found which reported on mean MFES scores and their standard deviation in elderly fallers and non-fallers (Hill et al, 1996; O'Halloran et al, 2010). The mean (SD) for healthy non-fallers was 9.76 (0.32) in the study by Hill et al (1996) and 9.56 (0.72) in the study by O'Halloran et al (2010). It was 7.69 (2.21) and 8.85 (1.68) respectively for fallers. To provide a conservative estimate of the sample size, the calculation used the two higher standard deviations. A margin of error of 0.5 was also chosen as this would produce a relatively precise estimate.

Using these data for a precision of +/- 0.5 with 95% confidence, it was estimated that we would need 75 returned questionnaires with the MFES completed if the SD was 2.21 and

43 if the SD was 1.68. As another objective of the study was to explore the correlation between fear of falling and BMI as a continuous variable, it was decided to aim for a sample size of 75 as this would give a 95% confidence interval of 0.31 to 0.65 for a correlation coefficient of 0.5. It was estimated that it would take 4 to 6 months to recruit the participants. After this time, there were only 63 completed questionnaires. As it was estimated that this would only increase the 95% confidence interval around a correlation coefficient of 0.5 to 0.29 to 0.67, the recruitment was ceased.

6.3.6 Statistical Analysis

The data were recorded manually by the lead researcher and entered into a database for statistical analysis (SPSS version 21, SPSS, Inc., Chicago, IL, USA). Descriptive and inferential statistics were used to describe sample characteristics and examine differences and relationships in the sample, including histograms and scatterplots.

i) Analysis relating to Self-Reported Falls

The self-reported incidence and distribution of falls were estimated for the overall study population and across BMI and age groups. The differences in continuous variables of BMI, anxiety and depression between fallers versus non-fallers were explored using independent t-tests. The differences in BMI, age and activity groups between fallers versus non-fallers were explored using chi-square tests.

ii) Analysis relating to Fear of Falling

The mean FOF was estimated for all three measures and the distribution of scores across BMI and age groups were compared. In addition, an analysis was performed on each multi-item questionnaire to compare mean individual item responses and also to highlight which activities the participants might have a higher FOF whilst performing. To explore whether previous falls are a contributory factor to FOF in obese women, a comparison of mean scores of all the FOF measures was made between fallers and non-fallers, using independent t-tests, to establish any significant differences. Subsequently, comparisons of the mean scores for individual activities of the MFES, CoF and MSAFFE of fallers, versus non-fallers were performed using independent t-tests. This was again to identify if a previous fall might affect FOF of individual activities.

iii) Analysis relating to exploration of associations of Fear of Falling with other variables

Initially, scatterplots and boxplots were generated to illustrate any potential relationships between FOF and the independent variables: BMI, age, physical activity, anxiety and depression, these are displayed in Appendix D4, p 327-335. Bivariate correlational analysis was performed to measure linear relationships between all three measures of FOF and the independent variables, BMI (continuous), anxiety, and depression. The statistical test used to measure correlation coefficients was Pearson's Product-Moment Correlation (Pearson's R). A two-sided P value level of <0.05 was used to indicate statistically significant difference. Differences between FOF measures and the categorical independent variables BMI group, age group, and activity level were explored using one-way Analysis of Variance (ANOVA). Post-hoc tests were applied as a multiple comparison test to identify which categorical groups were significantly different from which. There are numerous multiple comparison tests available, whose general purpose is to make adjustments to the overall significance level (P values) when several statistical inference tests are being performed simultaneously on a single data set to reduce the chances of obtaining type 1 errors (Bland and Altman, 1995). The various tests differ in how well they properly control the overall significance level and in their relative power. If the data met the assumption of homogeneity of variances, the Tukey's honestly significant difference (HSD) was chosen as the post-hoc test and if the data did not meet the homogeneity of variances, Games-Howell was used. Differences were considered statistically significant if P< 0.05.

iv) Analysis relating to relationship between FOF and Activity Participation

One objective of the study was to explore the relationship between FOF and activity participation, which literature in the elderly suggests could lead to reduced activity and avoidance of activity of obese adults (Bruce et al, 2002). Previous literature and the proposed conceptual framework suggests other independent variables can influence FOF and activity participation. Univariate analyses were initially completed to test the association of each independent variable, in turn with activity status. This was done in order to determine which variables to include in multivariate logistic regression analysis to estimate a model that could predict activity in obese women under 50 years of age. All variables with P values < 0.1 were included in the model.

v) Analysis relating to the associations between Independent Variables

Prior to multivariate analyses, relationships between the other independent variables were investigated to check for collinearity. This was completed using Pearson's correlation coefficients between continuous variables and the variance inflation factor in a linear regression. If this was the case this can cause problems during a multivariate analysis and cause less stable estimates of the coefficients leading to widely inflated standard errors. If collinearity was found, then consideration if one of the variables should be excluded from the multivariable analysis was undertaken.

vi) Analysis relating to the relationship between Fear of Falling and Activity Participation.

As activity level was categorical data and FOF continuous data, binary logistic regression was the analytical method chosen. Activity was the dichotomous dependent variable (low versus moderate and high activity) and FOF as the independent or predictor variable. This analysis was repeated using all three FOF measures, along with the variables found to be statistically significant in univariate analyses to explore the relationships between FOF and activity level. As the study was cross-sectional, it was not possible to predict the direction of the relationship between the variables.

6.3.7 Inputting Data and Data Verification

All the data were inputted into SPSS version 21 within 2 months of collection. The variables were listed in order as on the questionnaire and optional numerical values listed for each variable denoting the range of possible responses, e.g. 1 = not fallen, 2 = fallen once, 3 = fallen twice or more. Computed BMI was added as a variable to check the practitioner calculated BMI against the BMI estimated from recorded height and weights. Specific codes were given for missing data: 999 = missing or blank value and 777 = don't know or question mark. Data validation is essential to ensure the integrity of the data is maintained and for this study it was achieved by one observer checking twice in addition to the use of descriptive statistics (Dancey et al, 2011, Chapter 6). This method of checking data might not be deemed sufficient as systematic and repeated errors are more likely to be made by one individual than if another independent observer is used. Ideally, a second independent observer should be used to check the data entered by the first or ideally enter the data again (double-entry), as it is unlikely that two people will make the same systematic errors (Paulsen et al, 2012). This process was not possible to undertake due to financial constraints within the research. However, the researcher was aware of the importance of checking inputted data and used other methods within the time and resources available to reduce the possibility of errors. The relatively small size of the dataset made it feasible to check all the data manually for any errors after inputting. This manual checking of all inputted data was repeated again after one week so as to reduce the chance of repeating the same errors. Additional checks of inputting errors were made by using descriptive statistics in SPSS to check for missing values and outliers by looking at frequency or distribution tables and the ranges of answers. These were then checked manually against both missing and written values from the questionnaires for errors. Eighteen mistyped or miscalculated numbers were recorded and the overall percentage error rate was calculated to be 0.35% (18/5166). After correction all the data was again re-checked manually and no further input errors were observed.

6.3.8 Missing Values and Imputation

There were 29 missing or 'don't know' answers from all 63 questionnaires with the majority of these from the physical activity questionnaire (Table 6.1). Eleven respondents answered, 'don't know' to question 7 of the IPAQ-SF which asks about time spent sitting. As time spent sitting was not directly related to the study objectives or calculation of activity level it did not have a significant effect on the results. The remaining 18 missing answers (Table 6.1) were from different participants and not related to any particular questions when checked manually and using the MVA (Missing Value Analysis) function in SPSS. From this, it could be assumed that the missing values most probably resulted from being overlooked by the participants when completing the questionnaires. Imputation was used to replace missing answers. There were eight missing answers from the IPAQ-SF questionnaires which resulted in five questionnaires being omitted from the analysis, as a total activity score was not able to be calculated. The remaining nine missing responses from other multi-item questionnaires were from nine different participants and replaced with estimated means.

Table 6.1: Sources of Missing Data

Questionnaire/question	Number Missing
Single-item questions:	
Height	1
Multi-item questionnaires:	
Modified Falls Efficacy Scale	
Reach into cabinet	1
Light gardening	1
Yardley's Consequence of falling Scale	
Lose my confidence	1
Will be severely injured	1
Modified SAFFE	
Take a bath	1
Take a shower	1
Reach for something above head	1
HAD-D depression subscale	
Lose interest in my appearance	1
HAD-A anxiety subscale	
Feel restless as if I have to be on the move	1
IPAQ-SF	
Questions 1-6 covering activity levels	8
Question 7-sitting question	
Answered 'Don't know'	11
Total Number Missing	29

6.4 RESULTS

6.4.1 Participant Characteristics

The study population included obese women who were accessing weight management services across East Lancashire. The recruitment process took approximately 6 months to complete and 63 participants aged between 18 and 49 years completed the study questionnaire. A summary of all participant characteristics and responses are shown in Table 6.2.

Table 6.2: Participant Characteristics of 63 obese women under 50 years of age

Characteristic	Study Findings
Age Range	18-49 years
BMI	Range = 30 -76.6 kg/m² Mean = 42.1 kg/m² (SD =10.3) Median = 39.8 (IQR= 39-5-44.4)
Self-report incidence of falls	66.7%
Anxiety	Mean= 10.1 (SD= 4.8), Median=10, 95% CI= 8.83 to 11.28
Depression	Mean=7.5 (SD= 4.7), Median= 7, 95% CI=6.28 to 8.68
Falls-efficacy (MFES)	Mean=7.67 (SD=2.67), Median=8.5, 95% CI=6.99 to 8.34
Consequences of falling (CoF)	Mean=31.3 (SD =9.43), Median=32, 95% CI=28.96 to 33.71
Activity Avoidance (MSAFFE)	Mean=25.88 (SD =16), Median=23, 95% CI=23.69 to 28.07

CI= confidence intervals around the mean
IQR = Interquartile range
SD = standard deviation

i) Age

The participants were originally divided into 6 age groups ranging from <25 to 45-49 years of age, though once tabulated, an uneven distribution could be seen (Table 6.3). The numbers of participants below 30 years of age were relatively small compared with those in the groups above 40 years of age. Those over 45 years old made up 38% of the total number. The numbers in some of the younger age groups were too small to draw meaningful conclusions, thus the age groups were subsequently collapsed into 3 more equally distributed age groups of: under 35, 35 to 45 and over 45 years of age (Table 6.3).

Table 6.3: Distribution of participant age groups

Original Age Group (years)	No	Percent %	Collated Age Group (years)	No	Percent %
<25	3	4.8			
25-29.9	6	9.5	<35	18	28.6
30-34.9	9	14.3	35-44.9	21	33.3
35-39.9	8	12.7	45-50	24	38.1
40-44.9	13	20.6			
45-49.9	24	38.1			
Total	63	100		63	100

ii) BMI

The BMI ranged from 30-76.6 kg/m² with a mean of 42.1 years (SD =10.3) (Table 6.4). The over 45 years of age group had the lowest mean BMI of 41.23 kg/m² while those aged 35 to 45 years had the highest mean BMI at 42.9 kg/m² (SD=12.64) (Table 6.5). The participants were also categorised into four BMI subgroups of: 30-34.9, 35-39.9, 40-44.9 and over 45 kg/m². The distribution between the groups was relatively evenly split with slightly fewer participants in the over 45 categories (Table 6.4). The mean BMI of all three age groups were seen to be similar ranging between 42.90 kg/m² for the 35-44.9 years age group and 41.23kg/m² for the over 45 years age group (Table 6.5)

Table 6.4: Distribution of participant BMI

BMI (Kg/m²)	**No**	**%**
Total	63	
Mean	42.1	
SD	10.3	
Median	39.8	
Range	30-76.6	
30-34.9	16	25.4
35-39.9	17	27.0
40-44.9	17	27.0
>45	13	20.6

Table 6.5: Distribution of Age and BMI in 63 obese women under 50 years old.

Age Range (years)	**Number**	**Percent %**	**Mean BMI Kg/m²**
<35	18	28.6	42.50 (6.73)
35-44.9	21	33.3	42.90 (12.64)
45-50	24	38.1	41.23 (10.54)

iii) Physical Activity

Physical Activity was measured using the International Physical Activity Questionnaire (IPAQ-SF), whereby scores were categorised into 3 levels as recommended in the analysis protocol: low, moderate and high (IPAQ 2005). Five participants had missing values for physical activity, making it impossible to assess and so were excluded from the activity analysis. Of the remaining 58 participants, 26 participants were classed as having low activity, 21 were moderately active and 11 were highly active (Table 6.6). The MET score was calculated for each participant as a continuous measure. However, due to 8 missing answers, unable to be checked (as anonymous), and the presence of large standard deviations the results were considered to be unreliable, and so not used in further analysis.

Table 6.6: Distribution of Activity levels of 58 obese women under 50 years old

	IPAQ-SF Level				IPAQ-SF Level
	Low	**Mod**	**High**	**Missing**	**Moderate-to-High**
Total	26	21	11	5	32
Age Group (years)					
<35	5	9	4	0	13
35-44.9	7	8	3	3	11
45-50	14	4	4	2	8
BMI Group (Kg/m²)					
30-34.9	6	6	3	2	9
35-39.9	6	4	5	1	9
40-44.9	5	9	3	0	12
>45	9	2	0	2	2

As the numbers in each activity category were relatively small, no meaningful observations could be inferred from the results. The distribution of participants' activity level showed the high activity group had proportionately fewer numbers than both the moderately active and low activity groups. Boxplots of activity against other variables showed similarities in results of both the moderately active and highly active group compared with the low activity group (Appendix D4, p 333-335). To enable statistical analysis using contingency tables the IPAQ-SF scores had to first be collapsed into two categories of low activity and moderate-to-high activity to ensure that over 80% of the expected cell counts were over 5, and therefore valid. The low activity group included those participants who had IPAQ-SF scores of 1 and the moderate-to-high activity group had IPAQ-SF scores of 2 or 3. Analysis showed a statically significant association between BMI group and activity group (χ^2 (3, 58)=8.00, P=0.046) but no significant association between age group and activity group (χ^2(2, 58)=5.52, P=0.063) (Table 6.7). Chi-square tests were not performed between age groups and BMI groups as participant numbers were too small to achieve validity.

Table 6.7: Associations of BMI, Age and Activity level in obese women under 50 years of age

Variables	Pearson's Chi-square ($\chi 2$)	df	P value
BMI Group and Activity level	8.00	3	0.046
Age Group and Activity level	5.52	2	0.063

iv) Anxiety and Depression

The mean anxiety and depression scores were 10.1(SD 4.8) and 7.5 (SD 4.7) respectively suggesting on average participants had mild anxiety and depression (Table 6.8). The mean scores were both similar to the medians suggesting a symmetrical distribution. A one-way ANOVA showed that there were no significant differences between age groups in terms of anxiety and depression. However, significant differences were shown between the BMI groups in terms of anxiety and depression ($F(3, 59) = 5.83$, $P = 0.001$; $F(3, 59) = 5.81$, $P = 0.02$, respectively). Post-hoc tests (Tukey HSD) showed that participants with BMI above 45kg/m² had significantly higher anxiety and depression than participants with a BMI between 30-34.9kg/m² ($P = 0.001$ and $P = 0.001$ respectively).

Table 6.8: Mean Anxiety and Depression Scores in obese women under 50 years of age

	Mean Anxiety Score	Mean Depression Score
Total	63	63
Mean	10.05	7.48
SD	4.85	4.75
Median	10.0	7.0
IQR	6-13	4-11
Missing	1	1

v) History of Self-Reported Falls

Falling was measured using a single-item question asking how often the participant had fallen in the past 12 months. The number of falls were recorded as: never fallen, fallen once or fallen twice or more (Table 6.9). Approximately a third (n = 21) of all participants reported that they had never fallen compared with 14 who had fallen once and 28 who had fallen twice or more in the past year. The incidence of self-reporting falls in this study was 66.7%.

Table 6.9. Self-reported falls in obese women under 50 years of age.

	Number not fallen	Number fallen once	Number fallen twice or more	Total Number fallen
Total	21	14	28	42

6.4.2 Comparison of BMI, Age, Activity level, Anxiety and Depression between Fallers versus Non-fallers

Self-reported falls was categorised into two groups: fallers, who had fallen once or more in the past 12 months, and non-fallers who had not fallen. The characteristics of the fallers and non-fallers were compared (Tables 6.10 and 6.11). The difference in age groups, BMI (groups) and activity levels between the fallers and non-fallers were measured using contingency table analysis (Pearson's Chi-square) as the data was categorical (Table 6.10). No associations were found between self-reported falls and age group ($\chi^2(2, 63) = 1.29$, $P = 0.529$) and self-reported falls and BMI group ($\chi^2(3,63) = 5.79$, $P = 0.122$). Similarly, no association was found between self-reported falls and activity level ($\chi^2(1, 58) = 0.73$, $P = 0.393$). Furthermore, the mean BMI (continuous) of fallers compared to non-fallers were also found not to be statistically significantly different using an independent t-test (Table 6.11).

Table 6.10: Comparison of BMI (groups), Age and Activity between Non-fallers and Fallers.

	Non Fallers	**Fallers**	**Total**	**Pearsons Chi Square ($\chi2$)**	**df**	**P value**
BMI Group (Kg/m²)						
30-34.9	8	9	17	5.79	3	0.12
35-39.9	5	11	16			
40-44.9	7	10	17			
>45	1	12	13			
Age Group (Years)						
<35	5	13	18	1.29	2	0.52
35-44.9	9	12	21			
>45	7	17	24			
IPAQ Level						
Low	7	19	26	0.73	1	0.39
Moderate-to-high	12	20	32			

Both mean HAD-A and HAD-D scores were significantly higher (t =-2.67, df 61, P = 0.01; t=-2.66,df 61, P = 0.01, respectively) in the fallers compared with non-fallers. (Table 6.11).

Table 6.11: Comparison of BMI, Anxiety and Depression between non-fallers and fallers

Independent Variable	N	Mean	SD	t	df	P value	Mean diff	95% CI of the difference Lower limit Upper limit
BMI								
Not fallen	21	38.78	8.23	0.86	61	0.70	-5.02	-10.41 to 0.36
Fallen	42	43.81	10.86					
Total	63	42.14	10.28					
Anxiety (HAD-A)								
Not fallen	21	7.86	4.11	2.67	61	0.01	-3.30	-5.80 to -0.82
Fallen	42	11.15	4.86					
Total	63	10.05	4.84					
Depression (HAD-D)								
Not fallen	21	5.33	3.55	2.66	61	0.01	-3.22	-5.65 to -0.80
Fallen	42	8.56	4.95					
Total	63	7.48	4.75					

6.4.3 Fear of Falling

1) Falls-Efficacy (MFES)

For the MFES, an average score of below 8 indicates FOF and 8 or above indicates no FOF (Hill et al, 1996). Twenty-one participants (33.3%) had a score below 8 suggesting that they had a FOF. The mean score of all participants was 7.67 (SD = 2.67; 95% CI 6.99 to 8.34) and the median was 8.5 (IQR = 5.7 to 10) (Table 6.12). The mean scores of each individual activity from the MFES are shown in Table 6.13 in Appendix D4 (p 336) and can be seen to be relatively similar. However, due to the small sample size, no definitive conclusions can be drawn from these results.

Table 6.12: Mean Scores of Fear of Falling Questionnaires in 63 obese women under 50 years of age

	Mean Modified FES Scale	Mean Consequence of falling Scale	Mean Damage to Identity sub-Scale	Mean Loss of Functional Independence sub-Scale	Mean Modified SAFFE Scale
Total Mean	7.67	31.34	17.76	13.58	25.88
SD	2.67	9.42	4.51	5.52	8.69
Median	8.50	32.00	18.00	13.00	23.00
IQR	5.7-10	24-38	15-21	9-18	18-34
CI	6.99to 8.34	28.96 to 33.71	16.68 to 18.82	14.95 to 16.17	23.69 to 28.07
Missing	2	2	1	1	3

2) Consequences of Falling (CoF)

The mean total score for the Consequence of Falling scale was 31.34 (SD = 9.43; 95% CI = 28.96 to 33.71) and a median of 32.00 (IQR = 24-38) (Table 6.12). The mean scores for the two subscales, damage to identity and loss of functional independence, were 17.76 (SD = 4.51;95% CI = 16.68 to 18.82) and 13.58 (SD = 5.52 95% CI = 14.95 to 16.17) respectively (Table 6.12), suggesting that participants were more concerned about the social embarrassment of falling than the risk of injury or disability. Individual item means are shown in Table 6.14, Appendix D4, p 337. This suggestion was supported by further statistical analysis that showed that the two subscales to be highly correlated, (Pearson's correlation = 0.76), and using a paired t-test there was a significant difference between the participants' scores on the DI and LFI scales (paired t = 9.31(62), P = <0.001).

3) Activity Avoidance (MSAFFE)

The modified SAFFE measures activity avoidance due to FOF. The mean score of the MSAFFE was 25.88 (SD=16; 95% CI= 23.69 to 28.07) and median value of 23 (IQR=18-34) (Table 6.12). Individual item mean scores can be seen in Table 6.15, Appendix D4, p 338.

6.4.4 Comparison of the Effect of Self-report Falls on Fear of Falling measures

Comparisons of mean scores of the three FOF measures were made between those women who had not previously fallen and those who had fallen at least once (Table 6.16). Using independent t-tests, the non-fallers had statistically significant differences in all measures compared to the fallers.

Table 6.16: Comparison of Fear of Falling instrument scores between non-fallers and fallers using independent t-tests

Fear of Falling Instrument	Total Mean (SD)	Non-fallers (SD)	Fallers (SD)	t	df	P value
Number		21	42			
Modified Falls Efficacy Scale	7.67 (2.67)	9.03 (2.38)	6.99 (2.57)	3.13	60	0.003
Consequence of falling Scale	31.34 (9.42) (12-48 range)	25.71 (8.60)	34.15 (8.60)	-3.53	61	0.001
CoF-DI subscale	17.76 (4.51) (6-24 range)	15.28 (5.00)	18.99 (3.72)	-3.32	61	0.002
CoF FL subscale	13.58 (5.52) (6-24 range)	10.43 (4.09)	15.15 (5.49)	-3.45	61	0.001
Modified SAFFE Scale	25.87 (8.69)	20.07 (4.26)	28.78 (8.91)	-5.24	60	<0.001

i) Falls-Efficacy (MFES)

The MFES scale has a reverse scoring, where lower scores signify a higher FOF. Self-reported fallers had a significantly lower MFES mean score compared with non-fallers ($t = 3.13$; df 60, $P = 0.003$), suggesting that previous fallers have a greater concern of falling or lower falls-efficacy than non-fallers. However, when the mean values of the fallers and non-fallers are compared (Table 6.17), the mean score for fallers was over the threshold for FOF (<8) in every activity, whereas the non-fallers was not.

Statistically significant differences in mean scores between the two groups were seen for all activities except for getting dressed. The biggest differences were seen for simple shopping, using public transport and crossing roads.

Table 6.17: Comparison of activities of the Modified Falls Efficacy Scale between 21 non-fallers and 42 fallers in a study of 63 obese women under 50 years of age

Modified Falls Efficacy Scale	Fall	Mean	SD	t	df	p
Get dressed/undressed	Not fallen	8.71	2.72	1.60	61	0.115
	Fallen	7.62	2.48			
Prepare simple meal	Not fallen	9.24	2.30	2.05	61	0.045
	Fallen	7.83	2.68			
Take bath/shower	Not fallen	8.57	2.96	2.31	61	0.024
	Fallen	6.64	3.20			
Get in/out chair	Not fallen	8.81	2.56	2.28	61	0.026
	Fallen	7.19	2.69			
Get in/out bed	Not fallen	8.81	2.66	2.29	61	0.025
	Fallen	7.21	2.58			
Answer door/phone	Not fallen	9.24	2.26	2.17	61	0.034
	Fallen	7.83	2.50			
Walk inside house	Not fallen	9.29	2.24	2.80	45.4	0.007
	Fallen	7.52	2.57			
Reach inside cabinet	Not fallen	9.24	2.30	3.21	45.5	0.002
	Fallen	7.16	2.65			
Light housekeeping	Not fallen	9.14	2.39	3.21	47.9	0.002
	Fallen	6.93	2.92			
Simple shopping	Not fallen	9.19	2.32	3.73	51.7	<0.001
	Fallen	6.60	3.10			
Use public transport	Not fallen	9.10	2.43	4.04	53.7	<0.001
	Fallen	6.07	3.42			
Crossing roads	Not fallen	9.10	2.41	3.76	50.8	<0.001
	Fallen	6.40	3.15			
Light gardening/hang out washing	Not fallen	8.86	2.54	3.04	47.1	0.004
	Fallen	6.65	3.04			
Front/rear steps	Not fallen	8.86	2.52	3.23	51.3	0.002
	Fallen	6.43	3.34			

2) Consequence of Falling (CoF)

Self-reported fallers had a significantly higher fear of the consequences of falling compared with non-fallers ($t = -3.53$; df 61, $P<0.001$), suggesting that falling might be related to the consequences of falling in obese women. The 3 statements, “I will lose my independence”; “I cannot continue to be active”; and “I will become disabled”, showed the largest differences between the groups (t = -4.02, df 55.5, P<0.001; t = -3.98,df 61, P = <0.001; t = -3.53, df 57.7, P = 0.001 respectively) with fallers more likely to agree with the statements (Table 6.18). No statistically significant differences were seen between the two groups’ responses to the statements about being ‘embarrassed’, ‘feeling foolish’ and ‘will be severely injured’, suggesting a similar concern about these consequences of a fall, regardless of actually having fallen. There was a significant difference between the mean scores of non-fallers and fallers in both subscales, damage to identity and loss of functional independence (t = -3.32, df 61 P = 0.002 and t = -3.48, df 61, P = 0.001 respectively) where the fallers had higher scores on both subscales.

3) Activity Avoidance (MSAFFE)

Self-reported fallers had a significantly higher avoidance of activities due to a FOF compared with non-fallers (t = -5.24; df 60, P<0.001), suggesting that falling might be associated with activity avoidance due to FOF. The mean scores of each question about activity avoidance were higher (i.e., more likely to avoid the activity) in the fallers than the non-fallers and the analysis shows a significant difference between the mean scores of each group for all of the responses except ‘going to a Doctor or Dentist’. The greatest concern for both groups was ‘going out when it is slippery’ (mean non-faller = 1.76 vs mean faller = 2.36); ‘going to a place with crowds’ (mean non-faller = 1.33 vs mean faller = 2.07); and ‘going for a walk’ (mean non-faller = 1.24 vs mean faller = 1.98) (Table 6.19)

Table 6.18: Comparisons of the items of the Consequences of Falling Scale between 21 Non-fallers and 42 Fallers in 63 obese women under 50 years

Consequence of falling Scale	Fallen	Mean	SD	t	df	P value
Difficulty getting up	Not fallen	2.10	1.04	-3.10	61	0.003
	Fallen	2.98	1.07			
Cause a nuisance	Not fallen	2.00	1.05	-2.83	61	0.006
	Fallen	2.74	0.94			
Lose my confidence	Not fallen	2.29	1.15	-2.75	31.8	0.010
	Fallen	3.07	0.87			
Cannot continue to be active	Not fallen	1.67	0.80	-3.98	61	<0.001
	Fallen	2.67	1.00			
Lose my independence	Not fallen	1.67	0.73	-4.02	55.5	<0.001
	Fallen	2.60	1.08			
Will be embarrassed	Not fallen	3.14	1.06	-1.80	27.2	0.083
	Fallen	3.60	0.63			
Will be in pain	Not fallen	2.71	1.06	-2.80	61	0.007
	Fallen	3.33	0.69			
Will become disabled	Not fallen	1.57	0.68	-3.53	57.7	0.001
	Fallen	2.36	1.08			
Will feel foolish	Not fallen	3.05	0.97	-1.11	61	0.273
	Fallen	3.29	0.71			
Will be severely injured	Not fallen	2.14	0.85	-1.80	61	0.076
	Fallen	2.61	1.01			
Will be helpless	Not fallen	1.76	0.83	-2.96	51.6	0.005
	Fallen	2.50	1.11			
Will not be able to cope alone	Not fallen	1.62	0.81	-3.02	61	0.004
	Fallen	2.43	1.09			
Total CoF Score	Not fallen	25.71	8.60	-3.67	61	<0.001
	Fallen	34.15	8.60			
Damage to Identity Subscale	Not fallen	15.28	5.00	-3.32	61	0.002
	Fallen	18.99	3.72			
Loss of Functional Independence Subscale	Not fallen	10.43	4.09	-3.48	61	0.001
	Fallen	15.15	5.49			

Table 6.19: Comparison of Avoidance of Activities in 21 Non-fallers and 42 Fallers in 63 obese women under 50 years of age

Modified Survey of Activities and Fear of Falling in the Elderly	Fall	Mean	SD	t	df	P value
Go to the shops	Not fallen	1.14	0.36	-3.78	60.9	<0.001
	Fallen	1.64	0.69			
Clean your house	Not fallen	1.05	0.22	-3.28	57.9	0.002
	Fallen	1.38	0.58			
Prepare simple meals	Not fallen	1.05	0.22	-2.8	60.9	0.007
	Fallen	1.29	0.46			
Go to Doctor/dentist	Not fallen	1.19	0.40	-1.25	46.7	0.219
	Fallen	1.33	0.48			
Take a bath	Not fallen	1.07	0.24	-4.58	53	<0.001
	Fallen	1.69	0.81			
Take a shower	Not fallen	1.05	0.21	-3.56	59.3	0.001
	Fallen	1.39	0.54			
Go for a walk	Not fallen	1.24	0.44	-4.8	60.1	<0.001
	Fallen	1.98	0.78			
Go out when it is slippery	Not fallen	1.76	0.63	-3.45	61	0.001
	Fallen	2.36	0.66			
Visit a friend or relative	Not fallen	1.10	0.30	-4.02	60.9	<0.001
	Fallen	1.55	0.59			
Go to a place with crowds	Not fallen	1.33	0.66	-3.73	61	<0.001
	Fallen	2.07	0.78			
Go up/down stairs	Not fallen	1.14	0.36	-4.22	57.9	<0.001
	Fallen	1.64	0.58			
Walk around indoors	Not fallen	1.00	0.00	-4.05	41	<0.001
	Fallen	1.29	0.46			
Walk ½ mile	Not fallen	1.19	0.40	-4.93	60.9	<0.001
	Fallen	1.95	0.82			
Bend down to get something	Not fallen	1.24	0.44	-3.78	55.9	<0.001
	Fallen	1.76	0.66			
Travel by public transport	Not fallen	1.24	0.54	-3.76	55.6	<0.001
	Fallen	1.88	0.80			
Go out to a social event	Not fallen	1.14	0.36	-4.68	60.8	<0.001
	Fallen	1.81	0.77			
Reach for something above your head	Not fallen	1.14	0.36	-4.53	60.9	<0.001
	Fallen	1.78	0.75			

6.4.5 Associations between Fear of Falling and Physical Activity, BMI, Age, Anxiety and Depression in 63 obese women under 50 years

Relationships between the scores for each measure of FOF and the continuous variables (BMI, anxiety and depression) were examined using correlation coefficient. Associations between the scores for each FOF measure and categorical variables (age and activity) were investigated using one-way ANOVA.

1) Fear of Falling and Physical Activity

Boxplots of IPAQ levels against the scores for each of the FOF measures illustrated higher FOF in the low activity group (Appendix D4, Figures 6.2-6.4, p 327-328), suggesting a relationship between low activity levels and FOF. The boxplots illustrated little differences between FOF in the moderate and high activity level groups. Similar to age groups, the dispersal of FOF scores suggested a non-symmetrical distribution and thus the Kruskal-Wallis test was performed.

Analysis revealed significant differences between activity levels and FOF scores for all the three measurement scales (Table 6.20). For the CoF and MSAFFE in which higher scores indicate more FOF, the highest mean ranked group had low activity, suggesting that those participants with the highest FOF were the least active. The MFES ranked the groups opposite to the other tools as a higher score result signified a lower FOF, and lowest mean ranked group was those participants with the low activity.

Table 6.20: Results of Kruskal-Willis test to compare Activity Level and Fear of Falling

FOF Instrument	**Kruskal-Wallis H (2df)**	**Mean Rank of Activity Group**			**P value**
		Low	**Moderate**	**High**	
Modified Falls Efficacy Scale	12.64	20.94	37.31	34.82	0.002
Consequence of Falling	10.98	37.62	22.31	24.05	0.004
Modified SAFFE	10.55	37.42	23.67	21.91	0.005

2) Fear of Falling and BMI

Scatterplots (Appendix D4 Figs 6.5-6.7, p 328-329) showed possible relationships between scores of each FOF measure and BMI (as a continuous variable). Subsequent analysis revealed moderate correlations with all FOF measures and BMI, $R = 0.41$ (MFES), $R = 0.45$ (COF), $R = 0.47$ (MSAFFE) all statistically significantly at the 0.01 level (Table 6.21), whereby as BMI increases so does FOF.

Table 6.21: Correlation Coefficients between Fear of Falling and BMI

Fear of Falling Instrument	BMI kg/m²	95 % Confidence Intervals
Modified Falls Efficacy Scale	-0.41*	-0.61 to -0.18
Consequence of Falling Scale	0.45*	0.24 to 0.60
Modified Survey of Activities and Fear of Falling in the Elderly	0.47*	0.23 to 0.65

*Correlation is statistically significant at the 0.01 level (2 tailed)

Further analysis was undertaken to check for differences in FOF between the different BMI groups (Table 6.22). Interestingly, there were significant differences between the lowest and the highest BMI groups (30-34.9 kg/m² and >45 kg/m²) for all the FOF measures.

Table 6.22: One Way ANOVA table for BMI Groups and Fear of Falling Instruments

Fear Of Falling Instrument	Sum of Squares	df	Mean Square	F	P value
Modified FES					
Between Groups	74.13	3	24.71	3.95	0.012
Within Groups	368.87	59	6.25		
Total	443.01	62			
Consequence of Falling scale					
Between Groups	1014.91	3	338.30	4.44	0.007
Within Groups	4493.39	59	76.16		
Total	5508.30	62			
Modified SAFFE					
Between Groups	894.96	3	298.32	4.64	0.006
Within Groups	3791.55	59	64.26		
Total	4686.52	62			

Table 6.23: Multiple comparisons of Fear of Falling Instruments and BMI Groups in obese women under 50 years of age

Fear Of Falling Instrument	BMI Groups (I)	Comparison BMI Groups (J)	Mean difference (I-J)	Standard error	P value	95% Confidence Interval	
						Lower limit	Upper limit
Modified Falls Efficacy Scale	30-34.9	35-39.9	1.43	0.87	0.36	10.87	3.73
		40-44.9	0.58	0.86	0.90	-1.69	2.85
		≥45	3.00	0.92	0.01	0.57	5.44
	35-39.9	40-44.9	-0.85	0.87	0.76	-3.15	1.45
		≥45	1.58	0.93	0.34	-0.89	4.05
	40-44.9	≥45	-2.43	0.92	0.05	-4.86	0.01
Consequence of Falling Scale	30-34.9	35-39.9	- 5.37	3.04	0.30	-13.41	2.67
		40-44.9	- 4.72	2.99	0.40	-12.63	3.19
		≥45	-11.72	3.21	0.003	-20.22	-3.22
	35-39.9	40-44.9	0.65	3.04	0.99	- 7.38	8.69
		≥45	- 6.35	3.26	0.22	-14.96	2.27
	40-44.9	≥45	- 7.00	3.21	0.14	-15.50	1.50
Modified Survey of Activities and Fear of Falling in the Elderly	30-34.9	35-39.9	- 2.90	2.79	0.73	-10.28	-4.48
		40-44.9	- 3.28	2.75	0.63	-10.54	3.99
		≥45	-10.77	2.95	<0.001	-18.58	-2.96
	35-39.9	40-44.9	- 0.37	2.79	0.99	- 7.75	7.00
		≥45	- 7.87	2.99	0.05	-15.78	0.04
	40-44.9	≥45	- 7.49	2.95	0.06	-15.30	0.31

Post-hoc test = Tukey HSD. *The mean difference is significant at the P<0.05 level

3) Fear of Falling and Age

Boxplots were used to show the distribution of FOF scores in each of the three age groups (Appendix D4, Figs 6.8-6.10, p 329-330). The distribution of the FOF scores were not symmetrical as the mean and medians differed, suggesting that they were not normally distributed.

Kruskal–Wallis tests showed that there was a significant difference between age groups and the MFES only (Table 6.24). The highest mean (high score signifying a low FOF) ranked group for this scale was observed in the under 35 years of age and the lowest in the over 45 years of age suggesting the higher the age, the more likely the participant was to have a low falls-efficacy score signifying a higher FOF.

Table 6.24: Comparison of age group and Fear of Falling scores

Fear of falling Instrument	**Kruskal-Wallis H (2df)**	**Mean Rank of Age Group**			**P value**
		≤ 35	**35-44.9**	**≥ 45**	
Modified Falls Efficacy Scale	7.67	39.64	34.05	24.48	0.02
Consequence of falling	2.25	28.06	30.55	36.23	0.32
Modified SAFFE	4.03	28.03	28.09	37.88	0.13

4) Fear of Falling and Anxiety and Depression

Scatterplots of all the FOF questionnaires showed that there might be associations with both anxiety and depression (Appendix D4, Figures 6.11-6.16, p 330-332). The pattern of the scatterplots suggests a linear association between the CoF and MSAFFE with anxiety and depression, though less so between the MFES with anxiety and depression. Further analysis showed moderately strong correlations between all the FOF tools and anxiety and depression (Table 6.25) that were all statistically significant.

Table 6.25: Correlation coefficients between Fear of falling and anxiety and depression in 63 obese women under 50 years of age

Fear Of Falling Instrument	Anxiety R (95% CI)	Depression R (95% CI)
Modified Falls Efficacy Scale	-0.65* -0.78 to -0.49	-0.63* -0.78 to -0.44
Consequence of Falling Scale	0.66* 0.49 to 0.79	0.67* 0.51 to 0.79
Modified Survey of Activities and Fear of Falling in the Elderly	0.70* 0.55 to 0.81	0.74* 0.60 to 0.84

*****Correlation (R) is statistically significant at the 0.01 level (2 tailed)

The correlation between anxiety and depression and FOF is positive, whereby the more anxious or depressed the participant was, the more fearful they were of falling. The strongest associations were between the MSAFFE and depression (R = 0.74 P = 0.01) and anxiety (R = 0.70 P = 0.01).

5) Associations between Fear of Falling Instruments

Correlational analysis showed associations between all 3 measures of FOF. This may suggest that they may not measure completely separate constructs of FOF (Table 6.26). The correlation between MSAFFE and the CoF was particularly high.

Table 6.26: Correlational coefficients between Fear of Falling Instruments

Fear of falling Instruments	CoF	MSAFFE
MFES	-0.56	-0.76
CoF		0.81

6) Summary of Associations of Fear of Falling with Falls, Activity, BMI, Age, Anxiety and Depression

In addition to previous findings (Table 6.16, Section 6.4.4) of a relationship between falling and each FOF measure, the activity level was found to be significantly associated with all FOF measures, suggesting that the participants with the least activity had the highest FOF (Table 6.27). BMI, anxiety and depression appear to be associated with FOF, suggesting that as these variables increased, so did the participants' FOF. Age was not found to be significantly associated with FOF, except for the MFES, where FOF was shown to get worse with increasing age.

Table 6.27: Summary of Associations of Fear of Falling measures with Falls, Activity, BMI, Age, Anxiety and Depression

FOF Instrument	Falls	Activity (IPAQ Score)	BMI (Kg/m^2)	Age Group	Anxiety	Depression
Modified Falls Efficacy Scale (MFES)	t=3.13, P=0.003	H = 12.64, df=2, P=0.002	R=0.41* Post hoc sig diff btw 30-34.9 and >45	Statistically significant difference btw <35 and >45 years only	R=0.65*	R=0.63*
Consequence of Falling Scale (CoF)	t=-3.53, P=0.001	H = 10.98, df=2, P=0.004	R=0.45* DI =0.44* FL=0.40* Post hoc sig diff btw 30-34.9 and >45	No statistically significant difference	R=0.67*	R=0.67*
Modified Survey of Activities and fear of falling in the Elderly (MSAFFE)	t=-5.24, P=<0.001	H= 10.55, df=2, P=0.005	R=0.47* Post hoc sig diff btw 30-34.9 and >45	No statistically significant difference	R=0.70*	R=0.74*

R = Pearson's correlation coefficient *statistically significant at the P< 0.01 level (2-tailed), t= independent t test; Post hoc tests= Tukey HSD; $\chi 2$ = chi –square, H= Kruskal-Wallis test

6.4.6 Exploring the relationship between Activity and Fear of Falling

Section 6.4.5 suggested that fear of falling was worse in those that were least active. Irrespective of the FOF measurement tool, other variables including falls, BMI, anxiety and depression were also associated with a fear of falling. When measured by the MFES, age was also associated with a fear of falling. Further analyses to explore the relationship between activity and fear of falling using binary logistic regression are reported in this section. Separate models for each FOF measure were constructed. This decision was made because correlational analysis had suggested that there may be considerable overlap between the FOF measures. The correlations between MSAFFE and the other measures were high enough to raise concerns about collinearity. Furthermore, the purpose of this study was to assess different aspects of FOF within the framework and their relationship with activity which would inform the development of the framework, and therefore not essential to include all FOF tools in one model.

In addition**,** as examination of the relationships between the variables associated with FOF (Appendix D4, Table 6.29 p 339) showed that anxiety and depression scores were highly correlated (R = 0.77, P = 0.01). This raised concerns about the potential for collinearity which could affect interpretation of findings if both were included in the regression model. A number of researchers have suggested that FOF may be more a symptom of generalised anxiety than a diagnosis, as it is often characterised by high levels of anxiety related to walking, standing or falling (Howland et al, 1993; Arfken et al, 1994 Vellas et al, 1997; Legters, 2002; Harding and Gardner, 2009). Furthermore, a number of authors have suggested that anxiety and fear are separate emotional states, whilst others believe that they are indistinguishable (Steimer, 2002). Anxiety is widely acknowledged as a generalised response to an unknown threat or internal conflict, whereas fear is focused on known external danger (Steimer, 2002) Anxiety and fear are similar, in that their main function is to act as an indicator of danger, threat, or motivational conflict, and to elicit appropriate adaptive responses, though their responsive actions differ. Regardless of whether anxiety and fear are distinct or different emotional states, there appears to be overlap in their mechanisms (Barlow, 2000). This raised concerns that anxiety and fear of falling were so related that it should be excluded from the regression model, irrespective of the concern about collinearity.

Independent Variables associated with Activity and Fear of Falling

Before proceeding to the binary logistic regression analysis, univariate analyses were undertaken between activity level (low activity versus moderate-to-high activity), and variables found to be significantly associated with FOF to help decide which predictor variables to include in a single model (Table 6.33). The low activity group included all the participant results that were categorised as having an IPAQ-SF score indicating low activity and the moderate-high activity group included the participants with a scores suggesting 'moderate' or 'high activity'. The analysis was set up to predict low activity. Further consideration of the inclusion of variable was taken if the P-value was greater than or equal to 0.1

Table 6.33: Univariate analyses of variables with activity

Predictor	**B**	**Wald X^2**	**P-value**	**Odds ratio**	**95% Confidence intervals**
BMI -continuous	0.07	4.65	0.03	1.07	1.01 ..to . 1.14
Age Group					
<35 years of age		5.27	0.07		
35-44.9 years of age	0.50	0.50	0.48	1.65	0.41.. to…. 6.71
>45 years of age	1.51	4.85	0.03	4.55	1.18 ..to... 17.52
Fallen- Y/N	-0.49	0.72	0.39	0.61	0.20 to 1.89
Depression	0.14	4.70	0.03	1.14	1.01 to 1.29
MFES	-0.46	10.05	0.002	0.63	0.48 to 0.84
CoF	0.09	7.81	0.005	1.10	1.03 to 1.18
MSAFFE	0.12	9.90	0.002	1.12	1.05 to 1.21

Results showed the variables, BMI, depression and age (>45 years) to be significantly associated with activity in this group of obese women under 50 years of age and therefore, independent predictors of activity status.

Even though only the oldest age group was shown to be a significant predictor of activity status, those aged between 30 and 45 years had a higher odds of low activity albeit with P>0.1. There is strong evidence from literature in the elderly that shows age to be associated with both FOF and activity avoidance and therefore, helped justify the inclusion of the three age groups in the logistic regression model (Howland et al, 1998; Zijlstra et al, 2007b; Jung, 2008; Scheffer et al, 2008). However, self-reported incidences of falls were found to be non-significant (P = 0.39) at predicting activity level in this study, and so consequently were excluded from the model.

As explained above each FOF tool was analysed in a separate model, together with the other significant predictor variables of activity: BMI as a continuous variable, age, and depression. The variance inflation factors for each model were between 1 and 3 and the tolerance values all greater than 0.4 for all three analyses suggesting no collinearity between the variables in these final models.

1) Falls-Efficacy

A test of the full model against a constant only model was statistically significant indicating that the predictors MFES, BMI, age group and depression as a set reliably distinguished between low and moderate-to-high activity status ($\chi 2$ = 18.36, 5df, P = 0.003). The model explained 36.3% of the variance in activity and correctly classified 70.7% of the cases. MFES was an independent predictor of low activity (P = 0.03). Age group, BMI continuous and depression were not significant predictors (Table 6.34). There was a 35% decrease in the odds of low activity for each unit increase in MFES score. An increase in MFES score means less fear of falling.

Table 6.34: Multivariate model predicting activity from MFES, BMI, Age and Depression

Predictor	B	Wald X^2	P	Odds ratio (EXP B)	95% Confidence intervals
MFES	-0.43	4.66	0.03	0.65	0.44 to 0.96
BMI Continuous	0.06	2.15	0.14	1.07	0.98 to 1.16
Age Group					
<35 years of age		2.43	0.30	1	
35-44.9 years of age	0.48	0.37	0.54	1.62	0.34 to 7.58
> 45 years of age	1.24	2.37	0.12	3.45	0.71 ...to. 16.67
Depression	-0.07	0.47	0.49	0.93	0.77...to ...1.15

2) Consequences of Falling

A test of the model (Table 6.35) against a constant only model was statistically significant indicating that the predictors CoF, BMI, depression and age group as a set reliably distinguished between low and moderately-to-high activity status ($\chi 2$ = 16.10, 5df, P = 0.007). The model explained 32.4% of the variance in activity and correctly classified

72.4% of the cases. CoF was an independent predictor of low activity (P = 0.09), as age >45 years made significant contributions to prediction (P = 0.04) (Table 6.35). BMI and depression were not shown to be independent predictors of low activity. There was an 8 % increase in the odds of low activity for each unit increase in the consequences of falling score. An increase in the score denotes more fear of falling.

Table 6.35: Multivariate model predicting activity from CoF, BMI, Age and Depression

Predictor	**B**	**Wald X^2**	**P**	**Odds ratio (EXP B)**	**95% Confidence intervals**
CoF	0.08	3.21	0.07	1.08	0.99 to 1.18
BMI Continuous	0.06	1.87	0.17	1.06	0.97 to 1.15
Age Group					
<35 years of age		4.75	0.09	1	
35-44.9 years of age	0.53	0.46	0.50	1.70	0.37 to 7.83
>45 years of age	1.65	4.40	0.04	5.23	1.11 to 24.54
Depression	-0.04	0.18	0.67	0.96	0.78 to 1.16

3) Activity Avoidance

A test of the full model against a constant only model was statistically significant indicating that the predictors MSAFFE, BMI, Age and Depression as a set reliably distinguished between low and moderately-to-high activity status ($\chi 2$ = 17.54, 5df, P = 0.004). The model explained 34.9% of the variance in activity and correctly classified 75.9% of the cases. The Wald criterion demonstrated that MSAFFE and age group >45 years made significant contributions to prediction (P = 0.04; P = 0.04), though depression and BMI were not significant predictors (Table 6.36). There was a 14% increase in the odds of low activity for each unit increase in the modified SAFFE score. An increase in the score denotes intensification of fear of falling.

Table 6.36: Multivariate model predicting activity from MSAFFE, BMI, Age and Depression

Predictor	B	Wald X^2	P	Odds ratio (EXP B)	95% Confidence intervals
MSAFFE	0.13	4.40	0.04	1.14	1.01. to . 1.28
BMI Continuous	0.06	1.92	0.17	1.06	0.97...to...1.16
Age Group					
<35 years of age		4.07	0.13	1	
35-44.9 years of age	0.79	0.97	0.32	2.20	0.46…to...10.63
>45 years of age	1.62	4.04	0.04	5.06	1.04…to...24.55
Depression	-0.10	0.85	0.36	0.90	0.72…to....1.12

In summary, the results of the regression analysis found that FOF, as measured by all three FOF tools, predicted low activity levels in this sample of 58 obese women under 50 years of age (Table 6.37). Participants over 45 years of age predicted low activity with the CoF and MSAFFE. BMI and depression were not seen to be a significant predictor of low activity in any of the regression models.

Table 6.37 Prediction of low activity by FOF in obese adults

FOF Instrument	Variance of activity	Odds Ratio	95% CI	P value	Other Predictors of Low activity	Domains of Conceptual Framework
MFES	36.3%	0.65	6.99 to 8.34	0.03		Falls-efficacy/balance confidence
CoF	32.4%	1.08	28.96 to 33.71	0.07	>45 years of age	Social embarrassment Activity Restriction Fear of pain/injury
MSAFFE	34.9%	1.14	23.69-28.07	0.04	>45 years of age	Avoidance of activity

6.5 Study limitations

There are a number of limitations which may affect the interpretation of the findings of this study. Many of the study limitations were foreseeable due to the constraints of the resources available, and in order to maintain the integrity of the research. For instance, the participant’s age was included on the anonymous questionnaires as a categorical measure, as opposed to a continuous measure to protect the participant's identity because the source of participants was a relatively small cohort of obese women, from a specific healthcare setting. This gave confidence to the participants and the Research Ethics Committee that they would not be identifiable and their individual identity was secure. Furthermore, this helped in the recruitment process as potential participants were more likely to volunteer, secure in the knowledge that they could remain anonymous. Nonetheless, having exact ages in years may have allowed more flexibility in determining the set age groups and afforded age to be used as a continuous variable in the analyses whilst looking at the associations with FOF, activity and other variables.

Cross-sectional studies, although beneficial in allowing a researcher to compare many variables at once, in addition to being less time consuming to both participants and researcher, only records findings at one moment in time (Farrington 1991). So although this study measured positive associations between activity and FOF, it cannot measure the temporality between them which is an essential criteria for causality (Sedgewick et al 2014). Therefore, this study could not predict the direction of the relationship and confirm whether FOF leads to reduced activity or conversely, low activity leads to FOF.

Another limitation of this study was the sample size, which was smaller than originally planned. Sample size calculations, using a margin of error and assuming standard deviations of the only two available studies of MFES with this data, resulted in an estimated sample size of between 43 and 75 participants. These were the best estimates of mean and standard deviation available but they were based on elderly and not obese populations. Therefore, the sample size for the study was based on the more conservative higher estimate. In the end, only 63 participants were recruited in the time available for the study. It was not possible to carry on recruiting for governance reasons as the research student emigrated to Australia. The study SD for MFES was 2.67 which is higher than that used to determine the sample size (2.21) and the 95% CI around the mean MFES of 7.67 was 6.99 to 8.34, implying that even if the sample size had been 75, there would still be a higher margin of error or lower precision than originally estimated. Logistic regression analysis needs large sample sizes as maximum likelihood coefficients are large sample estimates. Small samples often generate large differences between the upper and lower 95% confidence intervals and a less precise estimate of effect.

Obesity was measured using the BMI classification, which although recognised as a widely used practical tool to measure both population and individual obesity in clinical settings, has its limitations (Burkhauser and Cawley 2008). The drawbacks of BMI include that it cannot distinguish between fat mass and lean mass and it does not take account of an individual's age, body shape, physical fitness or ethnicity (Aronne 2002). Many studies have reported that body fat distribution is a more powerful and sensitive predictor than BMI for risk factors, diseases and mortality, as this reflects areas of increased visceral or abdominal adipose tissue which is more metabolically active than subcutaneous fat (Grundy 2004). Waist circumference is a convenient measure of abdominal adipose tissue which correlates closely with BMI and total body fat, and is associated with cardiovascular disease risk factors independent of BMI (Zhu et al 2002). However, BMI is also highly correlated with other more accurate measures of adiposity such as dual-energy x-ray absorptiometry (DXA), which have limited use in the clinical setting due to their complexity and cost (Steinberger et al 2005). As this research was not looking into the comorbidities of obesity, BMI was a sufficient measure of obesity. However on reflection, weight circumference might have provided additional information on the effects of body shape, not just BMI on FOF and activity.

Reasons for using questionnaire-based or self-report tools above performance-based have previously been discussed in Chapter 5 and Section 6.3.4. A major disadvantage of self-report measures is that they frequently introduce recall or information bias, as they rely on the participant's ability to accurately recall information (Podsakoff et al, 2003; Pannucci et al, 2010). Furthermore, response biases may impact on the results leading to over or underestimations of the variables being measured in the study population, which pose a serious threat to the study's validity (Mazoe et al, 2002). Social desirability is the tendency of an individual to present themselves in a favourable light, regardless of their true feelings about a topic or issue and thus another type of response bias (Podsakoff et al, 2003). Using anonymous self-complete questionnaires helped to reduce this bias, as participants were able to complete and return questionnaires without being identified, though not being able to check missing data was a weakness. Furthermore, the quantitative study questionnaire was designed to be as concise as possible, with minimal overlap of questions, in order to help keep the participants focused and minimise responder fatigue.

Due to time and resources there was only one researcher to conduct this study, however, steps were taken to reduce biases by applying methods to check for errors of data inputting (Section 6.3.7). As previously stated, there is a lack of reliable, inexpensive tools to measure activity, and although the IPAQ-SF has frequently been used in studies of obese populations, as a fairly valid, easily accessible self-report tool compared to others, poor correlations with objective measures of physical activity have been documented (Lee et al 2011).

Different concepts of FOF and their relationships with activity were found to be present in this group of obese women, supporting the results of the qualitative study and proposed framework. However, it is possible these instruments not reliable in this population and their validity has not been ascertained. Undertaking studies to ascertain the reliability and validity of the instruments or developing new ones for use in young, obese populations before conducting the quantitative study might be considered to be more conducive as it would help give credence to the findings. However, at the time, this was not considered to be a good use of available resources, without further exploration of FOF in obese younger women and first trialling these tools for suitability in this population. Prior to this final study, the only evidence to suggest FOF might be an issue in young, obese adults was the results of the small qualitative study. This evidence was not enough to warrant validating FOF instruments or developing new ones before at least identifying there might be an issue and trialling them in a sample of young, obese women for appropriateness. All the FOF tools used showed FOF to be present in young obese women and all were associated with differences between fallers and non-fallers and were associated with activity, reflecting relationships found in elderly populations (Hill et al, 1996; O'Halloran et al, 2010; Yardley et al, 2002;). However, no single tool covered all elements of the conceptual framework, and furthermore, there were elements of the conceptual framework not included in any of the selected tools, suggesting they were not ideal to measure FOF in younger, obese women. More research is needed to fully validate the use of these tools in younger, obese groups, though the development of a more appropriate tool for this population is probably a more worthwhile option.

Another major limitation of this study was the lack of a control or comparative group of 'normal' weight (i.e. BMI 18.5-25kg/m^2) healthy women. A control group would have enabled the comparison of falls incidence and level of FOF with that of non-obese women under 50 years of age, and its subsequent association with low activity and other variables. Without this comparison group it is difficult to say for certain the study results were related to obesity or that the relationships with other measured variables were not due to other factors. However, normative values of FOF in healthy populations and in elderly non-fallers or populations with conditions known to have fear of falling are available using the same instruments (Hill et al, 1999; O'Halloran et al, 2010; Yardley et al, 2002; Collado-Mateo et al, 2015). The mean scores of all FOF tools in this sample of obese women are comparable to those of elderly fallers and other similar populations at risk of FOF (Hill et al, 1996; O'Halloran et al, 2010; Yardley et al, 2002; Jonasson et al, 2014) and higher than values for 'healthy' populations. For instance, the mean MFES scores of the obese study sample compared to a healthy population, elderly non-fallers and fallers were: obese young adults in this study = 7.67 (SD = 2.67): Healthy = 9.76 (SD = 0.32); non-fallers 9.68 (SD = 0.72): Fallers =7.69 (SD = 2.21); 8.77 (SD = 1.68) (Hill et al, 1996; O'Halloran et al, 2010). whereby the results of the fallers and obese sample were similar, with a lower score than the healthy population or non-fallers, suggesting FOF is higher in obese, younger women compared to healthy populations or non-fallers (Hill et al 1996; O'Halloran et al, 2010). Similar results were found in studies using the CoF and MSAFFE and will be discussed in more detail in the next chapter (Yardley et al, 2002; Jonasson et al, 2014).

6.6 Chapter Summary

The findings of this study reflected those found in studies in the elderly, suggesting obese women have a FOF that is associated with low activity status. Each FOF tool used was able to demonstrate different elements of the conceptual framework and were all found to be positively associated with low activity status, previous falls, increasing BMI, anxiety and depression. Age was found to be associated with the MFES only. Logistic regression models of each FOF measure together with BMI (continuous), age group and depression were shown to significantly predict low activity, where each FOF tool and age groups >45 years of age were independent predictors. These results helped to support some of the factors affecting FOF proposed in the previously developed conceptual framework and offer new insights regarding the interrelationship between FOF and activity in young obese women.

CHAPTER 7: GENERAL DISCUSSION

7.1 Introduction

The purposes of this final chapter are to (1) summarise the findings of the research, (2) discuss the key findings and (3) discuss the strengths and limitations of the research, (4) highlight the implications of this research for clinical practice and obese women under 50 years of age and finally (5) to identify areas for future research.

The main aim of this thesis was to investigate fear of falling as a phenomenon in younger obese women and its relationship with activity participation. Two exploratory studies and a review of instruments were conducted to achieve this aim:

- A qualitative study was undertaken to explore the experiences and concerns about falling in obese women under 50 years of age and its impact on activity restrictions and activity participation (Study 1, chapter 4).
- A quantitative study to measure the level of fear of falling and explore the relationship between fear of falling and physical activity in obese women under 50 years of age (Study 2, chapter 6).
- Before preceding to the quantitative study a review of questionnaire-based instruments of balance or fear of falling was undertaken to identify appropriate measures for the study (chapter 5).

7.2 Summary of Research

This research initially explored the experiences of activity restrictions and FOF in a small sample of obese women under 50 years of age and found a number of participants to have concerns about falling with suggestions that there might be a relationship between FOF and activity participation in this population. Though tentative, these findings reflected those of previous limited research that referred to a small sample of obese women having slightly higher measures of falls-efficacy than non-obese women, in addition to reports of obese women feeling foolish if they fell over and walking downstairs backwards to avoid falling (Dey et al, 2007; Larsson and Mattson, 2001; Deitel, 2001). Furthermore, the results of this qualitative study identified possible contributory factors, such as previous falls, age, low activity, social embarrassment, anxiety and depression, which have been associated with FOF in elderly obese women (Bruce et al, 2002; Austin et al, 2007).

Findings from the qualitative study, together with results of a scoping review led to the development of the first conceptual framework of FOF in obese women and its relationship with activity participation. This framework showed similarities to other constructs of FOF designed specifically for older people, such as 'falls-efficacy', 'activity avoidance' and 'perceived consequences of falling'. It also highlighted social embarrassment, perceived poor balance and fear of pain or injury as key factors why some obese women feared falling whilst active. Findings from the qualitative study were used to inform the design of a larger quantitative study to quantify FOF in this population and explore a proposed relationship between FOF and activity participation. However, in order to measure FOF in younger, obese women, appropriate tools were required. A review of all community-based, self-report balance and FOF tools, suitable to use in younger obese women, highlighted that there were no reliability or validity studies of these instruments for use in this population. Furthermore, none of the identified tools included all the concepts of FOF within the conceptual framework. Despite the lack of suitable FOF tools available, 3 tools identified for being the best match to measure the key concepts of FOF in younger obese women were selected for use in the exploratory quantitative study. In addition, other identified self-report tools to measure falls, physical activity, anxiety and depression in obese populations were incorporated into one study questionnaire and given to consenting participants who met the inclusion criteria, to complete anonymously.

Results of this study found reported mean FOF levels in a sample of 63 obese women to be comparable to findings in elderly fallers and other populations with FOF, and higher than those results of healthy elderly population (Hill et al, 1996; Yardley et al, 2002; Jonasson et al, 2014). Furthermore, FOF was higher in those participants who had fallen and found to be associated with low activity, increasing BMI, age, anxiety and depression, again similar to findings of studies in the elderly and similar populations with FOF. These results have been used to further develop the conceptual framework and highlight future areas for research, which together with the key findings, limitations and implications of the thesis will be discussed in more detail below.

7.3 Key Findings of the Research

7.3.1 Fear of falling in obese women under 50 years of age

Identification of Fear of falling

This research may provide only an exploration of the relationship between FOF and activity participation in younger obese women, however, there are several unique key findings that add to the literature of both FOF and obesity. The main key finding from this research is the identification of FOF in younger obese women. Results of both exploratory studies suggest FOF is an issue in younger, obese women, firstly, from the perspective and experiences of a sample of obese women under 50 years of age, and secondly from the measurements of FOF in a further sample which were found to be higher than those of healthy and non-fallers in elderly populations and comparative to elderly fallers and other populations at risk of FOF.

Participants from the qualitative study reported concerns and being afraid of falling whilst active, particularly whilst using exercise equipment or in front of other people, which suggests that they might have FOF. Those who had previously fallen or been injured following a fall reported a greater concern of falling than those who had not fallen. Older participants were also more likely to report FOF and some said that they had become more fearful with age. Other factors brought up in interviews included participants reporting having poor balance and those who were less active being more fearful of falling, which led to reducing or avoiding certain activities. To a lesser extent, anxiety and depression were mentioned in the interviews as possible factors that affected participation, though BMI was not identified as a probable factor in this small sample of obese women. All these findings reflected those in the literature of elderly populations and others at risk of FOF, where similar factors such as previous falls, poor balance, low activity and age have been found to be associated (Legters, 2002; Jung, 2008; Miller et al, 2001; Collado-Mateo et al, 2015).

Results of the quantitative study report obese, younger women who had previously fallen to have significantly higher FOF scores than those who had not fallen, which reflects the tentative findings of the qualitative study and is comparable to the results seen in other studies using the same instruments (Hill et al, 1996; O'Halloran et al, 2010; Yardley and

Smith, 2002; Jonasson et al, 2014). Hill et al (1996) and O'Halloran et al (2010) reported mean MFES scores in healthy (H) or non-faller (NF) elderly participants and those who had previously fallen (F); H = 9.76, (SD = 0.32), NF = 9.56, (SD = 0.72); F = 7.69, (SD = 2.21) and F = 8.85, (SD = 1.68) respectively (Table 7.1). These results support the findings of this research, where the mean MFES score for the sample of obese women was 7.67 (SD = 2.67), which was lower (signifying a higher FOF) than both the other studies healthy or non-faller control groups, but comparable to the fallers groups. This suggests that the study sample of younger, obese women had a higher FOF than healthy, elderly people, but similar to those who had previously fallen, which is to be expected if obese women have a FOF.

Table 7.1: Comparison of Mean Fear of Falling scores to other study populations

Population	Mean MFES Scores	Mean CoF-DI Scores	Mean CoF-LFI Scores	Mean MSAFFE Scores
Obese women<50 years of age	7.67 (SD=2.67) Significant difference between fallers and non-fallers	17.76 (SD=4.51) Significant difference between fallers and non-fallers	13.58 (SD=5.52) Significant difference between fallers and non-fallers	25.88 (SD=8.69) Significant difference between fallers and non-fallers
Healthy population	9.76 (SD=0.32) (1)			
Non-Fallers	9.56 (SD=0.72) (2)			
Elderly		14.40 (SD=3.8) (3) Significant difference between fallers and non-fallers	12.40 (SD=4.0) (3) Significant difference between fallers and non-fallers	24.0 (SD=6.3) (3) Significant difference between fallers and non-fallers
Fallers	7.69 (SD=2.21) (1) 8.85 (SD=1.68) (2)			
Other populations at risk of FOF				26.0 (SD=7.9) (4)
(1). Hill et al, 1996; (2). O'Halloran et al, 2010; (3). Yardley and Smith, 2002; (4). Jonasson et al, 2014				

Likewise, other studies using MSAFFE show comparable mean scores in a group of elderly (Yardley and Smith, 2002), and a group with Parkinson's disease (Jonasson et al, 2014), to the study sample of obese women (elderly = 24.0 (SD = 6.3); Parkinson's disease = 26.0 (SD =7.9); Obese, younger women = 25.88 (8.69) (Table 7.1). Yardley and Smith did not report the MSAFFE scores of fallers and non-fallers separately, but similar to this research, conducted statistical analysis that reported FOF to be significantly higher in the fallers compared to the non-fallers. This again suggests that obese, young women have comparable levels of FOF to both elderly and populations with other conditions associated with FOF. Studies in the elderly have also reported mean values of the CoF in the elderly similar to those in this research (Yardley and Smith, 2002), where in a sample of 166 elderly adults the mean CoF-LFI score = 12.4 (SD = 4.0), CoF-DI score = 14.4 (SD = 3.8), compared to the obese sample mean scores of CoF-LFI = 13.58 (SD = 5.52), CoF-DI = 17.76 (SD = 4.51). Interestingly, Yardley and Smith (2002) reported higher mean scores of the CoF-DI compared with the CoF-LFI, suggesting that elderly people fear falling due to a fear of damaging their identity if witnessed in public. Similarly, the mean scores of CoF-DI were higher than CoF-LFI in this research which supported the findings of the qualitative study, where a number of obese women reported concerns of looking foolish or being embarrassed if they were to fall whilst being active. These findings helped reinforce the proposed concept of social embarrassment in the framework.

The results of the quantitative study showed statistically significant associations of all FOF measures with low activity, anxiety, depression and BMI in this sample of younger, obese women and higher in previous fallers compared to non-fallers. Together these findings helped support many of those from the previous qualitative study (Table 7.2). used to develop the different components of the conceptual framework of the relationship between FOF and activity participation in younger, obese women.

Table 7.2: Comparison of findings from Qualitative study and Quantitative on Fear of Falling in Obese women under 50 years of age

Mediating Factor	Qualitative Study	Quantitative Study
Activity	The least active had more concern of falling	Activity associated with all FOF instruments. Least active had higher FOF
Activity avoidance	Some FOF led to avoiding activities, more in >40 yrs and those with injuries. Reasons given include: embarrassment, avoid pain/injury, gym or exercise equipment	Activity avoidance associated with FOF (MSAFFE)
BMI	No differences observed	BMI associated with all FOF instruments. Significant differences between BMI 30-34.9 and >45kg/m² BMI >45kg/m² with FOF is a predictor of low activity
Age	FOF more likely in those over 40 years of age	Women aged between 35-45 years associated with MFES. Women under 35 years and over 45 years of age with FOF due to consequences of falling (CoF) predicts low activity Women over 45 years of age who avoid activities (MSAFFE) due to FOF predict low activity
Falls	Previous trips or falls led to FOF and some injury	Higher FOF associated with previous falls in all instruments
Anxiety	Some reported social anxiety linked with embarrassment and FOF	Strong correlation with all FOF instruments and anxiety
Depression	Some reported depression though not clear related to FOF	Strong correlation with all FOF instruments and depression

As FOF is predominantly found in the elderly and has not previously been measured in young, obese adults, there are no earlier published levels of FOF in this population, with which to compare these findings. Studies in the elderly reported associations with low activity, obesity and FOF (Bruce et al, 2002; Sallinen et al, 2009), and found obesity to be a predictor of new onset FOF in a 3-year prospective study of 1282 elderly women

(Austin et al, 2007). However, levels of FOF in the obese participants were not published separately and so not known to be comparable (Austin et al, 2007; Bruce et al, 2002; Sallinen et al, 2009). A more recent study reported on the effects of obesity on falls-efficacy in 351 elderly people using the FES, Faces Pain scale and Timed Up and Go test (Jeon, 2013). High levels of obesity, increased pain and decreased mobility were all associated with lower falls-efficacy suggesting a FOF. In addition, this study reported on FOF in elderly obese men and women, whereas the previous studies by Austin et al (2007) and Bruce et al (2002) reported FOF in obese elderly women only. This more recent study provides evidence of FOF in some elderly obese men, though no significant difference was reported between genders (Jeon, 2013).

Relationship with Falls

As previously stated, the quantitative study reported FOF to be associated with falls in younger, obese women, supporting the findings of the qualitative study that showed women who had previously fallen, reported becoming more fearful of falling or sustaining an injury than those who had not fallen (Table 7.1). Falls are a common precursor to FOF in the elderly (Howland et al, 1998; Andresen et al, 2006; Jung, 2008; Scheffer et al, 2008), and have been associated with FOF in populations with Parkinson's disease (PD), chronic obstructive pulmonary disease (COPD), fibromyalgia and multiple sclerosis (Hellstrom et al, 2009; Gourlie et al, 2013; Jonasson et al, 2014; Mazumdor et al, 2014; Collado-Mateo et al, 2015).

Obese populations have a higher prevalence of falling, compared to those non-obese (Fjeldstad et al, 2008; Mitchell et al, 2014; Garman et al, 2015). Most studies measuring prevalence of falling in obese populations are in middle-aged or elderly subjects (Fjeldstad et al, 2008; Mitchell et al, 2014). Fjeldstad et al (2008) compared falls in 128 obese and 88 normal weight middle-aged (mean age = 50 years) women and found that those obese had a higher prevalence of falling (27%) compared to the non-obese (17%), though the prevalence data reported was actually from self-reported incidence of falls in the previous 12 months (Fjeldstad et al 2008). Another recent study reported older obese subjects had a 31% increased risk of falling compared to non-obese (Mitchell et al, 2014). The self-reported incidence of falling among the participants of this research were much higher at 67%. The disparities between the incidence or prevalence of falling between this research and other studies could be due to a number of factors, such as, the study sample was not representative of the target population, different measurement instruments, older participants avoid (more) activities that could lead to falling and thus also avoid falling and, conversely, younger participants might be more active and therefore have more opportunity to fall.

A more recent study compared groups of obese and normal weight adults and the effect of age, gender and obesity on the probability of tripping (Garman et al, 2015). The results identified a higher probability of tripping in older, female or obese participants, which support findings from the qualitative study, where a number of obese women reported frequently tripping, which sometimes led to falling or injuries. Similarly, other studies report obese individuals being at higher risk of sustaining injuries caused by trips and falls (Matter et al, 2007; Finkelstein et al, 2011). If, as these studies suggest, obese individuals, particularly those who are female or older are more likely to trip, this implies that they are at risk of falling and, might therefore be susceptible to FOF. However, the findings of the quantitative study showed no association between self-reported falls and age group, BMI or activity level (Chapter 6; Section 6.4.2, p 129).

Studies reporting the incidence of falls in young, healthy populations, often do so as a control measure to compare with other young adults with specific disabling conditions (Collado-Mateo et al, 2015; Mazumdor et al, 2014). A 6-month prospective study of falls in a sample of 18 to 50 year olds with or without multiple sclerosis (MS), found the 49 individuals without MS to fall an average of 1.20 times (SD = 2.49, range = 0-15), using a monthly calendar to monitor the falls (Mazumdor et al, 2014). Fifty-seven percent of this healthy control group did not fall at all and 40.8% fell more than once in the 6-month period. As expected this falls incidence of a healthy sample was lower than that of the obese participants in this thesis. However, the method of data collection and time frame were different as subjects recorded falls monthly over a 6-month period, as opposed to the self-report number of falls reported retrospectively over a 12-month period by the obese subjects in this study. Collado-Mateo et al (2015) measured the number of self-reported falls over a 12-month period in a comparative study of 125 women under 50 years old with fibromyalgia and 115 healthy women without. The mean number of falls recorded in the fibromyalgia group was 1.45 (SD=2.49), compared to the healthy control group of 0.40 (1.05). Differences in the methods of collecting data and recording mean number of falls rather than number of previous fallers makes comparisons between the obese study participants and other young healthy populations difficult.

Relationship with Activity Participation

A main objective of this research was to explore the relationship between FOF and activity participation in obese young women and whether FOF might be a barrier to obese women being active. Numerous reasons for inactivity in obese women have been reported, such as embarrassment, shyness, not motivated, not the 'sporty' type, cost, lack of time, or poor body image (Ball et al, 2000; Genkinger et al, 2006; Rosenberger et al, 2006; Thomas et al, 2008). Most research has focused on psycho-social factors of non-participation, influenced by motivation or cognition, and less on the physical difficulties experienced when overweight (Jewson et al, 2008; Rye et al, 2009). Low activity has been associated with FOF in the elderly, often arising as result of poor physical and/or mental health (Howland et al 1998; Bruce et al 2002; Legters 2002; Suzuki et al, 2002; Wilson et al 2005; Wijlhuizen et al 2007; Kempen et al 2008; Jung 2008). Furthermore, reduced confidence in balance capabilities, falls and subsequent FOF have been shown to predict poor functioning, which can lead to decreased activity and activity avoidance (Cummings et al, 2000). Interestingly, the literature reports obese individuals who are inactive are more prone to balance problems and at a higher risk of falling (Gauchard et al, 2003; Maffiulrtti et al, 2005; Singh et al, 2009). It is therefore, not surprising to find FOF reported more in the inactive obese women in the qualitative study, than those who were regularly active. Results of the quantitative study support these findings as FOF was associated with low activity using all FOF measures in the sample of younger, obese women. The participants under 35 years and over 45 years of age were more likely to be inactive due possibly to concerns about the consequences of falling such as feeling embarrassed or foolish, injured, in pain or not being able to get up; and those over 45 years of age were similarly, more likely to avoid activities due to a FOF. These findings support those in the qualitative study, as a number of participants interviewed reported concerns about the consequences of falling, particularly about the social embarrassment of falling in public and looking foolish. The majority of the participants reported avoiding some activities in case of falling; the fear of pain and injury were reported to a lesser extent.

Conversely, studies show obese individuals who are more active are reported to have less balance problems and a reduced risk of falling (Gauchard et al, 2003; Maffiulrtti et al, 2005), which supports the findings in both studies of this research, that the more active participants had less FOF than those least active. Likewise, studies in elderly populations show more active individuals, or those who have completed interventions to increase activity levels have less FOF than those less active, further supporting the research findings.

Relationship with Activity and Activity Avoidance

Another key finding of this research was that FOF was shown to influence the reduction or avoidance of some activities, this additionally reflected findings of studies in the elderly (Austin et al, 2007; Zijlstra et al, 2007(b); Van Haastregt et al, 2008; Dias et al, 2011; Painter et al, 2012). As previously stated activity avoidance and FOF in the elderly is associated with reduced physical and psychological functioning which can lead to social withdrawal and a poorer quality-of-life (Yardley and Smith, 2002; Delbaere et al, 2004; Bertera and Bertera, 2008). Studies in populations with COPD and PD also show associations of FOF with activity avoidance mediated by falls, anxiety and depression, and raise the concerns of consequential serious and adverse health outcomes (Hellstrom et al, 2009; Goulie et al, 2013). Activity avoidance was reported in 8 of the 12 participants from the qualitative study and seen more in those who had a previous fall-related injury and those above 40 years of age. Frequent reasons given for avoiding activities included embarrassment, avoiding using specific exercise equipment and fear of injury or pain. These findings were supported by results from the quantitative study that showed activity avoidance in obese women with significant differences seen between fallers and non-fallers in all the indoor, outdoor and social activities of the MSAFFE (Chapter 6; Section 6.4.4.(iii)), except for the activity visiting a doctor or dentist.

Relationship with BMI

Increasing BMI was found to be associated with FOF and activity participation in the quantitative study but had not been shown in the qualitative study findings. Possible reasons for this difference include that the BMI range was wider in the quantitative study (30-76.6kg/m²) than the qualitative study (28.8-49kg/m²), making it more likely to be a significant factor, or possible confounding factors such as activity, previous falls or age were masking an association between BMI and FOF. An example of this might be that many of the qualitative study participants were engaged in regular activity, particularly the younger aged participants (<35 years of age) who also as it happened, tended to have higher BMI than the least active, more fearful, older participants.

Relationship with Age

Increasing age is known to increase FOF in the elderly and middle-aged adults, including those with Parkinson's disease (Zijlstra et al 2007b; Andresen et al, 2006; Gourlie et al, 2013), though some studies report the converse (Kressig et al, 2001; Jung, 2008). Interestingly, a recent study of FOF in 240 women aged under 50 years, with or without fibromyalgia, found those without fibromyalgia only showed a linear relationship between increasing of FOF with increasing age (Collado-Mateo et al, 2015). This suggests that age is related to FOF in healthy populations and therefore perhaps regardless of other conditions such as obesity, which nevertheless, supports findings in the qualitative research that those obese women over 40 years of age were more likely to report FOF (Table 7.2). Further findings from the quantitative study showed a significant association of obese women aged between 35-45 years with the MFES only. However, when age was included in binary logistic regression models, women under 35 years and over 45 years of age with FOF due to consequences of falling (CoF), and women over 45 years of age who avoid activities (MSAFFE) due to FOF were all found to predict low activity. These results show differences between the relationship with age and each of the three FOF tools used. This suggests that either the differences are due to the three concepts of FOF being measured having different associations with age, or that there are other possible confounders influencing the results. Further prospective research is recommended to help clarify the relationship between age and FOF in this population.

Relationship with Anxiety and Depression

A number of participants in the qualitative study referred to having anxiety which led to social anxiety and concerns of falling in front of others, and depression which led to avoidance of some activities. Results of the quantitative study showed strong associations between anxiety, depression and all FOF scores, which further supported these inferences. These findings were to be expected as obesity has frequently been associated with both anxiety and depression and is often reported more in women than men (Jorm et al, 2003). Strine et al (2008) completed a large cross-sectional population based telephone survey, of 217,379 American adults which included questionnaires about anxiety, depression and unhealthy behaviours (Strine et al, 2008). Results showed adults who were diagnosed with current depression or lifetime diagnosis of depression or anxiety were significantly more likely to be obese and physically inactive. Furthermore, anxiety and depression are known to be significantly associated with FOF in studies of elderly populations, which implies that it is likely to be seen in obese women with FOF too (Austin et al, 2007; Gagnon et al, 2005; Painter et al, 2012; Van Haastregt et al, 2008). However, differences in the strength of these associations are seen in the literature, as Gagnon et al (2005) found depression, measured using the HADS score, showed a stronger association with FOF than anxiety, whereas Painter et al (2012) found strong associations only with anxiety (HAMA Scale) and not depression (GDS-30). Differences in the study settings, samples and FOF measures might have partly accounted for these contrasts in emotional states, as Gagnon et al (2005) studied hospital based subjects, who had all previously fallen, whilst Painter et al (2012) studied community dwelling adults, who had either fallen or not. Furthermore, Van Haastregt et al (2008) found anxiety and depression to be more common in elderly individuals who avoid activities with severe FOF and fear related activity avoidance (Van Haastregt et al, 2008). This supports the findings from both of the research studies that suggest associations between FOF, activity avoidance, anxiety and depression. Further evidence from a study in a sample of 80 COPD sufferers at risk of FOF, show anxiety and depression to be associated with FOF (Hellstrom et al, 2013).

Findings from the final study of this thesis tell us not only that FOF is significantly associated with anxiety and depression in the sample of young, obese women, but also that the measures of FOF may be related to the measures of anxiety and depression as they measure similar constructs. As previously stated in Chapter 6 (Section 6.4.6), there are similarities between the states of anxiety and fear, and some authors have referred to FOF as a symptom of generalised anxiety rather than a diagnosis (Howland et al, 1993; Arfken et al 1994 Vellas et al, 1997; Legters, 2002; Harding and Gardner, 2009; Steimer, 2002; Barber, 2000). Furthermore, the HAD-A subscale measures symptoms of anxiety and fear which are feasibly similar to the concept of FOF and include terms such as 'concern', 'worry', 'afraid' or 'fearful' in its measures (Legters, 2002). These similarities, in addition to the strong association between anxiety and depression led to anxiety being removed from the logistic regression model. To a lesser extent, depression shares similarities to FOF as the HADS-D subscale items focus on the 'hedonic state' or loss of pleasure, which is comparable to the reduction in physical and psychological health and subsequent quality-of-life often reported in those with long-term FOF (Scheffer et al, 2008; Jung, 2008). The strong correlations reported between all the FOF measures with anxiety and depression may provide evidence of validity between the measures (Van Haastregt et al, 2008; Gagnon et al, 2005). The type of validity demonstrated by the moderately strong associations between the FOF measures and the HADS-A and HADS-D, depends on whether anxiety and depression might be considered a 'gold standard' or 'criterion' measure of FOF, or just a closely related concept. If the HADS scale was considered to be a 'gold standard' measure, the correlations with FOF measures would demonstrate criterion validity of those measures, or more specifically, concurrent validity as the scores of both measures are considered at the same time (De Vet et al, 2011). Concurrent validity is how well a particular measure correlates with a previously validated measure when the two instruments are measuring similar things (De Vet et al, 2011). If however, the HADS scale was not considered to be a 'gold standard' measure of FOF, but nonetheless a related construct due to the similarities between anxiety, depression and FOF, the correlations would provide evidence of convergent validity (De Vet et al, 2011).

7.3.2 Development of Conceptual Framework of Fear of falling in Obese Women

The findings of this research led to the development of a conceptual framework of FOF in young, obese women and its relationship with activity participation. A conceptual framework can be defined as an illustration or document that "explains, either graphically or in narrative form, the main things to be studied, the key factors, concepts, or variables and the presumed relationships among them" (Miles and Huberman 1994, p.18). Conceptual frameworks are a tentative theory of the phenomenon to be studied and are constructed using pieces of knowledge from elsewhere. The main reason for developing conceptual frameworks is to show the relationship between the different concepts to be investigated, which leads to the development of relevant research questions, selection of appropriate study methods and to provide a context for interpreting the study findings (Maxwell, 2005, Chapter 3). The conceptual framework of FOF in obese women was developed primarily from the findings of the exploratory qualitative study together with findings in the literature from studies in obesity, activity restrictions, FOF and activity participation. The framework helped guide the selection of self-report FOF instruments identified from the review of FOF tools, which were most comparable to the key concepts and appropriate for use in a quantitative study of younger, obese women. The results of the quantitative study were then mapped onto the domains of the conceptual framework to illustrate how well they measured the components of FOF (Table 7.3). The development of this framework will help guide future research and interventions of FOF in obese populations.

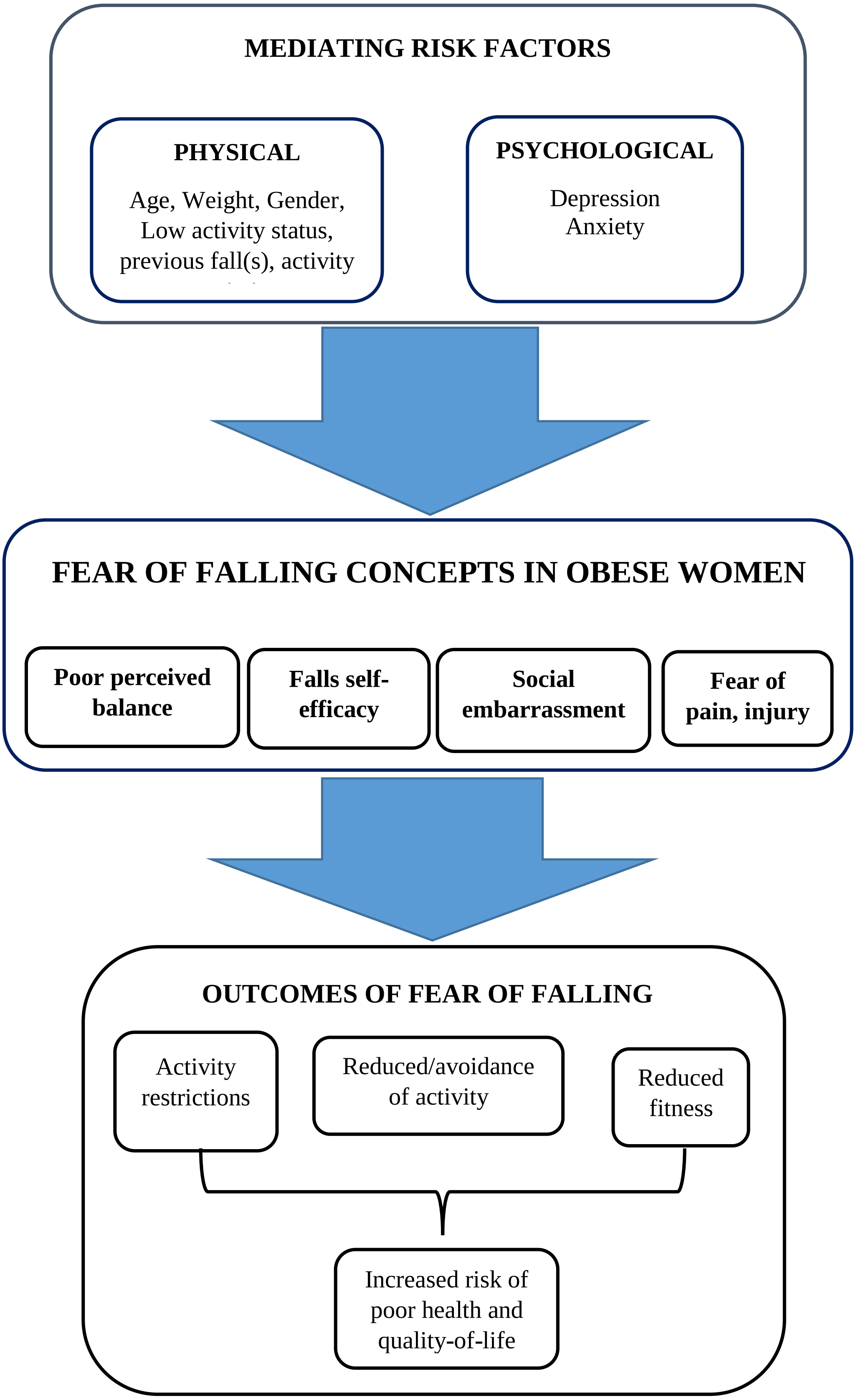
Table 7.3: Comparison of Conceptual Framework Domains to selected Fear of falling Instruments

Key Domain/Concepts	Measures identified	Components matched
Falls-efficacy	MFES	Indoor/outdoor activities
Social embarrassment	CoF Scale	Perceived consequence of falling: Damage to identity subscale Feel foolish/embarrassed
Fear of pain/injury	CoF	Perceived consequences of pain/injury/disabled
Previous fall/injury	Single item question	
Perceived poor Balance		
Activity Restriction	CoF	Loss of Functional independence subscale
Activity Avoidance	MSAFFE	Activities avoided in case of fall

Results of the quantitative study were compared with those of the qualitative study and subsequently used to amend the framework. Most of the preliminary findings of the qualitative study mapped onto the framework were supported by the results of the quantitative study, notably associations of falls, falls-efficacy, low activity, social embarrassment, activity restrictions, fear of pain or injury and activity avoidance (Table 7.2, Figure 7.1). Further evidence from the quantitative study identified significant associations between FOF and BMI, anxiety and depression (Figure 7.1). These relationships had previously been speculative as the qualitative study only provided tentative suggestions that anxiety and depression might be associated with FOF and no indication that BMI affected FOF in the sample of younger, obese women with a BMI below 50 kg/m². However, these speculations were also based on previous reports of associations of FOF with BMI, anxiety and depression from studies in the elderly (Austin et al, 2007; Bruce et al, 2002). The results of the regression analysis suggest both BMI and depression together with FOF and age predict low activity in younger, obese women and support their place in the conceptual framework. Although anxiety was not included in the regression model, its similarity to all the different concepts of FOF measured as previously stated, suggest that it too may have a relationship with FOF and activity.

This framework helps provides the first tentative theory into the phenomenon of FOF in younger, obese women, and its relationship with activity participation, and other contributory factors. However, further research is needed to fill the gaps in the framework, as not all the key concepts and contributory risk factors have been explored during the time frame of this research.

Figure 7.1 Conceptual Framework of Fear of Falling in obese women under 50 years of age



7.3.3 Review of Fear of falling Instruments suitable for use in Younger Obese Adults

This review was the first of its kind looking to identify self-report balance and FOF tools suitable for use in younger obese adults. The review was completed using a systematic method and therefore enabled an informed selection of suitable tools for the quantitative study matched against the conceptual framework. The results of the review highlighted a deficiency of suitable tools to measure FOF that had been validated for use in younger, obese populations. These results were anticipated as FOF is predominantly found in older populations and therefore all the identified tools were designed for use in the elderly. Similar findings were reported in a recent systematic review of FOF instruments for use in people with chronic obstructive pulmonary disease (COPD), whereby none were found to have been validated for use in COPD individuals and therefore not generalisable to the COPD population (Oliveira et al, 2013). During the selection of FOF tools for use in the final study of younger, obese women, none were found to comprise all the concepts of FOF proposed in the conceptual framework, and those selected to be used together in the final study, did not cover all of the key concepts. Again, this was not surprising, as many of the instruments included items or activities relevant to the elderly population they were designed for, and subsequently not necessarily relevant to younger, obese women. Activities including using handrails or going out when it is slippery did not reflect those activities most obese participants were concerned with in the qualitative study, and other more relevant activities such as those using exercise equipment or partaking in group activity sessions were not found in any identified instruments. These findings reflected those of a preliminary study using the FES-I in a sample of obese women that suggested the FOF tool might not include those activities most suitable to the obese population (Dey et al, 2007). Furthermore, the results of the quantitative study found the 3 selected tools to measure different concepts of FOF in younger, obese women to be correlated which implied that they overlapped in the items they measured and thus provided further evidence of their unsuitability as FOF measures in this population.

Following the review, the decision to conduct further exploratory research to strengthen the evidence of FOF as an issue in young, obese adults and its association with activity participation was made. Designing a new FOF tool, specific to the younger, obese population might be considered a better option. However, this is a difficult and lengthy process, and at this point of the research, the only evidence to suggest FOF might be an issue in young, obese populations was from a qualitative study of 12 women and a tentative conceptual framework, the likelihood of obtaining the necessary funding was thought improbable. However, since then, findings of the quantitative study have provided both more information about FOF in younger obese women, and further information of the suitability of the FOF tools available. Developing a new FOF tool, specific to younger, obese women might now be a worthwhile option.

7.3.4 Other Study Instruments

Another finding of this research was the lack of suitable self-report tools for use in younger, obese populations. For reasons already discussed in chapter 6, the quantitative study used a cross-sectional design, including self-report anonymous questionnaires and so only self-report instruments were required.

Previous discussions in chapter 5 highlighted the recommendation of using both observed and self-report measures of perceived balance together, as differences are frequently seen between both modes of measurement due to an individual's perception of their ability to remain stable (Delbaere et al, 2010). This suggests a benefit of using a performance-based or objective measures in future research, which might also be the case for other measurements.

As previously stated, there were disparities found between the self-reported incidence of falling of participants in the quantitative study and findings in the literature (Fjeldstad et al, 2002; Mazumdor et al, 2014; Collado-Mateo et al, 2015). The disparities between the incidence or prevalence of falling between this research and other studies could be due to a number of factors, such as, the study sample was not representative of the local population, different modes of measurement instruments and therefore biases, older participants avoid (more) activities that could lead to falling and thus also avoid falling. Conversely, younger participants might be more active and therefore increase the opportunities of sustaining a fall. Self-reported measures of previous falls are known to be less accurate than prospective measures such as using a falls diary and are susceptible to under-reporting and recall bias (Mackenzie et al, 2006; Garcia et al, 2015). However, the main reason for measuring falls in this research was to record how many participants had previously fallen and therefore the number of falls was not essential, suggesting the falls measure used in this study, though not faultless, was adequate for its purpose.

The IPAQ-SF has been shown to have good reliability and validity compared to objective measures of activity in healthy populations, (Wolin et al, 2008 Warner et al, 2012; Craig et al, 2003; Tehard et al, 2005), but mixed opinions of its reliability and validity in obese populations (Tehard et al, 2005; Barreto da Canha, 2013; Egeland et al, 2008; Warner et al, 2012). The literature suggests that the differences may be as a result of obese individuals over-estimating the intensity of their activities when completing questionnaires, which are predominantly based on the data from non-obese populations (Fogelholm et al, 2006; Slentz et al, 2005). That is to say, these over-estimations are not necessarily deliberate, but possibly due to the constraints extra adipose tissue puts on the metabolic system and on an obese subject's ability to partake, giving the perception that more effort is required and therefore the activity is more intense compared to the perceptions of non-obese subjects. The results of this research found the IPAQ-SF to be inadequate as a measure of energy expenditure as a number of participants failed to complete all questions of the instrument and so it was not possible to calculate their daily energy expenditure (METS). The relatively large number of missing values from the completed IPAQ-SF questionnaires also suggests that it might not have been suitable for this population, though due to them being anonymous, the reasons why could not be ascertained. However, the purpose of this study was to identify those participants who were relatively active and those who were relatively inactive, for which the IPAQ-SF was adequate.

The HADS scale had previously been found to be a frequently used, suitable valid and reliable tool to measure mood disorders among community-based obese populations (Bjerkeset et al, 2007; Bjelland et al, 2002; Andersen et al, 2010; Brumpton et al, 2013; Karlsson et al, 2007; Dahl et al, 2012). The results of this research showed anxiety and depression to be highly correlated with FOF in obese populations, which was expected, given both are frequently reported to be associated with FOF and obesity. There were only two missing answers from the study completed questionnaires, one from each subscale, which suggests that the questionnaire was acceptable to the participants and suitable for use in further studies of obese adults and FOF.

7.4 Strengths and Limitations of the Research

A strength of this research was the use of an exploratory sequential multi-methods design which is ideal for the exploration of new concepts when little is previously known about the research topic (Creswell and Plano Clarke, 2007) The combination of both qualitative and quantitative study designs gave complementary support to the original findings, as both found evidence of FOF in younger, obese women and a relationship with activity participation. Despite the lack of comparative studies in younger populations, or a control group, the findings of this research are satisfactorily supported by the results of similar studies in the elderly, implying it is likely that FOF is present in some younger, obese women. However, further research is recommended to confirm these findings. Furthermore, the results of this exploratory research, although tentative, will help inform decisions of how to conduct further studies, by 1) the identification of variables that are likely to be associated with FOF in obese, younger women and therefore 2) the relationships to be further investigated. In addition, this research has highlighted the inadequacies of available self-report tools to measure FOF and physical activity in obese populations.

Despite this research making several unique contributions to the literature, there were a number of limitations, many of which were due to the time and resource constraints of real-life. Individual study limitations have been discussed within the appropriate chapters and this section focuses on the limitations which affect the interpretation of the thesis.

As previously stated, the participants of both studies were recruited using non-random methods of purposive and convenience sampling, which relied on participants from a specific clinical setting (i.e. non-representative) agreeing to participate. Though these methods are pragmatic and cost effective, they compromise the generalisability of the results (Pannucci et al, 2010). The relatively small sample sizes of both studies and the eligibility criteria seeking only women aged under 50 years of age, accessing specific weight management services in a small location of northern England further limit the generalisability of the results to the target population of obese women. Furthermore, in both studies, proportionately more of the participants who volunteered were in the upper age range, suggesting that the results may be biased in favour of obese women over 40 years of age, and therefore not reflect FOF among all obese women under 50 years of age.

The designs of both exploratory studies were cross-sectional and therefore only measured the relationship between FOF and activity participation in a group of obese women at a single point in time. This makes it difficult to determine the temporal relationship between FOF and low activity in obese women, as to whether FOF in obese adults leads to reduced activity or reduced activity leads to a FOF. However, some participants in the qualitative study reported being less active since being overweight and concerned about falling, which led to them avoiding certain activities as a result of these fears/concerns; though it was still not clear whether FOF or reduced activity came first. One participant who had undergone bariatric surgery reported retrospectively how her previous weight had led to her falling more and FOF and her subsequent reduced and avoidance of activity. Since losing weight post-surgically, she reported becoming more active and less fearful of falling. Though speculative, these findings suggest FOF might lead to reduced activity, though reduced activity is also plausible as a cause of FOF. Similarly, the other variables found to be associated with FOF such as BMI, previous falls, age, anxiety and depression were also measured at a single point and so the causal direction of all of these variables with FOF or each other cannot be presumed. Some participants from the qualitative study did report being more fearful of falling since falling or with increasing weight gain, suggesting falls and higher BMI are precursors to FOF. Also a few of the older participants reported being more fearful with increasing age, though they were also often less active which makes any association less clear.

In contrast, longitudinal or prospective, cohort studies include several observations of the same subjects over a period of time, making it possible to detect changes or developments in the characteristics of the population at both the group and the individual level (Mann, 2003; Sedgewick, 2014). Furthermore, longitudinal studies can establish sequences of events and thus direction of causality (Farrington, 1991; Mariani & Pego-Fernandes, 2014). Despite these benefits, a huge disadvantage of longitudinal studies is that they take substantially more time and resources than cross-sectional studies, which was of paramount importance when choosing the design of the research, as well as fitting with the exploratory nature of the study. However, regardless of the limitations of using a cross-sectional study design, this research succeeded in providing sufficient information along with the literature review to develop a conceptual framework and provide preliminary data which can inform further studies.

The thesis was set up as an exploratory study of FOF in this population. Thus the thesis can only present tentative conclusions. An exploratory design was more appropriate for this research as there were few earlier studies to refer to regarding FOF in obese adults. The focus of exploratory research is about gaining information and insights into a little known about topic that can then be used in future investigations (Singh, 2007). The goals of exploratory research are: to gather a well-grounded picture of the situation being developed; generate new ideas, theories or hypotheses; determine whether a future study is feasible; refine concepts for more systematic investigation or develop the direction for future research (Singh, 2007; Wellington and Szczerbinski, 2007). A benefit of an exploratory research design includes that it is flexible and so can address different types of research questions in addition to providing an opportunity to define new terms or clarify existing concepts. However, a drawback of this design is that it tends to use small sample sizes and convenience samples and thus findings are not generalisable to the population being investigated. Furthermore, though the research process is flexible, it often leads to only tentative results and is unable to make definitive conclusions about them, meaning further research is required to confirm any findings. Nonetheless, this research design achieved all its aims and succeeded in providing important, original evidence of FOF in younger, obese women which provides a foundation of knowledge of this topic. This knowledge can be used to inform the design of further research to provide definitive evidence of these relationships of FOF and activity participation in this population.

Despite the key findings of this research, a major limitation was the lack of a control group of normal weight (BMI between 18.5-25 kg/m^2) women, with which to compare these results. A comparative group of normal weight women of similar age would help to confirm the findings that FOF and other previously identified variables were associated with obesity and not another variable or unknown confounder (other factors that are associated with the risk factor and may potentially be a cause of the outcome of interest) of the study. In other words, without a comparative group, the study results cannot be confirmed as only being present in obese women. Control groups strengthen the observations of participants with the same condition of interest, by determining the relative importance of a predictor variable (in this case obesity) in relation to the presence or absence of the condition of interest (FOF), in addition to controlling for known confounders (Mann, 2003). However, control groups need extra time and resources to recruit the participants, and to ensure the control group are similar to the study group (Song and Chung, 2011).

As previously stated, despite the lack of a control group, the literature provided normative data from other studies using the same FOF tools in the elderly and other populations associated with FOF with which to compare the findings (Section 7.3.1). Furthermore, though there are no previous published studies on FOF in younger obese populations, similar associations between obesity, FOF and activity levels reported in this research have been found in studies in the elderly (Bruce et al, 2002; Austin et al, 2007; Sallinen et al, 2010; Jeon et al, 2013) and a recent study validated a FOF instrument for use in women over 45 years of age (Mehta et al, 2015). However, levels of FOF in these populations were measured using other FOF tools to those used in this research study. So, although they provide evidence of increased BMI being associated with increased FOF, or in the case of Mehta et al (2015), validity of a FOF instrument in younger aged women, they were not comparable to the results of this research.

Overall, despite a lack of control group, the results of both studies suggested FOF is an issue in some young, obese women, and were comparable to results of other populations at risk of FOF and dissimilar to those seen in healthy populations. Therefore, the results of this research, together with evidence from a previous preliminary study, suggest that it is plausible that a FOF is an issue in young, obese women (Dey et al 2007; Austin et al 2007; Bruce et al 2002).

The development of the conceptual framework was challenging as some of the terms used to describe the key concepts of FOF in younger obese women were also FOF constructs used to describe FOF in the elderly. As previously stated in Chapter 5, there is no standardised definition of FOF and the FOF constructs ‘balance confidence’ and ‘falls-efficacy’ are based on different definitions and have been used to develop FOF tools in the elderly (Tinetti et al 1990; Myers et al, 1998). Many researchers report using these constructs and their measurement instruments interchangeably, which has led to confusion in studies as to which FOF construct they were actually measuring. (Legters, 2002; Hadjstavropoulos et al, 2011; Greenberg, 2014). Furthermore, the results of the review in Chapter 5 found the self-report tools that measured the constructs of falls-efficacy and balance confidence to be very similar and measures of balance confidence did not reflect the interpretations of the findings of the qualitative study of the balance issues the obese participants were describing. This highlights the disadvantages of using tools designed for different populations, but more importantly, the lack of standardised definitions, constructs and measures of FOF. A taxonomy of the different constructs of FOF would be beneficial for future researchers of FOF as it would provide clearer descriptions of all the constructs used and ensure a common understanding of their meanings. This would help with the development of future conceptual frameworks of FOF, regardless of what populations are being investigated, however it was out of the timeframe and resources of this research.

7.5 Implications of Research Findings

7.5.1 Implications for Clinicians/Healthcare Workers

In spite of the exploratory nature of this study, the findings do have practical implications. This research provides original exploratory evidence that FOF is an issue in young obese women and that it is associated with low activity participation. The implications of these findings, though speculative, could help improve current understanding of the barriers to physical activity in obese women and to help providers of weight management services to review their practices and lead to more appropriate activity interventions. As previously discussed, the research results do not provide conclusive evidence that could lead to policy change, however the developed conceptual framework, although not fully tested, offers preliminary findings of the two studies in a format that can be introduced to public healthcare workers. Firstly, this framework can be used to raise awareness and understanding of some of the difficulties obese women experience whilst trying to be active. Secondly, it can be used when assessing clients for weight management treatment to help identify factors that suggest an individual might have FOF. This could lead to more appropriate referrals of obese adults to activities that could help improve balance or reduce FOF.

Some of the qualitative study findings conveying the concerns some participants had about balancing or falling whilst using certain exercise equipment could lead to immediate, small but significant changes in the way interventions are delivered. In addition, providers of activity interventions or gym facilities could benefit from these findings. Changes to risk assessments of equipment or inductions of new clients that take account of FOF and balance would ensure more appropriate guidance and use of equipment, increase confidence in clients, and help to reduce the number of activity related injuries in obese individuals (Xiang et al, 2005; Matter et al, 2007 Janney and Jakicic,.2010). Many local primary care providers have exercise referral schemes to refer less able, obese clients for prescribed exercise delivered by local leisure providers, with the aim of providing an individually-tailored programme of exercise (Pavey et al, 2011).

Acknowledgment of the balance difficulties some obese individuals have and the effect on activity participation could lead to the addition of programs that include activities to improve balance or confidence as well as fitness. In addition, highlighting the participants' feelings of social anxiety when participating in activities, of being watched or feeling judged because of their weight could provide a better understanding of their beliefs and experiences. A recent review of obesity and healthcare avoidance identified perceived or actual weight bias and discrimination by healthcare workers as a main contributory factor, particularly in women (McGuigan and Wilkinson, 2014). Obese women were reported to present less often for healthcare examinations and interventions than obese men and were more likely to suffer from psychological disorders such as anxiety, depression and social phobia. However, there is little original research into activity avoidance in obese individuals and explanations of these associations. The findings of this research provides original information that offers a proposal of why some obese women might not be active. A clearer understanding of the viewpoints and difficulties overweight patients have when trying to increase their activity, could also help practitioners feel less frustrated when they are unable to help overweight patients change behaviour and reduce the weight discrimination reported by some healthcare providers (Campbell et al, 2000; McGuigan and Wilkinson, 2014).

This research targeted obese individuals already attending weight management services, who possibly were already motivated to change behaviour and have a certain level of self-efficacy. Research into reasons for physical activity avoidance in obese populations show both physical and psychological barriers such as poor physical functioning and low self-efficacy can lead to unpleasant experiences of activity and subsequent reduced motivation and avoidance (Petersen et al, 2004; Ekkekakis et al, 2016). Furthermore, as previously stated, being female, having poor mental health and actual or perceived weight discrimination from healthcare professionals are major factors of healthcare avoidance in obese populations (McGuigan and Wilkinson, 2014). Findings from this thesis suggest a relationship between obesity, FOF and low activity participation in younger, obese women, which in the presence of anxiety, depression, social embarrassment or activity restrictions, can lead to activity avoidance. It is therefore feasible to speculate there might be a number of obese women with FOF who are already avoiding activities and local healthcare services. In light of this, the prevalence of FOF might be difficult to estimate. Nonetheless, this research provides important information for public health workers, as it suggests why some obese women might be less active than their lean counterparts and offers a better understanding of some of the difficulties they encounter when trying to be active.

There is a significant amount of research on improving balance and reducing falls in elderly people which might be applicable to younger obese adults (Sattin et al, 2005; Visschedijk et al, 2010; Rand et al, 2011; Tennstedt et al, 1998). Fear of falling is a multifactorial condition with physical, psychological and functional influences and as such a multicomponent intervention is often recommended to prevent or treat the effects (Legters 2002). A number of systematic reviews and meta-analyses of interventions to reduce the effects of poor balance or FOF in elderly people report the design and approach of interventions vary but can include: exercise based; psychologically based; and educationally based programmes, focusing on FOF and falls and how to reduce, avoid or manage them (Jung et al, 2009; Visschededijk et al, 2010; Zijlstra et al, 2007; Rand et al, 2011; Kendrick et al, 2014). Interventions can be delivered singularly or combined as a multi-dimensional program and can be delivered individually or as a group; supervised or unsupervised and home-based or facility based. Exercise-based interventions include either strengthening, resistance, balance and mobility or task specific activities such as sit to stand or walking through an obstacle course.

Kendrick et al (2014) conducted a recent systematic review of exercise interventions to reduce FOF in older community dwelling adults and reported small to moderate reductions in FOF up to six months after, without increasing the risk or number of falls. There were limitations to the review as designs of most of the studies were of poor quality as they were non-blinded, vague about the intervention, short term and did not report on the effects of other factors relating to FOF. Rand et al (2011) conducted a review and meta-analysis of randomised controlled trials to improve balance in elderly people where Tai chi was found to be the most effective treatment at increasing balance confidence in this population. Other Tai chi interventions have also been found to be effective at reducing FOF in community dwelling older people (Zijlstra et al, 2007; Wolf et al, 1996). A meta-analysis of interventions to reduce FOF in the elderly concluded that multifactorial programs, combining exercise and education were more effective at reducing FOF than exercise alone, which seems feasible as FOF is not only influenced by physical problems but also psychological issues (Jung et al, 2009). Also home-based interventions were found to be more effective than facility based programs. Overall, interventions were reported to be most effective at reducing FOF after a period of at least four months. Very few of the interventions have reported on long term outcomes of their effects on balance or FOF, so it is not known how effective they might be at increasing activity in the long term or reducing avoidance of activities.

Results of interventions to reduce FOF in the elderly together with the results of this research could be considered in future work exploring intervention and strategies to reduce FOF and increase activity in younger, obese populations. However, in the short-term, current interventions to increase activity levels in obese individuals could be improved to offer more appropriate activities for those with activity restrictions or FOF, to improve balance, strength and coordination to help increase confidence and participation.

7.5.2 Implications for Obese Women

The past few years have seen a growing interest in the association between obesity and activity avoidance, though the reasons behind it remain poorly understood (Ekkekakis et al, 2016). Awareness of FOF as a possible factor in why some obese women might reduce or avoid activity could offer a number of obese women some optimism and reassurance. Firstly, it acknowledges FOF might be an issue in this population and a barrier to activity. Secondly, if it is found to be a barrier, there are a number of tried and tested treatments from studies in the elderly, that may help individuals overcome their fear, improve their balance and progress to lead a more active life. Lastly, the results of this research and the development of a conceptual framework to help outline the key factors contributing to FOF in obese women, can help provide a better understanding of some of the difficulties they encounter from their perspective. Subsequently, this knowledge can help individuals to seek more appropriate interventions or activities to help improve balance, self–efficacy, confidence and fitness and reduce social anxiety and activity avoidance.

7.5.3 Future Research

The findings of this research provide essential, though tentative, information that underpins the phenomenon of FOF in obese women and its relationship with activity participation. Further research is recommended to confirm these findings and provide robust, definitive evidence that FOF is a problem in some obese women and what other factors may influence it. Gaps in the conceptual framework of FOF and obesity that still need to be addressed include evidence of relationships with physical balance, mobility problems and reduced fitness. However, this research highlighted the lack of appropriate FOF tools suitable for use in younger, obese women which needs addressing prior to further definitive research being conducted.

As previously stated, (Chapter 2; Section 2.5) the lack of a standardised definition of FOF has led to several different definitions emerging over the past 30 years and subsequently several constructs developed based on these definitions (Greenberg et al, 2008; Jorstad et al, 2005). Many instruments have been developed to measure FOF or the different constructs of FOF which has resulted in confusion of what instruments to use and a variety of modified versions being developed (Jung, 2008). This lack of consistency in research on FOF make it difficult to compare results of studies when different FOF instruments have been used, and also when attempting to compare the measurement properties of these tools during the instrument review in chapter 5. Furthermore, the different FOF tools used in studies do not always measure the same construct or what they purport to measure, which make it difficult to draw meaningful conclusions (Legters, 2002; Visschedijk et al, 2010; Hadjstavropoulos et al, 2011). Increasing research has been reported on FOF in other health conditions and other authors report similar concerns of the disparities found in the different tools and constructs (Oliveira et al, 2013, Rombaut et al, 2011, Jonasson et al, 2014) In order to reduce this confusion, it is essential that a consensus is reached among authors on a standardised definition of FOF and its constructs. However as other populations reported to have FOF often differ in other characteristics, such as Parkinson's disease, MS, rheumatoid arthritis and lower extremity amputees (Gourlie et al, 2013; Jonasson et al, 2014; Collado-Mateo et al, 2015; Miller et al, 2001; Borman et al, 2002; Prado et al, 2011) a further recommendation that different frameworks of FOF, such as with obesity are developed, relevant to each disease condition.

The review of community-based FOF instruments determined the tools available are inadequate for the younger, obese population as they have not been validated in this population and items in the questionnaires do not reflect all relevant activities identified in the qualitative study and reported in the literature. Similar findings of a previous study suggested that some items of the FES-I, designed for use in elderly populations might not be suitable for use in obese populations (Dey et al, 2007). A recent pilot study by Mehta and colleagues (2015) demonstrated that commonly used FOF tools (ABC and FES-S) have good reliability and validity for use in a subgroup of women over 45 years of age with distal radius fractures, which provides further evidence of their use in young to middle-aged populations than had previously been seen (Mehta et al, 2015). However, the characteristics of women with distal radius fractures and FOF may still differ to those of obese women with FOF, which together with findings from this research, advocates the development of a new FOF tool, specific to younger, obese female populations being a more appropriate course of action, than attempting to validate existing instruments designed for the elderly.

Developing a new measurement instrument is a long process and can be completed using the conceptual framework as a guide of what relevant items to include. The lack of a standardised definition of FOF and the different constructs it measures could be addressed by creating a taxonomy of all the FOF terms used and classifying their meanings. This would be beneficial for other researchers particularly those looking at fear of falling in younger populations, or those with other disabling conditions who might plan to develop new conceptual frameworks specific to those populations. A taxonomy of FOF terms would ensure the common understanding and consistent use of all FOF terms and their meanings, or where plausible, the addition of new terms. A taxonomy could be used to map the terms of the conceptual framework of this thesis, which can then be used as a basis for the content and face validity of a new tool, to ensure all relevant items or activities are included. Further work will require the engagement of experts working in the fields of obesity and FOF to form an expert panel to develop a suitable questionnaire, and obese patients or representatives of the obese female population to assess the relevance of each item in the questionnaire. Finally, reliability and validity studies will be conducted to confirm whether this newly developed tool measures the construct of FOF in younger, obese women.

Following the development of a new FOF tool for the research population, a large longitudinal study testing associations between variables in the proposed conceptual framework would help provide this evidence and direction of causality between these variables. The inclusion of a non-obese control group would provide normative data of both incidence of falls and FOF, using the new tool and thus, help verify the findings in the obese group and the conceptual framework. Further studies may also include performance based measures such as those measuring balance or fitness, and where applicable, objective measures, e.g., accelerometers to measure physical activity or falls diaries. As previously stated, the use of performance-based and self-report measures of balance together in a future study will help to account for any disparities that have been shown, between actual and perceived measures as the result of psychological factors (Delbaere et al, 2010). The results of this research also highlighted the lack of physical activity measurements valid for use in obese populations, particularly for measurements of energy expenditure. Future research looking at measuring energy expenditure, distance walked or steps counted in obese populations would require a more accurate, objective measure of activity such as accelerometers or heart-rate monitors, as there is a lack of self-reported measures of physical activity that are valid for use in obese populations, sufficient to meet this purpose (Harvey et al, 2001; Richardson et al, 2011).

Other measures of associated variables must be reliable and valid for use in obese women. Alternatively, further studies could provide evidence of the instruments measurement properties for use in obese populations by administering the tools on more than one occasion over the study period and assessing reliability and validity. This is crucial to ensure study results are credible and generalisable to the wider population. Having verified the relationship between FOF and activity participation, the framework can then be amended and used to develop more appropriate interventions to reduce FOF and improve the uptake of activity in younger obese women.

There are increasing numbers of studies reporting FOF in younger to middle-aged populations with specific disabling conditions such as rheumatoid arthritis, fibromyalgia, Ehlers-Danlos syndrome, lower-extremity amputees and MS, which highlights the growing concerns about this complex, potentially devastating condition (Miller et al, 2001; Borman et al, 2002; Prado et al, 2011; Rombaut et al, 2011; Collado-Mateo et al, 2015; Mazumder et al, 2015). Comparisons of contributory variables associated with FOF in these other conditions show mobility, impaired or perceived balance and falls to be commonly reported in all, though other factors specific to the conditions of interest such as prosthetic problems, multiple stumps or joint stiffness, were also stated (Miller et al, 2001; Collado-Mateo et al, 2015). Further comparisons between studies of other populations and the research population showed that no studies were found to use the same FOF tools as this research study, and more often, performance-based measures, particularly of balance, or self-report quality-of-life measures were reported to be used (Rombaut et al, 2011; Collado-Mateo et al, 2015). This might suggest, other FOF tools designed for use in the elderly, might not be considered suitable for these populations, and perhaps the development of conceptual frameworks and more appropriate FOF tools for these populations need to be considered.

Research into why obese women are not active remains limited (Leone et al, 2013), though a recent cross-sectional study in Canada analysing data from the Canadian Health survey has suggested an increased BMI may be a risk factor for body injury in women (Chasse et al, 2014). Though the reasons why these injuries occur in overweight women are not conclusive, it might be pertinent to contact the authors of the study for more information as it is reasonable to suggest poor balance might be a mediator in some injuries and possibly lead to reduced activity. Another recent mixed methods study comparing the perceived benefits and barriers to exercise between obese and non-obese women over 50, using focus groups and surveys, highlighted interesting findings (Leone et al, 2013). Firstly, 40% of obese women reported only exercising when they were trying to lose weight, which similar to published research did not achieve significant weight loss when used alone, without dietary change (Physical Activity Guidelines Advisory Committee report, 2009). There did not appear to be an understanding of other health benefits of exercise in the obese group or perhaps they believed that the long term benefits of weight loss are only achieved with dietary changes, though other studies report the regular paradoxical co-occurrence of obese adults, who despite being fully aware of the benefits of regular activity and intention to be active, remain similarly inactive (Ekkekakis et al, 2016). In addition, the obese women were less likely to report enjoying exercise than the non-obese women, which might indicate a higher number of barriers obese women have to exercise or that they have a different physiological experience during exercise. Different to the findings of other studies, the obese women did not associate their reduced participation in activity with weight stigma and poor body image, which might be partly due to them being older than the non-obese participants (Kruger et al, 2008; Andersen et al, 2009). These findings need to be considered in future intervention studies to reduce FOF and increase activity in obese women, in order to ensure awareness of all the benefits of regular activity regardless of weight loss and to focus more on making activities more enjoyable.

Finally, this research looked at FOF as a phenomenon in women only, as studies in the elderly suggested women were less active and more likely to have activity restrictions and FOF than men. However, studies in the elderly have confirmed the presence of FOF in obese elderly men, though no difference was reported between genders (Sallinen et al, 2009; Jeon 2013). Whether FOF is an issue in younger obese men needs to be established. Findings of this research can also be disseminated through research networks and publications to raise awareness to others interested in this areas of obesity, FOF and physical activity and help inform further studies into this phenomenon.

7.6 Conclusions

This exploratory research has successfully achieved its original objectives and provides supportive evidence that FOF is an issue in younger obese women and associated with reduced activity participation. A review of the literature highlighted a gap in knowledge around the physical causes of reduced activity in younger obese adults and evidence in the elderly that FOF and activity participation is linked to obesity. Surprisingly, no one has previously reported the similarities in factors associated with FOF in elderly populations to those of obese adults, such as risk of falls, poor balance and walking patterns. Obesity and FOF are both complex, chronic conditions that can have serious long-term effects. The identification of FOF in obese adults and the development of a conceptual framework together with the discovery that there are no FOF tools validated or suitable for use in this population has provided an original contribution to knowledge and filled a gap in the literature. Further research is needed to develop both the conceptual framework and confirm relationships between FOF and activity participation. The development and validation of appropriate measures of FOF in this population for use in future definitive studies will help provide a better understanding of low activity participation in obese women and lead to more appropriate interventions to both increase activity levels and reduce FOF. These findings are paramount in providing a new research contribution to support and inform both public health specialists and practitioners of more appropriate treatments and interventions, in order to promote and increase activity in obese populations. This ultimately can benefit all concerned in helping to improve their long-term health outcomes.

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APPENDIX A – SCOPING REVIEW

A1: Summary of Search Strategy

Search History of CINAHL, AMED, MEDLINE and PsycINFO via EBSCOhost. Date of search 5.01.2016		
Keyword	Limiters	No
(Obes* OR overweight OR high body mass index OR high BMI OR high body weight) AND (activity restriction* OR functional limitation* OR physical function* OR activit* of daily living OR ADL) NOT (pregnant OR pregnancy OR preg* OR anorexia OR anorexia nervosa OR anorex* OR bulimia OR bulimia nervosa OR bulim*)	Limiters - Published Date: 19850101-20100331; English Language; Human; Age Groups: Adolescent: 13-18 years, All Adult; Language: english; English Language; Human; Age Related: Adolescent: 13-18 years, All Adult: 19+ years; Publication Year: 1985-2010; English; Age Groups: Adolescence (13-17 yrs), Adulthood (18 yrs & older) Search modes - Boolean/Phrase	329
(Obes* OR overweight OR high body mass index OR high BMI OR high body weight) AND activity participation OR participation OR physical activit* OR exercise OR physical exercise OR physical fitness OR activity avoidance OR physical inactivity OR barrier* to activity OR barrier* to exercise OR non-participation NOT (pregnant OR pregnancy OR preg* OR anorexia OR anorexia nervosa OR anorex* OR bulimia OR bulimia nervosa OR bulim*)	Limiters - Published Date: 19850101-20100331; English Language; Human; Age Groups: Adolescent: 13-18 years, All Adult; Language: english; English Language; Human; Age Related: Adolescent: 13-18 years, All Adult: 19+ years; Publication Year: 1985-2010; English; Age Groups: Adolescence (13-17 yrs), Adulthood (18 yrs & older) Search modes - Boolean/Phrase	142
(Obes* OR overweight OR high body mass index OR high BMI OR high body weight) AND (postural balance OR postural control OR postural stability) NOT (pregnant OR pregnancy OR preg* OR anorexia OR anorexia nervosa OR anorex* OR bulimia OR bulimia nervosa OR bulim*)	Limiters - Published Date: 19850101-20100331; English Language; Human; Age Groups: Adolescent: 13-18 years, All Adult; Language: english; English Language; Human; Age Related: Adolescent: 13-18 years, All Adult: 19+ years; Publication Year: 1985-2010; English; Age Groups: Adolescence (13-17 yrs), Adulthood (18 yrs & older) Search modes - Boolean/Phrase	5
(Obes* OR overweight OR high body mass index OR high BMI OR high body weight) AND (fall* OR fall* risk OR accidental fall* OR slip and fall OR fear of fall*) NOT (pregnant OR pregnancy OR preg* OR anorexia OR anorexia nervosa OR anorex* OR bulimia OR bulimia nervosa OR bulim*)	Limiters - Published Date: 19850101-20100331; English Language; Human; Age Groups: Adolescent: 13-18 years, All Adult; Language: english; English Language; Human; Age Related: Adolescent: 13-18 years, All Adult: 19+ years; Publication Year: 1985-2010; English; Age Groups: Adolescence (13-17 yrs), Adulthood (18 yrs & older) Search modes - Boolean/Phrase	134
Total		610
Booleon “OR”		571

Search history of EMBASE via OvidSP. Date of search 5.1.2016		
Keywords	Limiters	Number
(Obes* OR overweight OR high body mass index OR high BMI OR high body weight) AND (activity restriction* OR functional limitation* OR physical function* OR activit* of daily living OR ADL) NOT (pregnant OR pregnancy OR preg* OR anorexia OR anorexia nervosa OR anorex* OR bulimia OR bulimia nervosa OR bulim*)	Human, abstracts and English language. Years 1985-2010 (adolescent <13 to 17 years> or adult <18 to 64 years> or aged <65+ years>	31
(Obes* OR overweight OR high body mass index OR high BMI OR high body weight) AND Activity participation OR participation OR physical activit* OR exercise OR physical exercise OR physical fitness OR activity avoidance OR physical inactivity OR barrier* to activity OR barrier* to exercise OR non-participation NOT (pregnant OR pregnancy OR preg* OR anorexia OR anorexia nervosa OR anorex* OR bulimia OR bulimia nervosa OR bulim*)	Human, abstracts and English language. Years 1985-2010 (adolescent <13 to 17 years> or adult <18 to 64 years> or aged <65+ years>	278
(Obes* OR overweight OR high body mass index OR high BMI OR high body weight) AND (postural balance OR postural control OR postural stability) NOT (pregnant OR pregnancy OR preg* OR anorexia OR anorexia nervosa OR anorex* OR bulimia OR bulimia nervosa OR bulim*)	Human, abstracts and English language. Years 1985-2010 (adolescent <13 to 17 years> or adult <18 to 64 years> or aged <65+ years>	2
(Obes* OR overweight OR high body mass index OR high BMI OR high body weight) AND (fall* OR fall* risk OR accidental fall* OR slip and fall* OR fear of fall*) NOT (pregnant OR pregnancy OR preg* OR anorexia OR anorexia nervosa OR anorex* OR bulimia OR bulimia nervosa OR bulim*)	Human, abstracts and English language. Years 1985-2010 (adolescent <13 to 17 years> or adult <18 to 64 years> or aged <65+ years>	250
Total		561
Booleon "OR"		172

A2: RESULTS OF SCOPING REVIEW: DATA CHARTING FORMS

TABLE A2.1: OBESITY, ACTIVITY RESTRICTION AND ACTIVITY PARTICIPATION

i) IN ELDERLY OBESE

AUTHOR, YEAR & COUNTRY	**STUDY TYPE & PARTICIPANT CHARACTERISTICS**	**OBJECTIVE or STUDY TITLE**	**CONCEPT/KEY FINDINGS**
Launer et al (1994)	Prospective cohort study Women aged >55 years	Body mass index, weight change, and risk of mobility disability in middle-aged and older women: the Epidemiologic Follow-up Study of NHANES I	Findings suggest that high BMI is a strong predictor of long-term risk for mobility disability in older women and that this risk persists even to very old age. However, the paradoxical increase in risk associated with weight loss in the old-old women requires further study.
Visser et al (1998) USA	3-year prospective study 4,809, 65-100 year old male and female Self-reported and body mass measurement using bioelectrical impedance	High body fatness, but not low fat-free mass, predicts disability in older men and women: the Cardiovascular Health Study	High body fatness is an independent predictor of mobility-related disability in older men and women
Himes (2000) USA	2 Longitudinal surveys in elderly >17,000 >70 year olds	Obesity, disease and functional limitation in later life	Obesity linked to lower functioning, particularly strong in women.
Friedmann et al (2001) USA	Cross sectional cohort study	The relationship between Body Mass Index and self-reported functional	Women consistently report more functional limitations than men.

	>7,000 community dwelling elderly >65 years old	limitation among older adults: a gender difference.	
Jensen and Friedmann (2002) USA	Cohort cross sectional 2,634 community dwelling >65years old	Obesity is associated with functional decline in community dwelling rural older persons.	Women had higher prevalence of reported functional decline than men at the upper range of BMI
Davison et al (2002) USA	Cross-sectional population based sample 1,526 women and 1,391 men ≥ 70 years old	Percentage of body fat and body mass index are associated with mobility limitations in people aged 70 and older from NHANES III	Obese elderly women appear to suffer more from functional limitations than non-obese
Sternfeld et al (2002) USA	Community based cohort study 1,655 aged ≥55 years old	Associations of body composition with physical performance and self-reported functional limitation in elderly men and women.	Higher fat mass associated with slower walking speeds and functional limitation. Higher lean to fat mass ratio associated with faster walking speeds. Central adiposity, independent of lean or fat mass, negatively impacts on physical functioning.
Larrieu et al (2004) France	Cross sectional, 8,966 adults aged ≥65 years old	Relationship between BMI and different domains of disability in older persons: the 3c study	Significant association between obesity and each of 3 areas of disability – ADL, IADL and mobility, more so in women. Not known if weight is consequence or cause of disability, though probable both mechanisms co- occur.
Brach et al (2004)a USA	Cross sectional, 3,075 well-functioning adults aged 70-79 years old	The Association Between Physical Function and Lifestyle Activity and Exercise in the Health, Aging and Body Composition Study	Older adults who participate in 20 to 30 minutes of moderate-intensity exercise on most days of the week have better physical function than older persons who are active throughout the day or who are inactive
Di Francesco et al (2005) Italy	Cross-sectional 85 community dwelling men aged 68-79 years	Relationships between leisure-time physical activity, obesity and disability in elderly men	In elderly men, leisure-time physical activity is inversely associated with body fat, BMI, and reported disability, but positively associated with appendicular fat-free mass. The highest prevalence of reported disability was observed in sedentary subjects with BMI higher than 25 kg/m2.

Houston et al (2005) USA	Longitudinal, cohort study. 9416 African American and white men and women aged 45–64 years	Abdominal fat distribution and functional limitations and disability in a biracial cohort: the Atherosclerosis Risk in Communities Study	Waist circumference, WHR, and BMI were positively associated with functional limitations and ADL and IADL impairment approximately 9 y later among African American and white men and women.
Van Gool et al (2005) USA	Prospective, RCT 134 elders with knee arthritis	Effects of exercise adherence on physical function among overweight older adults with knee osteoarthritis.	Higher exercise adherence was associated with greater improvements in 6-minute walking distance after 6 and 18 months and in disability after 6 months. Pain and body mass index (BMI) contributed, to some extent, to explaining the link between exercise adherence and changes in physical performance and self-reported disability.
Sharkey et al (2006) USA	Prospective cohort, 1 year follow up 282 homebound >60 year old 282 ≥60 year old, home bound but considered ambulatory adults	Severe Elder Obesity and 1-Year Diminished Lower Extremity Physical Performance in Homebound Older Adults	Compared with normal weight, overweight and moderately obese (BMI30-34.9kg/m2), only severe obesity (BMI>35kg/m2) independently increased the odds of diminished performance at 1 year (timed walking, static and dynamic balance, and chair rise)
Simoes et al (2006) USA	>3000 adults >60 years old data from telephone survey	Associations of physical activity and body mass index with activities of daily living in older adults	ADL and IADL dependence decreased with physical activity and increased with BMI regardless of the presence of the other, presence of functional limitation, gender or race-ethnicity.
Jinks et al (2006) UK	Prospective cohort 5784 Adults aged over 50 years	Disabling knee pain--another consequence of obesity: results from a prospective cohort study	Among responders with no knee pain at baseline, obesity predicted onset of severe knee pain compared to normal body mass index (BMI) category. Considering overweight and obese categories together, 19% of new cases of severe knee pain over a 3-year period could potentially be avoided by a one-category shift downwards in BMI.

Alley and Chang (2007) USA	Longitudinal study of 9,928 none institutionalised US elderly pop (>60 years old) 1988-2004. Interviews and clinical examinations	The changing relationship of obesity and disability, 1988-2004.	There has been a decline in reported functional impairment in non-obese older individuals alongside improvements seen in cardiovascular health over 16 years old – this was not the case in obese individuals, and in fact some types of disability are increasing.
Lang et al (2007) USA and UK	Prospective nationally representative cohort studies across US and England 8702 and 1507 people aged 50-69 years old	Physical activity in middle-aged adults reduces risks of functional impairment independent of its effect on weight	Excess bodyweight is a risk factor for impaired physical function in middle-aged and older people. Physical activity is protective of impaired physical functioning in this age group in subjects with recommended weight, overweight, and obesity.
Woo et al (2007) Hong Kong	Cross-sectional 4,000 men and women aged ≥ 65 years living in community 5 categories of BMI using Asian cut offs	BMI, Body Composition, and Physical Functioning in Older Adults	Subjects in the 2 obese categories (BMI 25-29.9kg/2 and ≥30kg/m²) had a significantly greater number of instrumental activities of daily living (IADL) impairments compared with the underweight and normal-weight groups Those with BMI ≥30 kg/m2 had the worst walking performance, and the groups with BMI in the normal and overweight range had optimal performance. Fat mass, but not appendicular muscle mass, was associated with walking speed after adjusting for BMI
Kostka and Bogus (2007) Poland	Cross-sectional 177 women and 123 men aged between 66-79 years old	Independent contribution of overweight/obesity and physical inactivity to lower health-related quality of life in community-dwelling older subjects	Excess body fatness and sedentary lifestyle have, together with several functional and medical comorbidities, an independent contribution to inferior health related quality of life in community dwelling older subjects.

Rolland et al (2007) France	Cross sectional 215 obese (80.0 +/- 3.5 years, BMI 31.9+/- 2.6) 630 normal (80.2 +/- 3.7 years, BMI 26.3+/- 1.4) 598 lean (80.7+/- 4.1 years, BMI 21.6+/- 1.8) Women with good functional ability	Disability in obese elderly women: Lower limb strength and recreational physical activity.	Low knee extensor strength (KES) is associated with disability and difficulty with physical functioning in elderly women. High level of KES in participants engaged in regular physical activity may prevent disability related to obesity.
Chen and Guo (2008) USA	Cross-sectional population based survey >3000 >60years old	Obesity and functional disability in elderly Americans	Indicators of obesity are related to functional disabilities. In women BMI and WC were each related to higher prevalence of all measures of disabilities. Moderate associations in men. WC appeared to be better predictor than BMI of disability in women.
Lang et al (2008) UK	5-year population based cohort 3,793 ≥65years old. Self-reported and measured physical functions assessed.	Obesity, physical function, and mortality in older adults	Excess body weight in elderly is associated with greater risk of impaired physical function but not with greater mortality risk
Stenholm et al (2010) USA	Data from 2,984 adults aged 70-79 years (health Aging, Body Composition study).	Joint association of obesity and metabolic syndrome with incident mobility limitation in older men and women.	Obesity is an independent risk factor for mobility limitation among obese older adults.
Riebe et al (2009) USA	Community based SENIOR health promotion study 821 over 60 years old	The relationship between obesity, PA and Physical function in older adults*	Obesity is associated with lower levels of physical activity and physical function. Women had lower physical function scores than men placing them at higher risk of future disability

Walter et al (2009) Netherlands	Population based longitudinal study 5,980 >55 year olds	Mortality and disability: the effects of overweight and obesity	Increased body weight was associated with a higher risk of becoming and remaining disabled.
Valentine et al (2009) USA	Cross-sectional 85 females and 49 males sedentary, healthy, community-dwelling older adults mean age 69.6 and 70.3 years, respectively	Sex impacts the relation between body composition and physical function in older adults.	In sedentary healthy older adults, the relation between body composition, aerobic fitness, and balance and gait differs between sexes such that women are more strongly affected by alterations in body composition. Lower %Fat and preservation of lower body lean mass have important implications for reducing the risk of physical disability, especially in older women.
Jensen and Hsiao (2010) USA	Review	Obesity in older adults: Relationship to functional limitation	The association between obesity and functional decline is well documented and there must be research priority to establish how obesity impacts on function so appropriate prevention and treatment strategies can be adopted.
Gadalla (2010) Canada	Data from Canadian Community Health Survey 2005 in 21,255 ≥65 year olds	Relative body weight and disability in older adults: results from a national survey	Limitations in performing IADLs were higher for women, those underweight or obese, but not overweight.
ii) IN ELDERLY OBESE WOMEN			
AUTHOR, YEAR & COUNTRY	**STUDY TYPE & PARTICIPANT CHARACTERISTICS**	**OBJECTIVE or STUDY TITLE**	**CONCEPT/KEY FINDINGS**
Coakley et al (1998) USA	Cross sectional 56,510 45-71 year old women	Lower levels of physical functioning are associated with higher body weight among	In addition to increasing risk of chronic health conditions, greater adiposity is associated with lower every day physical functioning, such as climbing stairs or other moderate activities, as well as lower feelings of wellbeing and greater burden of pain.

		middle-aged and older women	
Apovian et al (2002) USA	90 elderly women mean age 71 Performed 18 functional tasks	BMI and physical function in older women.	Higher BMI affects physical function, especially upper-body Function, and to a lesser extent, lower-body function. BMI does not seem to be associated with levels of coordination or strength.
Aoyagi et al (2002) Japan	Cross sectional 351 community-dwelling Japanese women aged 40-85 years	Association of body mass index with joint pain among community-dwelling women in Japan	Knee pain was associated with greater BMI. This finding supports previous longitudinal studies, suggesting that some knee pain could be prevented by avoidance of excess weight, if the association is causative
Brach et al (2004)b USA	14-year prospective study 171 older women, mean age 74.3 years	The relationship among Physical Activity, obesity and physical function in community dwelling older women	Overweight or obese women who were physically active had better physical function than those who were inactive. PA appears to be as important if not more as body weight in predicting future physical function.
Larsson (2004) Sweden	12-week weight loss Intervention 43 women aged 40-65 years old	Influence of weight loss on pain, perceived disability and observed functional limitations in obese women	Weight reduction had positive short-term effects on musculoskeletal pain, perceived disability and observed functional limitations. A partial weight relapse had some impact on perceived pain and disability, but not on observed limitations. The maintained improvements may be due to weight loss, but also less pain and increased physical activity
Kim et al (2008) Japan	Cross sectional survey 925 women aged 70 years and older	Prevalence of geriatric syndrome and risk factors associated with obesity in community dwelling elderly women	High percentage body fat is associated with lower level of walking ability and balance. Suggests regular physical activity and weight control may contribute to the prevention of IADL disability and improvement of fitness in obese elderly women.
Newton et al (2009) USA	45 obese and 88 non obese Mean age of 76.3 ± 7.3 years	The Relationship Between Physical Performance and Obesity in Elderly African-American Women	The obese group had significantly lower self-reported daily activities and poorer scores on several physical performance measures than non-obese older African-American women. These findings substantiate a relationship between obesity and physical performance in African-American women.

iii) IN YOUNG– MIDDLE-AGED OBESE ADULTS			
AUTHOR, YEAR & COUNTRY	**STUDY TYPE & PARTICIPANT CHARACTERISTICS**	**OBJECTIVE or STUDY TITLE**	**CONCEPT/KEY FINDINGS**
Lusky et al (1996) Israel	Population based study of ~110,000 17 year old Israeli males	Relationship between morbidity and extreme values of body mass index in adolescents	Overweight is associated with joint conditions of hip, ankle and knee.
Han et al (1998) Netherlands	Comparison of anthropometric and functioning questionnaire data of >4000 adults aged 20-59 years old	Quality of life (QOL) in relation to overweight and body fat distribution	Large waist circumference and high BMIs are more likely to be associated with impaired QOL and disability affecting basic activities of daily living, including mobility problems and range of musculoskeletal pains
Ferraro and Booth (1999) USA	National longitudinal survey, non-institutionalised self-reported height and weight 3,617 adults aged 25 and over	Age, BMI and functional illness	Obesity is associated with functional illness of all ages and the effect on some measures of functional illness is greater in the young and middle aged.
Hills et al (2001) Australia	Review: Cross sectional study measurements – anthropometric, QOL, other factors.	The biomechanics of adiposity structural and functional limitations of obesity and implications for movement	Obesity significantly increases risk of developing numerous medical conditions. However, there is a lack of information relating to the structural and functional limitations of obesity. Subjective references have been made to difficulties encountered.
Larsson and Mattsson (2001a) and b) Sweden	Comparison 57 obese vs 22 controls mean age 44 years and 49 years old consecutively	a) Functional limitations linked to high body mass index, age and current pain in obese women b) Perceived disability and observed functional limitations in obese women	Functional limitations linked to high BMI, age and current pain in obese women. Obese women perceive disability too much higher extent than non-obese. Lack of obesity specific instruments. Some differences between self-reported disabilities and observed measures.

Ferraro et al (2002) USA	6,833 adults aged 25-74 years old. Data from national longitudinal survey 20-year prospective study to examine lagged effect of BMI on disability	Body mass index and disability in adulthood: a 20-year panel study	Adult obesity increases the long term risk of disability. Obesity is associated with higher levels of both upper and lower body disability which increase more rapidly over time.
Tsuritani et al (2002) Japan	709 Women aged 40-69 years old Self-reported questionnaire and BMI measurements	Impact of obesity on musculoskeletal pain and difficulty of daily movements in Japanese middle aged women	Most common pain is lower back and not associated with age. Prevalence of leg pain increased with age. Physical function declines with increase in age and BMI in middle aged and elderly women.
Kuh et al (2005) UK	Prospective cohort 2,956 53 year old men and women	Grip strength, postural control, and functional leg power in a representative cohort of British men and women: associations with physical activity, health status, and socioeconomic conditions.	In this middle-aged group, physical performance levels varied widely, and women were seriously disadvantaged compared with men. In general, physical performance was worse for men and women living in poorer socioeconomic conditions with greater body weight, poorer health status, and inactive lifestyles.
Swallen et al (2005) USA	Cross sectional population based study 4743 adolescents with direct measures of height and weight	Overweight, obesity and health related quality-of-life among adolescents: the National Longitudinal study of Adolescent Health	Obesity in adolescents in linked with poor physical quality of life. However overweight adolescents did not report poorer emotional or social functioning.
Lidstone et al (2006) UK	Cross sectional survey of community dwelling adults 8,613 aged ≥18 years old	Independent associations between weight status and disability in adults: results from the HSE	Obesity is independently associated with a range of disabling conditions, including musculoskeletal, arthritis and rheumatism, though these were self-reported.
Wearing et al (2006) Australia	Review	The biomechanics of restricted movement in adult obesity	Body adiposity is linked with greater risk of musculoskeletal (MSK) pain and injury. Obesity has been linked with MSK disorders involving back, hip, knee, ankle and foot, and to lesser extent upper body and wrist. The mechanisms how remain unclear.
Lang et al (2007) USA and UK	Prospective cohort studies in US and England	Physical activity in middle-aged adults reduces risks of functional impairment independent of its effect on weight	Self-reported and measured BMI and self-reported physical activity. In both studies, being overweight or obese were associated with greater risk of impairment than recommended weight. In all weights, higher levels of physical activity associated with lower levels of mobility impairment. Excess body weight is a risk factor for impaired

	8,702 and 1,507 aged 50-69 years, 6 years		physical function in middle-aged people. Physical activity is protective of impaired physical functioning.
Bish et al (2007) USA	Data from 1999-2002 NHNES 5608 aged ≥20 years old	Activity participation limitation and weight loss among overweight and obese US adults	Approx. 30 % of overweight and obese adults report some degree of limitation. Obese (BMI ≥ 30) men with vs. without activity/participation limitations were more likely to try to lose weight (OR = 1.59, 95% CI 1.05–2.41). This was not the case for overweight women and men (BMI 25–29.9), or obese women. Overweight women with vs without activity/participation limitations had significantly reduced likelihood of attaining recommended physical activity.
Tukker et al (2009) Netherlands	Cross sectional data from population based study – aged ≥25 years old 3,664 Self-reported postal questionnaires	Overweight and health problems of the lower extremities: osteoarthritis, pain and disability	Overweight is associated with Osteoarthritis of hip and knee. About 25% health problems of lower extremities are estimated to be due to overweight and obesity.
Capodaglio et al (2010) Italy	Review	Functional limitations and occupational issues in obesity: A Review	A review of the functional limitations often experienced by obese individuals and the impact it has on their work life. Also highlights the importance of multi-level interventions to help improve the working lives of obese adults.
iv) WALKING AND MOBILTY PROBLEMS IN OBESE ADULTS			
AUTHOR, YEAR & COUNTRY	**STUDY TYPE & PARTICIPANT CHARACTERISTICS**	**OBJECTIVE or STUDY TITLE**	**CONCEPT/KEY FINDINGS**
Spyropoulos et al (1991) USA	Comparison observational 12 obese men 30 - 47 years old	Biomechanical gait analysis in obese men	Obese subjects walk significantly slower, take shorter steps and strides than non-obese. Also take greater stride widths and longer gait cycle times than non-obese

LaCroix et al (1993) USA	Prospective 4 year 6,981 men and women aged 65 years	The effect of BMI and physical activity on maintaining mobility in later life.	Risk of losing mobility was significantly associated with high (>80th percentile) compared with moderate (21-80th percentiles) body mass index, and low physical activity levels in both men and women.
Sternfeld et al (2002) USA	community based cohort study 1,655 aged ≥55years old	Associations of body composition with physical performance and self-reported functional limitation in elderly men and women.	Higher fat mass associated with slower walking speeds and functional limitation. Central adiposity, independent of lean or fat mass, negatively impacts on physical functioning.
Wearing et al (2006) Australia	Review	The biomechanics of restricted movement in adult obesity	Body adiposity is linked with greater risk of MSK pain and injury. Obesity has been linked with MSK disorders involving back, hip, knee, ankle and foot, and to lesser extent upper body and wrist. The mechanisms how remain unclear.
Mendes de Leon (2006) USA	Longitudinal 4195, mean age 73.8+/-6.3(SD) years, 61.4% women, 60.9% black	Relative weight and mobility: A longitudinal study in a biracial population of older adults	Higher levels of BMI may lead to mobility impairments earlier in life, but there is little evidence that they increase the rate of decline in mobility in older age.
Stenholm et al (2007)b Finland	2055 women and 1337 men aged ≥ 55 years	Effect of co-morbidity on the association of high body mass index with walking limitation among men and women aged 55 years and older	Obesity increases risk of walking limitation, independent of obesity related diseases, smoking, marital status and education, especially in older women.
Stenholm et al (2007)a Finland	Longitudinal prospective study of 2055 women and 1337 men aged ≥ 55 years	Obesity history as a predictor of walking limitation at old age	Early onset of obesity and obesity duration increased the risk of walking limitation, and the effect was only partially mediated through current BMI and higher risk of obesity-related diseases
Koster et al (2007) USA	2027 non-obese and 667 obese 70-79 year old adults	Lifestyle factors and incident mobility limitation in obese and non-obese older adults	Overall obese persons had a significantly higher risk of mobility limitation compared with non-obese persons, independent of lifestyle factors such as smoking, alcohol, unhealthy diet and low activity.

Koster et al (2008) USA	Longitudinal 70-79 years old	Joint effects of adiposity and physical activity on incident mobility limitation in older adults	High adiposity and low self-reported physical activity (PA) predicted the onset of mobility limitation in well-functioning older persons. People with higher PA levels are less likely to become functionally disabled than inactive people.
Tukker et al (2009) Netherlands	Cross sectional data from population based study – Dutch	Overweight and health problems of the lower extremities: osteoarthritis, pain and disability	Overweight is associated with osteoarthritis (OA) and that overweight increases the risk of disability in mobility both in general population and those with OA. Overweight also associated with both hip and knee OA, the association being stronger for knee OA. Compared with other chronic diseases, people with OA of hip or knee report the worst QOL among people with MSK diseases. OW plays a role in this relationship. Among patients with OA and chronic pain, both moderate OW and obesity are associated with disability in walking. Around 25% health problems of lower extremities are estimated to be due to OW and obesity.
Lai et al (2008) China	Cross-sectional 14 obese adults mean age 35.4 years old, BMI =33.6(4.2) kg/m² 14 non-obese mean age 27.6 years old BMI 21.3(1.5) kg/m²	Three-dimensional gait analysis of obese adults	Obese adults walk slower and had shorter stride lengths, they also spent more time in stance phase and double support in walking
Houston et al (2009) USA	Prospective and retrospective self-reporting 2,845 70 -79 year old	Overweight and Obesity Over the Adult Life Course and Incident Mobility Limitation in Older Adults	Men and women who were overweight or obese at 3 time points had increased risk of mobility limitation than those normal weight throughout. Cumulative effect of overweight and/or obesity over adult course increases risk of mobility limitation in old age.

TABLE A2 2: FEAR OF FALLING, ACTIVITY PARTICIPATION AND OBESITY

i) IN ELDERLY ADULTS			
AUTHOR, YEAR & COUNTRY	**STUDY TYPE & PARTICIPANT CHARACTERISTICS**	**OBJECTIVE or STUDY TITLE**	**CONCEPT/KEY FINDINGS**
Simonsick et al (1999) USA	Cross-sectional 920 moderately to severely disabled community-resident women, aged 65 years and over	To determine how severity of walking difficulty and sociodemographic, psychosocial, and health related factors influence walking behaviour in disabled older women	Sociocultural, psychological, and health-related factors were independently associated with walking behaviour including obesity. Obesity was significantly associated with lower likelihood of walking in disabled older women. However, FOF was not associated with walking ability outside the home.
Bruce et al (2002) Australia	Cross sectional analysis 1,500 aged 70-85 years old women	To examine whether FOF is probable cause of reduced activity participation	FOF is common in older women and is independently associated with reduced levels of participation in recreational PA. Associated with high BMI
Andresen et al (2006) USA	Cross sectional and longitudinal 998 middle-aged community based African Americans, mean age 56.8 years, men =41.8%	To cross-sectionally and longitudinally identify risk factors for falls, fear of falling, and falls efficacy in late-middle-aged African Americans	The most consistent association for all outcomes was depressive symptoms. Age was associated with increased risk of prior and prospective falls. Lower-body functional limitations were associated with prior falls, baseline fear of falling, and low falls efficacy, FOF increased with higher BMI but not statistically significant
Austin et al (2007) USA	Longitudinal 1,282 community dwelling 70 -85 years old women	To determine longitudinal predictors of incident and persistent fear of falling (FOF) in older women	FOF in older women is common complaint caused mainly by impairment of balance and mobility. Other variables independently associated with FOF include; obesity, cognitive impairment, depression baseline predictors of FOF that persisted after 3 years were similar,

			whereas obesity and slower timed up and go test scores predicted new-onset FOF.
Deshpande et al (2008) a USA	Cross-sectional 848 participants aged ≥65 years. (average age 75.9 ± 6.4, average BMI 26.49 ± 3.94, 470 females	To identify psychological, physical and sensory function parameters that are specifically associated with FOF and fear-induced activity restriction in a population based sample of older adults	Psychological and physical factors are independently associated with FOF. A higher but not significant risk of FOF reported with increased BMI.
Deshpande et al (2008)b USA	Prospective cohort study 673 community living elderly > 65 years old who reported FOF	To examine whether activity restriction specifically induced by fear of falling (FOF) contributes to greater risk of disability and decline in physical function.	In elderly pop 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.
Sallinen et al (2009) Finland	Cross-sectional 619 community living elders aged 75-81 years 436 non-obese, 127 moderately obese, 56 severely obese	To examine what older obese people consider as constraints on their physical exercise and to determine whether these constraints can explain the differences in physical activity.	Risk of physical inactivity was 2 times higher in mod obese group, and 4 times higher in severe obese group compared to non-obese. Higher prevalence of comorbidities, pain, tiredness, FOF and injury, discomfort and feelings of insecurity when exercising explained almost half the increased risk of physical inactivity of older severe obese
ii) IN YOUNG OBESE ADULTS			
AUTHOR, YEAR & COUNTRY	**STUDY TYPE & PARTICIPANT CHARACTERISTICS**	**OBJECTIVE or STUDY TITLE**	**CONCEPT/KEY FINDINGS**
Larsson and Mattsson (2001) Sweden	Cross sectional 57 women mean age =44yrs, mean BMI =37 Outpatients, 22 controls	To describe functional limitations in obese women	Obese women reported a fear of falling due to a fear of feeling clumsy and being mocked and stared at if they fell

Deitel (2001) Canada	Editorial 1,549 morbidly obese Bariatric patients	Overlooked problems in morbidly obese patients	Bariatric surgeon reported 16% of patients reporting walking downstairs backwards as cannot see lower steps due to truncal obesity and feared falling.
Dey et al (2007) UK	Cross sectional 8 obese adults and 8 controls	To compare FOF in obese and non-obese adults	Obese participants scored lower on falls efficacy scale

TABLEA2.3: BALANCE FALLS AND OBESITY

i) BALANCE PROBLEMS IN OBESE ELDERLY			
AUTHOR, YEAR & COUNTRY	**STUDY TYPE & PARTICIPANT CHARACTERISTICS**	**OBJECTIVE or STUDY TITLE**	**CONCEPT/KEY FINDINGS**
Means et al (2000) USA	Cross sectional 180 white and 118 African American women aged ≥65 years	To compare balance, mobility, recent falls, and injuries among elderly African American and white women	Compared with white women, African American women took fewer medications, had greater body mass indexes, had less muscle strength, and had more medical conditions and neurologic abnormalities. Additionally, these women were less active and had poorer performances on an obstacle course. The two groups had similar histories of falls and injuries.
Bulbulian and Hargan (2000)	56 older adults in 4 groups of former athletes currently active	To investigate the effects of former athleticism and current activity status on	The results indicated that current activity status plays a key role on balance performance in older adults regardless of weight.

USA	and inactive and controls-currently active and inactive	static and dynamic postural balance in older adults.	Furthermore, former athletic activity history provides no protection for the age related onset of postural imbalance.
Jadelis et al (2001) USA	Cross sectional 480 adults ≥ 65 years old and with knee pain	To examine the relationship between muscular strength and dynamic balance in a sample of older adults with knee pain and to determine the role that obesity and severity of knee pain play in the ability to maintain balance.	Obesity is associated with decreased muscular strength per mass ration therefore obese individuals tend to be weaker than normal weight individuals. This on top of larger forces needed to correct balance means obese more likely to have poorer balance.
Manckoundia et al (2008) France	Observational 2,368 community dwelling elderly adults ≥60 years old	Clinical determinants of failure in balance tests in elderly subjects	Female sex, low self-perception of health, low cognitive status and overweight were associated with higher risk of failure in balance tests.
ii) BALANCE PROBLEMS IN OBESE ADULTS			
AUTHOR, YEAR & COUNTRY	**STUDY TYPE & PARTICIPANT CHARACTERISTICS**	**OBJECTIVE or STUDY TITLE**	**CONCEPT/KEY FINDINGS**
Torgessen et al (1993) UK	Population based screening programme for osteoporosis 45 - 49 year old women	The relationships between falling, fracture and bone density in perimenopausal women	Risk of falling may be related to menopausal status, increased body weight, use of diuretics, self-reported arthritis and absence of car ownership.
Corbeil et al (2001) Canada	Mathematical modelling Obese and lightweight humanoids	To examine the impact of an abnormal distribution of body fat in the abdominal area upon postural stability	Obese persons (particularly those with an abnormal distribution of body fat in the abdominal area) may be at higher risk of falling than lightweight individual.
Bertocco et al (2002) Italy	Cross sectional 10 normal weight (mean age 26.5 years, mean BMI	Analysis of the sit-to-stand movement in healthy and obese subjects using a biomechanical model	During sit to stand obese subjects use a strategy with low trunk flexion and high momentum at knee joint. This overload could be

	22.2kg/m²) and 30 obese (mean age 48.1 years and mean BMI 37.52kg/m²)		harmful in degenerative conditions, joints and poor functional activities of daily living.
Gravante et al (2003) Italy	Cross sectional study in university setting 38 obese and 34 control adults mean age 23 years old	To determine whether centre of pressure location, plantar surface areas, or plantar pressures differ between obese and control young adults during quiet standing.	Centre of pressure location was unaffected by obesity, but significantly increased plantar contact areas and pressures. In obese which may have negative ramifications for foot function over the longer term.
Gauchard et al (2003) France	Case controlled study 427 male railway company employees who had been injured due to imbalance 427 controls	To assess the relations between certain individual characteristics and occupational accidents due to imbalance	Individual characteristics such as high BMI or inactivity can contribute to increased incidence of accidents due to imbalance such as falling, though BMI was not statistically significantly associated with increased incidence of falls, was significantly associated with increased time off work for work-related injury.
Maffiuletti et al (2005) Italy	Comparative trial 19 non obese (66.7kg +/- 13.2kg) and 20 extremely obese (124.1kg +/- 26.0kg) 20-40 year old adults	To compare postural stability between obese and lean subjects and to investigate the effect of a 3-week body weight reduction (BWR) program entailing specific balance training on postural stability of extremely obese patients	Extremely obese individuals have inadequate postural stability (compared to their lean counterparts) that could be improved by few sessions of specific balance training incorporated into a multidisciplinary weight loss program. This could reduce the risk of overweight individuals falling while performing everyday activities
Greve et al (2007) Brazil	Descriptive, observational study Males 20-40 years old no physical activity for at least 6 months	To evaluate the correlation between BMI and postural balance	Positive correlation between BMI and increased postural instability
Hue et al (2007) Canada	Cross sectional 59 males aged 24-61 years old. BMI 17.4-63.8 kg/m²	To determine the contribution of body weight to predict balance stability	A decrease in balance stability is strongly correlated to an increase in body weight. This suggests body weight may be an important risk factor for falling.

Teasdale et al (2007) Canada	Longitudinal and clinical intervention trial Obese men before and after weight loss 16 control (BMI <25kg/m²) 14 obese, BMI 30-40 kg/m² 14 morbidly obese >40kg/m²	To investigate the effect of weight loss on balance control in obese and morbid obese men.	Weight loss improves balance control in obese men and the extent of improvement is directly related to the amount of weight lost. This should help reduce likelihood of falling seen in obese individuals.
Fjeldstad et al (2008) USA	Cross-sectional 128 obese and 88 normal weight mean age 50 years	To determine whether obese older adults had higher prevalence of falls and ambulatory stumbling, impaired balance and lower health related quality-of-life (HRQL) than their normal weight counterparts, and whether the falls and balance measures were associated with HRQL in obese adults.	Obesity associated with higher prevalence of falls and stumbling in middle age
Duvigneaud et al (2008) Belgium	Cross-sectional 807 men and 633 women aged 18-75 years	To analyse differences in physical activity, cardiorespiratory fitness (CRF) and muscle strength between normal weight, overweight and obese adults and to investigate the role of physical activity variables in the analyses of differences in CRF and muscle strength between these groups.	Confirms the lower level of physical activity and the impaired CRF and knee strength in obese adults compared to their lean counterparts.
Davis et al (2009) USA	13 firefighters - 6 obese and 7 overweight/normal	To determine whether obesity places firefighters at a higher risk of slips/falls by impacting postural balance.	Obese firefighters were found to have less postural sway, particularly when their postural control systems were compromised. When standing on foam, obese firefighters reduced their sway area by 26% as compared to overweight/normal firefighters. Similarly, obese firefighters had an 18% decrease in postural sway during the reach task. In all, the results indicate obese firefighters compensated

			posturally, reducing the potential for external demands resulting in a slip or fall
Blaszczyk et al (2009) Poland	Cross sectional 100 obese and 33 lean women 18-53 years of age	To clarify the impact of excessive body weight on postural control	Increased body weight imposed new biomechanical constraints that resulted in functional adaptation of the control of the erect posture. Balance control can be preserved in obese
Matrangola and Madigan (2009) USA	Cross sectional 9 obese men BMI 30.1-36.9kg/m²	To investigate the effects of obesity on balance recovery using an ankle strategy	Balance recovery can improve with weight loss or strength gain, but a smaller amount of weight loss is needed than strength gain for a targeted improvement in balance recovery. This suggests that weight loss is a more potent intervention than strength training in improving balance recovery using an ankle strategy
Singh et al (2009) USA	Cross sectional 10 obese and 10 non obese Performance based	To examine the effects of obesity level, standing time and their interaction on postural sway during a prolonged quiet upright standing task.	ANOVA and regression analyses showed that for all the 11 postural sway measures, the extremely obese group had higher postural sway than the non-obese at the beginning of the prolonged standing task and postural sway increased significantly faster for the extremely obese group than the non-obese over time. Suggest obesity may impair postural control and be a risk factor for falls.
Menegoni et al (2009) Italy	Cross-sectional comparative 22 obese females and 22 obese males 10 healthy females and 10 healthy males	To investigate the effect of body weight increases on postural performance in males and females	Increased body mass produces antero-posterior instability in both genders but only medio-lateral axis instability in males.
Handrigan et al (2010)a Canada	Letter to editor	Balance control is altered in obese individuals	Strongly disagree with Blaszczyk et al (2009) research that balance control is preserved in obese individuals.
Handrigan et al (2010)b	Force and balance control were studied in three groups; normal weight (BMI <25 kgm²),	Investigate the effect that a change in body mass has on relative strength and balance control	Suggests, in overweight individuals, weight loss is more efficient at improving balance control than increasing, or even maintaining muscle strength.

Canada	obese (30 kgm²- 40 kgm²) and excess obese (BMI >40 kgm²) Caucasian male individuals.		
Berarducci et al (2009) USA	Retrospective descriptive study 167 adults (122=female) Mean age =47 years (age 20-72 years)	To determine the incidence of and associated risks for falls and fractures after gastric bypass surgery for morbid obesity	Findings suggest that bone loss is a critical issue in post bariatric surgery patients, with 25% reporting a decrease in height, 8% reporting a new diagnosis of osteoporosis or osteopenia, and 5% reporting fractures during a mean postoperative interval of 2.4 years. In addition, risk for skeletal fragility is profound in this cohort of individuals, with 34% (n = 57) indicating a history of one or more falls postoperatively.
iii) BALANCE PROBLEMS IN OBESE ADOLESCENTS			
AUTHOR, YEAR & COUNTRY	**STUDY TYPE & PARTICIPANT CHARACTERISTICS**	**OBJECTIVE or STUDY TITLE**	**CONCEPT/KEY FINDINGS**
Bernard et al (2003) France	Observational 16 obese adolescents 13-17 years old	To define the influence of obesity on static postural control of teenagers	Suggests obesity leads to less stable posture/poorer balance though the effect of fat distribution was not verified.
Goulding et al (2003) New Zealand	Observational, comparative 93 boys aged 10-21 years	To evaluate the effects of (a) previous forearm fracture and (b) high body weight on balance and postural sway	Balance scores were negatively correlated with body weight, body mass index, percentage fat and total fat mass. Overweight subjects (n=25) had lower scores ($P<0.05$) than boys of healthy weight (n=47), supporting the view that overweight adolescents have poorer balance than those of healthy weight.
Colne et al (2008) France	Case control 16 obese adolescents mean age 16 years old	To assess the adaptation in static and dynamic control of equilibrium when the body mass to be stabilized and moved is increased through obesity.	Weight loss in obese improves balance and control of upper limb movements

iv) INCREASED RISK OF INJURY

AUTHOR, YEAR & COUNTRY	STUDY TYPE & PARTICIPANT CHARACTERISTICS	OBJECTIVE or STUDY TITLE	CONCEPT/KEY FINDINGS
Xiang et al (2005) USA	Population based survey 370 adults reporting injuries in previous year	Obesity and risk of nonfatal unintentional injuries	Larger workers and physically unfit individuals may be more prone to accidents and nonfatal injuries. Observed a linear dose-response trend among women. An estimated 7.0% of underweight individuals (with BMI less than 18.5) reported injuries. In contrast, 26.0% of men and 21.7% of women with a BMI greater than 35.0 reported injuries
Finkelstein et al (2007) USA	Cross sectional analysis 42,304 US adults fall, motor vehicle, and sport-related injuries	To quantify the relationship between body mass index (BMI) and rates of medically attended injuries by mechanism (overall, fall, motor vehicle, and sport-related) and by nature (strain/sprain, lower extremity fracture, and dislocations), and between BMI and injury treatment costs.	The odds of sustaining an injury are 15% (overweight) to 48% (Class III obesity) greater among those with excess weight. Clear association between BMI and the probability of sustaining an injury. Particularly related to falls, sprains/strains, lower extremity fractures, and joint dislocations
Matter et al (2007) USA	Cross sectional analysis 160,707 in patient records comparing characteristics of injuries in obese and non-obese adults	To compare characteristics of injuries between a sample of U.S. obese and non-obese inpatients	Sprains, strains, and dislocations represented significantly higher proportions of injury-related hospitalizations among obese persons compared with non-obese persons. By cause of injury, injuries among obese persons were more frequently due to falls, overexertion, and poisonings compared with non-obese persons.
Janney and Jakicic (2010) USA	Longitudinal – study time 18 months 397 adults with BMI between 25-40 kg/m²	The frequency and type of injuries and illnesses among overweight and obese adults who engage in regular physical activities as part of weight loss or weight gain prevention programs	46% reported at least one injury/illness, and 32% reported at least one injury that was attributed to exercise. Lower-body musculoskeletal injuries (21%) were the most commonly reported injury followed by cold/flu/respiratory infections (18%) and back pain/injury (10%). Knee injuries comprised one-third of the lower-body musculoskeletal injuries. Only 7% of the injuries were attributed to exercise alone,

			and 59% of the injuries did not involve exercise. Participants with higher BMIs were injured earlier or had increased odds of injury over time than participants with lower BMIs.

TABLE A2.4: OBESITY AND PHYSICAL ACTIVITY PARTICIPATION

i) OBESITY AND PHYSICAL ACTIVITY			
AUTHOR, YEAR & COUNTRY	**STUDY TYPE & PARTICIPANT CHARACTERISTICS**	**OBJECTIVE or STUDY TITLE**	**CONCEPT/KEY FINDINGS**
Segar et al (2006) USA	Cross-sectional 59 middle-aged women, mean age 45.6 years	To investigate the relationship between midlife women's physical activity motives and their participation in physical activity	Participants with body-shape motives were significantly less physically active than those with non-body-shape motives (p < .01). Body Mass Index (BMI) was not related to physical activity motives or participation.
Nitz and Choy (2007) Australia	5-year prospective cohort 459 women aged 40-80 years old	To report habitual physical activity levels in women and document the change in level of activity and factors affecting this change over a 5-year period	Only activity level and body mass index at baseline significantly affected change in activity level The forties and fifties cohorts accounted for the baseline body mass index effect on activity change. In the forties cohort, number of medical conditions at base line and, in the sixties cohort, increase in number of medical conditions affected activity level change. Activity level at baseline and body mass index in younger women were most likely to affect change over time. Being unsteady or having already fallen did not stimulate change
Jenkins and Fultz (2008) USA	Cross sectional Mean age 66.85 years (54-99) 64.56% obese or overweight	To investigate the relationship between Body Mass Index (BMI) and older adults' hours of participation in 31 activities	The hypothesis that being overweight or obese is associated with older adults' activities was supported. For example, compared to those of normal weight, obese older adults spend fewer hours walking, exercising, praying and meditating, house cleaning, and

			engaging in personal grooming. And, compared to normal weight older adults, obese older adults spend a greater number of hours watching television
Sallinen et al (2009) Finland	Cross-sectional 619 community living elders aged 75-81 years 436 non-obese, 127 moderately obese, 56 severely obese	To examine what older obese people consider as constraints on their physical exercise and to determine whether these constraints can explain the differences in physical activity.	Risk of physical inactivity was 2 times higher in mod obese group, and 4 times higher in severe obese group compared to non-obese. Higher prevalence of comorbidities, pain, tiredness, FOF and injury, discomfort and feelings of insecurity when exercising explained almost half the increased risk of physical inactivity of older severe obese
Trout and Graber (2009) USA	Interview 12 students 13-18 years, 7 females, 5 males. BMI $\geq 85^{th}$ age specific percentile	To examine overweight students' perceptions of and experiences in physical education	Findings indicate that students have mixed opinions concerning the benefits of physical education. Despite recognizing the relationship between lack of physical activity and obesity, many participants avoided participation because they had been traumatised and exhibited symptoms consistent with learned helplessness. Participants demonstrated greater concern about visibility than they did about their performance, which suggests that they might engage in physical activity if shielded from the view of peers.
Young et al (2009) USA	1,648 overweight and obese participants aged 25 years and older	Patterns of Physical Activity Among Overweight and Obese Adults	Participants who were younger than 50 years, male, non-African American, or overweight were more active than were those who were older than 50, female, African American, or obese.
Biddle et al (2010) UK	Review	Sedentary behaviour and obesity	Sedentary behaviour refers to low levels of movement and sitting and often used instead of term 'physical inactivity'. Is often linked with TV viewing and computer use. Sedentary behaviour in adults is associated with age, gender(female), occupation, weight status and some characteristics of the physical environment. These are independent of physical activity.
ii) **OBESITY AND BARRIERS TO PHYSICAL ACTIVITY**			
AUTHOR, YEAR & COUNTRY	**STUDY TYPE & PARTICIPANT CHARACTERISTICS**	**OBJECTIVE or STUDY TITLE**	**CONCEPT/KEY FINDINGS**
Felton et al (1994) USA	Case control study	To determine 9 variables that might predict activity in sample of overweight and non-overweight women	Personal control, race, regular participation in organizations and groups, and interpersonal support were the significant predictors of physical activity in overweight women

	225 normal weight and 115 overweight young women aged 17-26 years		
Ball et al (2000) Australia	Cross sectional, self-report 2,298 adults	To describe perceptions of being 'too fat' as a barrier to physical activity by gender and body mass index, and to examine the associations between feeling fat and other weight-related barriers to physical activity.	Associations were found between being too fat as a barrier, and being too shy or embarrassed to exercise; being too lazy or not motivated; having an injury or disability (males only); and being not the sporty type (females only). There was no association between feeling too fat and poor health. Feeling too fat to exercise is a common barrier among the overweight, particularly for women. Results suggest gender differences in weight–related barriers to physical activity.
Faith et al (2002) USA	Cross sectional 576 grade 5-8 children	To explore variables that determine whether children are active or not	Children who are the targets of weight criticism by family and peers have negative attitudes toward sports and report reduced physical activity levels. More in girls
Rosenberger et al (2006) USA	131 extremely obese female bariatric patients	To investigate correlates of body image dissatisfaction	Highlight the importance of adult psychological functioning (depression, self-esteem and perfectionism) for predicting body image dissatisfaction in extremely obese female bariatric surgery candidates.
Genkinger et al 2006 USA	Randomised trial of exercise 120, 25 -70 year old community based African American women, varying BMIs, not active	To examine the frequency and type of barriers.	Obese participants were more likely to report ‘‘lack of motivation’’ as a barrier compared with normal-weight participants (63% vs 31%). Normal-weight and overweight participants were more likely to report no barriers compared with the obese (31%, 0%, 5%, respectively, P=.05).
Thomas et al (2008) Australia	Qualitative, in-depth interviews 76 obese, mean age =47 years, mean BMI = 42.5 kgm^2	A qualitative investigation of dieting, weight loss, and physical exercise, in obese individuals	The majority of participants (n = 63, 83%) said that they found exercising difficult because of their weight, physical health problems, that they could not afford gym subscriptions, or personal trainers, did not have time to exercise, or felt uncomfortable or embarrassed about taking part in organised exercise activities. Other reasons for not exercising included, *"it is dark when I get home from work, so I can't go for a walk"*, *"feeling fat"*, *"too lazy"* and *"I can't be bothered"*.
Atlantis et al (2008) Australia	Cross sectional 16,314 adults	Weight status and perception barriers to healthy physical activity and diet behaviour	Obesity is associated with lower prevalence of sufficient physical activity for health benefits, but many of these associations are weakened by acceptable weight perception. Overweight perception may be another barrier to physical activity participation among men and women with excess body weight

Jewson et al (2008) Australia	Cross-sectional 30 women, aged 25-71 years, mean age 46.8 years (+12.95) average BMI of 31.2kg/m² (+5.6).	A preliminary analysis of barriers, intentions, and attitudes towards moderate physical activity in women who are overweight	Active participants were more likely to identify social reasons for participating in physical activity, while inactive participants perceived that their laziness prevented them from being physically active. There were no significant differences between active and inactive overweight women for attitude, intention or subjective norm for moderate-intensity physical activity. There was a significant difference between these women in perceived behavioural control for moderate-intensity physical activity, as women who felt more in control of their physical activity behaviour were more likely to engage in physical activity than inactive women
Rye et al (2009) USA	40-64 years old 733 women, 84% overweight (24.1%) or obese (59.8%) Interviewed using health risk survey	Perceived barriers to physical activity according to stage of change and body mass index	Participant's perceptions of 6 barriers to physical activity. Greatest barrier – lack of support and lack of willpower. Obese reported time less frequently than non-obese.
Dalle Grave et al (2011) Italy	Review	Cognitive-Behavioural Strategies to Increase the Adherence to Exercise in the Management of Obesity	Summarised difficulties obese encounter when trying to be active including: body dissatisfaction; pain; low fitness

APPENDIX B – QUALITATIVE STUDY

B.1 Ethical Approval

NHS

National Research Ethics Service

NRES Committee North West - Greater Manchester West

Barlow House
3rd Floor
4 Minshull Street
Manchester
M1 3DZ

Tel: 0161 625 7845

09 May 2011

Mrs Gilly Rosic
HIS, Accrington Victoria Hospital
Hyndburn Locality Offices
Haywood Road, Accrington
BB5 6AS

Dear Mrs Rosic

Study title:	**Exploring the relationship between restricted activities of daily living and physical activity in obese women under 50 years old**
REC reference:	**11/NW/0006**
Amendment number:	**Minor Amendment 1**
Amendment date:	**06 May 2011**

- The amendment proposes some minor alterations to the protocol in line with the committees recommendations made on the 04 February 2011.

Thank you for your letter of 06 May 2011, notifying the Committee of the above amendment.

The Committee does not consider this to be a "substantial amendment" as defined in the Standard Operating Procedures for Research Ethics Committees. The amendment does not therefore require an ethical opinion from the Committee and may be implemented immediately, provided that it does not affect the approval for the research given by the R&D office for the relevant NHS care organisation.

Documents received

The documents received were as follows:

Document	Version	Date
Protocol	6	20 February 2011
Notification of a Minor Amendment	Minor Amendment 1	06 May 2011

Statement of compliance

The Committee is constituted in accordance with the Governance Arrangements for Research Ethics Committees (July 2001) and complies fully with the Standard Operating Procedures for Research Ethics Committees in the UK.

This Research Ethics Committee is an advisory committee to the North West Strategic Health Authority
The National Research Ethics Service (NRES) represents the NRES Directorate within
the National Patient Safety Agency and Research Ethics Committees in England

East Lancashire Hospitals NHS

NHS Trust

Ref No. 2011/017
Our Ref:

Tel: 01254 733008
Fax: 01254 733683
E-Mail: shirley.bibby@elht.nhs.uk

Research and Development
Level 3
Royal Blackburn Hospital
Haslingden Road
Blackburn
BB2 3HH

13 April 2011

Mrs Gilly Rosic
Advanced Practitioner and Weight Management Care Pathway Coordinator
Hynburn Locality Offices
Accrington Victoria Community Hospital
Haywood Road
ACCRINGTON
BB5 6AS

Dear Mrs Rosic

Study Title: **Exploring the relationship between restricted activities of daily living and physical activity in obese women under 50 years old.**

REC Ref: **11/NW/006**

Thank you for your application to undertake a piece of research within the East Lancashire Hospitals NHS Trust. The documents reviewed and approved by the Committee are as follows:

Main Documents reviewed	Version	Date
REC Application Form	65512/195770/14/227	
SSI form	65512/194422/6/657/78977/207203	
Protocol	V.5	4 January 2011
Participant Information Sheet	6	21 February 2011
Participant Consent Verification	6	21 February 2011
REC Approval Letter	11//NW/0006	24 February 2011

The Trust is happy to grant NHS permission for research and for you to undertake the project as specified in your application. If for any reason you need to amend your study in any way please inform us before this is undertaken. Please remember that any protocol amendments/changes will also require further review by the Research Ethics Committee.

NHS
East Lancashire

East Lancashire Teaching Primary Care Trust
Walshaw House
Regent Street
Nelson
Lancashire
BB9 8AS

Tel: 01282 644700
Fax: 01282 615559
www.eastlancspct.nhs.uk

Enquires to: Paula Cooper
Direct Dial: 01282 644812
Email: paula.cooper@eastlancspct.nhs.ul
Our Ref: RD173
Date: 28th March 2011

Gilly Rosic
HIS, Accrington Victoria Hospital
Hyndburn Locality Offices
Haywood Road
Accrington
BB5 6AS

Dear Gilly

Research Protocol: Exploring the relationship between restricted activities of daily living and physical activity in obese women under 50 years old.
REC Reference: 10/0808/159
CSP ID Number: n/a
Protocol Version: v5 04.01.2011
PCT Reference: RD173

The above research has been considered and documents reviewed. I am pleased to confirm that the study has been approved for NHS East Lancashire and their respective contracted care providers in line with the framework for Research Governance in Health and Social Care, on the understanding that you follow the conditions set out below:

- You complete and return a progress report at 12 month intervals and on completion
- You must not deviate from, or make changes to the protocol; without ethical approval and Research Governance permission
- All data collection must be compliant with the Data Protection Act (1998) http://www.opsi.gov.uk/acts/acts1998/19980029.htm, Caldicott Principles and NHS Code of Confidentiality
- You must apply the principles ICH-GCP in conduct of your research (whether a clinical trial or not)
- Adhere to the research governance framework for health and social care http://www.dh.gov.uk/assetRoot/04/12/24/27/04122427.pdf and all current Trust policies relating to R&D
- Take part in PCT routine monitoring and audit of research governance compliance as and when requested
- In the event that and adverse event or compliant arises in the conduct of this research, you must notify NHS East Lancashire quoting the title of the study, Local reference number and REC reference number

Your details will be retained on our local research database. If you have any queries regarding compliance with the conditions set out herein, please do not hesitate to ask.

Yours sincerely

P. Cooper

Paula Cooper
RESEARCH AND DEVELOPMENT MANAGER

Cc Paola Dey, University of Central Lancashire

B.2 Participant letter & information sheet

East Lancashire Hospitals NHS
NHS Trust

Lancashire Care NHS
NHS Foundation Trust

uclan
University of Central Lancashire

School of Postgraduate Medical & Dental Education

What prevents younger overweight women from being physically active?

I am a part time research student at the University of Central Lancashire and I also work within NHS East Lancashire Community Health Services. I am particularly interested in finding out what physical restrictions stop some younger overweight women from being active, and what impact these might have. I am looking for about 20 volunteers who are currently attending the Healthy Lifestyles Weight Management services to interview and would be very grateful if you would agree to take part. The interview should take no longer than an hour to complete and will be done at a time most convenient to you. Your input is vital to help us improve services for you and other women with a similar condition, and provide the best quality care and support.
Please find attached participant information sheets that will give you more information about the study, what it involves, how long it will take etc., but if you would like more information please feel free to contact me on 01254 358046. We would be very grateful it you would agree to take part in this short study, and to do this all you need to do is complete and return the agreement slip in the stamped addressed envelope attached to this letter. Following this I will give you a call to check you are still happy to take part and then arrange a suitable time to meet you.

Yours Sincerely

Gilly Rosic

Gilly Rosic
Lead Researcher
Health Improvement Services
Accrington Victoria Community Hospital
Hyndburn Locality Offices
Haywood Road
Accrington
BB5 6AS

Tel ; 01254 358046

East Lancashire Hospitals NHS Trust

Lancashire Care NHS Foundation Trust

University of Central Lancashire

School of Postgraduate Medical & Dental Education

Participant Information Sheet

Title of Project:

What prevents younger overweight [*]women from being physically active?

We would like to invite you to take part in a research study. Before you decide we would like you to understand why the research is being done and what it will involve for you. Please take time to read the following information carefully. Talk to others about the study if you wish.

Ask if there is anything not clear or if you would like more information. The research is being led by Gilly Rosic from the Health Improvement Service in NHS East Lancashire Community Health Services and the University of Central Lancashire. You can contact her on the following Telephone number: 01254 358046

A member of the healthy lifestyle team will go through the information sheet with you and answer any questions you have. (Part 1 tells you the purpose of the study and what will happen to you if you take part. Part 2 gives you more detailed information about the conduct of the study).

Part 1

What is the purpose of the study?

The purpose of the study is to identify what hinders overweight women performing routine activities and thus prevents them being physically active. By doing this, it will help us to understand how we can best support similar women to becoming more active by offering more appropriate activity sessions.

The study is also part of a Postgraduate MPhil /PHD Research project.

Why have I been chosen?

You have been chosen as a possible participant in this study because you attend NHS East Lancashire Healthy Lifestyle Services. A total of 20 participants will be interviewed as part of this study.

[*] **overweight is defined as having a BMI > 28 kg/m^2**

Do I have to take part?

No. It is up to you to decide whether or not to take part in the study. If you do agree to take part, we will ask you to sign a consent form to show you have agreed to take part. You are still free to withdraw, without giving a reason and at any time before the transcribed interview has been checked by you and returned. After this time, your personal details linked by code to your anonymous transcript will be destroyed, making it impossible to identify your data. You can withdraw at any point, but once data has been analysed and anonymised it will not be taken out. A decision to withdraw up until this point or a decision not to take part, will not affect the care / support you receive or your legal rights.

What will happen to me if I take part?

If you decide to take part you will be interviewed for between 30 minutes to 1 hour by the lead researcher about how being overweight has affected your activity. The interview will take place in a private room at Accrington Pals Primary Health Care Centre. The interview will be audio recorded to help keep a clear record of what is said. The researcher will also take notes during the interview, to enable her to check and clarify any information shared. You will not be asked to volunteer any information you wish to keep private.

Will my taking part in this study be kept confidential?

Yes confidential means that we will not tell anyone you have taken part in this study and anything you say that might be repeated will be done so without giving your name.

The data collected will have your personal details removed and then coded. It will be stored within a locked filing area within the Healthcare Trust or at the University of Central Lancashire. The researcher will give you a copy of the transcript to check it is a clear record of the interview prior to it being used as data within the study. We will only keep your personal details until you have read and checked the written transcript of your interview. After this time they will be shredded and disposed of securely. At the end of the study the anonymous transcripts and any associated clinical data will be kept for 5 years in line with Research Protocol and then destroyed.

Everything you say/ report is confidential unless you tell us something that indicates that you or someone else is at risk of harm. We would discuss this with you before telling anyone else.

If you decide to take part, the data collected for the study will be looked at by authorised persons in the research team. All have a duty of confidentiality to you as a research participant, and we will do our best to meet this duty.

Gilly Rosic, as the Lead Researcher, is responsible for ensuring that during collection, handling, storing, using or destroying data, she is complying with the Data Protection Act 1998, and is not contravening the legal or regulatory requirements in any part of the UK.

Expenses and payments:

Travel expenses will be reimbursed. Arrangements for this payment will be discussed when booking your appointment to be interviewed.

What do I have to do?

Please take time to read this information sheet and ask any questions. If you wish to take part in the study you can ring Gilly Rosic directly on 01254 358046 or return the agreement slip in the stamped addressed envelope attached to this information. You will then be followed up with a phone call from the lead researcher, Gilly Rosic, who will discuss the study further and ensure you are happy to proceed before arranging a date to be interviewed. You need to be happy to take part in an audio-taped interviewed for up to 1hour about how your weight has affected your physical ability to perform everyday tasks. You will also be given a copy of the transcript produced by the interview and will need time to check you are happy for this transcript before it can be used in the study.

Contact Details:

Gilly Rosic
Lead Researcher
Health Improvement Services
Accrington Victoria Community Hospital
Hyndburn Locality Offices
Haywood Road
Accrington
BB5 6AS

Tel; 01254 358046

gilly.rosic@elht.nhs.uk

Part 2

What will happen if I don't want to carry on with the study?

You are free to withdraw, without giving a reason and at any time before the transcribed interview has been checked by you and returned. After this time, your personal details linked by code to your anonymous transcript will be destroyed, making it impossible to identify your data. You can withdraw at any point, but once data has been analysed and anonymised it will not be taken out. If you withdraw your care/ support will not be affected.

What if there is a problem?

If you have a concern about any aspect of this study, please ask to speak with the researcher who will do their best to answer your questions (Contact no 01254 358046). If you remain unhappy and wish to complain formally, you can do this through the NHS Complaints Procedure. Details can be obtained from the PCT.

You will not be asked any distressing or intrusive questions. However, if you need to discuss and gain support and advice about any issues that may come up in the interview, you can contact the Healthy Lifestyle Referral Manager on 01254 282270. She will offer confidential advice and support and discuss possible further action.

The Researcher is an employee of an NHS Institution

NHS bodies are liable for clinical negligence and other negligent harm to individuals covered by their duty of care. NHS Institutions employing researchers are liable for negligent harm caused by the design of studies they initiate. Therefore:

'In the event that something does go wrong and you are harmed during the research study there are no special compensation arrangements. If you are harmed and this is due to someone's negligence then you may have grounds for a legal action for compensation against NHS East Lancashire Community Healthcare Trust, but you may have to pay your legal costs. The normal National Health Service complaints mechanisms will still be available to you.'

NHS Indemnity does not offer no-fault compensation i.e. for non-negligent harm, and NHS bodies are unable to agree in advance to pay compensation for non-negligent harm.

What will Happen to the Results of the Research

The results of all the interviews will be looked at together. The results of the information gathered will provide some insight into the physical restrictions experienced by overweight women and how these affect their ability to be physically active. The results will be included in a research thesis, and be published and presented at conferences. They will also be used to develop further studies which might improve weight management practice.

You will not be identified in any report or publication.

If you would like a copy of the final report, please let us know.

Who is organising and funding the research?

The Research is being undertaken as part of an MPhil/PhD Educational Qualification through the University of Central Lancashire.

Who has reviewed the study?

All research in the NHS is looked at by independent group of people called a Research Ethics Committee to protect your safety, rights, wellbeing and dignity.

This study was given a favourable ethical opinion for conduct in the NHS by the North West 9 Research Ethics Committee.

The Academic quality and supervision will be provided by:

Professor P Dey

Professor of Public Health

School of Public Health and Clinical Sciences

University of Central Lancashire

Adelphi Street

Preston PR1 2HE

You will be given a copy of the information sheet and a signed consent form to keep.

Thank you for considering taking part and taking time to read this sheet.

Centre: NHS East Lancashire Community Healthcare Trust

Study Number:

What prevents younger overweight women from being physically active?

I have read and understood the letter and information sheet about the study into what prevents overweight women from being active.

- ❑ I would be happy to be contacted and discuss being a participant in this study
- ❑ I do not wish to be contacted or be a participant in this study

Name : ____

Address: ____

Tel Number Daytime: ***Evening***

Age:

I understand that I do not have to take part in this study and can withdraw at any time.

Signed: ***…………………………………………........***

Date: ***…………………………………….***

CONSENT FORM

Title of Project: What prevents younger overweight women from being physically active?

Name of Researcher: Gilly Rosic

Thank you for considering taking part in this study. If you have any questions please ask before you decide to take part. You will be given a copy of this consent form to keep and refer to at any time.

Please initial box

1. I confirm that I have read and understand the information sheet (V6) for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.

2. I understand that my participation is voluntary and that I am free to withdraw at any time up until I have verified the written transcript of my interview and returned it. After this time all my personal details linking me as an individual with my coded, anonymised transcript will be destroyed, and therefore it will be impossible to withdraw my data.

3. I understand that the interview will be audio taped and transcribed and that I will be given a copy of this transcript to read and verify before it is used in the analysis for this study.

4. I agree to direct quotes being used but in such a way where I will not be identified

5. I understand that relevant data collected during the study may be looked at by individuals from the University of Central Lancashire, from regulatory authorities or

from the NHS Trust, where it is relevant to my taking part in this research. I give permission for these individuals to have access to this data.

6. I agree to take part in the above study. ☐

7. I would like to receive a copy of the completed report ☐

________________________ ________ ______________

Name of Participant Date
Signature

________________________ ________ ______________

Name of Person taking consent Date Signature

(if different from researcher)

________________________ ________ ______________

Researcher Date Signature

When completed, 1 for patient; 1 for researcher site file;

East Lancashire Hospitals NHS
NHS Trust

uclan
University of Central Lancashire

Lancashire Care NHS
NHS Foundation Trust

B.3 Interview Schedule

………**School of Postgraduate Medical & Dental Education**

Interview Schedule

Title of project: What prevents younger overweight women from being physically active?

Introduction

1) Welcome, invite to sit down, make yourself comfortable.

2) Interviewer introduces one self and her role; ***I am a PhD student at the University of Central Lancashire and am carrying out this interview as part of my research project. Thank you again for agreeing to take part. Your contribution is very valuable to us. I hope that what we learn from you will result in better care and treatment for others in a similar situation to you. I will be interviewing about 20 participants in total.***

3) Then explain to participant:

- What the interview is about, - ***The interview is to find out what movement and activity restrictions are experienced by overweight women and to explore the possible causes and impacts on physical activity these restrictions have. I am particularly interested in if being overweight might affect somebody's balance, steadiness and if so how this affects their everyday activities and whether it makes it more difficult to perform these tasks, and how it might affect them.***
- Why you were chosen as an interviewee, - ***you are either attending or have attended East Lancashire Healthy Lifestyle Services, and have been identified by a healthcare practitioner you probably already know.***
- ***The interview should last between 30-60 minutes and will be audio recorded in addition to some notes been taken. You will be asked a number of questions in relation to your activity level and ability. The interview will then be transcribed into written document and a copy posted to you to check for accuracy which we would like you to return to us in a stamped addressed envelope.***
- What will happen to the results- ***I'll report the results of all the interviews only in summary. I'll do it in such a way that you can't be identified as the source of any information.***

- Your rights as a participant in the research***; everything you say will be treated confidentiality, all the transcripts will be anonymised and coded so that it can't be traced back to you; you have the right to withdraw at any point until the transcribed interview has been checked by you and returned. After this point all personal data linking you to the anonymised transcript will be destroyed, and therefore impossible to withdraw your data. You do not have to give a reason for your withdrawal; and you do not have to say anything you do not want to.***
- Check that they consent to take part **– clarify/ obtain written consent before interview.**

Interview

Small talk prior to recording to relax participant – check demographic details i.e. name, date of birth, address, height, weight etc.

Check all medical conditions and note down

Check if use any assistive devices e.g. special bed, chair, walking aid, walking stick shower seat, etc.

--------------------- CHECK EQUIPMENT AND START RECORDING -----------------------------

Make sure that your recorder has a full battery status. Do not use mains (or plug ins) as it picks up other noises etc.

As I mentioned before – the research is looking into the restrictions or difficulties overweight women might have in everyday life –, *DON'T PROMPT* ***unless really necessary i.e. walking, bathing, cleaning, moving up and down stairs, carrying shopping etc.***

Questions

1. ***Could you tell me a little bit about your daily routine, perhaps describe a typical day of what you do from waking up at the start of your day to going to bed at the end?***

(*Spend time exploring all activities mentioned and getting clarification of what each involved)*

2. ***Since being overweight, have you changed the way you do activities? If so in what way have you changed****? (prompts –note down all reported changes and then for each change- explore reasons)*

3. ***Are there any activities you currently don't do but would like to try? What is stopping you?***

4. ***How do you feel your size and the physical restrictions you have mentioned today affect your ability to be physically active?***

5. ***Do you regularly partake in physical activity i.e. including walking, home based activity or attending exercise classes or a gym? If so what, for how long & how much do you do each week?***

6. ***What would you like to be available for someone else in your situation?***

7. ***Whilst doing any of the activities you have mentioned, do you have any concerns? And if so what are they?***

Only ask if not previously brought up

8. ***Do you ever avoid an activity because you think you might fall?***

9. ***Is there anything else you think I should know to understand your condition better?***

Thank you for your time, is there anything you have said that you would like to expand on or change? Is there anything you would like to ask me?

Summary and exit: remind participant coming to end, pull together common themes raised in interview, thank participant for time and effort. Very briefly repeat key points about what will happen to the information, and how they will be contacted in future. Give envelope with travel expenses.

East Lancashire Hospitals NHS Trust

Lancashire Care NHS Foundation Trust

University of Central Lancashire

School of Post Graduate Medical and Dental Education

B.4 Participant Letter & Verification Form

Dear Madam,

Please find enclosed a transcribed copy of your interview. I have removed all identifiable data such as names and places so that it remains anonymous. The data will not be used until you have read and checked it to make sure it is a true reflection of what you said and meant during the interview. I would be grateful if you could do this and make any corrections in pen to the transcript, sign the content verification form below and then return the transcript and this form in the stamped addressed envelope provided to Gilly Rosic at the address below. Alternatively, the envelope can be handed to a member of the Hyndburn healthy lifestyle team or community Dietitian at Accrington Pals Primary Care Centre.

Many thanks again for your valuable contribution to this research study

Yours sincerely

Gilly Rosic
Lead Researcher
NHS East Lancashire Community Health Services

Health Improvement Services
Accrington Victoria Community Hospital
Hyndburn Locality Offices
Haywood Road
Accrington
BB5 6AS

Tel; 01254 358046

Content Verification form

Title of project: what prevents younger overweight women from being physically active?

Participant identification number:

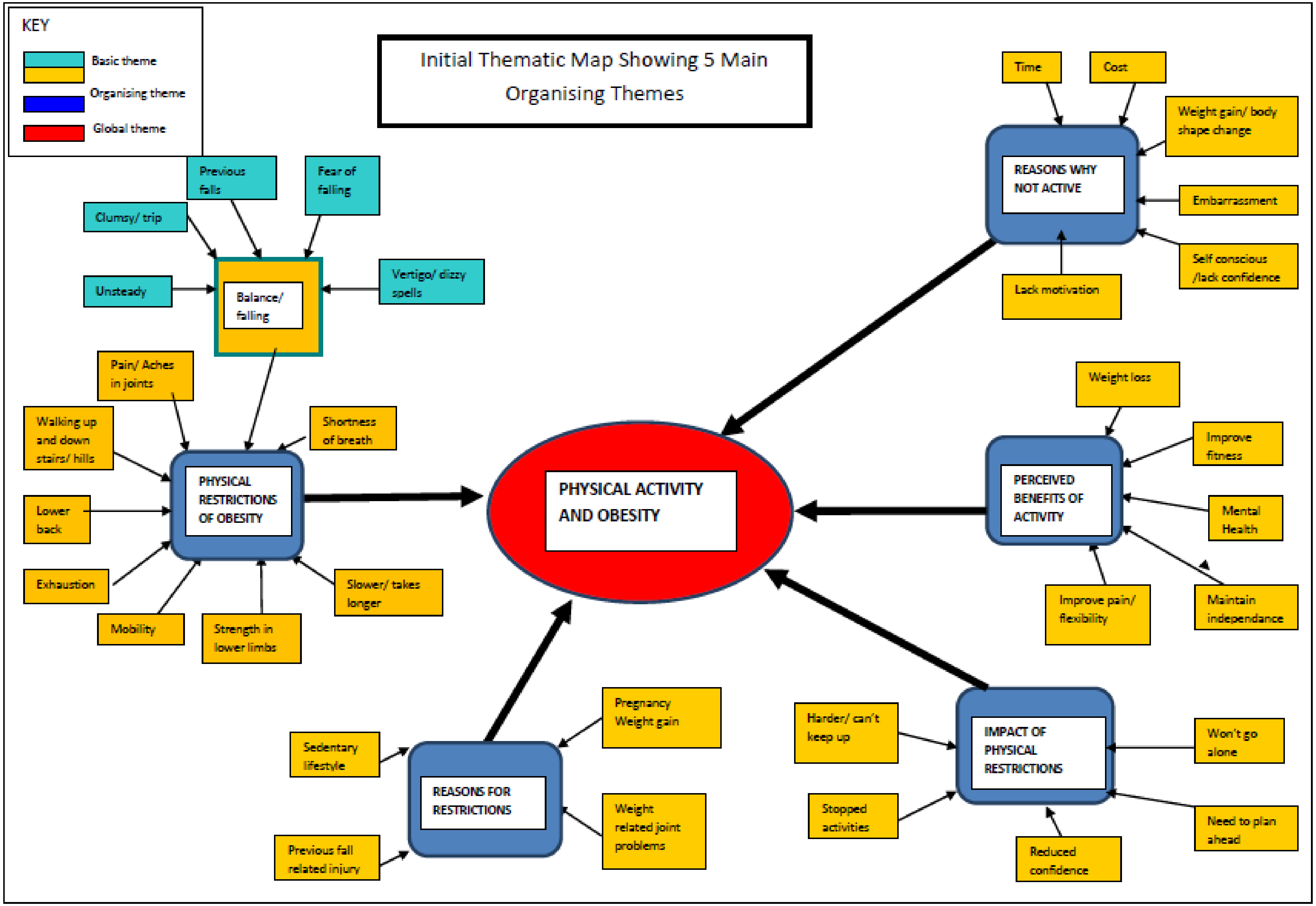
I confirm that I have read and checked the enclosed transcript of my interview and thereby verify that it is a true reflection of what I said and meant at that time. ☐

I would like to receive a copy of the completed report ☐

____ ______________________________

Name of Participant Date Signature

B.5


KEY
Basic theme
Organising theme
Global theme
Initial Thematic Map Showing 5 Main Organising Themes
PHYSICAL ACTIVITY AND OBESITY
PHYSICAL RESTRICTIONS OF OBESITY
Balance/ falling
Previous falls
Fear of falling
Clumsy/ trip
Unsteady
Vertigo/ dizzy spells
Pain/ Aches in joints
Walking up and down stairs/ hills
Shortness of breath
Lower back
Exhaustion
Mobility
Strength in lower limbs
Slower/ takes longer
REASONS WHY NOT ACTIVE
Time
Cost
Weight gain/ body shape change
Embarrassment
Self conscious /lack confidence
Lack motivation
PERCEIVED BENEFITS OF ACTIVITY
Weight loss
Improve fitness
Mental Health
Maintain independance
Improve pain/ flexibility
REASONS FOR RESTRICTIONS
Sedentary lifestyle
Pregnancy Weight gain
Weight related joint problems
Previous fall related injury
IMPACT OF PHYSICAL RESTRICTIONS
Harder/ can't keep up
Stopped activities
Won't go alone
Need to plan ahead
Reduced confidence

B.6: Thematic Analysis: Examples of Participant text extracts	CODES	Basic Themes
I have had a few dizzy spells when I have been doing my exercises in my weight loss class so I have had to sit out as I go light headed and I go really funny if I get too hot and do too much exercise and I think 'oh god I am going to pass out' If I lean down and pick something up I might get a bit of vertigo…. Feels like my head is spinning If I am stood up too long it makes me dizzy I got a lot more of that where you stand up too quickly and your head spins a bit I used to feel quite dizzy quite a lot of the time with doing certain thing	Dizzy when active Vertigo/head spinning when pick something up/ bend down Dizzy when stood up too long	Vertigo/dizzy
I have fallen but I have got right clumsy feet anyway I trip over my own feet I am just walking and I just trip over my feet and stuff When you are just walking and you fall over your own feet, do it in work all the time, I would just be walking on the carpet and I just trip over my own feet But I can walk into things, I am so clumsy	Falls due to clumsy feet Trip over feet Clumsy	Clumsy/trip
if I am walking or playing my ankle just gives way, so I have been falling quite a while It's like my knee literally turns inside out and I just fall, I just go so that is what I am worried about on the cross trainer	Ankle gives way when active causing fall Knee gives way causing fall	Ankles/knees give way

You don't feel steady at all because everything is distributed differently to how it was before I came down on my bum a couple of times when I was unsteady on my feet (on stairs) Yes, you just feel unsteady for a bit and you think you are going to go over so you just have to stay still or sit back down. I didn't really have any proper balance at the time, I felt a bit like a weeble if you will, very wobbly You do sometimes have to grab hold of something because you feel like you are going to fall over but have never actually fallen over or anything	Feel unsteady as weight distributed differently Felt unsteady on stairs Feel unsteady whilst active Poor balance Feel unsteady	Feel unsteady
Sometimes I get the feeling I am going to fall over A little trampolines, now you had to go on them and I thought I might fall off, I was a bit wary… because I think I would fall Yes, you just feel unsteady for a bit and you think you are going to go over so you just have to stay still or sit back down. I am always a bit scared I am going to fall; I have been falling quite a while - (whilst) doing some exercise or walking	Often feel like going to fall Feel like fall on exercise equipment Think will fall while active Fear of falling when active	Feel likely to fall
The biggest problem I had when I was overweight was going up stairs. I fell going up stairs a few times because of the amount of weight at the front of you You slip and fall a lot more and you are frightened of slipping and falling a lot more as well I have always been big and I have always fallen Fell basically when I was out shopping	Fall on stairs Fall more when overweight Fear of falling increased since fall (s)	Previous fall

Oh, she has hit the deck again'. I think it got to where I have to fall, do you know what I mean, psychologically I have to fall to give them a laugh, yeah of course I fell again I am always a bit scared I am going to fall; I have been falling quite a while - (whilst) doing some exercise or walking	Fall when out shopping Fall in front of others Fall when exercising	
Do you know you can't realise you can't do it until you try to do it but then again is it a case of I daren't do it because will I get up? I am not saying I can't get up, I just don't know if I can get up. Seriously I don't think I could. Yes (fearful) about getting up because I couldn't get up. I couldn't actually get up by myself at all	Concern not able to get up from fall Couldn't get up following a fall	Concern won't be able to get up
I knew I couldn't do it because you have to be able to balance to do things like that, Because I didn't really have any proper balance at the time, I felt a bit like a weeble if you will, very wobbly I think I would struggle to keep balance on a bike - , I am fearful of being… I don't know if it is because… I don't know, it must be a balance thing now because you can't, I'm not, someone is not going to drive into me, but I think I would be slightly wobbly	Belief not able to do activity because of balance	Reduced ability/ belief in ability/confidence
well the other thing you hear about so many people who have a simple fall and they break a hip or they break their wrist and I think I will be even worse off if that happens so I won't do them how much you are going to hurt after it, if you fall over or something like that, how you are going to hurt more than you would normally	Fearful of injury if fall Fear of pain if fall	Fear of pain/ injury if they fall
Well I can go so far but then I start to feel that I am going to tip over again. The fear now is that I am going to fall, I totter when I walk, I am very unsure	Fear of falling after fall (s)	Concerns that more likely to fall again

Before we moved ..I did have a tumble. I was running in the hall and it was a long hall and had some baggy trouser things on and I went crash straight to the floor but I got up ok. Now I am frightened. once I had actually had a proper accident and ended up having to have my knee operated on, once I got the stick I felt much better about walking then, once I had that little bit of security.		
I did stumble a couple of times because obviously my knees are dodgy and things but as I say, the first at least the first 3 weeks that I was going there a few times a week, there was actually somebody standing there at the side of me or behind me. Yes, I felt much safer so I did stumble a couple of times, yes I did but when somebody is keeping an eye on you that fear of actually falling goes a bit - You purposely slow everything down…. to prevent falling and things like that or too many aches and pains so that you can actually get up and walk the day after. but I used to go to aerobics here but it was really really fast and it used to tire me out and now, I was looking yesterday and I was doing slowly slowly but just not, I am always a bit scared I am going to fall; I have been falling quite a while - (whilst) doing some exercise or walking	Concern about falling again Concern falling again – activity too fast	Concern about falling again during activity
Yes, I have hurt my knees a couple of times I went on my knee. I smashed my knee to bits because of the extra weight I was carrying.	Injured when fallen Slow activity as fear of injury/ pain	Fear of more pain/ injury
I did avoid the Zumba ones at first because I thought that I can't do them, there is no way. I've got two left feet and I going to look like a right numpty and I am going to fall on my face That's why I have to be careful because they say that the age and the weight and it is going to get more worse The cross trainer is the confidence thing with my knee. I am sure I won't fall off it but I will, I will fall off - Yes, it is a lack of confidence in that knee and I am making it a disability	Avoid activity as reduced belief can do without falling Belief weight and age make falling more likely	Reduced confidence in participation because might fall

	Belief will fall on exercise equipment Reduced confidence as injured knee	
It's making yourself took an idiot if you fall over and things I suppose feeling like I was going to make an idiot of myself because I was always quite fit, I didn't want to look unfit in front of other people or be tripping over my own feet Oh god, it took about 4 people to help me up. I kept saying 'no, leave me alone, leave me and I will get up in my own time'. I couldn't actually get up by myself at all; I don't know why I was even saying it. I couldn't feel a thing at the time; I couldn't feel a thing except embarrassment. Just embarrassment, pure embarrassment. That is all I felt at the time. I couldn't feel the pain in my knee at all. No, one leg went one way and one leg went the other and everybody was looking at me and (my husband) walked off I have done in the past but not for a while but I was once walking through a town and all these people were 'are you ok? Are you ok' and I was 'move away, move away, I am fine, just let me get up and don't look' but I was on my own then you see and that's not funny, not when I am on my own.	Concern of looking foolish in front of others if fall over whilst active Embarrassment of falling over outside Embarrassment at falling worse than pain from injury Being stared at following a fall outside	Embarrassment/ look foolish/ feel judged
I stopped using that (step ladder) because I thought I was going to topple off it All this, stopping yourself from doing certain things, it all contributes to you putting even more weight on because you are getting less and less activities all the time Anything you avoid? -Well there is I know of the fit for life a little trampolines, now you had to go on them and I thought I might fall off, I was a bit wary –(I don't do) Because I think I would fall	Avoiding/avoided activities due to fear Avoided exercise equipment for fear of falling	Reduced/ avoidance of activities

Probably slipping, I nearly slipped, luckily I had my stick, it panicked me. That was just walking. It felt like slipping on ice but it wasn't ice, it was a nice day but it just happened.	Anxiety about slipping/falling when active	Panic/ anxious about falling during activity
with my depression and anxiety I have passed out at home before then and fell down the stairs before today	Anxiety and depression contributed to increased falls	Emotional problems increases risk of falling
Not so much physical, I think it is more mental with people that suffer from depression and anxiety, you don't always feel like getting up and doing things. Sometimes you feel like you don't want to get out of bed some days and you think I am not getting up today, what's the point? At first it bothered me and then you just sort of get numb, you switch off because you think you can't do it, you get to the point where nothing seems to touch you. You get very numb when you stop doing things. but I need to go to a gym to not be this size or to help me not be this size so it is a vicious circle but I am so down on myself all the time so I am not going to go to the gym anyway because they are looking at me in that gym	Anxiety and depression reduces motivated to be active Avoidance of activities when overweight due to reduced confidence Avoid going to gym affects mental health	Low mood leads to activity avoidance

APPENDIX C – REVIEW OF FEAR OF FALLING MEASUREMENT TOOLS

C.1: Results of Database Searches

Search History of AHMED database 21.06.2013

1	“fear of fall*”	179
2	(“tool*” OR “measure*”)	41841
3	1 AND 2	94
4	FEAR/ OR “fright” OR “afraid”	334
5	ACCIDENTAL FALLS/	1399
6	4 AND 5	69
7	2 AND 6	32
8	3 OR 7	95
9	BALANCE/ OR “postural stability”	2241
10	2 AND 9	985
11	8 OR 10	1048
12	(“fear avoidance” OR “avoidance behaviour” or “avoidance behaviour” OR “activity avoidance”	187
13	2 AND 12	98
14	11 OR 13	1143
15	(“Falls efficacy scale” OR “Mobility efficacy scale” OR “survey of activities and fear of falling in the elderly” OR “university of Illinois in Chicago fear of falling measure” OR “SAFFE” OR “UICFFM” OR “activities specific balance confidence scale” OR “confidence in maintaining balance scale” OR “CON-Fbal” OR “ABC-UK” OR “Tinettis falls efficacy scale” OR “FES” OR “concern about falling scale” OR “CAF” OR “concerns about the consequences of falling scale” OR “CONSFall” OR “consequences of falling scale” OR “Cof” OR “fear of falling avoidance behaviour questionnaire”)	453
16	14 OR 15	1535
17	16 [limit to: (Languages English) and Publication Year 1982-Current]	1504
	SELECTED ABSTRACTS	74

Search History of PsycINFO database 28.06.2013

1	"fear of fall*"	361
2	("tool*" OR "measure*")	456236
3	1 AND 2	148
4	FEAR/ OR "fright" OR "afraid"	11337
5	FALLS/	1290
6	4 AND 5	135
7	2 AND 6	70
8	3 OR 7	148
9	("fear avoidance" OR "avoidance behaviour" or "avoidance behaviour" OR "activity avoidance")	1649
10	2 AND 9	432
11	8 OR 10	570
12	BALANCE/ OR "postural stability"	2180
13	2 AND 12	732
14	11 OR 13	1272
15	("Falls efficacy scale" OR "Mobility efficacy scale" OR "survey of activities and fear of falling in the elderly" OR "university of Illinois in Chicago fear of falling measure" OR "SAFFE" OR "UICFFM" OR "activities specific balance confidence scale" OR "confidence in maintaining balance scale" OR "CON-Fbal" OR "ABC-UK" OR "Tinettis falls efficacy scale" OR "FES" OR "concern about falling scale" OR "CAF" OR "concerns about the consequences of falling scale" OR "CONSFall" OR "consequences of falling scale" OR "Cof" OR "fear of falling avoidance behaviour questionnaire")	739
16	14 OR 15	1950
17	16 [limit to: (Languages English) and Publication Year 1982-Current]	1455
	SELECTED ABSTRACTS	34

Search History of Medline database 1.7.2013

1	“fear of fall*”	742
2	(“tool*” OR “measure*”)	2424440
3	1 AND 2	381
4	FEAR/ OR “fright” OR “afraid”	24400
5	ACCIDENTAL FALLS/	14954
6	4 AND 5	413
7	2 AND 6	210
8	3 OR 7	406
9	BALANCE/ OR “postural stability”	1528
10	2 AND 9	789
11	8 OR 10	1185
12	(“fear avoidance” OR “avoidance behaviour” or “avoidance behaviour” OR “activity avoidance”	3114
13	2 AND 12	721
14	11 OR 13	1897
15	(“Falls efficacy scale” OR “Mobility efficacy scale” OR “survey of activities and fear of falling in the elderly” OR “university of Illinois in Chicago fear of falling measure” OR “SAFFE” OR “UICFFM” OR “activities specific balance confidence scale” OR “confidence in maintaining balance scale” OR “CON-Fbal” OR “ABC-UK” OR “Tinettis falls efficacy scale” OR “FES” OR “concern about falling scale” OR “CAF” OR “concerns about the consequences of falling scale” OR “CONSFall” OR “consequences of falling scale” OR “Cof” OR “fear of falling avoidance behaviour questionnaire”)	6282
16	14 OR 15	8073
17	16 [limit to: English Language and humans and Publication Year 1982-current and (age groups All adult 19 plus years or adolescent 13 to 18 years or young adult 19-24 years or adult 19-44 years)]	3032
	SELECTED ABSTRACTS	45

Search History of CINAHL database 5.7.2013

1	"fear of fall*"	458
2	("tool*" OR "measure*")	251466
3	1 AND 2	209
4	FEAR/ OR "fright" OR "afraid"	19443
5	ACCIDENTAL FALLS/	9998
6	4 AND 5	387
7	2 AND 6	134
8	3 OR 7	230
9	"balance" OR "postural stability"	16226
10	2 AND 9	4914
11	8 OR 10	5019
12	("fear avoidance" OR "avoidance behaviour" or "avoidance behaviour" OR "activity avoidance"	430
13	2 AND 12	174
14	11 OR 13	5185
15	("Falls efficacy scale" OR "Mobility efficacy scale" OR "survey of activities and fear of falling in the elderly" OR "university of Illinois in Chicago fear of falling measure" OR "SAFFE" OR "UICFFM" OR "activities specific balance confidence scale" OR "confidence in maintaining balance scale" OR "CON-Fbal" OR "ABC-UK" OR "Tinettis falls efficacy scale" OR "FES" OR "concern about falling scale" OR "CAF" OR "concerns about the consequences of falling scale" OR "CONSFall" OR "consequences of falling scale" OR "Cof" OR "fear of falling avoidance behaviour questionnaire")	786
16	14 OR 15	5827
17	16 [limit to: Publication Year 1982-2013 and (Language English) and (Age Groups Adolescent ~ 13 to 18 years or All Adults]	3828
	SELECTED ABSTRACTS	45

Search History of Embase database 5.7.2013

1	“fear of fall*”	893
2	(“tool*” OR “measure*”)	2494388
3	1 AND 2	412
4	FEAR/ OR “fright” OR “afraid”	30106
5	ACCIDENTAL FALLS/	20339
6	4 AND 5	460
7	2 AND 6	210
8	3 OR 7	433
9	POSTURAL BALANCE/ OR “postural stability”	9492
10	2 AND 9	4053
11	8 OR 10	4392
12	(“fear avoidance” OR “avoidance behaviour” or “avoidance behaviour” OR “activity avoidance”	2583
13	2 AND 12	748
14	11 OR 13	5137
15	(“Falls efficacy scale” OR “Mobility efficacy scale” OR “survey of activities and fear of falling in the elderly” OR “university of Illinois in Chicago fear of falling measure” OR “SAFFE” OR “UICFFM” OR “activities specific balance confidence scale” OR “confidence in maintaining balance scale” OR “CON-Fbal” OR “ABC-UK” OR “Tinettis falls efficacy scale” OR “FES” OR “concern about falling scale” OR “CAF” OR “concerns about the consequences of falling scale” OR “CONSFall” OR “consequences of falling scale” OR “Cof” OR “fear of falling avoidance behaviour questionnaire”)	6241
16	14 OR 15	11207
17	16 [limit to: Human and English Language and Publication Year 1982-2013 and (Human Age Groups Adolescent 13 to 17 years or adult 18 to 64 years or Aged 65 + years]	5569
	SELECTED ABSTRACTS	89

C.2: Gold Standard papers for review of Fear of Falling Tools

Author(s)	**Title**	**Journal**	**Medline search 11.6.13**
Greenberg, S.A.	Analysis of measurement tools of fear of falling for high-risk, community-dwelling older adults	Clin. Nursing Research Feb 2012, 21/1 (113-130).	✓
Durand, C., Powell, D.	Development of a scale to assess avoidance behaviour due to fear of falling: The fear of falling avoidance behaviour questionnaire (FFABQ)	Dissertation Abstracts International: Section B: The Sciences and Engineering, 2012 72/9-B	✓
Landers, M.R. Durand, C. Powell, D.S. Dibble, L.E. Young, D.L.	Development of a scale to assess avoidance behavior due to fear of falling: a fear of falling avoidance behaviour questionnaire	Physical therapy. 2011; 91/8 (1253-65).	✓
Perez-Jara, J. Walker, D. Heslop, P, Robinson, S.	Measuring fear of falling and its effect on quality-of-life and activity	Reviews in clin Geront, Nov 2010; /20/4 (277-287).	X but in Cinahl
Scheffer, A.C. Schuurmans, M.J. vanDijk, N. van der Hooft, T. de Rooij, S.E.	Reliability and validity of the visual analogue scale for fear of falling in older persons	J of American Geriatrics Society. 2010;58/11 (2228-30)	✓
Ersoy Y, Mac Walter RS, Durmus B et al	Predictive effects of different clinical balance measures and the fear of falling on falls in postmenopausal women	Gerontology;2009; 55/6 (660-665)	✓
Kempen, G.I. Yardley, L., van Haastregt, JCM et al	The short FES -1: a shortened version of the falls-efficacy scale – international to assess fear of falling.	Age & aging; 2008; 37(1); 45-50.	✓
Scheffer, A.C., Schuurmans, M.J. et al	Fear of Falling: measurement strategy, prevalence, risk factors and consequences among older persons	Age and ageing; 2008 ;37:19-24	✓
Hadjistavropoulos, T., Martin, R.R., Sharpe, D., Lints, A.C., et al	A longitudinal investigation of fear of falling, fear of pain, and activity avoidance in community–dwelling older adults.	J of aging & Health; 2007;19(6);965-84	✓
Yardley L, Beyer, N, Hauer, K et al	Development and initial validation of the falls-efficacy scale international (FES-1)	Age and ageing; 2005;34(6):614-9	✓
Jorstad, E.C., Hauer, K. et al	Measuring the psychological outcomes of falling: A systematic Review	JAGS 53:501-510. 2010	✓
Velozo, CA, Peterson, EW	Developing meaningful fear of falling measures for community dwelling elderly	American J of Physical Medicine & Rehab 2001:80(9):662-73	✓
Lachman, ME, Howland, J., Tennstedt, S et al	Fear of falling and activity restriction: the survey of activities and fear of falling in the elderly (SAFE).	J of gerontol series B-psychological Sciences & Social sciences 1998;53(1):43-50	✓
Tinetti, M., Richman, D., Powell, L	Falls-efficacy as a measure of fear of falling	J of Gerontology 1990;45(6):239-43	✓

C.3 Review: Selection Process Stage 1 – Review of Abstracts Selected

No	Paper	Fit criteria? Yes/no/ unknown	Full paper required	Reason for rejection
1	The relationship of FOF and balance confidence with balance and dual tasking performance	N	N	Performance based tool
2	Obese elderly women exhibit low postural stability: a novel three-dimensional evaluation system	N	N	Performance based tool
3	component analysis and initial validity of the exercise fear avoidance scale	Y	Y	
4	Assessment of balance in unsupported standing with elderly inpatients by force plate and accelerometers	N	N	Performance based tool
5	Physical activity improves strength, balance and endurance in adults aged 40-65 years: a systematic review	N	N	NA – not measurement properties
6	Effects of obesity on balance and gait alterations in young adults	N	N	NA – not measurement properties
7	Analysis of measurement tools of fear of falling for high risk community dwelling adults	Y – FES -1	Y	
8	Postural balance in patients with social anxiety disorder	N	N	Performance based tool and social anxiety tool NA
9	Intra and intersession reliability of balance measures during one-leg standing in young adults	N	N	Performance based tool
10	Development of a scale to assess avoidance behaviour due to fear of falling: the FOF avoidance behaviour questionnaire	Y	Y	
11	Between day reliability of time to contact measures used to assess postural stability	N	N	Performance based tool
12	Development and initial validation of the iconographic falls efficacy scale	U	Y	
13	Unified balance scale: classic psychometric and clinical properties	N	N	Performance based tool
15	The relationship between parameters of static and dynamic stability tests	N	N	Performance based tool

No	Paper	Fit criteria? Yes/no/ unknown	Full paper required	Reason for rejection
16	Reliability of an inexpensive and portable dynamic weight bearing asymmetry system incorporating dual Nintendo Wii Balance Boards	N	N	Performance based tool
17	Real time stability measurement system for postural control	N	N	Performance based tool
18	Association of BMI with self-report and performance based measures of balance and mobility	N	N	Not assessing tools – association study
19	Using psychometric techniques to improve the balance evaluation system test: the mini-BESTest	N	N	Performance based tool
20	The falls efficacy scale international (FES-1). A comprehensive longitudinal validation study	Y	Y	
21	The narrow ridge balance test: a measure for one leg lateral balance control	N	N	Performance based tool
22	Measuring balance, lower extremity strength and gait in the elderly: construct validation of an instrument	N	N	Performance based tool
23	A novel tool for the assessment of dynamic balance in healthy individuals	N	N	Performance based tool
24	Comparison of FOF, physical activity and balance according to gender in the elderly	N	N	Not looking at measurement properties
25	Comparison of 3 established measures of FOF in community dwelling older adults: Psychometric testing	Y	Y ? some Questionnaire based tools	
26	Development of a self-report measure of fearful activities for patients with low back pain: the fear of daily activities questionnaire	N	N	NA –specific pain related
27	Fear avoidance and endurance related response to pain: Development and validation of the Avoidance Endurance Questionnaire (AEQ)	N	N	NA –specific pain related
28	Reliability of centre of pressure summary measures of postural steadiness in healthy young adults	N	N	Performance based tool
29	Repeatability of posturographic measures of the mCTSIB static balance tests –A preliminary investigation	N	N	Performance based tool

No	Paper	Fit criteria? Yes/no/ unknown	Full paper required	Reason for rejection
30	Evaluation of postural control in quiet standing using center of mass acceleration: comparison among the young , the elderly and people with stroke	N	N	Performance based tool
31	The short FES-1: a shortened version of the falls efficacy scale international to assess fear of falling	Y	Y	
32	correlation between bmi and postural balance	N	N	Performance based tool
33	Psychometric properties of the activities specific balance scale and the survey of activities and FOF in older women	Y	Y	
34	Age related changes in postural stability	N	N	NA
35	Development of a new FOF scale in Hong Kong: an exploratory study	N	N	exploratory and culturally differs
36	Balance and its measure in the elderly: a review	N	N	Performance based tools
37	Reliability of performance measurements obtained using the stability testing and rehabilitation station (STAR station)	N	N	Performance based tool
38	Fear of falling and postural performance in the elderly	N	N	Performance based tool
39	Falls efficacy as a measure of FOF	Y	Y	
40	Measuring balance in the elderly: validation of an instrument	N	N	Performance based tool and conference paper
41	The activities-specific confidence (ABC) scale	Y	Y	
42	Postural stability measures: what to measure and for how long?	N		Performance based tool
43	Measures of postural steadiness: differences between healthy young and elderly adults	N	N	Performance based tool
44	The relationship between FOF and balance and gait abilities in elderly adults in a sub-acute rehabilitation facility	N	N	Performance based tool
45	Use of the ‘fast evaluation of mobility, balance, and fear in the elderly community dwellers: validity and reliability	N	N	Performance based tool

No	Paper	Fit criteria? Yes/no/ unknown	Full paper required	Reason for rejection
46	Postural stability of normal subjects measured by sway-magnetometry: Path length and area for the age range 15 to 64 years	N	N	Performance based tool
47	FOF and activity restriction: the survey of activities and FOF in the elderly (SAFE)	Y	Y	
48	An accelerometry based system for the assessment of balance and postural sway	N	N	Performance based tool
49	Measures of balance and FOF in the elderly: a review	Y	Y	
50	Normal variability of postural measures: implications for the reliability of relative balance performance outcomes	N	N	Performance based tool
51	Reliability of clinical balance outcome measures in the elderly	N	N	Performance based tool
52	A review of balance instruments for older adults	N	N	Performance based tool
53	Inter-and intra-tester reliability of the balance performance Monitor in a non-patient population	N	N	Performance based tool
54	Factor structure and validity of a revised pain anxiety symptom scale	N	N	Pain related tool NA
55	Relationship between clinical and force plate measures of postural stability	N	N	Performance based tool
56	Intratester and intertester reliability during the star excursion balance tests	N	N	Performance based tool
57	Factors affecting reliability of the biodex balance system: a summary of four studies	N	N	Performance based tool
58	Defining and measuring balance in adults	U	Y	
59	Validity of weight distribution and sway measurements of the balance performance monitor	N	N	Performance based tool
60	Trunk sway measures of postural stability during clinical balance tests: effects of age	N	N	Performance based tool
61	Relationship between FOF and balancing ability during abrupt deceleration in aged women having habitual physical activities	N	N	Performance based tool

No	Paper	Fit criteria? Yes/no/ unknown	Full paper required	Reason for rejection
62	Developing meaningful FOF measures for community dwelling adults	U	Y	
63	Reliability and validity of standing balance measurements with a motion analysis system	N	N	Performance based tool
64	Evaluation of the specificity of selected dynamic balance tests	N	N	Performance based tool
65	BMI and physical function in older women	N	N	Not relevant
66	Towards objective quantification of the Tinetti Test	N	N	Performance based tool
67	The relationship between anthropometric factors and body-balancing movements in postural balance	N	N	Performance based tool
68	A new balance measurement system: some analytical and empirical considerations	N	N	Performance based tool
69	A comparison of standing steadiness measurements from 2 devices: covariates and normal values	N	N	Performance based tool
70	Inter-rater reliability of a clinical test of standing function	N	N	Performance based tool
71	Dynamic balance testing with electrically evoked perturbation: a test of reliability	N	N	Performance based tool
72	Repeatability of body sway measurements: day to day variation measured by sway magnetometry	N	N	Performance based tool
73	Correlation between two clinical balance measures in older adults: Functional mobility and sensory organization	N	N	Performance based tool
74	Interpreting validity indexes for diagnostic tests: An illustration using the berg balance test	N	N	Performance based tool
75	Gait and postural stability in obese and non-obese prepubertal boys	N	N	Performance based tool
76	Correlations between force plate measures for assessment of balance	N	N	Performance based tool
77	A simplified measure of balance by functional reach	N	N	Performance based tool
78	Validity of the multi-directional reach teat: a practical measure for limits of stability in older adults	N	N	Performance based tool
79	Determinants of balance confidence in community dwelling elderly people	N	N	Performance based tool
80	Changes in postural stability in women aged 20 to 80 years	N	N	Performance based tool
81	Normal values of balance tests in women aged 20-80	N	N	Performance based tool
82	Measures of postural stability	N	N	Performance based tool

No	Paper	Fit criteria? Yes/no/ unknown	Full paper required	Reason for rejection
83	Evidence of the psychometric qualities of a simplified version of the Activities –Specific Balance confidence scale for community Dwelling seniors	Y	Y	
84	Low levels of physical activity in back pain patients are associated with high levels of fear –avoidance beliefs and pain catastrophizing	N	N	Pain related
85	Development of a valid and reliable measures of postural stability	N	N	Performance based tool
86	Fear of movement (re)injury in chronic pain: a psychometric assessment of the original English version of the Tampa scale of Kinesiophobia	N	N	Pain related
87	Assessing fear of falling: can a short version of the activities – specific balance confidence scale be useful?	Y	Y	
88	Geriatric fear of falling measure: development and psychometric testing	N	N	Taiwanese – not generalizable
89	Fear of pain and FOF among younger and older adults with musculoskeletal pain conditions	U	Y	
90	Development and initial validation of the falls efficacy scale –international (FES-1)	Y	Y	
91	Measuring the psychological outcomes of falling: a systematic review	U	Y –different scales used as part of review?	
92	Validation of a quality of life questionnaire measuring the subjective FOF in nursing homes	U	Y? – limited as low no of participants	
93	High fear avoiders of physical activity benefit from an exercise program for patients with back pain	N	N	Specific to back pain
94	Psychometric properties of the social phobia inventory (SPIN). New self-rating scale.	N	N	NA
95	Correlations between force plate measures for assessment of balance	N	N	Performance based tool
96	Postural stability of normal subjects measured by sway magnetometry: Path length and area for the age range 15 to 64 years	N	N	Performance based tool
97	Use of the “fast evaluation of mobility, balance, and fear” in elderly community dwellers: validity and reliability	U	Y? – to look at refs – FEMBF tool might be applicable	

No	Paper	Fit criteria? Yes/no/ unknown	Full paper required	Reason for rejection
98	The assessment of anxiety and fear in persons with chronic pain: a comparison of instruments	U	Y – to assess whether applicable	
99	Psychometric properties of the Tampa Scale for Kinesiophobia -11 (TSK-11)	N	N	Specific to pain
100	ISway: a sensitive, valid and reliable measure of postural control	N	N	Performance based tool
101	Validity and reliability of limits-of-stability testing: a comparison of 2 postural stability evaluation devices	N	N	Performance based tool
102	Improved postural control after dynamic balance training in older overweight women	N	N	NA
103	Validity and sensitivity to change of the falls efficacy international to assess FOF in older adults with and without cognitive impairment	U	Y – some MPs relevant in non-dementia subjects	
104	Predictive effects of different clinical balance measures and the FOF on falls in post-menopausal women aged 50 years and over	N	N	Performance based tool
105	The relationship between FOF and human postural control	N	N	Performance based tool
106	Development and validation of a modified falls efficacy scale	U	Y	
107	Physical and psychosocial correlates of FOF: among older adults in assisted living facilities	U	Y – some questionnaire based tools	
108	Feelings of anxiety and symptoms of depression in community –living older persons who avoid activity for FOF	Y	Y	
109	FOF: measurement strategy, prevalence, risk factors and consequences among older persons	N	N	NA – no MPs
110	Comparison of reliability, validity, and responsiveness of the Mini-BESTest and Berg Balance Scale in patients with balance disorders	N	N	Performance based tool
111	Correlations of clinical and laboratory measures of balance in older men and women	U	Y	
112	Construct validity of a modified bathroom scale that can measure balance in elderly people	N	N	Performance based tool
113	Validity and reliability of Nintendo Wii fit balance Scores	N	N	Performance based tool

No	Paper	Fit criteria? Yes/no/ unknown	Full paper required	Reason for rejection
114	FOF and its relationship with anxiety, depression, and activity engagement among community dwelling older adults	Y	Y	
115	Sensitivity to change and responsiveness of four balance measures for community dwelling older adults	N	N	Performance based tool
116	Short berg balance scale –correlation to static and dynamic balance and applicability among the aged	N	N	Performance based tool
117	Association of BMI with self-report and performance based measures of balance and mobility	U	Y – some self-reported measures of balance – also to view refs	
118	Development and validation of a modified falls efficacy scale	Duplicate paper	N	
119	Validation of an adapted falls efficacy scale in older rehabilitation patients	Y	Y	
120	The unilateral forefoot balance test: reliability and validity for measuring balance in late midlife women	N	N	Performance based tool
121	Functional balance assessment of older community dwelling adults: a systematic review of the literature	N	N	Performance based tool
122	A balance screening tool for older people: reliability and validity	N	N	Performance based tool
123	A new force plate technology measure of dynamic postural stability: the dynamic postural stability index	N	N	Performance based tool
124	Postural stability index is a more valid measure of stability than equilibrium score	N	N	Performance based tool
125	The measurement properties and performance characteristics among older people of TURN180, a test of dynamic postural stability	N	N	Performance based tool, need physio to assess
126	Psychometric comparisons of the timed up and go, one–leg stand, functional reach, and Tinetti balance measures in community–dwelling older people	N	N	Performance based tool
127	Measurements of balance: comparison of the timed “up and go” test and functional reach test with the berg balance scale	N	N	Performance based tool
128	Development and initial validation of a questionnaire for measuring fear-avoidance associated with pain: the fear–avoidance of pain scale	N	N	Pain specific
129	Inter-tester reliability using the Tinetti gait and balance assessment scale	N	N	Performance based tool

No	Paper	Fit criteria? Yes/no/ unknown	Full paper required	Reason for rejection
130	A review of balance instruments for older adults	Duplicate paper		
131	Clinical measures of balance in community-dwelling elderly female fallers and non-fallers	N	N	Performance based tool
132	Factor structure and validity of a revised pain anxiety symptom scale	N	N	Performance based tool
133	Validity and reliability of measures obtained from the balance performance monitor during quiet standing	N	N	Performance based tool
134	FOF: measuring fear and appraisals of potential harm	Y	Y	
135	The association between FOF and physical activity in older women	N	N	Performance based tool
136	Perceived effort of walking: relationship with gait, physical function and activity, FOF and confidence in walking in older adults with mobility limitations	N	N	Performance based tool
137	Fear and avoidance of movement in people with chronic pain psychometric properties of the 11-item Tampa scale for Kinesiophobia (TSK-11)	N	N	Pain specific
138	Wii fit and balance: does the Wii fit improve balance in community-dwelling older adults?	N	N	Performance based tool
139	Is the berg balance scale an internally valid and reliable measure of balance across different etiologies in neurorehabilitation? A revisited Rasch Analysis study	N	N	Performance based tool
140	A comparison between performance on selected directions of the star excursion Balance test and the Y Balance Test	N	N	Performance based tool
141	Development of a geriatric FOF questionnaire for assessing the FOF of Thai elders	N	N	Not generalisable as in Thai population
142	An examination, correlation and comparison of static and dynamic measures of postural stability in healthy, physically active adults	N	N	Performance based tool
143	Validity and reliability of limits–of–stability testing: a comparison of 2 postural stability evaluation devices	N	N	Performance based tool
144	The effects of exercising on unstable surfaces on the balance ability of stroke patients	N	N	NA
145	Balance assessment practices and use of standardized balance measures among Ontario physical therapists	N	N	Performance based tool

No	Paper	Fit criteria? Yes/no/ unknown	Full paper required	Reason for rejection
146	Validation of a robotic balance system for investigations in the control of human standing balance	N	N	Performance based tool
147	Rasch analysis of the fullerton advanced balance (FAB) scale	N	N	Performance based tool
148	Measurement of balance in computer posturography: comparison of methods – a brief review	N	N	Performance based tool
149	FOF after hip fracture: A systematic review of measurement instruments, prevalence, interventions and related factors	U	Y	
150	What is the relationship between FOF and gait in well-functioning older persons aged 65-70 years?	N	N	NA
151	A psychometric investigation of fear-avoidance model measures in patients with chronic low back pain	N	N	Specific to back pain
152	Screening for elevated levels of fear-avoidance beliefs regarding work or physical activities in people receiving outpatient therapy	N	N	NA
153	The influence of FOF on gait and balance in older people	N	N	Performance based tool
154	The CONFbal scale: a measure of balance confidence – a key outcome of rehabilitation	U	Y	
155	The balance evaluation systems test (BESTest) to differentiate balance deficits	N	N	Performance based tool
156	Task–specific measures of balance efficacy, anxiety, and stability and their relationship to clinical balance	N	N	Performance based tool
157	Psychometric properties of the fear avoidance beliefs questionnaire and Tampa scale of Kinesiophobia in patients with neck name	N	N	Specific to pain
158	Functional balance and mobility tests in healthy participants: reliability, error and influencing factors	U	Y	
159	A balance screening tool for older people: reliability and validity	duplicate		
160	The effect of depression on balance decline in mature women	N	N	Performance based tool
161	Postural steadiness and weight distribution during tandem stance in healthy young and elderly adults	N	N	Performance based tool
162	Rating scale analysis of the berg balance scale	N	N	Performance based tool

No	Paper	Fit criteria? Yes/no/ unknown	Full paper required	Reason for rejection
163	Medial-lateral postural stability in community dwelling women over 40 years of age	N	N	Performance based tool
164	Reliability of the modified figure of eight –a balance performance test for elderly women	N	N	Performance based tool
165	The relationship between anthropometric factors and body-balancing movements in postural balance	N	N	Performance based tool
166	Age and gender related test performance in community dwelling elderly people: six minute walk test, berg balance scale, timed up and go test and gait speeds	N	N	Performance based tool
167	Review of the different methods for assessing standing balance	N	N	Performance based tool
168	FOF in patients with stroke: a reliability study	N	N	Specific to stroke patients
169	Functional tools for assessing balance and gait impairments	N	N	Performance based tool
170	Functional reach: does it really measure dynamic balance?	N	N	NA
171	Interrater reliability of the Tinettti Balance scores in novice and experienced physical therapy clinicians	N	N	Performance based tool
172	FOF revisited	Y	Y	
173	Quantitative evaluation of stance balance performance in the clinic using a novel measurement device	N	N	Performance based tool
174	Functional reach: a new clinical measure of balance	N	N	Performance based tool
175	Force platform measures for evaluating postural control: reliability and validity	N	N	Performance based tool
176	Fear, avoidance and physiological symptoms during cognitive – behavioural therapy for social anxiety disorder	N	N	NA
177	Postural balance and physical activity in daily life (PADL) in physically independent older adults with different levels of aerobic exercise capacity	U – PA measure	Y – to see subjective PA questionnaire – Mod Baecke	
178	Reliability and validity of the visual analogue scale for FOF in older persons	U	Y	
179	Development and validation of a scale to measure fear of physical response to exercise among overweight and obese adults	U	N? – maybe look at refs	Dissertation abstract

No	Paper	Fit criteria? Yes/no/unknown	Full paper required	Reason for rejection
180	Activity restriction induced by FOF and objective and subjective measures of physical function: a prospective cohort study	U	Y?	
181	Validity of functional stability limits as a measure of balance in adults aged 23-73 years	N	N	Performance based tool
182	The physical activity and sport anxiety scale (PASAS): scale development and psychometric analysis	U	Y	
183	A systematic review of FOF measures and interventions	Y	U? abstract only available ?Look at refs	Dissertation abstract
184	Psychological indicators of balance confidence: Relationship to actual and perceived abilities	U	Y? some questionnaire based	
185	The role of self-efficacy and fear avoidance beliefs in the prediction of disability	N	N	NA
186	Balance and gait measures	N	N	Performance based tool

C4: Comparison of Results with Systematic Review: Measuring the Psychological Outcomes of Falling (Jorstad et al, 2005)

The results of the review were compared with those of an earlier published systematic review measuring the psychological outcomes of falling performed by Jorstad and colleagues (2005). Jorstads search strategy differed in that it was an exact replication of that used in the Cochrane Review of interventions to prevent falls in older people (Gillespie et al, 2003). Similarities of the two reviews were that they both excluded studies including participants with specific medical conditions that could affect the results, such as Parkinson's disease, or lower limb amputees and they both included single and multi-item methods. Differences to Jorstad and colleagues' inclusion criteria compared to this study's included that it: was not restricted by language; excluded studies in younger people, was not limited to studies in community-based adults and it was originally designed to look at interventions. Although this review used a different inclusion criteria, it was interesting to compare the studies selected and check those that fitted both inclusion criteria's had been picked up in both reviews.

Seventeen multi-item measures and six single-item measures and their measurement properties were identified in the review by Jorstad et al (2005). Twenty four papers of the identified tools were assessed for eligibility against this study's inclusion criteria (Table 5.5). Eleven papers were found to have already been identified in this review of self-reported, tools for community based adults. On further investigation of the remaining 13 papers from Jorstad and colleagues, five were found to fit this study's inclusion criteria that had not previously been identified. The remaining 8 were excluded for various reasons such as not suitable for community dwelling adults, did not report measurement properties or were conference papers.

Comparison of Review Results with a Systematic Review: 'Measuring the Psychological Outcomes of Falling' by Jorstad et al (2005).

Reference Paper	Measurement Instrument	Already identified?	Does it fit my review Criteria	Include in review?
Myers et al (1996) Psychological indicators of balance confidence: Relationship to actual and perceived abilities	FES	Yes	Yes	Yes
Powell and Myers (1995) The Activities –specific Balance and Confidence (ABC) scale	ABC	Yes	Yes	Yes
Tinetti et al (1990) Falls efficacy as a measure of fear of falling	FES	Yes	Yes	Yes
Petrella et al (2000) Physical functioning and fear of falling after hip fracture rehabilitation in the elderly	FES,ABC	No	No – specifically used for rehab patients after hip fracture	No
Harada et al (1995) Screening for balance and mobility impairment in elderly individuals living in residential care facilities	rFES	No	Majority of tools used were observed and residential inpatients	No
Tinetti et al (1994) Fear of Falling and Fall-Related Efficacy in Relationship to Functioning Among Community-Living Elders	rFES, single-item	No	Yes	Yes
Cameron et al (2000) hip protectors improve falls efficacy	rFES, mFES	No		Yes
Lachman et al (1998) Fear of falling and activity restriction; The survey of activities and fear of falling in the elderly	rFES, SAFFE	Yes	Yes	Yes
Hill et al (1996) fear of falling revisited	rFES, mFES	Yes	Yes	Yes
Cumming et al, 2000 Prospective study of the impact of fear of falling on activities of daily living, SF-36 scores and nursing home admission	rFES	No	Does not look at relevant measurement properties	No
Rosengren et al, 1998 gait adjustments in older adults' activity and efficacy influences	rFES	No	Does not look at relevant measurement properties	No
Parry et al, 2001 falls and confidence related quality of life outcome measures in an older British cohort	FES-UK, ABC UK	Yes	Yes	Yes
Simpson et al, 1998 Balance confidence in elderly people the CONFbal scale.	CONFbal	Yes	Yes also references Hallman and Hinchcliffe paper	Yes

Kressig et al 2001, Associations of demographic, functional and behavioural characteristics with activity related fear of falling among older adults transitioning to frailty	ABC, amFES	No	No– does not look at measurement properties of instruments	No
Li et al, 2002. Self-efficacy as a mediator between fear of falling and functional ability in the elderly	ABC, SAFFE	No	Yes	Yes
Simpson, 2000. Having fallen does not fully explain fear of falling. British Psychological Society annual conference	CONFbal, Caf, CONSfall	No	No as Conference paper	No
Simpson, 2003 Questionnaires, concern about falling, balance confidence concern regarding the consequences of falling. Prevention of falls network Europe work package 4 consensus meeting. University of Southampton 2003	CONFbal, Caf,	No	No as conference paper	No
Lusardi et al, 1997 development of a scale to assess concern about falling and applications to treatment programs	MES, aFES	No	Yes	Yes
Velozo et al, 2001 developing meaningful fear of falling measures for community dwelling elderly	UICFFM	Yes	Yes	Yes
Yardley et al 2002 a prospective study of the relationship between feared consequences of falling and avoidance of activity in community living older people	mSAFFE, CoF	Yes	Yes	Yes
Steadman et al, 2003 a randomised controlled trial of an enhanced balance training program to improve mobility and reduce falls in elderly patients	FHI	No	No does not look at measurement properties	No
Myers et al, 1998 discriminative and evaluative properties of the activities specific balance (ABC) scale	ABC	Yes	Yes	Yes
Howland, J., Peterson, E.W., Levin, W.C., Fried, L., Pordon, D, Bak, S. (1993). Fear of Falling among the community dwelling elderly. *Journal of aging Health*; 5:229-243.	FOF	Yes	Yes single-item FOF	Yes
Rai, G.S., Kiniorns, M., Wientjes, H. Falls Handicap Inventory (FHI): An instrument to measure Handicaps associated with repeated falls. *Journal of American Geriatric Society*; 43:723-724.	FHI	No		Yes

C.5: Review Selection Process Stage 2: Full Paper Screening for Eligibility

No		Study published in English	Participants Age, gender medical condition	Meets inclusion criteria (Y/N)	Does it measure one or more domain of FOF?	Type of Instrument used	Include Study (Y/N)	Reason for rejection
1	Ayre M., Tyson G.A. (2001). The Role of self-efficacy and fear avoidance beliefs in the prediction of disability. Australian Psychologist, 36/3/(250-53), 0005-0067; 1742-9544	✓	21-62 yrs	N	N	PSEQ, FABQ	N	Related to avoidance due to pain not falling
2	Boyd, R. and Stevens, J. (2009). Falls and fear of falling: burden, beliefs and behaviours. Age and Ageing;38:423-428.	✓	≥65 years	Y		FOF	Y	
3	Bula C.J., Martin E., Rochat S., Piot-Ziegler C. (2008).Validation of an adapted falls efficacy scale in older rehabilitation patients. Archives of Physical Medicine & Rehabilitation, 89/2(291-296), 00039993	✓	65+ yrs	N	Y	Adapted FES	N	Post-acute rehab pats
4	Busse M.E., Tyson S.F. (2007).Functional balance and mobility tests in healthy participants: reliability, error and influencing factors. Physiotherapy Research International,12/4(242-50), 1358-2267	✓	20-60yrs	N	Y	Performance based	N	Performance based tools
5	Cameron, I.D., Stafford, B.,Cumming, R.G., Birks, C., Kurrle, S.E., Lockwood, K., Quine, S et al (2000). Hip protectors improve falls self-efficacy. Age and Ageing; 29:57-62.	✓	≥75 years	Y	Y- Falls-efficacy	MFES	Y	
6	Chamberlin, M.E., Fulwider, D., Sanders, S.L., Medeiros, J.M.(2005). Does fear of falling influence spatial and temporal gait parameters in elderly persons beyond changes associated with normal aging? Joutrnal of Gerontology;MEDICAL SCIENCES;9:1163-1167.	✓	60-97 years	Y	Y- Falls-efficacy	MFES	Y	
7	Cleland J.A., Fritz J.M., Childs J.D. (2008). Psychometric properties of the fear avoidance beliefs questionnaire and Tampa scale of Kinesiophobia in patients with neck pain. Am J Physical Medicine and Rehabilitation, 87/2 (109-17), 0894-9115	✓	18-60 yrs	Y	Y	FABQW FABQPA, TSK	N	Neck Pain
8	Dayhoff N.E., Baird C., Bennett S., Backer J. (1994). FOF: measuring fear and appraisals of potential harm. Rehabilitation Nursing Research, 3/3 (97-104), 10705767	✓	60+yrs	Y	Y- FOF, Falls self-efficacy	FFQ, FES	Y	
9	Delbaere K., Close J.C.T., Mikolaizak A.S., Sachdev P.S., Brodaty H., Lord S.R. (2010).The falls efficacy scale international (FES-1). A comprehensive longitudinal validation study. Age and ageing,39/2(210-216), 0002-0729; 1468-2834	✓	70-90 M&F	Y	Y- Falls efficacy	FES-1	Y	
10	Delbaere K., Smith S.T., Lord S.R. (2011).Development and initial validation of the iconographic falls efficacy scale. The J gerontology, series A, Biological sciences and medical sciences, 66/6(674-680),1758-535X	✓	70-90 M&F	Y	Y – Falls efficacy	ICON-FES	Y	
11	Delbaere, K., Crombez, G., Vanderstraeten, G., Willems, T., Cambier, T. (2004).	✓	61-92 years	Y	Y-Activity avoidance	SAFFE	Y	

	Fear-related avoidance of activities, falls and physical frailty. A prospective community-based cohort study Age Ageing; 33 (4): 368-373							
12	Di Fabio R.P., Seay R. (1997).Use of the fast evaluation of mobility, balance and fear in the elderly community dwellers: validity and reliability. Physical Therapy, 77/9(904-917), 0031-9023	✓	Mean 79.9 yrs	N	Y	FEMBAF	N	Performance based tool
13	Doughty P.D. (2003).A systematic review of FOF measures and interventions. Dissertation Abstracts International Section A: Humnities and Social Sciences, 63/7-A(2654), 0419-4209	✓	various	N	Y	various	N	Dissertation, not published and a review
14	Edwards N., Lockett D. (2008).Development and validation of a modified falls efficacy scale. Disability & Rehabilitation: Assistive Technology,3/4(193-200)	✓	>60 yrs	Y	Y	MFES	N	Questionnaires translated into French
15	Filiatrault J., Gauvin L., Fournier M., Parisien M., Robitaille Y., Laforest S., Corriveau H., Richard L. (2007). Evidence of the psychometric qualities of a simplified version of the Activities –Specific Balance confidence scale for community Dwelling seniors. Archives of physical Medicine & Rehabilitation, 88/5 (664-72), 0003-9993.	✓	60+yrs	Y	Y –balance confidence	ABC-S	Y	
16	French D.J., France C.R., Vigneau F., French J.A., Evans R.T. (2007).Fear of movement (re) injury in chronic pain: a psychometric assessment of the original English version of the Tampa scale of Kinesiophobia(TSK). Pain, 127/1-2(42-51), 0304-3959; 1872-6623	✓	Mean 40 yrs with chronic pain	Y	N	TSK	N	Fear of Movement due to pain not FOF
17	George S.Z., Valencia C., Beneciuk J.M. (2010).A psychometric investigation of fear avoidance model measures in patients with chronic low back pain. J of Orthopaedic and Sports Physical Therapy, 40/4 (197-205)	✓	Mean 44.3yrs Chronic LBP	Y	N	Fear avoidance of Muscular pain (FAM)	N	Not related to falling
18	George S.Z., Valencia C., Zeppieri Jr. G., Robinson M.E. (2009).Development of a self-report measure of fearful activities for patients with low back pain: the fear of daily activities questionnaire. Physical Therpay, 89/9(969-979), 1538-6724	✓	15-60 yrs + acute or subacute LBP	Y	N	Fear of daily activities Q	N	Relates to fear of pain when exercising, not falling
19	Greenberg S.A. (2012). Analysis of measurement tools of fear of falling for high risk community dwelling adults. Clin Nursing Res 21/1(113-130), 1054-7738; 1552-3799	✓	various	Y	Y	Various	N	review
20	Hadjistavropoulos, T., Carleton, N.R., Delbaere, K., Barden, J., Zwakhalen, S., Fitzgerald, B., Ghandehari, O.O., Hadjistavropoulos, H. (2012).The Relationship of FOF and balance confidence with balance and dual tasking performance. Psychology and Aging; 27/1(1-13), 0882-7974	✓	Mean 76.8 yrs	N	N	SAFFE, ABC + performance based	N	No MP reported
21	Hapidou E.G., O'Brien M.A., Pierrynowski M.R., de las Hera E., Patla T. (2012).Fear and avoidance of movement in people with chronic pain. Psychometric properties of the 11-item Tampa scale for kinesiophobia (TSK-11). Physiotherapy Canada 64/3 (235-41), 0300-0508	✓	Mean age 43.8 yrs	N	Y	Tsk-11	N	Tool not related to falls

22	Hasenbring M.I., Hallner D., Rusu A.C. (2009).Fear avoidance and endurance related response to pain: Development and validation of the Avoidance Endurance Questionnaire (AEQ) European journal of Pain, 13/6 (620-628), 1090-3801; 1532-2149	✓	Mean 44.9 yrs	N	Y	Fear Avoidance Belief & AEQ & PASSTSK	N	Relates to burden of pain and tool in German
23	Hauer K.A., Kempen G.I., Schwenk M., Yardley L., Beyer N., Todd C., Oster P., Zijlstra G.A. (2011).Validity and sensitivity to change of the falls efficacy international to assess FOF in older adults with and without cognitive impairment. Gerontology, 57/5(462-72), 0304-324X	✓	>65, with and without dementia	Y	Y	FES-1, FES, FES-1(short)	Y	
24	Hill K.D., Schwartz J.A., Kalogeropoulos A.J., Gibson S.J. (1996). FOF revisited. Archives of Physical Medicine and Rehabilitation, 77/10(1025-9).	✓	65+	Y	Y- falls efficacy	MFES	Y	
25	Hotchkiss, A., Fisher, A., Robertson, R., Ruttencutter, A., Schuffert, J., Barker, D.B. (2004). Convergent and Predictive Validity of Three Scales Related to Falls in the Elderly. *Am J Occup Ther*;58(1):100-103	✓	≥60 years	Y	Y- FOF, Falls-efficacy, balance confidence	ABC, FES, SAFFE	Y	
26	Howland, Peterson , Levin et al (1993). Fear of falling among the community-dwelling elderly. J aging Health;5:229-243	✓	≥58 years	Y	Y-FOF	FOF Single item	Y	
27	Huang T.-T., Wang W.-S. (2009).Comparison of 3 established measures of FOF in community dwelling older adults: Psychometric testing. Int J Nursing studies, 46/10(1313-1319), 0020-7489	✓	60+	N	Y – Falls efficacy, balance confidence	FES, ABC, GFFM	N	Tool in Taiwanese
28	Jorstad E.C., Hauer K., Becker C., Lamb S.E., ProFaNE Group. (2005). Measuring the psychological outcomes of falling: a systematic review. J of American Geriatrics Society, 53/3(501-10), 0002-8614	✓	Various	Y	Y	Various	N	review
29	Kempen G.I.J.M., Yardley L., Van Haastregt J.C.M., Zijlstra G.A.R., Beyer N., Hauer K., Todd C. (2008).The short FES-1: a shortened version of the falls efficacy scale international to assess fear of falling. Age and Ageing 37/1(45-50), 0002-0729; 1468-2834	✓	>60 2 samples – UK and Dutch	Y	Y	Short FES-I and FES I	Y	
30	Kempen, G.I.J.M., Todd, C.J., Van Haastregt, J.C.M., Zijlstra, G.A.R., Beyer, N., Freiberger, E., Hauer K., Piot-Ziegler, C., Yardley L. (2007). Cross-cultural validation of the Falls Efficacy Scale International (FES-I) in older people: Results from Germany, the Netherlands and the UK were satisfactory. *Disability and Rehabilitation*; 29(2): 155-162.	✓	≥70 years – 3 samples fGermany, NL and UK	Y	Y- falls-efficacy	FES-I	Y	
31	Klein P.J., Fiedler R.C., Rose D.J. (2011). Rasch analysis of the fullerton advanced balance scale (FAB) scale. Physiotherapy Canada, 63/1 (115-25), 0300-0508	✓	Mean 76.4	N	Y	FAB	N	Performance based
32	Lachman M.E., Howland J., Tennstedt S., Jette A., Assmann S., Peterson E.W. (1998). FOF and activity restriction: the survey of activities and FOF in the elderly (SAFE). J Gerontology –series B Psychological Sciences and Social Sciences, 53/1(P43-P50), 1079-5014	✓	62-93	Y	Y	SAFE, single FES	Y	

33	Landers M.R., Durand C., Powell D.S., Dibble L.E., Young D.L. (2011).Development of a scale to assess avoidance behaviour due to fear of falling: the FOF avoidance behavior questionnaire. Physical Therapy, 91/8(1253-1265), 1538-6724	✓	60+ M&F	Y	Y avoidance behavior	fear of falling avoidance behavior Q	Y	
34	Li, F., McAuley, E., Fisher, K.J., Harmer, P., Chaumeton, N., & Wilson, N.L. (2002). Self-efficacy as a mediator between fear of falling and functional ability in the elderly. *Journal of Aging and Health*; 14: 452-466	✓	Mean age =77.5 years	Y	Y-FOF, balance confidence	SAFFE, ABC	Y	
35	Lusardi, M.M. and Smith, E.V. Jr (1997). Development of a scale to assess concern about falling and applications to treatment programs. PTHMS Faculty Publications. Paper 45. http://digitalcommons.sacredheart.edu/pthms_fac/45	✓	≥65 years	Y	Y	MES, aFES	Y	
36	Manning J., Neistadt M.E., Parker S. (1997).The relationship between FOF and balance and gait abilities in elderly adults in a sub-acute rehabilitation facility. Physical and Occupational Therapy in Geriatrics, 15/2(33-47), 0270-3181	✓	39 inpatients age 54-93 yrs	N	Y	FES	N	Not community dwelling
37	Martin R.R., Hadjistavropoulos T., McCreary D.R. (2005).Fear of pain and FOF among younger and older adults with musculoskeletal pain conditions. Pain Research & Management,10/4(211-9), 1203-6765	✓	>18 yrs	N		N	N	Not MPs
38	McAuley, E.M., Mihalko, S.L., Rosengren, K. (1997). Self-efficacy and balance correlates of fear of falling in the elderly. J Aging Physical Activity;5:329-340	✓	52-85 years	Y	Y- FOF, falls-efficacy	FOF –single item, FES	Y	
39	McCracken L.M., Gross R.T., Aikens J., Carnrike C.L. Jr (1996).The assessment of anxiety and fear in persons with chronic pain: a comparison of instruments Behaviour Research & Therapy, 34/11-12(927-33),0005-7967.	✓	Mean =46.3 yrs with chronic pain	N	Y	Pass,FPQ, FABQ,STAI	N	Not related to falls
40	Moore, D.S., Ellis, R. (2012). Measurement of fall-related psychological constructs among independent living older adults: A review of the reseach literature. *Aging &Mental Health*:12;6:684-699.	✓	various	Y	Y	Various	N	Review
41	Myers A.M., Powell L.E., Maki B.E., Holliday P.J., Brawley L.R., Sherk W. (1996). Psychological indicators of balance confidence: Relationship to actual and perceived abilities. J of Gerontology: series A: Biological Sciences and medical Sciences, 51A/1(M37-M43), 1079-5006; 1758-535X	✓	65-95	Y	Y – falls efficacy, balance confidence	FES, ABC	Y	
42	Myers, A.M., Fletcher, P.C., Myers, A.H. and Sherk, W. (1998). Discriminative and evaluative properties of the Activities- specific Balance Confidence (ABC) Scale. J Gerontology: MEDICAL SCIENCES, 53A;4;M287-M294	✓	Mean age 74.6 years	Y	Y	ABC	Y	
43	Nakamuru D.M., Holm M.B., Wilson A. (1998). Measures of balance and FOF in the elderly: a review. Physical and occupational therapy in geriatrics, 15/4(17-32), 0270-3181	✓	Various elderly	Y	Y	FES , GUGT, BBS, POAB, FR	N	Mainly Performance based and Review

44	Nguyen U.S., Kiel D.P., Li W., Galica A.M., Kang H.G., Casey V.A., Hannan M.T. (2012).Correlations of clinical and laboratory measures of balance in older men and women. Arthritis Care & Research (2151464X), 64/12(1895-1902)	✓	64-97 yrs	N	Y		N	Performance based
45	Norton P.J., Hope D.A., Weeks, J.W. (2004).The physical activity and sport anxiety scale (PASAS): scale development and psychometric analysis. Anxiety, Stress & Coping: An International Journal, 17/4(363-382), 1061-5806; 1477-2205	✓	17-45	Y	N	PASAS	N	Anxiety about exercise but not related to falls
46	Olivera, Lee et al 2013. Postural Control and FOF assessment in people with chronic obstructive pulmonary disease: a systematic review of instruments, international classification of functioning, disability and health linkage, and measurement properties.	✓	Various with COPD	Y	Y	Various	N	Review
47	Ozcan, A., Donat, H., Gelecek, N., Ozdirenc, M., Karadibak, D. (2005). The relationship between risk factors for falling and the quality of life in older adults. *BMC Public Health;* 5:90	✓	≥65 years	Y	Y-FOF	FOF-VAS	Y	
48	Parry, S.W., Steen, N., Galloway, S.R., Kenny, R.A. and Bond, J. (2001). Falls and Confidence related quality of life outcome measures in an older British Cohort. Postgrad Med; 77: 103-108	✓	Mean age =63 years	Y	Y	FES –UK, ABC- UK	Y	
49	Peretz C., Herman T., Hausdorff J.M., Giladi N. (2006). Assessing fear of falling: can a short version of the activities – specific balance confidence scale be useful? Movement Disorders, 21/12(2101-5), 0885-3185	✓	3 groups – and controls- mean age75yrs	N	Y	ABC-16 and 6	Y	
50	Powell L.E., Myers A.M. (1995).The activities-specific confidence (ABC) scale. J of Gerontology –series A Biological Sciences and Medical Sciences, 50 A/1 (M28-M34), 1079-5006	✓	65-95 yrs	Y	Y – balance confidence falls efficacy	ABC,FES	Y	
51	Rai, G.S., Kiniorns, M., Wientjes, H. (1995). Falls Handicap Inventory (FHI): An instrument to measure Handicaps associated with repeated falls. *Journal of American Geriatric Society*; 43:723-724.	✓	Mean age 78+/-5.6 yeras	Y	Y	FHI	Y	
52	Scheffer A.C., Schuurmans M.J., van Dijk, N., van der Hooft T., de Rooij S.E. (2008). Fear of falling: measurement strategy, prevalence, risk factors and consequences among older personsAge Ageing; 37 (1): 19-24	✓	various				N	Review
53	Scheffer A.C., Schuurmans M.J., van Dijk, N., van der Hooft T., de Rooij S.E. (2010).Reliability and validity of the visual analogue scale for FOF in older persons. J of American Geriatrics Society, 58/11 (2228-2230), 0002-8614; 1532-5415	✓	65+yrs		Y	VAS, FOF	Y	
54	Simpson J.M., Worsfold C., Fisher K.D., Valentine J.D. (2009).The CONFbal scale: a measure of balance confidence –a key outcome of rehabilitation. Physiotherapy (London), 95/2 (103-9), 0031-9406	✓	Mean 85 yrs	Y	Y – balance confidence	ConFbal scale	Y	
55	Simpson, J.M., Worsfold, C. and Hawke, J. (1998). Balance confidence in elderly people. The CONFbal scale. Age Ageing; 27 (Suppl 2): 57.	✓	Mean age 87.6(6.7) yrs	Y	Y	CONFbal	Y	

56	Talley K.M.C., Wyman J.F., Gross C.R. (2008).Psychometric properties of the activities specific balance scale and the survey of activities and FOF in older women. J of American geriatrics Society, 56/2(328-333), 0002-8614; 1532-5415	✓	70-98yrs women	Y	Y- balance confidence, FOF, activity restriction	ABC, SAFE	Y	
57	Tinetti M.E., Richman D., Powell L. (1990). Falls efficacy as a measure of FOF. J Gerontology, 45/6(P239-P243), 0022-1422	✓	>65yrs	Y	Y – falls efficacy	FES	Y	
58	Tinetti, M.E., Mendes de Leon, C.F., Doucette, J.T. & Baker, D.I. (1994). Fear of falling and fall-related efficacy in relationship to functioning among community living elders. *Journal of Gerontology; Medical Sciences;* 49: 140-147.	✓	≥72 yrs	Y	Y-falls-efficacy	FES	Y	
59	Velozo C.A., Peterson E.W. (2001). Developing meaningful FOF measures for community dwelling adults. Am J of Physical Medicine and Rehabilitation, 80/9(662-673), 0894-9115	✓	62-95yrs	Y	Y-FOF	UICFOFM	Y	
60	Visschedijk J., Achterberg W., Van Balen R., Hertogh C. (2010).FOF after hip fracture: A systematic review of measurement instruments, prevalence, interventions and related factors. Journal – American Geriatrics society, 58/9 (1739-48).	✓	various	N	Y		N	Review and Post hip fracture pats
61	Warnke A., Meyer G., Bott U., Muhlhauser I. (2004).Validation of a quality of life questionnaire measuring the subjective FOF in nursing homes. Zeitschrift fur Gerontologie und Geriatrie, 37/6(459-66), 0948-6704	✓	80+yrs	N	Y		N	Tool in German
62	Whitney S.L., Poole J.L., Cass S.P. (1998). A review of balance instruments for older adults. Am J Occupational Therapy,52/8(666-671), 02729490	✓	various	N	Y	All Performance based tools	N	Not self-reporting
63	Wingo B.C., Baskin M., Ard J.D., Evans R., Roy J., Vogtle L., Grimley D., Snyder S. (2013). Component analysis and initial validity of the exercise fear avoidance scale. American J Health Behavior; 37/1(87-95), 1087-3244:1945-7359	✓	20 - 65 years, BMI =18.5- 60 kg/m²	Y	N?	Exercise Fear Avoidance Scale	N	Not related to falls
64	Yardley L., Beyer N., Hauer K., Kempen G., Piot-Ziegler C., Todd C. (2005).Development and initial validation of the falls efficacy scale –international (FES-1).Age and Ageing,34/6(614-9), 0002-0729	✓	60+yrs	Y	Y- falls self-efficacy	Fes-1	Y	
65	Yardley, L. and Smith, H. (2002). A prospective study of the relationship between feared consequences of falling and avoidance of activity in community living older people. Gerontologist;42; 17-23	✓	75+yrs	Y	Y –feared consequence, activity restriction and avoidance	COF, mSAFFE	Y	
66	Yim-Chiplis P.K., Talbot L.A. (2000). Defining and measuring balance in adults. Biological research for nursing,1/4(321-331), 1099-8004)	✓	Various	Y	Y	Performance based	N	Performance based and Review

C6. Review Selection Process Stage 2: Selected Full Papers – final selection 35 papers

No		Study published in English	Participants Age (yrs), gender medical condition	Meets inclusion criteria (Y/N)	Does it measure one or more domain of FOF?	Type of Instrument used
1	Boyd, R. and Stevens, J.A. (2009). Falls and fear of falling: burden, beliefs and behaviours. *Age Ageing;* 38(4): 423-428.	✓	1,709 aged 65 years or over	Y	FOF	Single item tool
2	Cameron, I.D., Stafford, B., Cumming, R.G., Birks, C., Kurrle, S.E., Lockwood, K. et al (2000). Hip protectors improve falls eslf efficacy. *Age and Ageing*; 29:57-62.	✓	131 women aged ≥75 years	Y	Falls-efficacy	FES, MFES
3	Chamberlin, M.E., Fulwider, B.D., Sanders, S.L., Medeiros, J.M. (2005). Does fear of falling influence spatial and temporal gait parameters in elderly persons beyond changes associated with normal aging? *Journal of Gerontology series A Biological Sciences Medical Sciences*; 60(9):1163-7.	✓	95 60-97 year olds		Falls-efficacy	MFES
4	Dayhoff N.E., Baird C., Bennett S., Backer J. (1994). FOF: measuring fear and appraisals of potential harm. Rehabilitation Nursing Research, 3/3 (97-104).	✓	60+	Y	FOF, Falls self-efficacy	FFQ, FES
5	Delbaere K., Close J.C.T., Mikolaizak A.S., Sachdev P.S., Brodaty H., Lord S.R. (2010).The falls efficacy scale international (FES-1). A comprehensive longitudinal validation study. Age and ageing; 39/2(210-216).	✓	70-90 M&F	Y	Falls efficacy	FES-I
6	Delbaere K., Smith S.T., Lord S.R. (2011).Development and initial validation of the iconographic falls efficacy scale. The Journal of Gerontology, series A, Biological Sciences and Medical Sciences, 66/6(674-680).	✓	70-90 M&F	Y	Falls efficacy	ICON-FES
7	Delbaere, K., Crombez, G., Vanderstraeten, G., Willems, T., Cambier, T. (2004). Fear-related avoidance of activities, falls and physical frailty. A prospective community-based cohort studyAge Ageing; 33 (4): 368-373	✓	225 ≥60 year olds	Y	Avoidance of activities	MSAFFE
8	Filiatrault J., Gauvin L., Fournier M., Parisien M., Robitaille Y., Laforest S., Corriveau H., Richard L. (2007).Evidence of the psychometric qualities of a simplified version of the Activities –Specific Balance confidence scale for community Dwelling seniors. Archives of physical Medicine & Rehabilitation, 88/5 (664-72).	✓	≥ 60 year olds	Y	Balance confidence, FOF	ABC-S, single item

9	Hauer, K.A., Kempen, G.I., Schwenk, M., Yardley, L., Beyer, N., Todd, C., Oster, P., Zijlstra, G.A.R. (2011). Validity and sensitivity to change of the falls efficacy scales international to assess fear of falling in older adults with and without cognitive impairment. *Gerontology*; 57(5):462-72.	✓	284 65+ years With or without impaired cognition	Y	Falls-efficacy, FOF	FES-shortened and long version, single item
10	Hill K.D., Schwartz J.A., Kalogeropoulos A.J., Gibson S.J. (1996). FOF revisited. Archives of Physical Medicine and Rehabilitation, 77/10(1025-9).	✓	179 65+ year olds	Y	Falls efficacy	MFES
11	Hotchkiss, A., Fisher, A., Robertson, R., Ruttencutter, A., Schuffert, J., Barker, D.B. (2004). Convergent and Predictive Validity of Three Scales Related to Falls in the Elderly. *Am J Occup Ther*; 58(1):100-103.	✓	118 ≥60 year olds	Y	FOF	ABC, FES, SAFFE
12	Howland, Peterson, Levin et al (1993). Fear of falling among the community-dwelling elderly. J aging Health;5:229-243	✓	196 >58 year old	Y	FOF	Single item tool
13	Kempen G.I.J.M., Yardley L., Van Haastregt J.C.M., Zijlstra G.A.R., Beyer N., Hauer K., Todd C. (2008).The short FES-1: a shortened version of the falls efficacy scale international to assess fear of falling. Age and Ageing 37/1(45-50).	✓	>60 2 samples – UK and Dutch	Y	FOF, falls-efficacy	Short FES-I and FES I Single item
14	Kempen, G.I.J.M., Todd, C.J., Van Haastregt, J.C.M., Zijlstra, G.A.R., Beyer, N., Freiberger, E., Hauer K., Piot-Ziegler, C., Yardley L. (2007). Cross-cultural validation of the Falls Efficacy Scale International (FES-I) in older people: Results from Germany, the Netherlands and the UK were satisfactory. *Disability and Rehabilitation*; 29(2): 155-162.	✓	178 UK adults aged >70 years	Y	Falls-efficacy, FOF	FES-I, single item
15	Lachman M.E., Howland J., Tennstedt S., Jette A., Assmann S., Peterson E.W. (1998). FOF and activity restriction: the survey of activities and FOF in the elderly (SAFE). J Gerontology –series B Psychological Sciences and Social Sciences, 53/1(43-50).	✓	62-93	Y	FOF	SAFFE, single item
16	Landers M.R., Durand C., Powell D.S., Dibble L.E., Young D.L. (2011). Development of a scale to assess avoidance behaviour due to fear of falling: the FOF avoidance behaviour questionnaire. Physical Therapy; 91/8(1253-1265).	✓	60+ M&F	Y	Avoidance behaviour	fear of falling avoidance behaviour Q
17	Li, F., McAuley, E., Fisher, K.J., Harmer, P., Chaumeton, N., & Wilson, N.L. (2002). Self-efficacy as a mediator between fear of falling and functional ability in the elderly. *Journal of Aging and Health*; 14: 452-466	✓	256 mean age 77.5 years	Y	FOF, Falls-efficacy	SAFFE, ABC
18	Lusardi, M.M. and Smith, E.V. Jr (1997). Development of a scale to assess concern about falling and applications to treatment programs. PTHMS Faculty Publications. Paper 45. http://digitalcommons.sacredheart.edu/pthms_fac/45	✓	100 ≥65 year olds	Y	Falls-efficacy	MES, aFES
19	McAuley, E.M., Mihalko, S.L., Rosengren, K. (1997). Self-efficacy and balance correlates of fear of falling in the elderly. J Aging Physical Activity;5:329-340	✓	58 mean age 70.97 years (SD =6.25)	Y	FOF	Single item tool

20	Myers A.M., Powell L.E., Maki B.E., Holliday P.J., Brawley L.R., Sherk W. (1996). Psychological indicators of balance confidence: Relationship to actual and perceived abilities. J of Gerontology: series A: Biological Sciences and medical Sciences, 51A/1(M37-M43).	✓	60 65-95 year olds	Y	Falls efficacy, balance confidence, FOF	FES, ABC, single item
21	Myers, A.M., Fletcher, P.C., Myers, A.H. and Sherk, W. (1998). Discriminative and evaluative properties of the Activities- specific Balance Confidence (ABC) Scale. J Gerontology: Medical Sciences; 53A; 4; M287-M294.	✓	475 older adults	Y	Balance confidence	ABC
22	Ozcan, A., Donat, H., Gelecek, N., Ozdirenc, M., Karadibak, D. (2005). The relationship between risk factors for falling and the quality of life in older adults. *BMC Public Health;* 5:90	✓	116 65 years + nursing home residents	Y	FOF	FOF, visual analogue scale
23	Parry, S.W., Steen, N., Galloway, S.R., Kenny, R.A. and Bond, J. (2001). Falls and Confidence related quality of life outcome measures in an older British Cohort. Postgrad Med; 77: 103-108.	✓	193 mean age 63 (SD=14.8)	Y	Falls-efficacy, balance confidence	FES–UK, ABC-UK
24	Peretz, C., Herman, T., Hausdorff, J.M., Giladi, N. (2006). Assessing fear of falling: Can a short version of the activities-specific balance confidence scale be useful? *Movement Disorders;* 21; 12:2101-2105.	✓	157 adults mean age 72 (+-6)-78 years (+-5)	Y	balance confidence	ABC long and short
25	Powell L.E., Myers A.M. (1995).The activities-specific confidence (ABC) scale. J of Gerontology –series A Biological Sciences and Medical Sciences, 50 A/1 (M28-M34).	✓	65-95	Y	Balance confidence falls efficacy	ABC,FES
26	Rai, G.S., Kiniorns, M., Wientjes, H. (1995). Falls Handicap Inventory (FHI): An instrument to measure Handicaps associated with repeated falls. *Journal of American Geriatric Society*; 43:723-724.	✓	28 mean age 78 +/-5.6 years CLS	Y	Handicaps associated with repeated falls	FHI
27	Scheffer, A.C., Schuurmans, M.J., vanDijk, N., van der Hooft, T., de Rooij, S.E. (2011). Reliability and Validity of the visual anologue scale for fear of falling in older persons. Journal of American Gerontologist;58;11:2228-2230	✓	440 65+ years		FES	FOF single item visual analogue scale
28	Simpson J.M., Worsfold C., Fisher K.D., Valentine J.D. (2009).The CONFbal scale: a measure of balance confidence –a key outcome of rehabilitation. Physiotherapy (London), 95/2 (103-9).	✓	Mean 85 yrs	Y	Balance confidence	ConFbal scale
29	Simpson, J.M., Worsfold, C. and Hawke, J. (1998). Balance confidence in elderly people. The CONFbal scale. Age Ageing; 27 (Suppl 2): 57.	✓	45 mean age 81.6 years (SD=6.7)	Y	Balance confidence	CONFbal

30	Talley K.M.C., Wyman J.F., Gross C.R. (2008).Psychometric properties of the activities specific balance scale and the survey of activities and FOF in older women. J of American geriatrics Society, 56/2(328-333).	✓	70-98 women	Y	Balance confidence, FOF, activity restriction	ABC, SAFFE
31	Tinetti M.E., Richman D., Powell L. (1990). Falls efficacy as a measure of FOF. J Gerontology, 45/6(239-243).	✓	>65	Y	Falls efficacy, FOF	FES, single-item
32	Tinetti, M.E., Mendes de Leon, C.F., Doucette, J.T. & Baker, D.I. (1994). Fear of falling and fall-related efficacy in relationship to functioning among community living elders. *Journal of Gerontology; Medical Sciences;* 49: 140-147.	✓	1103 adults >72 years	Y	FOF, falls-efficacy	rFES, single-item measure
33	Velozo C.A., Peterson E.W. (2001). Developing meaningful FOF measures for community dwelling adults. Am J of Physical Medicine and Rehabilitation, 80/9(662-673).	✓	62-95	Y	FOF	UICFFM
34	Yardley L., Beyer N., Hauer K., Kempen G., Piot-Ziegler C., Todd C. (2005).Development and initial validation of the falls efficacy scale –international (FES-1).Age and Ageing,34/6(614-9).	✓	60+	Y	Falls self-efficacy	FES-I
35	Yardley, L. and Smith, H. (2002). A prospective study of the relationship between feared consequences of falling and avoidance of activity in community living older people. Gerontologist; 42; 17-23.	✓	75224 ≥75 years old+	Y	Perceived feared consequence, FOF, activity restriction Activity avoidance	COF, mSAFFE, single-item

APPENDIX D – QUANTITATIVE STUDY

D.1 Ethical Approval

NHS
Health Research Authority
NRES Committee North East - York
Room 002
TEDCO Business Centre
Viking Business Park
Rolling Mill Road
Jarrow, Tyne & Wear
NE32 3DT

Telephone: 0191 4283476

05 March 2014

Mrs Gilly Rosic
PhD student
East Lancashire Hospitals NHS Trust
Department of Nutrition and Dietetics
First Floor, 211-213 Leeds Road
Nelson
BB9 8EH

Dear Mrs Rosic

Study title:	**To quantitatively explore fear of falling and activity levels in younger obese women**
REC reference:	**14/NE/0064**
IRAS project ID:	**137069**

Thank you for your email correspondence of 3rd March 2014 responding to the Proportionate Review Sub-Committee's request for changes to the documentation for the above study.

The revised documentation has been reviewed and approved by the sub-committee.

We plan to publish your research summary wording for the above study on the NRES website, together with your contact details, unless you expressly withhold permission to do so. Publication will be no earlier than three months from the date of this favourable opinion letter. Should you wish to provide a substitute contact point, require further information, or wish to withhold permission to publish, please contact the REC Manager Hayley Henderson, nrescommittee.northeast-york@nhs.net.

Confirmation of ethical opinion

On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above research on the basis described in the application form, protocol and supporting documentation as revised.

A Research Ethics Committee established by the Health Research Authority

D.2 Participant letter & information sheet

Concerns about falling and activity in younger overweight women

I am a Dietitian working within East Lancashire Hospitals NHS Trust and I am also undertaking a PhD at the University of Central Lancashire. I am interested in finding out about what physical restrictions stop some younger overweight women from being active, and what impact these might have. Research has shown that some older women have expressed concern around falling when doing certain activities and this can sometimes lead to avoidance of activity. I want to see if the same might be true in younger women. I am looking for about 75 volunteers who are currently attending the Dietetics or Hyndburn Healthy Lifestyles services to complete a short questionnaire and would be very grateful if you would agree to take part. The process should take about 10-15 minutes to complete.

It is hoped the results will help inform future interventions to improve participation in overweight women and take account of issues of fear of falling that some individuals might have.

Please find attached a participant information sheet that will give you more information about the study, what it involves, how long it will take etc., but if you would like more information please feel free to contact me on 01282 462052. We would be very grateful it you would agree to take part in this short study, and to do this all you need to do is to complete and return the questionnaire to the practitioner you are seeing.

Yours Sincerely

Gilly Rosic

Gilly Rosic
Lead Researcher
Department of Nutrition and Dietetics
First Floor
211-213 Leeds Road
Nelson
BB9 8EH
Tel ; 01282 462052

Participant Information Sheet

Title of Project:

Concerns about falling and activity in younger overweight women

We would like to invite you to take part in a research study. Before you decide we would like you to understand why the research is being done and what it will involve for you. Please take time to read the following information carefully.

Ask if there is anything not clear or if you would like more information. The research is being led by Gilly Rosic from East Lancashire Hospitals NHS Trust and the University of Central Lancashire. You can contact her on the following Telephone number: 01282 602452

What is the purpose of the study?

The purpose of the study is to explore and measure the concerns about falling and levels of physical activity in younger overweight women. By doing this, it will help us to understand how we can best support similar women to be more active by offering the most appropriate activity sessions. Your input is really valuable to help us improve our services.

The study is part of a PhD Research project.

Why have I been chosen?

You have been chosen as a possible participant in this study because you attend East Lancashire NHS Services. About 75 participants are needed for the study.

Do I have to take part?

No. It is up to you to decide whether or not to take part in the study. By completing the questionnaire you will be agreeing to take part in the study. You are under no obligation to take part in the study and it will not affect the care/support you receive or your legal rights.

What will happen to me if I take part?

If you decide to take part in this study, you will be asked to complete a self -administered questionnaire which will include questions on concerns about falling, how you feel and activity levels. As part of this study it is important to have an accurate height and weight recorded and so the practitioner you are seeing will ask your permission to record your current weight and height on the questionnaire before giving it to you to complete. The questionnaire should take no longer than about 10-15 minutes to complete and if possible be done after your appointment/session. The questionnaire will not have your name on it, but a number. We will not be asking for your name or address and the number will in no way be linked back to you. After completing the questionnaire you can put it in the pre-paid addressed envelope provided and either hand back to the practitioner, who will not open it but forward on to the researcher, or else you can complete the questionnaire at your leisure and return it direct to the researcher via the post. Returning the completed questionnaire will be implied as you giving your consent to take part in the study. Once you have returned your completed questionnaire it will not be possible to withdraw from the study as there will be no way of being able to identify who completed it. All returned questionnaires will be kept secure in a locked filing cabinet in an NHS office until picked up by the researcher, who will be the only person to open the envelope.

Will my taking part in this study be kept confidential?

Yes confidential means that we will not tell anyone you have taken part in this study and anything you have written will remain anonymous. We are not asking for your name or any other information that will link the questionnaire back to you and the researchers looking at the completed questionnaire will not know who you are.

The data collected will be coded and not linked in any way to your personal details, which will not be recorded. It will be stored within a locked filing area within the University of Central Lancashire. At the end of the study the anonymous questionnaires will be kept for 5 years after the end of the study and then destroyed.

Everything you write is confidential and it will not be possible to link it back to you.

If you decide to take part, the data collected for the study will be looked at by authorised persons in the research team. All have a duty of confidentiality to you as a research participant, and we will do our best to meet this duty.

Gilly Rosic, as the Lead Researcher, is responsible for ensuring that during collection, handling, storing, using or destroying data, she is complying with the Data Protection Act 1998, and is not contravening the legal or regulatory requirements in any part of the UK.

What will happen if I don't want to carry on with the study?

You do not have to take part in the study, and don't have to give a reason for not taking part. If you decide to not take part, your care/ support will not be affected.

What if there is a problem?

If you have a concern about any aspect of this study, please ask to speak with the researcher Gilly Rosic who will do her best to answer your questions (Contact no 01282 602452). If you remain unhappy and wish to complain formally, you can do this through the NHS Complaints Procedure. Details can be obtained from East Lancashire Hospitals NHS Trust.

You will not be asked any distressing or intrusive questions, but the questionnaire does include questions around anxiety and depression. As the questionnaires are anonymised we will not be able to follow up any issues participants have that might be raised by the questionnaires. However if the questionnaire has raised any concerns or worries you can talk to either the researcher Gilly Rosic about this, or the Dietetics Service Manager Tara Green on 01282 602452 who will offer confidential advice and support and discuss possible further action. Alternatively you can talk to your GP or Practice Nurse.

The Researcher is an employee of an NHS Institution

NHS bodies are liable for clinical negligence and other negligent harm to individuals covered by their duty of care. NHS Institutions employing researchers are liable for negligent harm caused by the design of studies they initiate. Therefore:

'In the event that something does go wrong and you are harmed during the research study there are no special compensation arrangements. If you are harmed and this is due to someone's negligence then you may have grounds for a legal action for compensation against East Lancashire Hospitals NHS Trust, but you may have to pay your legal costs. The normal National Health Service complaints mechanisms will still be available to you.'

NHS Indemnity does not offer no-fault compensation i.e. for non-negligent harm, and NHS bodies are unable to agree in advance to pay compensation for non-negligent harm.

What will happen to the Results of the Research

The results of all the questionnaires will be looked at together. The results of the information gathered will provide some insight into the concerns around falling experienced by some overweight women and if current activity levels might play a part. The results will be included in a research thesis, and be published and presented at conferences. They will also be used to develop further studies which might improve weight management practice.

You will not be identified in any report or publication.

Who is organising and funding the research?

The Research is being undertaken as part of a PhD Educational Qualification through the University of Central Lancashire.

Who has reviewed the study?

All research in the NHS is looked at by independent group of people called a Research Ethics Committee to protect your safety, rights, wellbeing and dignity.

This study was given a favourable ethical opinion for conduct in the NHS by the North East - York Research Ethics Committee.

The Academic quality and supervision will be provided by:

Professor P Dey

Professor of Public Health Epidemiology

School of Medicine and Dentistry

University of Central Lancashire

Adelphi Street

Preston PR1 2HE

mpdey@uclan.ac.uk

What do I have to do?

Please take time to read this information sheet and ask any questions. If you wish to take part in the study at a later date or want more information you can ring Gilly Rosic directly on 01282 602542. You need to be happy to complete the questionnaire about concerns of falling, feelings and emotions and activity levels. The whole process should take no longer than 10-15 minutes.

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Thank you for considering taking part and taking time to read this sheet.

Lancashire Care NHS
NHS Foundation Trust

East Lancashire Hospitals NHS
NHS Trust

uclan
University of Central Lancashire

D.3 Study Questionnaire

PARTICIPANT NO. ____________________

TO BE FILLED IN BY THE PRACTITIONER

Height (m):	
Weight (kg):	
BMI (kg/m²):	

QUESTIONNAIRE ON CONCERNS ABOUT FALLING AND ACTIVITY LEVELS IN YOUNGER OVERWEIGHT WOMEN

Thank you for agreeing to take part in this short study, it should take approximately **10-15 minutes** to complete.

Please answer **all** the following questions:

Q1) what is your Age? (Please circle)

<25 25-29 30-34 35-39 40-44 45-49 years

Q2) How concerned are you about **falling**? Please circle **one** number below that best describes your fear. A zero (0) would mean 'no concern about falling' and a ten (10) would mean 'concern about falling as bad as it could be'

No concern about falling	0	1	2	3	4	5	6	7	8	9	10	Concern about falling as bad as can be

Q3) During the past year, how often have you fallen over? (Please circle)

Never Once twice or more

Please turn over and complete all the questions in the questionnaire

The Modified Falls Efficacy Scale (Hill et al 1996)

On a scale of 0 to 10, how confident are you that you can do each of these activities without falling, with 0 meaning 'not confident/ not sure at all', 5 meaning 'fairly confident/ fairly sure' and 10 meaning 'completely confident/ completely sure'. If you do not do the activity **please circle the number nearest to your own opinion if you had to do the activity today.**

	Not confident at all					Fairly confident					Completely confident
	0	1	2	3	4	5	6	7	8	9	10
1. Get dressed and undressed	0					5					10
2. Prepare a simple meal	0					5					10
3. Take a bath or a shower	0					5					10
4. Get in/out of a chair	0					5					10
5. Get in/out of bed	0					5					10
6. Answer the door or telephone	0					5					10
7. Walk around the inside of your house	0					5					10
8. Reach into cabinets or closet	0					5					10
9. Light housekeeping	0					5					10
10. Simple shopping	0					5					10
11. Using public transport	0					5					10
12. Crossing roads	0					5					10
13. Light gardening or hanging out the washing	0					5					10
14. Using front or rear steps at home	0					5					10

Consequences of Falling Questionnaire (Yardley and Smith 2002)

We want to know whether or not you have any worries about what might happen if you fell over. **Please circle the answer which is closest to your own opinion.**

I think that if I fall over ....

I will have difficulty getting up.	disagree strongly / disagree / agree / agree strongly
I will cause a nuisance.	disagree strongly / disagree / agree / agree strongly
I will lose my confidence.	disagree strongly / disagree / agree / agree strongly
I cannot continue to be active.	disagree strongly / disagree / agree / agree strongly
I will lose my independence.	disagree strongly / disagree / agree / agree strongly
I will be embarrassed.	disagree strongly / disagree / agree / agree strongly
I will be in pain.	disagree strongly / disagree / agree / agree strongly
I will become disabled.	disagree strongly / disagree / agree / agree strongly
I will feel foolish.	disagree strongly / disagree / agree / agree strongly
I will be severely injured.	disagree strongly / disagree / agree / agree strongly
I will be helpless.	disagree strongly / disagree / agree / agree strongly
I will not be able to cope alone.	disagree strongly / disagree / agree / agree strongly

The Modified Survey of Activities and Fear of Falling in the Elderly Scale (Yardley and Smith 2002)

Now please circle the opinion closest to your own to show whether there are things you avoid doing in case you fall over. Even if you currently don't need to do the activity (e.g. if someone else does your shopping for you), please answer to show whether you think you would or would not avoid the activity.

Go to the shops.	Would never avoid / sometimes avoid / always avoid
Clean your house.	Would never avoid / sometimes avoid / always avoid
Prepare simple meals.	Would never avoid / sometimes avoid / always avoid
Go to the doctor or dentist.	Would never avoid / sometimes avoid / always avoid
Take a bath.	Would never avoid / sometimes avoid / always avoid
Take a shower.	Would never avoid / sometimes avoid / always avoid
Go for a walk.	Would never avoid / sometimes avoid / always avoid
Go out when it is slippery.	Would never avoid / sometimes avoid / always avoid
Visit a friend or relative.	Would never avoid / sometimes avoid / always avoid
Go to a place with crowds.	Would never avoid / sometimes avoid / always avoid
Go up and down stairs.	Would never avoid / sometimes avoid / always avoid
Walk around indoors.	Would never avoid / sometimes avoid / always avoid
Walk half a mile.	Would never avoid / sometimes avoid / always avoid
Bend down to get something.	Would never avoid / sometimes avoid / always avoid
Travel by public transport.	Would never avoid / sometimes avoid / always avoid
Go out to a social event.	Would never avoid / sometimes avoid / always avoid
Reach for something above your head.	Would never avoid / sometimes avoid / always avoid

International Physical Activity Questionnaire – Short Form

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. 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/garden 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 at a time.

1. 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 3***

2. 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

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.

3. During the last 7 days, on how many days did you do moderate physical activities like carrying light loads, cycling at a regular pace, or doubles tennis? Do not include walking.

   ______ **Days per week**

   ☐ No moderate physical activities → ***skip to question 5***

4. 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 might solely do for recreation, sport, exercise or leisure.

5. 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 7***

6. 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.

7. 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

Hospital Anxiety and Depression Scale (HADS)

Read each item below and **underline the reply** which comes closest to how you have been feeling in the past week. Ignore the numbers printed at the edge of the questionnaire.

Don't take too long over your replies, your immediate reaction to each item will probably be more accurate than a long, thought-out response.

A	D	
		I feel tense or 'wound up'
3		Most of the time
2		A lot of the time
1		From time to time, occasionally
0		Not at all
		I still enjoy the things I used to enjoy
	0	Definitely as much
	1	Not quite so much
	2	Only a little
	3	Hardly at all
		I get a sort of frightened feeling as if something awful is about to happen
3		Very definitely and quite badly
2		Yes, but not too badly
1		A little, but it doesn't worry me
0		Not at all
		I can laugh and see the funny side of things
	0	As much as I always could
	1	Not quite so much now
	2	Definitely not so much now
	3	Not at all
		Worrying thoughts go through my mind
3		A great deal of the time
2		A lot of the time
1		Not too often
0		Very little
		I feel cheerful
	3	Never
	2	Not often
	1	Sometimes
	0	Most of the time
		I can sit at ease and feel relaxed
0		Definitely
1		Usually
2		Not often
3		Not at all

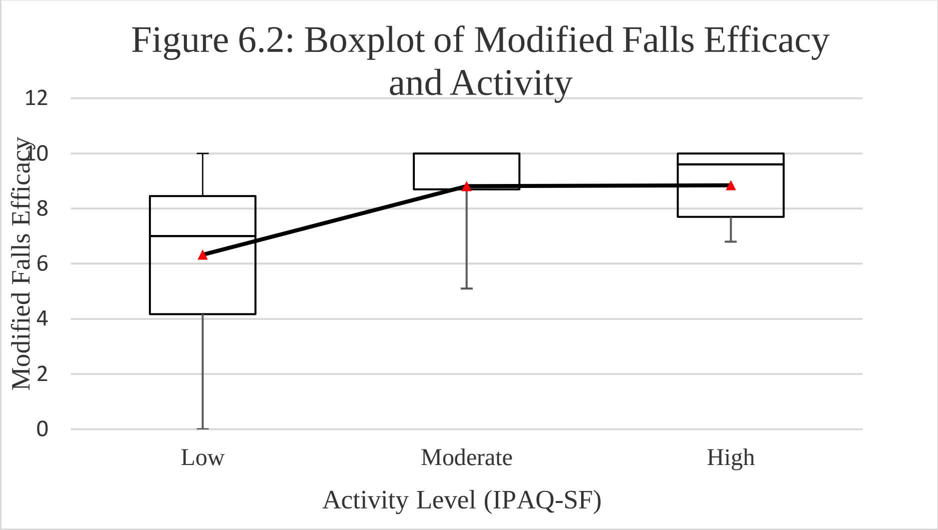
	A	D
I feel as if I am slowed down		
Nearly all the time		3
Very often		2
Sometimes		1
Not at all		0
I get a sort of frightened feeling like 'butterflies' in the stomach		
Not at all	0	
Occasionally	1	
Quite often	2	
Very often	3	
I have lost interest in my appearance		
Definitely		3
I don't take as much care as I should		2
I may not take quite as much care		1
I take just as much care as ever		0
I feel restless as if I have to be on the move		
Very much indeed	3	
Quite a lot	2	
Not very much	1	
Not at all	0	
I look forward with enjoyment to things		
As much as I ever did		0
Rather less than I used to		1
Definitely less than I used to		2
Hardly at all		3
I get sudden feelings of panic		
Very often indeed	3	
Quite often	2	
Not very often	1	
Not at all	0	
I can enjoy a good book or radio or television programme		
Often		0
Sometimes		1
Not often		2
Very seldom		3

Please check that all the questions have been answered

Thank you for completing this questionnaire

D4 Chapter 6 Analysis

Analysis relating to exploration of associations of Fear of Falling with other variables



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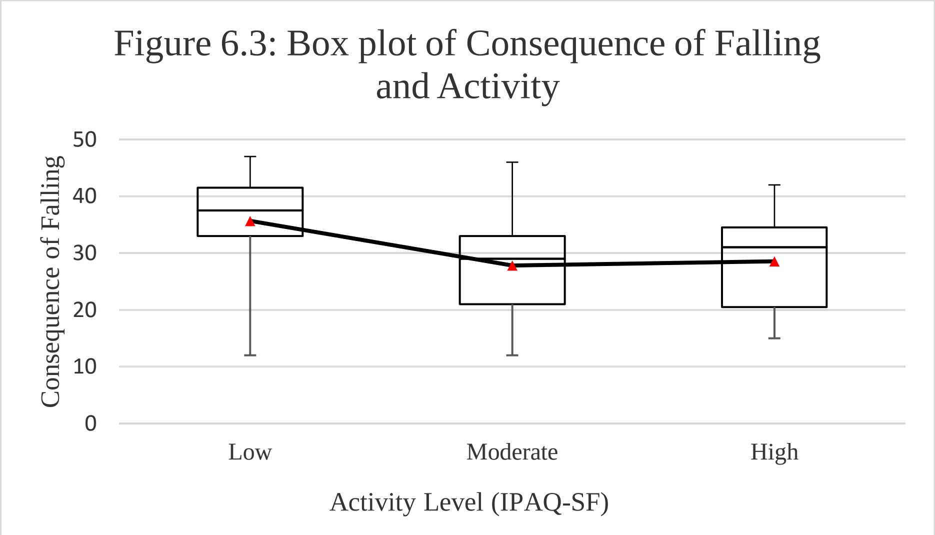

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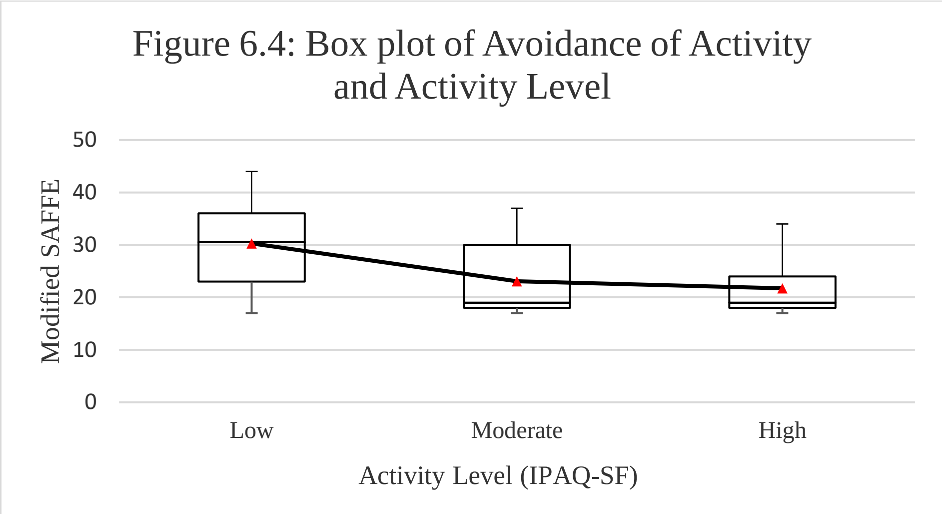


Figure 6.4: Box plot of Avoidance of Activity and Activity Level
Modified SAFFE
50
40
30
20
10
0
Low
Moderate
High
Activity Level (IPAQ-SF)

▲ = mean

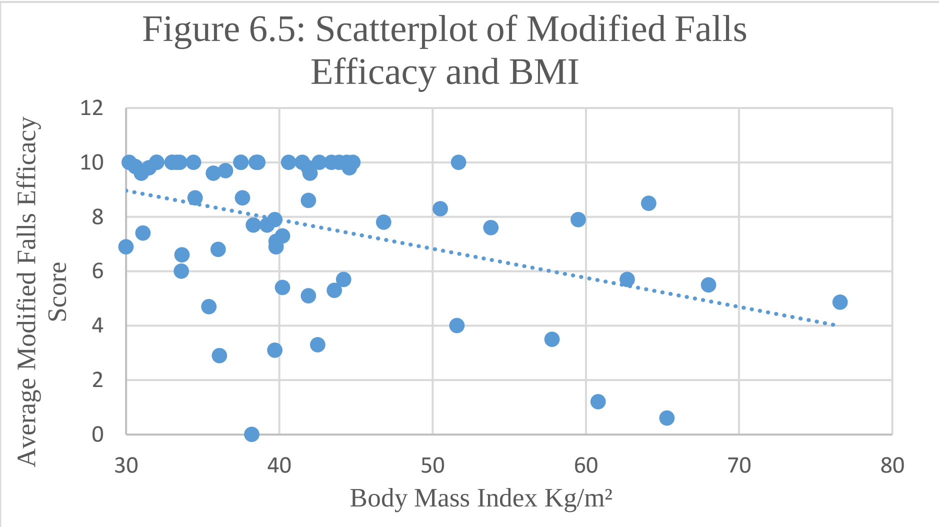


Figure 6.5: Scatterplot of Modified Falls Efficacy and BMI
Average Modified Falls Efficacy Score
12
10
8
6
4
2
0
30
40
50
60
70
80
Body Mass Index Kg/m²

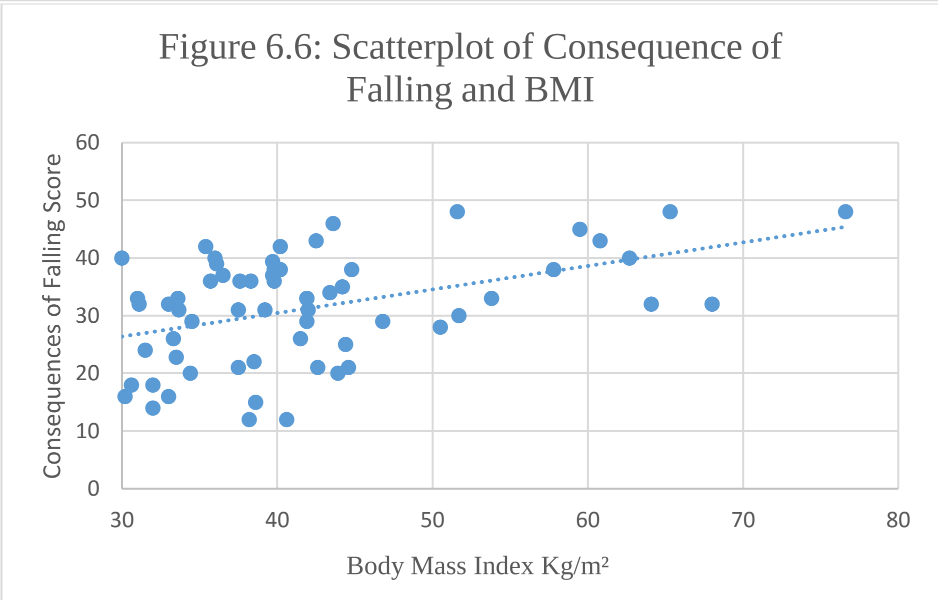


Figure 6.6: Scatterplot of Consequence of Falling and BMI
Consequences of Falling Score
60
50
40
30
20
10
0
30
40
50
60
70
80
Body Mass Index Kg/m²

Figure 6.7: Scatterplot of Modified SAFFE and BMI

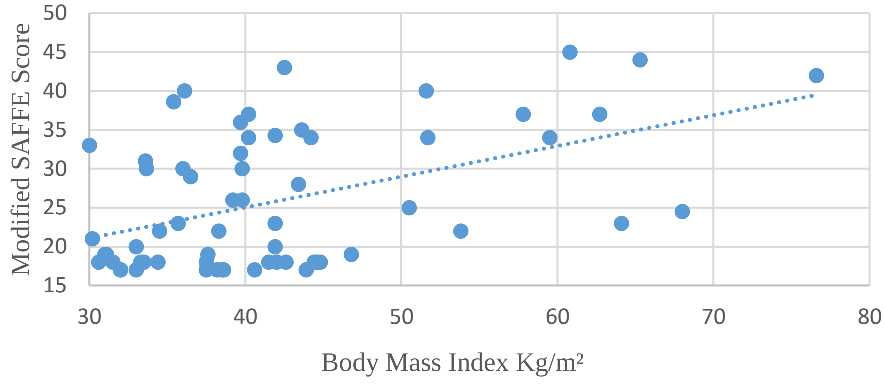
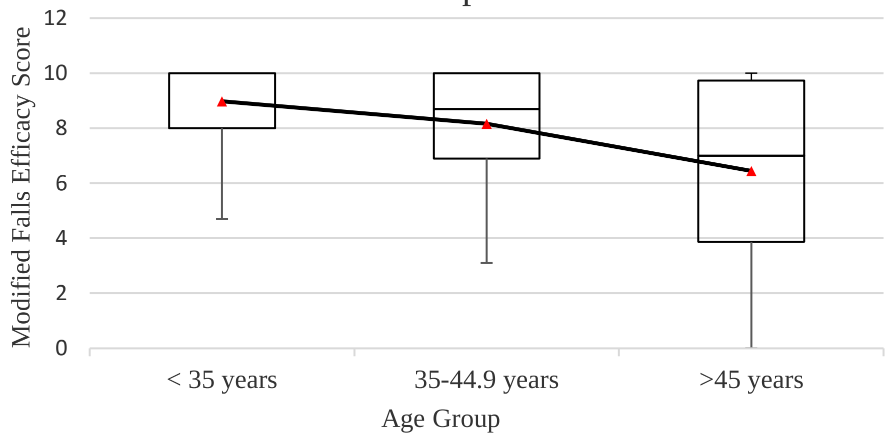
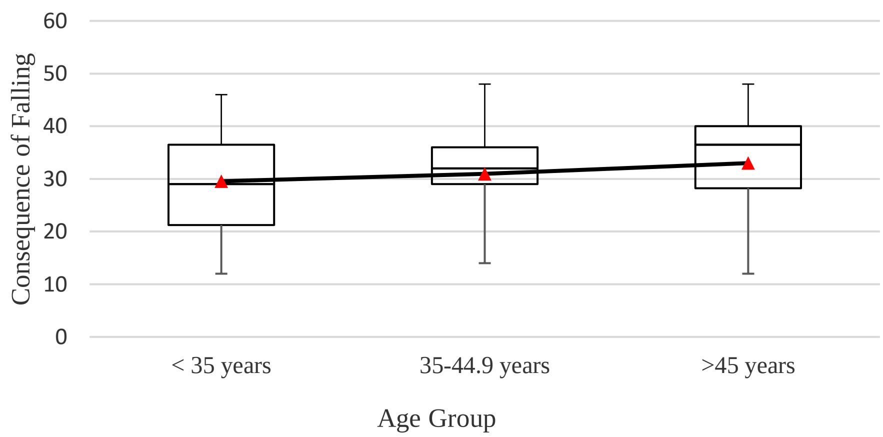


Figure 6.8: Boxplot of Modified FES and Age Group



▲ = mean

Figure 6.9: Box Plot of Consequence of Falling and Age



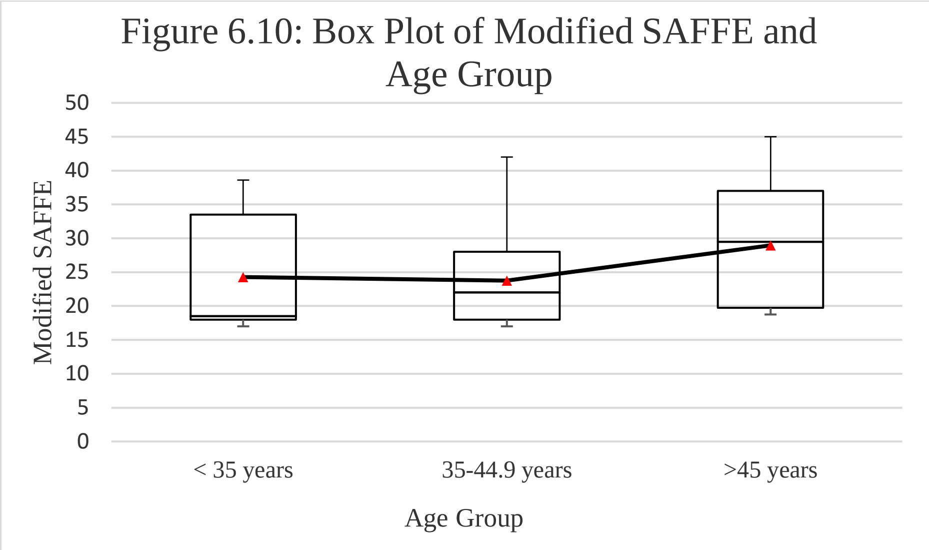


Figure 6.10: Box Plot of Modified SAFFE and Age Group
Modified SAFFE
50
45
40
35
30
25
20
15
10
5
0
< 35 years
35-44.9 years
>45 years
Age Group

▲ = mean

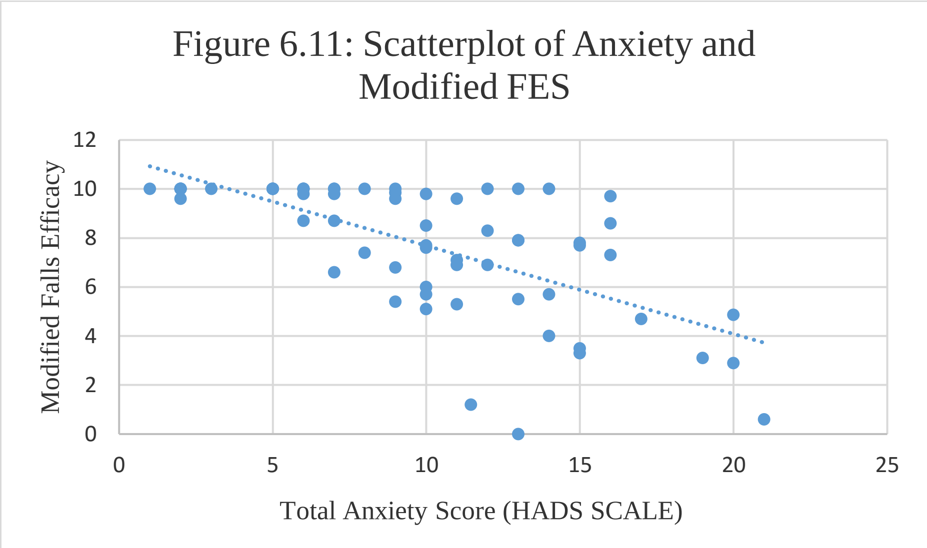


Figure 6.11: Scatterplot of Anxiety and Modified FES
Modified Falls Efficacy
12
10
8
6
4
2
0
0
5
10
15
20
25
Total Anxiety Score (HADS SCALE)

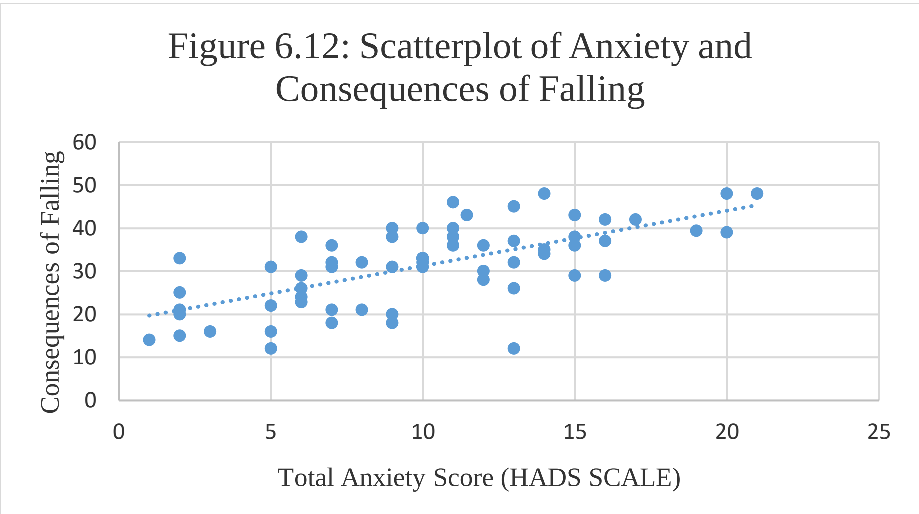


Figure 6.12: Scatterplot of Anxiety and Consequences of Falling
Consequences of Falling
60
50
40
30
20
10
0
0
5
10
15
20
25
Total Anxiety Score (HADS SCALE)

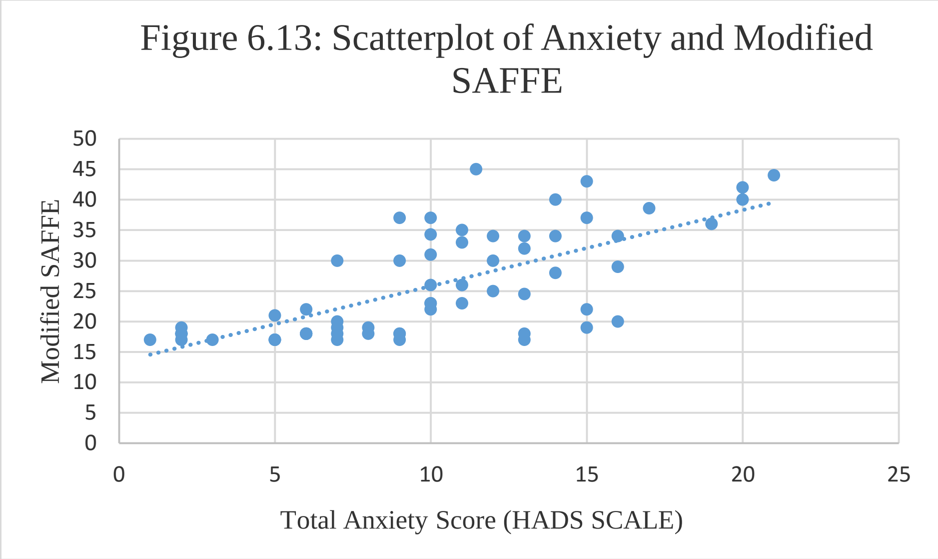


Figure 6.13: Scatterplot of Anxiety and Modified SAFFE
Modified SAFFE
50
45
40
35
30
25
20
15
10
5
0
0
5
10
15
20
25
Total Anxiety Score (HADS SCALE)

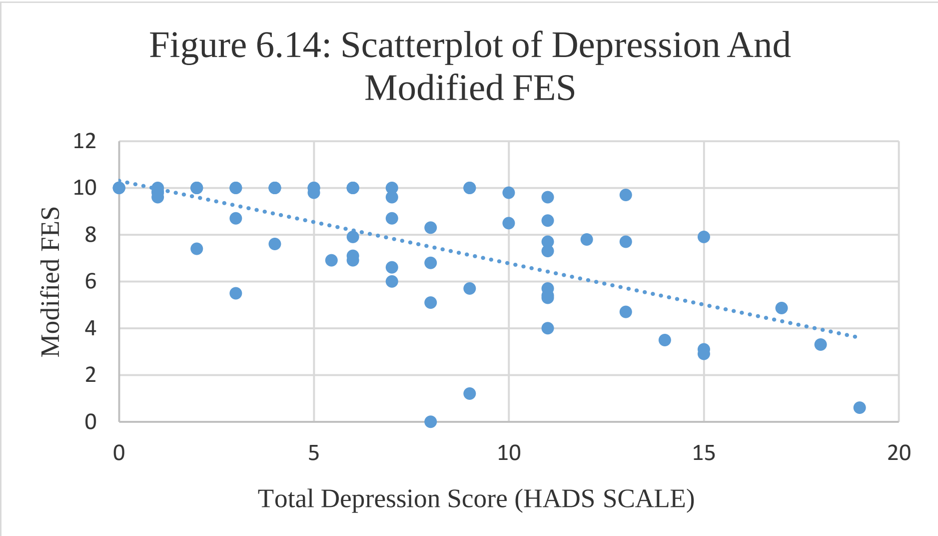


Figure 6.14: Scatterplot of Depression And Modified FES
Modified FES
12
10
8
6
4
2
0
0
5
10
15
20
Total Depression Score (HADS SCALE)

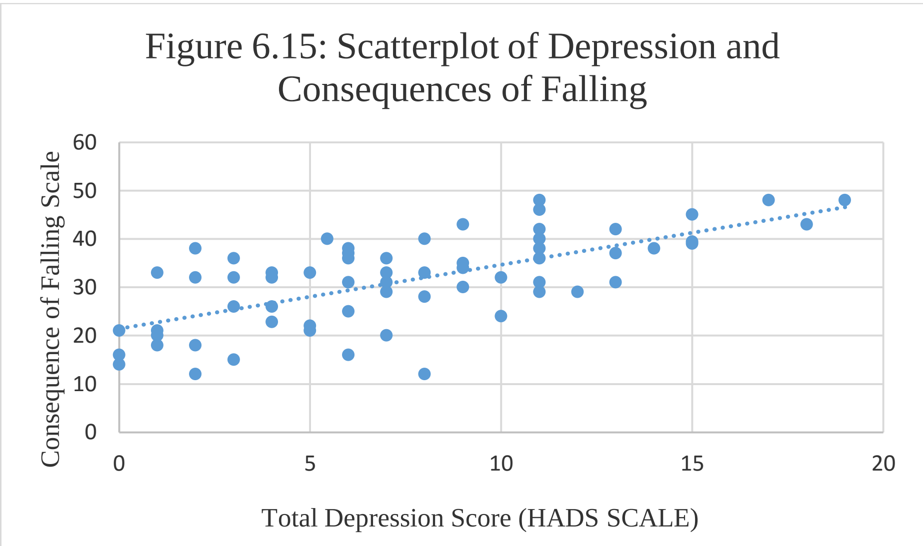


Figure 6.15: Scatterplot of Depression and Consequences of Falling
Consequence of Falling Scale
60
50
40
30
20
10
0
0
5
10
15
20
Total Depression Score (HADS SCALE)

Figure 6.16: Scatterplot of Depression and Modified SAFFE

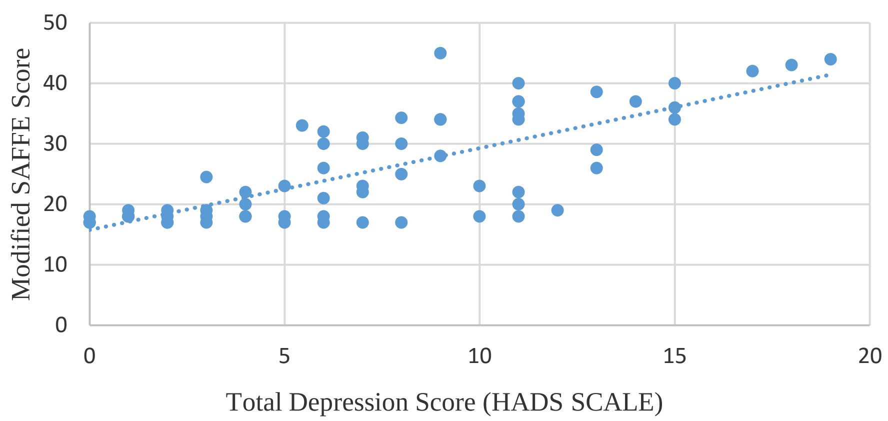
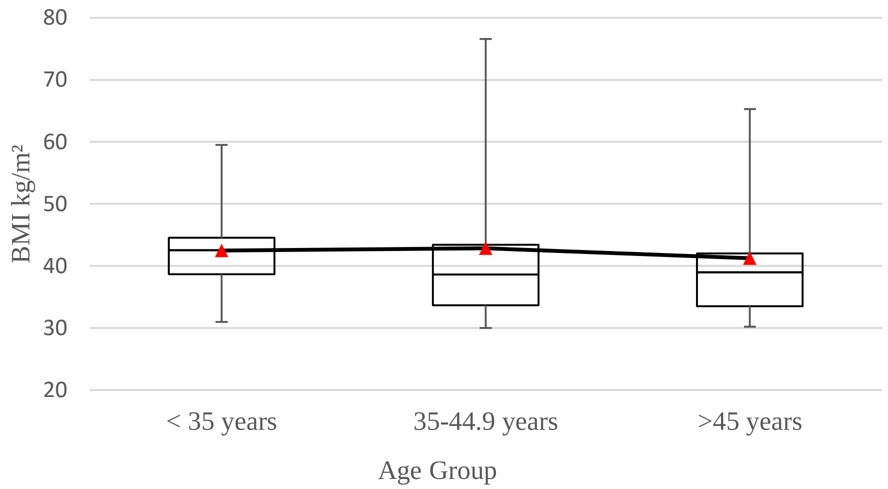


Figure 6.17: Boxplot of BMI and Age Groups



▲ = mean

Figure 6.18: Boxplot of Anxiety and Age Groups

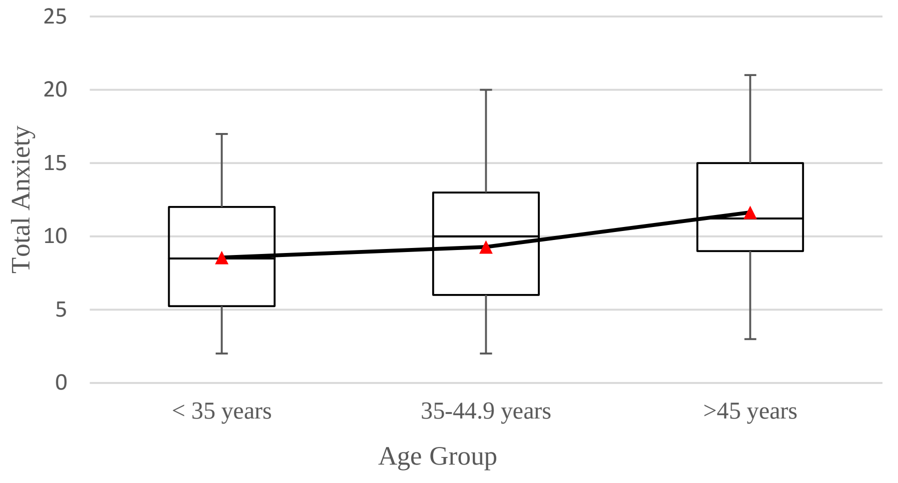


Figure 6.19: Box Plot of Depression and Age Groups

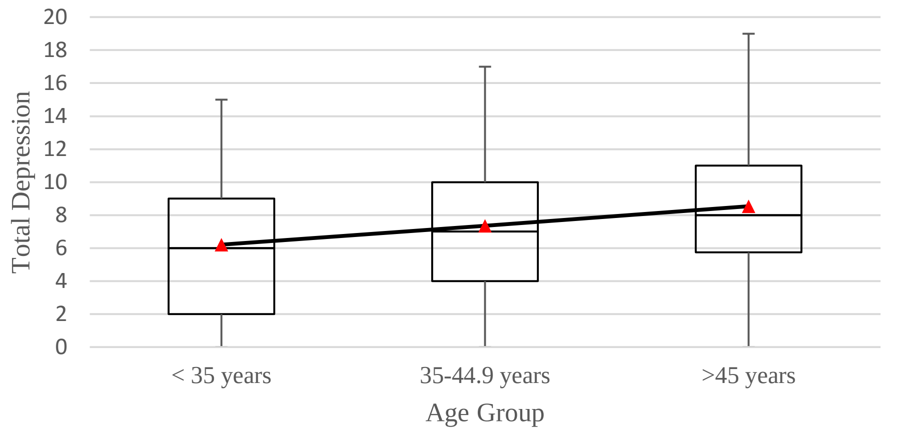


Figure 6.20: Boxplot of BMI and Activity

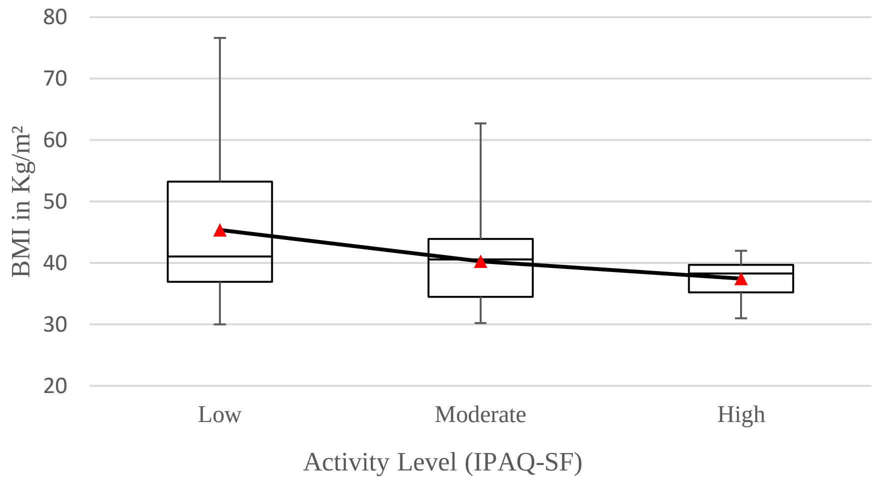


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Figure 6.21: Scatterplot of BMI and Anxiety

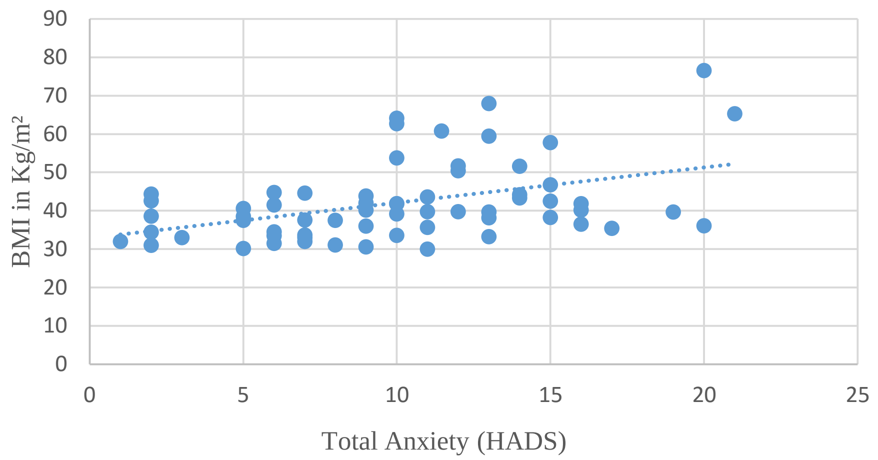


Figure 6.22: Scatterplot of BMI and Depression

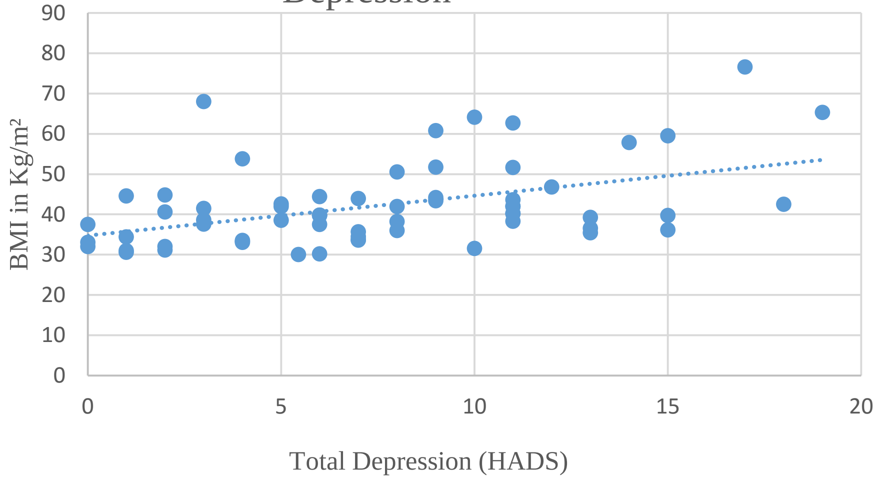
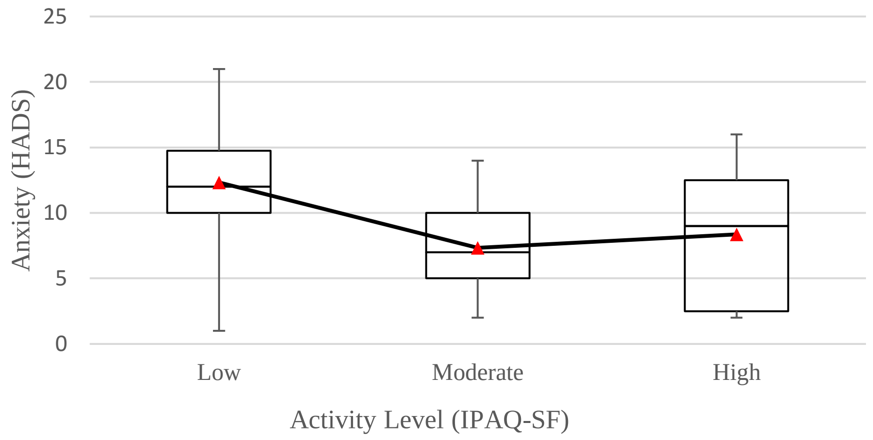
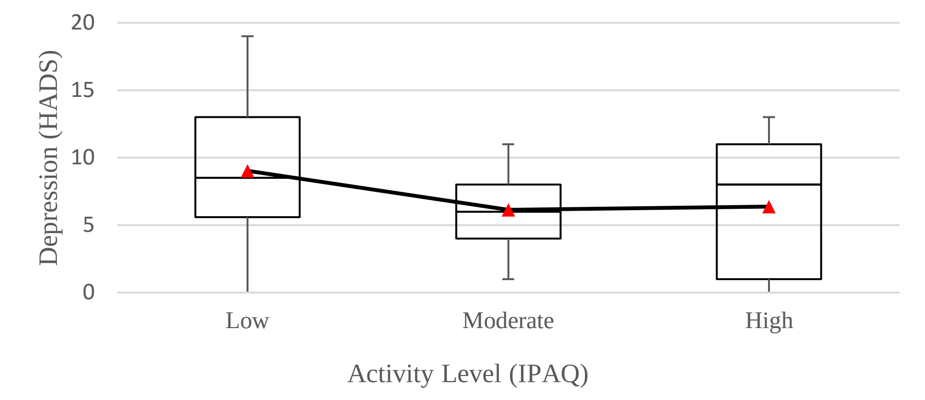


Figure 6.23: Box plot of Anxiety and Activity



▲ = mean

Figure 6.24: Box plot of Depression and Activity



▲ = mean

Figure 6.25: Scatterplot of Anxiety and Depression

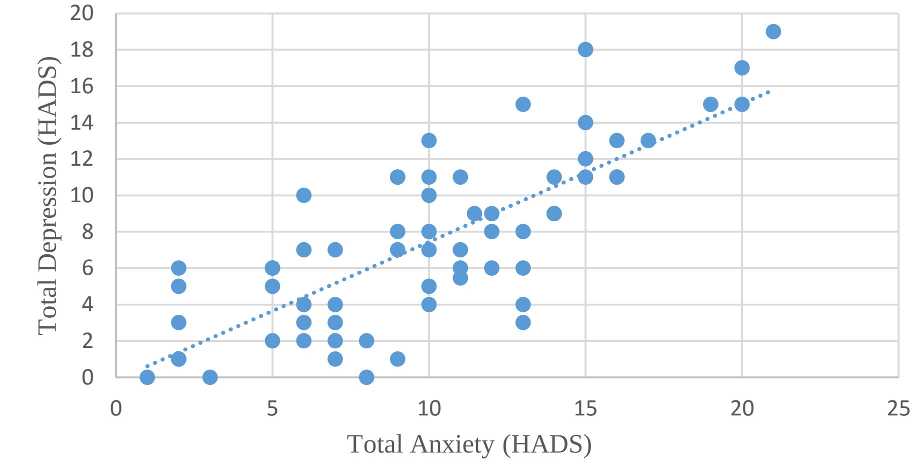


Table 6.13: The Modified Falls Efficacy Scale mean scores of individual activities reported in 63 obese women under 50 years of age

Activity	Mean	SD	Median	IQR
Get dressed/undressed	7.98	2.59	9	6-10
Prepare simple meal	8.30	2.63	10	8-10
Take bath or shower	7.29	3.23	9	5-10
Get in/out of chair	7.73	2.74	9	5-10
Get in /out of bed	7.75	2.69	9	5-10
Answer door or telephone	8.30	2.49	10	7-10
Walk around inside	8.11	2.58	9	7-10
Reach into cabinet or closet	7.85	2.70	9	6-10
Light housekeeping	7.67	2.93	9	6-10
Simple shopping	7.46	3.10	9	5-10
Use public transport	7.08	3.42	9	5-10
Crossing roads	7.30	3.18	9	5-10
Light gardening/ hanging out washing	7.39	3.04	9	5-10
Use front or rear steps	7.24	3.23	9	4-10

Table 6.14: The Consequences of Falling Scale Mean Scores of individual items reported by 63 obese women under 50 years of age

Item	Mean	SD	Median	IQR
Damage to Identity Subscale	17.76	4.51	18	15-21
Difficulty getting up	2.68	1.13	3	2-4
Cause a nuisance	2.49	1.03	3	2-3
Lose my confidence	2.81	1.03	3	2-4
I will be embarrassed	3.44	0.82	4	3-4
I will be in pain	3.13	0.87	3	3-4
I will feel foolish	3.21	0.81	3	3-4
Loss of Functional Independence Subscale	13.58	5.52	13	9-18
I cannot continue to be active	2.33	1.05	2	1-3
Lose my independence	2.29	1.07	2	1-3
I will become disabled	2.10	1.03	2	1-3
I will be severely injured	2.45	0.98	3	2-3
I will be helpless	2.25	1.08	2	1-3
I will not be able to cope	2.16	1.07	2	1-3

Table 6.15: Distribution of items from the Modified Survey of Activities and Fear of Falling in the Elderly Scale in 63 obese women under 50 years of age

Activity	Mean	SD	Median	IQR
Go to the shops	1.48	0.42	1	1-2
Clean your house	1.27	0.26	1	1-1
Prepare simple meals	1.21	0.17	1	1-1
Go to the Doctor or Dentist	1.29	0.21	1	1-2
Take a bath	1.48	0.54	1	1-2
Take a shower	1.27	0.23	1	1-2
Go for a walk	1.73	0.59	2	1-2
Go out when it is slippery	2.16	0.49	2	2-3
Visit a friend or relative	1.40	0.31	1	1-2
Go to a place with crowds	1.83	0.66	2	1-3
Go up and down stairs	1.48	0.32	1	1-2
Walk around indoors	1.19	0.16	1	1-1
Walk half-a-mile	1.70	0.63	1	1-2
Bend down to get something	1.59	0.41	2	1-2
Travel by public transport	1.67	0.61	1	1-2
Go out to a social event	1.59	0.54	1	1-2
Reach for something above your head	1.56	0.50	1	1-2

Associations between BMI, Age, Falls, Activity, Anxiety and Depression

In order to evaluate the relationship between FOF and levels of activity in obese women using regression analysis, an exploration of the relationships of other independent variables with FOF, activity and each other was essential to identify any potential confounders. Strong associations between independent variables might suggest collinearity which could potentially give spurious results to the analysis and subsequent findings.

No significant associations were found between BMI (continuous) and age group using one way ANOVA ($F_{2,62}$ =0.15, P=0.859) (Table 6.30), though there were significant differences between the BMI groups in terms of anxiety and depression ($F_{3, 62}$ = 5.83, P=

0.001; $F_{3, 62}$ = 5.81, P= 0.002 respectively) (Table 6.30). Post hoc tests suggested those participants with a BMI above 45 kg/m^2 were significantly more anxious and depressed than those with a BMI 30 -34.9kg/m^2 (Table 6.31). Furthermore, these associations were seen in correlational analysis between continuous BMI and anxiety and depression (R= 0.43 and R=0.46 respectively) (Table 6.29). Previous analysis found no significant associations between falls and BMI or age groups (Table 6.28), though significant differences were seen between both anxiety and depression in fallers versus non-fallers (t=-2.67, df=61, P=0.01 and t=-2.66, df=61, P=0.01 respectively) (Chapter 6 Section 6.11).

The strongest relationship between other variables was seen between anxiety and depression. Correlational analysis showed a moderately high significant association between anxiety and depression in the participants (R=0.77 at 0.01 level), which was close to an R value 0.8 to 0.9 which suggests collinearity (Table 6.29).

Table 6.28: Associations of Falls, BMI, Age and Activity categories using Pearson's Chi –Square Test

Independent Variables	Pearson's Chi-square ($\chi 2$)	df	P value
BMI Group and Falls	5.79	3	0.12
BMI Group and Activity level	8.00	3	0.05
Age Group and Falls	1.29	2	0.52
Age Group and Activity level	5.52	2	0.06
Falling and Activity level	0.73	1	0.39

Table 6.29: Associations between Anxiety, Depression and BMI

	Anxiety	Depression
BMI (continuous)	R= 0.43	R= 0.46
Anxiety		R= 0.77

R= Pearson's r. P=0.01

Table 6.30: One Way ANOVA table for Comparisons of Independent Variables; BMI, Age, Activity, Anxiety and Depression

Independent Variables	Sum of Squares	df	Mean Square	F	Sig
BMI Group vs Anxiety					
Between Groups	333.61	3	111.20	5.83	0.001
Within Groups	1124.31	59	19.06		
Total	1457.90	62			
BMI Group vs Depression					
Between Groups	319.79	3	106.59	5.81	0.002
Within Groups	1081.89	59	18.34		
Total	1401.68	62			
Age Group vs BMI (continuous)					
Between Groups	33.23	2	16.62	0.15	0.859
Within Groups	6520.84	60	108.68		
Total	6554.07	62			
Age Group vs Anxiety					
Between Groups	106.97	2	53.48	2.38	0.10
Within Groups	1350.93	60	22.52		
Total	1457.90	62			
Age Group vs Depression					
Between Groups	55.86	2	27.93	1.24	0.29
Within Groups	1345.83	60	22.43		
Total	1401.68	62			
IPAQ-SF vs Anxiety					
Between Groups	376.94	3	125.65	6.86	<0.001
Within Groups	1080.97	59	18.32		
Total	1457.91	62			
IPAQ-SF vs Depression					
Between Groups	112.77	3	37.59	1.72	0.17
Within Groups	1288.91	59	21.85		
Total	1401.68	62			

Table 6.31: Multiple Comparisons for Independent Variables using Post Hoc tests

Independent Variables	Groups (I)	Comparison Groups (J)	Mean difference (I-J)	Standard error	Sig	95% Confidence Interval	
						Lower limit	Upper limit
BMI vs Anxiety (Tukey)	30-34.9	35-39.9	-3.94	1.52	0.05	-7.96	0.08
		40-44.9	-2.41	1.49	0.38	-6.37	1.55
		>45	-6.51	1.61	0.001	-10.77	-2.26
	35-39.9	40-44.9	1.53	1.52	0.75	-2.49	5.55
		>45	-2.57	1.63	0.39	-6.88	1.74
	40-44.9	>45	-4.10	1.61	0.06	-8.35	0.15
BMI vs Depression (Tukey)	30-34.9	35-39.9	-3.43	1.49	0.11	- 7.38	0.51
		40-44.9	-3.27	1.47	0.13	- 7.15	0.61
		>45	-6.54	1.58	0.001	-10.71	-2.37
	35-39.9	40-44.9	0.16	1.49	1.00	- 3.78	4.11
		>45	-3.11	1.59	0.22	- 7.34	1.12
	40-44.9	>45	-3.27	1.58	0.17	- 7.45	0.89
Activity vs Anxiety (Tukey)	Low	Mod	4.99	1.25	0.001	1.67	8.31
		High	3.96	1.54	0.06	- 0.11	8.03
	Mod	High	-1.03	1.59	0.92	- 5.24	3.18

In summary, significant associations were seen between anxiety and depression; BMI and activity; BMI and anxiety and depression; falls and anxiety and depression, and activity and anxiety, with the strongest associations being between anxiety and depression (Table 6.32).

Table 6.32: Summary of Associations between Independent Variables

	Age Group	Falls	Activity level	Anxiety	Depression
BMI	4.34(6) P=0.63	$\chi^2(3,63)$ =5.79 P=0.12	$\chi 2(3,58)$ = 8.0 P=0.05	5.83(3) P=0.001 R=0.43	5.81(3) P=0.002 R=0.46
Age Group		$\chi^2(2,63)$ =5.79 P=0.12	$\chi 2(3,58)$= 5.52 P=0.06	2.38(2) P=0.10	1.24(2) P=0.29
Falls			$\chi^2(1,58)$= 0.73 P=0.39	t=-2.67(61), P=0.01	t=-2.66 (61), P=0.01
Activity level				6.86(3) P=<0.001	1.72 (3) P= 0.17
Anxiety					R= 0.77

$\chi 2$ –Pearson's Chi square test. R= Pearson's correlation coefficient. t= independent t-test.