NUTRITION AND PHYSICAL ACTIVITY BEHAVIOURS IN OLDER WOMEN AGEING IN A SUPER-

DIVERSE CITY: A MIXED-METHODS STUDY

by

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A thesis submitted to the

University of Birmingham

for the degree of

DOCTOR OF PHILOSOPHY

School of Sport, Exercise & Rehabilitation Sciences

College of Life and Environmental Sciences

University of Birmingham

July 2016

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ABSTRACT

The purpose of the present thesis was driven by the limited existing evidence examining nutritional and physical activity (PA) profiles of older migrant women, and the importance of such studies for the planning and development of appropriate strategies to promote healthy ageing. The present thesis provided an opportunity to better understand the dietary and PA profiles of first generation migrant older women and how they relate to physical function (e.g., frailty) and ageing within the contemporary super-diverse UK context.

Using a mixed-methods (MM) approach, this thesis was conducted in four phases: 1) A MM study exploring dietary intake, nutrient status, and key factors influencing dietary factors; 2) A MM study examining the association between low energy and nutrient intake and frailty; 3) A MM study examining PA, sedentary time (ST), and frailty, and 4) A qualitative study exploring perceptions and experiences of ageing of first generation migrant women and how these, in turn, shape nutrition and PA behaviours.

Seventy-six first generation migrant women (Mean age ± SD= 70.5 ± 7.6yrs) completed a 24-hr dietary recall; frailty status was assessed using a modified version of the frailty phenotype. Semi-structured interviews were conducted with a sub-sample (n=46). Results indicated that despite having high rates of overweight/obesity, older migrant women living in the UK are at risk of poor nutrition. Participants' low energy intake was associated with frailty (OR: 11.71, 95% CI: 2.36-57.97). After adjusting for energy and other confounders, a poor nutritional status was associated with frailty (OR: 6.58, 95% CI: 1.01-43.08). In addition, a sub-sample (n=60) wore a GT3X accelerometer. Accelerometry-derived data revealed that on average participants spent 69% of their waking time engaged in ST, with only 15% of the

sample meeting the weekly recommendations for moderate-to-vigorous PA (MVPA). Low MVPA was independently associated with frailty after controlling for confounding factors. Important factors associated with participants' nutrition and PA included the presence and increased awareness of chronic diseases, weight issues, and joint pain and fear of injuries. Key socio-cultural factors were strongly related to women's household roles and changes in their home environments, as well as cultural norms related to their religious beliefs.

Maintaining independence in order to remain living in the community was a major motivator for engaging in healthier lifestyles. Despite commonalities among ethnic groups, differences such as diverse migration backgrounds, age at migration, varied English language proficiency, and early onset of chronic diseases were perceived as playing a key role in successful/healthy ageing. Policy makers, health professionals and scholars need to take into account these factors when planning services and health promotion strategies for older women living in an ever-increasingly super-diverse UK context. Both community-based and family-oriented interventions are recommended in order to promote healthy ageing through healthy eating and regular PA by optimising nutrient adequacy, physical function, a healthy body weight and a socially and spiritually engaged lifestyle among this growing segment of the UK population.

ACKNOWLEDGEMENTS

for their guidance and endless opportunities they have given me. To my sister, Paola, who has been the best role model I could ever wish for. Thank you for believing in me! I owe an enormous thanks to my husband's family who has gone to great lengths to support me beyond my PhD; you all have made me feel at home so far away from what home used to be.

Finally, I reserve my most special thanks for my husband, Jazz. You have supported me, encouraged me, and put up with me. I feel blessed to be a part of your life, and am fortunate to be married to the most kind-hearted and generous person I have ever known. Home is wherever I am with you! Gracias!

I would like to dedicate this thesis to my mother, María Norma Gameros Romero. Her support, strength, encouragement, and constant love have sustained me throughout my life.

Gracias mamá.

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LIST OF PAPERS

This thesis is comprised of the following four papers:

1. **Castaneda-Gameros, D.,** Redwood, S., & Thompson, J.L. (*under review*). Dietary Intake, Nutrient Status, and Factors Influencing Eating Behaviours in Older Migrant Women with Varying Frailty Status, *Appetite*

2. **Castaneda-Gameros, D.,** Redwood, S., & Thompson, J.L. (*in press*). Low Nutrient Intake and Frailty Among Overweight and Obese Migrant Women from Ethnically Diverse Backgrounds Aged 60+ Years: A Mixed-Methods Study, *Journal of Nutrition Education and Behaviour*

3. **Castaneda-Gameros, D.,** Redwood, S., & Thompson, J.L. (*under review*). Physical Activity, Sedentary Time, and Frailty in Older Women from Ethnically Diverse Backgrounds: A Mixed-Methods Examination, *Journal of Aging and Physical Activity*

4. **Castaneda-Gameros, D.,** Thompson, J.L., & Redwood, S. *(manuscript in preparation for publication).* Experiences and Perceptions of Ageing Among First Generation Older Migrant Women: Implications for Healthy Eating and Physical Activity Promotion in a Super-diverse UK Context*, Ageing& Society*

<center>**LIST OF CONFERENCE PRESENTATIONS**</center>

During the period of postgraduate study within the School of Sport, Exercise and Rehabilitation Sciences at the University of Birmingham, the following conference abstracts were accepted for publication/presentation.

Conference presentations

1. **Castaneda-Gameros, D.,** Redwood, S., &Thompson, J.L. Understanding nutrition and physical activity behaviours among older migrant women living in a super-diverse City. *Superdiversity International Conference, Birmingham, UK, June 2014.*

2. Thompson, J.L., **Castaneda-Gameros, D.** Dietary intake and its association with frailty in a group of older ethnically diverse migrant women. *64th Annual Meeting of the American College of Sports Medicine Annual Meeting, Boston, Massachusetts, US, June 2016.*

3. **Castaneda-Gameros, D.,**Redwood., S., &Thompson, J.L. A mixed-methods examination of physical activity, sedentary time, and their association with frailty among ethnically diverse migrant women 60+ years. *21st Annual Congress of the European College of Sports Sciences, Vienna, Austria, July 2016.*

Workshop organised as part of the IRiS seed-corn funding awarded during this PhD:

1. **Castaneda-Gameros, D.,**Redwood., S., & Thompson, J.L.Examining diet and physical activity behaviours among older women through the lens of super-diversity, *University of Birmingham,UK, September, 2014* (See Appendix 10 for Workshop report).

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LIST OF ABBREVIATIONS

AC	African-Caribbean
ANCOVA	Analysis of covariance
ANOVA	Analysis of variance
BME	Black and Minority Ethnic
BMI	Body Mass Index
CES-D	The Center for Epidemiological Studies-Depression
CEB	Community Energy Balance
CHD	Coronary Heart Disease
CI	Confidence Interval
CPM	Counts Per Minute
CVD	Cardiovascular disease
DCG	Diana Castaneda-Gameros
DWP	Department for Work and Pensions
EU	European Union
FI	Frailty Index
FP	Frailty Phenotype
GP	General practitioner
HSE	Health Survey for England
IDF	International Diabetes Federation
IMD	Index of multiple deprivation
IPAQ	International Physical Activity Questionnaire
IPAQ-E	International Physical Activity Questionnaire modified for the elderly
IRiS	Institute for Research into Superdiversity

JLT	Janice L. Thompson
LHPA	Low-High physical activity
LLPA	Low-Light physical activity
MM	Mixed-methods
MVPA	Moderate-to-vigorous Physical Activity
NCEP	National Cholesterol Education Program
ONS	Office for National Statistics
OR	Odds ratio
PA	Physical activity
PRIAE	Policy Research Institute on Ageing and Ethnicity
SA	South Asian
SD	Standard deviation
SportExR	Sport, Exercise & Rehabilitation Sciences
SR	Sabi Redwood
ST	Sedentary time
UK	United Kingdom
USA	United States of America
WC	Waist circumference
WHO	World Health Organization
WHR	Waist-to-hip-ratio

CHAPTER 1

GENERAL INTRODUCTION

This chapter reviews the literature on the key components underpinning the research

conducted during this PhD study. The chapter opens with a brief introduction of the topic

followed by a review of the existing literature supporting the need to explore nutrition and

physical activity (PA) behaviours within the context of ageing in, and migrating to, a super-

diverse city among a sub-group of the population that has been poorly studied. Finally, a

summary providing a rationale for carrying out the present research concludes this chapter.

BACKGROUND

Demographic trends such as the decreased birth rate and the increase in life expectancy are

contributing to the ageing of the global population (Torres-Gil& Moga, 2002). Currently,

people aged 60 and older make up 12.3% of the global population. By 2050, this number is

expected to rise to almost 22%, with the oldest old (≥85 years) being the world's fastest

growing segment of the population (Collerton, Davies et al., 2009, WHO, 2002). The ageing

of the population has huge economic, political, and social implications related to the care

and welfare, as there is the potential for many adults to live a greater number of years in

poor health (Patel, 2015, Thompson, 2014).

In an ageing society such as the United Kingdom (UK), there will be a nexus between ageing

and super-diversity given the growth of minority populations and the continued migration

(Torres-Gil & Moga, 2002). Super-diversity refers to a large number of ethnicities,

nationalities, languages, faiths and cultures found across UK society (Vertovec, 2007). Given

these demographic changes, the UK will face the challenge of promoting healthy ageingfor an ever-increasing diverse older population (de Valk, Huisman & Noam, 2012, Coleman & Rowthorn 2004). For instance, it is expected that by 2051, there will be 6.6 million older adults from diverse minority ethnic backgrounds aged 65 and older in England and Wales, with more women fitting in this category (Lievesley, 2010, Evandrou, 2000).

The experience of Western countries shows that minority populations have significantly higher risks for obesity and its metabolic complications (Misra & Ganda, 2007). In the UK, both South Asian (SA)and African-Caribbean (AC) women have higher prevalence of central obesity, hypertension, and type 2 diabetes (T2DM)than the mainstream population (Tillin, Sattar, Godsland et al., 2015). While genetic factors play an important role in the aetiology of disease, a combination of genetic, environmental, and modifiable factors such as unhealthy eating and physical inactivity may explain these health disparities (Ngo, Gurinovic, Frist-Andersen et al., 2009, Garduno-Diaz & Khokhar, 2013).

It is well recognised that an adequate nutrition and regular PA play an essential role in terms of malnutrition, management of related metabolic complications and coping with functional decline among older adults (Blane, Abraham, Gunnel et al., 2013, WHO, 2002). However, minority ethnic groups experience diverse barriers including socio-cultural, and economic factors that may have a cumulative impact on how individuals age. In addition, the environments in which ethnic minorities live may influence the uptake and maintenance of healthy lifestyles related to healthy eating and regular PA and consequently, healthy or successful ageing (Johnson and Garcia, 2003).

While there have been efforts to understand healthy ageing in Black and Minority Ethnic (BME) communities living in the UK, previous research has mainly focused on the older population as a homogenous group (e.g., mainly White older men) or in exploring well-established migrant groups (Wray, 2003). Given that the population in the UK continues to age and will continue to become more ethnically diverse (Evandrou 2007), there is a call for health professionals, scholars, and policy makers to fully understand and adopt a broader perspective of health-related behaviours in order to plan and develop strategies to promote healthy ageing through healthy eating and regular PA in vulnerable sub-groups of the population such as older migrant women (Thompson, 2014). Increasing our understanding of key influences of nutrition and PA behaviours and how they relate to physical decline (e.g., frailty) and healthy ageing of migrant older women is critically needed to target these strategies effectively.

With this in mind, the present mixed-methods (MM) study sought to enhance our understanding of the influence of key factors on current nutrition and PA behaviours in older women from diverse ethnic, socio-economic and migrant backgrounds. A MM approach provided not only quantitative data on the current women's nutrition and PA behaviours and its association with frailty, it also created the opportunity for participants to express in their own words important factors influencing their dietary and PA behaviours. Moreover, it addressed the gap of research into experiences and perceptions of ageing within super-diverse communities and important implications for health promotion related to nutrition and PA.

The exploration of nutrition and PA behaviours in a sub-group of the population that is traditionally labelled as 'hard-to-reach' offers a unique contribution to the field of public health. It is hoped that insights from this research will provide useful information that may potentially guide policy on helping older migrant women to overcome important barriers for healthy eating and regular PA, which in turn will contribute to healthy/successful ageing.

Aims of this thesis

The main aims of this thesis are four-fold:

1) To provide a better understanding of the factors influencing dietary intake and PA in this group.

2) To examine current dietary and PA behaviours and how are they related to frailty in a sample of older women from diverse ethnic, socio-economic and migration backgrounds living in the UK.

3) To gain a greater understanding of women's perceptions of the link between, dietary intake, PA and frailty.

4) To explore experiences of ageing focusing on how participants' perceptions of old age shape their nutrition and PA behaviours, and how these in turn influence successful/healthy ageing.

Research questions

The central research addressed in this thesis are listed below:

1. What are the current nutrition and PA behaviours of a group of first generation older women living in a super-diverse city?

2. Are these behaviours associated to their frailty status?

3. How are participant's dietary intake and PA in comparison to the UK guidelines?

4. What are the key factors that participants' identify as influencing their nutrition and PA behaviours?

5. What does successful ageing mean and how does this phenomenon shape dietary and PA behaviours among this group of women?

Thespecific research questions addressed in each empirical chapter (Chapters 3-6) generated from this PhD research are listed in table 1.

Table 1.Specific questions addressed in each empirical chapter

Empirical chapters	Specific questions addressed in each chapter
Chapter 3:A MM study exploring dietary intake, nutrient status, and key factors influencing dietary factors in older migrant women with varying frailty status.	- What are the current energy and dietary intakes of a sample of free-living older women from ethnically diverse backgrounds living in the UK? - Are there differences in energy and nutrient intakes between women of varying frailty status? - What are the key factors identified by participants as influencing their current dietary intake?
Chapter 4:A MM study examining the association between low intake and frailty among overweight and obese migrant women from ethnically diverse backgrounds.	- Are energy and nutrient intakes associated with frailty among a sample of predominantly overweight and obese first generation migrant women aged ≥60 years? - Are low intakes of energy and nutrients stronger predictors of frailty than unintentional weight loss and indices of overweight and obesity (e.g., body mass index, waist circumference and waist-to-hip circumference) in this sample? - How do first generation migrant women aged ≥60 years, with high prevalence of overweight and obesity, perceive their dietary intake in relation to their body weight and physical function?
Chapter 5: A MM study examining PA, sedentary time (ST), and frailty in older women from ethnically diverse backgrounds living in the UK	- What are the current PA/ST patterns of older women from ethnically diverse backgrounds living in the UK? - Are PA and ST predictive of frailty in older women from ethnically diverse backgrounds living in the UK? - What are key factors identified by participants that influence their PA behaviour, specifically related to physical function?
Chapter 6: A qualitative study exploring perceptions and experiences of ageing of first generation migrant women and how this in turn, shape nutrition and PA behaviours.	- What does ageing mean to a group of older women from diverse ethnic, socio-economic and migration backgrounds living in a super-diverse city? - How does this phenomenon shape participants' dietary and PA behaviours?

LITERATURE REVIEW

Search strategy

For this chapter, a search of the available literature was conducted from January 2013 to May 2016 in the following databases: Medline, PubMed, PsychInfo, Web of Science, and CINHAL, and Google Scholar. The FindIt@Birmingham search tool was used to identify books and journals in other disciplines, such as anthropology and social policy thatare related to the present work but not commonly included in biomedical databases. In addition, the reference lists of articles and citations from selected articles were also used to identify a wider selection of references. For demographic information, online resources from different agencies/organisations were searched including the Office of National Statistics (ONS), Birmingham City Council, the Migration Observatory, the World Health Organization (WHO) and Age UK. Since this literature review includes different topics such as migration, ageing, and lifestyle behaviours, the search was divided in three main topics. Each topic search included a combination of keywords and synonyms of search terms shown in Table 2.

Table 2. Electronic search strategy

Topics	Search terms including combinations
1. Migration and ageing	'Migration', 'super-diversity', 'ethnic older adults', 'Birmingham census', 'West Midlands census', 'women', 'health inequalities', 'minority population/groups', 'social disadvantage', 'immigrant health', 'diabetes', 'hypertension', 'cardiovascular disease', 'South Asian', 'African-Caribbean','migrant', 'ageing', ' frailty', 'successful ageing', and 'ageing well'.
2. Dietary behaviours	'Diet', 'migration', 'food habits', 'food beliefs', 'dietary assessment', 'migrant population', 'South Asians', 'African-Caribbean', 'dietary changes', 'acculturation', 'traditional diet', 'cultural beliefs', and body image'.
3. Physical Activity	'Physical activity','exercise', 'migrants', 'ethnic older adults', 'women', 'South Asians', 'African-Caribbean', 'minority population/groups', and 'assessment', 'acculturation', 'accelerometry', and 'questionnaires'.

Migration and ageing

Two trends have become key determinants of health and social development in contemporary Europe. First is the ageing of the population, and second is the increasing diversity of the population (Lievesley, 2010). The ageing of the population is derived from the decrease in fertility rates and the improvements in quality of life, which haveincreased the life expectancy of the population (Warnes, Friedrich, Kellaher & Torres, 2004). Notably, people are not only living longer, but older people represent a greater portion of the global population than ever before (Ory, Abeles & Lipman, 1992, ONS, 2015). Over the last 25 years in the UK, both male and female period life expectancy at birth rose to 78.5 and 82.4 years,

respectively. By 2035, male expectancy of life is predicted to increase to 83.4 years, and to87

years for females (ONS, 2011a). Although male period life expectancy has the greater

increase as a consequence of major improvements in male mortality rates than females,

women will continue to live longer andhence will numerically dominate the global older

population (Knodel & Ofstedal, 2013, ONS, 2015). Moreover, the older population is

becoming increasingly diverse and is expected to be more so in the future (Lievesley, 2010).

The shift from multiculturalism tosuper-diversity in the UK

In the UK, migration was usuallycharacterised byrelatively static large groups of low- or semi-

skilled labourer migrants from Commonwealth countries or colonial territories. From the

1980s and 1990s, the UK started experiencing a large migration of citizens from other

member countries of the European Union (EU) and non-European citizens with no historical

ties with the UK (Phillimore, 2011). This new pattern of migration has been labelled 'super-

diversity'(Vertovec, 2007), which is associated with group heterogeneity as individuals differ

according to age, gender, migration status and associated rights and entitlements, faith,

socio-economic status, and more.

The West Midlands is one of the most diverse areas in the UK, and it is the only area in the

country where the largest non-British born group is non-White (ONS, 2011b). During the

2011 UK Population Census, the percentage for minority ethnic groups[1] in the West

Midlands was higher than the national average, with 4.1% of Pakistani, 3.9% of Indian and

1.5% of Caribbean descent. Birmingham is the largest borough in the West Midlands and the

second most ethnically diverse city in the UK after London, with approximately 42% of its

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[1] Minority ethnic groups are largely of migrant origin as such, the different categories are often treated as comparable (Bloemraad &Schönwälder, 2013)

population belonging to a minority group. Although Birmingham has well-established migrant groups (e.g., White-Irish, SAs and ACs), in recent years the city has experience the emergence of super-diversity as many new migrants have been arriving in small groups or as individuals(Birmingham City Council, 2011). Currently Birmingham houses migrants from over 170 countries and will become UK's first minority majority city by 2020 (Birmingham Chamber of Commerce, 2005, Phillimore, Goodson, Kayembe et al., 2010).

According to Birmingham's population forecasts, by 2026 approximately a quarter of the population will be minority ethnic residents aged 65 years and older (See Figure 1). Furthermore, the increase in number of the 'young old' (65-74 years) will lead to the rise of the 'oldest old' (85+ years) and therefore, there is likely to be a major demand for health and caring services (Spijker & MacInnes, 2013). The 2011 census showed that 47.2% of the older population ($\geq$ 65 years) in Birmingham reported having a long-term illness; with a higher proportion of women than men in this category (5.8% vs. 7.3%, respectively)(ONS, 2015).

Figure 1. Estimates of ethnic composition of non-White minority ethnic older adults (65+y) in Birmingham between 1991-2026.
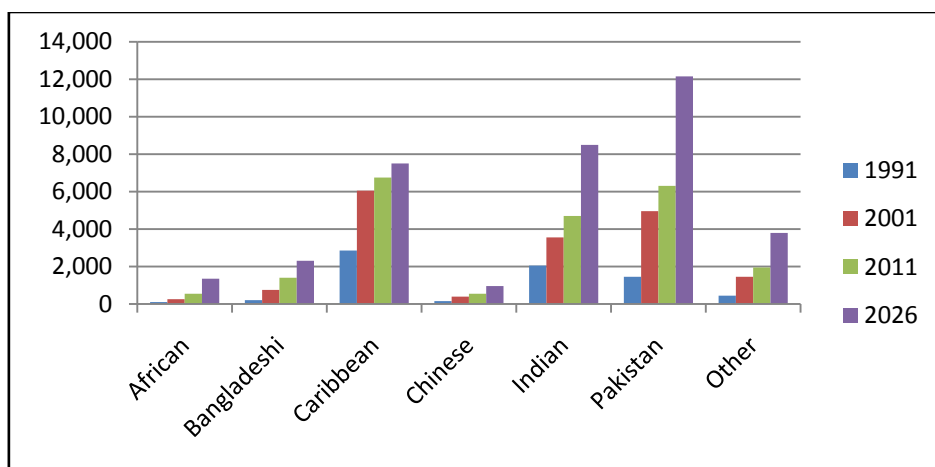
Source: Population forecasts for Birmingham. Cathie Marsh Centre for Census and Survey Research. University of Manchester

Implications for researching diversity and ageing

For decades social and health provisions in the UK were guided by the belief that migrants were transient workers and would not settle permanently (Patel, 2015). It was until the 1970s, that policymakers focused on addressing inequalities between the migrant and the general population (Nazroo, 2006). For instance, efforts to provide culturally tailored services were made such as employing minority staff in a variety of social and health services (Phillimore, 2015). However, multicultural models of delivery have been largely criticised for pathologising ethnicity as the cause of negative outcomes instead of addressing health and structural inequalities (Boccagni, 2015, Phillimore, 2015). For example, housing analysis of minority populations indicates that they tend to live in more deprived areas than the White population (Home Office, 2011). Furthermore, areas with higher concentration of minority groups are also those who have the most disadvantaged service provision and environmental characteristics (e.g., urban and industrial areas)(Phillimore and Goodson, 2006, Clark and Drinkwater, 2002).

Despite having increased rates of morbidity and premature mortality, ethnic minorities in European countries are under-represented in both clinical and applied research. The lack of inclusion of ethnic groups affects the allocation of, and access to, resources that exacerbate health inequalities. As Plumridge and colleagues (2012) argue, the exclusion of groups with a greater burden of disease is not only bad science, but it becomes and issue of ethics and social justice. Increasing the participation in health research is crucial to plan and accommodate culturally sensitive health strategies and services (Redwood & Gill, 2013).

The scale and scope of super-diversity along with the ageing of migrant populations provide both challenges and opportunities for policy makers, researchers, and health and social care

providers to plan for an ever-increasing super-diverse ageing population (Thompson, 2014,

Fenton, 2014). Whilst changes in public policies are underway, some scholars have argued

that Britain has failed to cope with the needs of its well-established migrant groups and

therefore, it is possible that a more diverse population will put more pressure on social and

health services (Segolene, 2007, Phillimore, 2011).

In an ageing society, both super-diversity and ageing are factors that will require to move

beyond generalised notions of ethnicity and race, and to have a better understanding of

population ageing and its long-term consequences (Torres-Gil & Moga, 2002). In the past,

older adults were referred to as a uniformly homogenous group with the same

characteristics and needs. However, in super-diverse communities, we need to recognise not

only the diversity between the majority White population but to recognise the variety and

many differences to be found within minority ethnic groups (Berry, 2014).

Defining race and ethnicity

There are several issues when it comes to defining 'ethnicity' and 'race,' both in research

and in the use of these terms in common speech. Both terms are used interchangeably, but

they are two different concepts (Sillitoe & White, 1992). 'Ethnicity' or 'ethnic group' is a term

often used to describe a group of people that identify themselves to each other, on the basis

of common genealogy or ancestry. This term also refers to shared cultural background (i.e.,

geographical origin, values and family patterns); however not all ethnic groups share the

same religious and linguistic characteristics (Williams, 1997, Bhopal, 2007).'Ethnicity' has

been described as a "multi-faceted and changing phenomenon" which is normally a self-

assessed concept that may change over time and it is not the same as nationality or country

of birth(ONS, 2003). In contrast, the term 'race' is commonly referred to the concept of tangible genetic differences between groups such as the colour of the skin and facial type (Bhopal, 2007).

For research purposes, ethnicity is often treated as a fixed and self-reported characteristic. In the UK, minority groups are classified according to their self-reported ethnicity from a list of 18 categories (ONS, 2012). The study and measurement of ethnicity, although highly controversial, plays a pivotal role in determining the influence of different exposures to health risk (Bhopal, 1997). Nonetheless, ethnic groups do not differ from each other just by their genetic background. For instance, socio-economic status is strongly associated with ethnicity and is a strong predictor of low education levels and poorer access to and quality of health, which, in turn, may be correlated with an increased susceptibility of diseases and the consequences of those diseases (Kaufman & Cooper, 2001, Bhopal, Rahemtulla & Sheikh, 2005). Increasing knowledge about the relationship between ethnicity and health may allow directing public health interventions and health care resources that could be tailored to specific ethnic groups. Nonetheless, precaution must be taken when measuring ethnic identity so as not to be used to attribute traits to ethnic groups in an unquestioning manner through assumed group prescribed norms (Burchard, Ziv, Coyle et al., 2003).

Ageing

Current health is not only influenced by present socio-economic conditions, but also by the exposure to these conditions throughout one's lifetime. More than twenty years ago Barker showed for the first time that intrauterine growth retardation due to maternal malnutrition was associated with higher risk for chronic diseases such as type 2 diabetes mellitus (T2DM), coronary heart disease (CHD) and respiratory disease in adulthood (Barker, 1990, Paneth

&Susser, 1995). Supporting the 'Barker hypothesis,' studies conducted in individuals who were conceived during the Dutch famine between 1944 and 1945 have consistently reported higher prevalence of abdominal obesity, cardiovascular disease, impaired glucose tolerance, hypertension, certain cancers and mental illness (Painter, Roseboom & Bleker, 2005, Stein, Ravelli & Lumey, 1995, Lumey, Stein & Susser, 2011). Among women who were exposed to early gestation malnutrition (i.e., <1000 kcal/day during a 13-week period), BMI was significantly higher by 7.4% (95% CI: 0.7%, 14.5%) than that of their non-exposed counterparts. Furthermore, the effects of poor maternal nutrition were shown to decrease if individuals were exposed in late gestation (Ravelli, Van Der Meulen, Osmond, 1999).

Regarding demographic factors, economic resources tend to decline with age. For example, housing conditions deteriorate significantly with advanced age as well as perceptions of physical environment and safety in their neighbourhoods (Smith & Kington, 1997). Although pensioner poverty in the UK has declined in the last two decades, approximately 1.6 million (14%) pensioners are presently living in poverty (DWP, 2014). The 'oldest old', those who live alone, those who are private and social tenants, and those from Asian and African origin are at higher risk (Age UK, 2016). According to DWP statistics (2013), approximately 31% of Asian or British Asian and 20% of black or Black British pensioners live in poverty. Interestingly, older women have been shown to have fewer economic resources than men independently of their ethnic background. In part, this is likely to be the result of them being previously employed in low status jobs or never to have been employed in comparison to men (Bajekal, Blane, Grewal et al., 2004).

Successful ageing

Researchers from a wide range of disciplines have been searching for ways to promote healthy ageing in the population and much of this research is related to theories of "ageing well" (Hilton, Gonzalez, Saleh, et al, 2012). Notably, one of the criticisms in the literature on ageing well is the variety of terms used to describe this concept (Romo, Wallhagen, Yourman et al., 2013, Bowling, 2007). Overall, "successful ageing" is the most commonly used, but terms such as healthy ageing, positive ageing, active ageing, and good old ageare commonly used in the literature (Dionigi, Horton & Bellamy, 2011, Hung, Kempen & De Vries, 2010, Bowling, 1993, Holstein & Minkler, 2003).

Conceptualisations of successful ageing have been developed since the second half of the 20th Century (Havighurst, 1961). This concept is linked to an individual's ability to adapt to changes in body and mind (Baltes & Baltes, 1990). There are two main approaches that have emerged in the field, the psychosocial and the biomedical approaches. Rowe and Kahn's (1997) biomedical conceptualisation of ageing is associated with longevity, mental and physical health and functioning, and social engagement. Other researchers have added psychosocial (e.g., spirituality) elements to broaden this model (Strawbridge, Wallhagen & Cohen, 2002a, Crowther, Parker, Achenbaum et al., 2002). Although this model is the most widely used in successful ageing research, it has been criticised because of its failure to consider that disease-free old age is unrealistic for the vast majority of older adults (Bowling & Dieppe, 2005).

On the other hand, psychosocial models characterise ageing as a dynamic, life-long adaptive process (Baltes & Baltes, 1990). Previous studies have reported important psychological resources associated with people's views on successful ageing. These include: personal

growth, autonomy and independence, sense of accomplishment, financial security, and

physical appearance, as well as being able to cope with challenges of old age (Hsu, 2007,

Reichstadt, Sengupta, Depp, et al., 2010, Duay & Bryan, 2006). Studies exploring lay

perspectives of successful ageing have found an overlapping of both models, suggesting that

successful ageing is multi-faceted. As such, any meaningful definition of successful ageing

should take into consideration the opinion of the individual to whom it is applied (McCann

Mortimer, Ward & Winefield, 2008).

More recently, there has been an interest in considering ageing from a life-course or

biographical perspective (Beard, Officer, Araujo de Carvalho, et al., 2016). As Chapman

(2005) proposes, successful ageing can be achieved regardless of an individual's health or

socio-economic position, going beyond the biomedical and psychosocial models of

successful ageing. In other words, each individual may interpret success according to their

own experiences of ageing taking into account changing resources, events and abilities

throughout one's lifetime (Chapman, 2005, Dionigi et al., 2011).

To date, the literature is predominated by research conducted among male, White, well-

educated, middle or upper class, and relatively healthy older adults (Cosco, Prina, Perales et

al., 2013, Troutman, Nies & Mavellia, 2011). Research exploring cultural variations in views

about successful ageing is limited. Cross-cultural research conducted mainly in the United

States (US) has identified important differences in perceptions of ageing well between ethnic

groups (Laditka, Corwin, Laditka et al., 2009, Hitlon et al., 2012, Romoet al., 2013). However,

research of this type is limited in the UK.

One of the few studies exploring successful ageing in a UK context found that AC, Dominican,

Pakistani, Indian, and British-Polish women were more likely to relate spirituality to

happiness and fulfilment at an old age than were English participants (Wray, 2003). Being involved in religious activities provided them with a sense of belonging within a collective identity. In this study, Wray (2003) also found that maintaining this sense of belonging in women who experienced racism and social inequalities throughout their lives is very profound at an older age. In another study exploring expectations and levels of support by adult children in a sample of Asian-British and White-British older adults, Sin (2007) concluded that expectations of support and care are strongly linked with a range of factors such as gender, ethnicity, and migration histories. In accordance to previous research conducted in non-Western societies (Thiamwong, McManus & Suwanno, 2013, Chong, Woo & Kwan, 2006), these two studies suggest that the concept of successful ageing cannot be simply defined universally without considering the impact of cultural nuances on experiences and perceptions of ageing.

Whilst research has been done in relation to planning and management of health services for minority ethnic groups in the UK, scholars have argued that planning for successful ageing remains largely neglected (Fenton & Draper, 2014). Gaining a better understanding of older migrant women's needsis something that researchers, health professionals and policymakers should prioritise in order to promote healthy ageing in an increasingly diverse population (Birmingham Policy Commissions, 2014).

Frailty

While some older adults age successfully and enjoy a long life, many others are likely to experience a higher proportion of comorbidities leading to poor quality of life and premature death (Beard et al., 2016). One major concern for older adults is frailty. This

concept has been defined as "a physiologic state of increased vulnerability to stressors that results from decreased physiologic reserves, and even dysregulation, of multiple physiologic systems" (Fried, Tangen, Walston et al., 2001). This progressive age-related deterioration increases the risk of a range of negative health outcomes, such as care dependence and mortality(Clegg, Young, Iliffe et al., 2013). In Western countries, the prevalence of frailty has been estimated between 4% at age 50-64 years and around 17% among individuals older than 65 years (Santos-Eggimann, Cuenoud, Spagnoli et al., 2009). In England, results from the Hertfordshire Cohort Study indicated that the prevalence of frailty was 8.5% and 4.1% among community-dwelling (64-74 years) women and men, respectively (Syddall, Roberts, Evandrou et al., 2010). Interestingly, previous studies have indicated that individuals with lower education levels and socio-economic status are more likely to be frail than those with better socio-economic indicators (Harttgen, Kowal, Strulik, et al., 2013).

The two principal conceptualisations of frailty are the frailty index (FI) based on the Canadian Study of Health and Aging (Rockwood, Song, MacKnight, et al., 2005), and the frailty phenotype (FP) based in the Cardiovascular Health Study (Fried et al., 2001). The FI defines frailty as a cumulative effect of individual deficits that appear first at a subcellular level before affecting tissues, organs and function. The FI expresses the notion that frailty has different grades rather than being present or absent. On the other hand, the most widely employed frailty definition developed by Fried and colleagues (2001) considers frailty a syndrome resulting in exhaustion, decreased muscle mass, strength, low PA, and slow walking speed. The FP has been used to identify older adults at risk of falls, disability, hospitalisation, and mortality in both cross-sectional and longitudinal studies (de Souto

Barreto, Greig& Ferrandez, 2012, Xue, Walston, Fried, et al., 2011, Ensrud, Ewing, Taylor, et al., 2007).

Health and Migration

The following section focuses on the diverse health implications of migration including mental health and non-communicable diseasessuch as obesity and its negative health consequences.

Health implications of migration

Uprooting, displacement and resettlement come along with the challenge of maintaining lifetime beliefs and practices, while at the same time individuals try to adopt new ways of establishing a new life and social ties in the host country (Oxman-Martinez, Abdool & Loiselle-Leonard, 2000).Population movements have far-reaching implications for the health of those who move, for those who are left behind, and for the health of the host population (Cunningham, Ruben & Narayan, 2008). Although migration is not new in European countries, the increase of asylum-seekers and refugees as well as the enlargement of the EU may contribute to an increased number of migrants within and into the EU. Making these 'people movements' healthy and socially productive will be one of the biggest challenges for both policy and research, as countries such as the UK need to develop a multicultural model to cover the needs of its 'super-diverse' population (Phillimore, 2011).

Mental health

Mental health is one health component that appears to deteriorate with length of stay in the recipient country (Carta, Bernal, Hardoy et al., 2005). Isolation and loneliness play an

important role in the mental health of migrants (Livingston, Leavey, Kitchen et al., 2001). This may be the case for many women,who tend to migrate as dependant migrants rather than economic migrants. As a consequence, they are at greater risk of social isolation than men who have the opportunity to establish social relationships through the workplace (Iredale, 2005, Piper, 2005). Moreover, for women, the risk of mental health decline is even greater for those who have experienced any type of violence or extreme hardships (Bhugra, Still, Furnham et al., 2004). Advanced age is a risk factor for poor health amongmigrants as they may have fewer opportunities to gain language skills and recreate a social network, leaving them lonelier and more isolated than the native older population (Cunningham, et al., 2008). For women with strong religious practices, learning a new language and establishing social relationships could represent a big challenge. Besides this, they can also feel restricted to leave their homes because of fear of racial abuse (Dunn and Dyck, 2000). Racism is another type of discrimination that migrants face upon arrival to a new country (Burnett & Peel, 2001); however, it is not exclusive for new migrants but for already established minority groups (Noh, Beiser, Kaspar et al., 1999, Robinson, 2005). For instance, racial harassment and discrimination have long been reported among Black populations in the US and the UK (Moody-Ayers, Stewart, Covinsky et al., 2005, Corrigan, Thompson, Lambert et al., 2003, Williams & Mohammed, 2009). According to the Fourth National Survey of Ethnic Minorities in Britain, self-reported poor health was associated with experiences and perceptions of racial discrimination (Karlsen & Nazroo, 2002). It is argued, that for UK minority groups, racial discrimination has also dictated the well-known socio-economic disadvantagesobserved in these groups, which has its roots in slavery and colonial history (Nazroo, 2003, Smith, 2000).

The healthy migrant effect

There is a common belief that migrants from low-income countries have different health behaviours than that from the host country population and thus, the general notion of migrant's health tends to be negative (Cunningham, et al., 2008). However, several studies have reported that new migrants, particularly those from non-European countries, arrive to the receiving country in a better health status than the native population (Thomson, Nuru-Jeter, Richardson et al, 2013, Fennelly, 2007, Chen, Wilkins & NG, 1996). Over time, immigrants change their traditional meal pattern by increasing their consumption of less healthy food and adopting a sedentary lifestyle (McDonald and Kennedy, 2004, Perez-Escamilla, 2011). Furthermore, migrants are likely to be employed in low-status jobscharacterised by long working hours, poor working conditions and low salaries; that have a long-term negative effect on health and well-being. As migrants adapt to a more industrialised society, the initial 'healthy migrant effect' is dramatically inverted (Meshefedjian, Leaune, Simoneau et al., 2014, Antecol & Bedard, 2006). They tend to become more vulnerable to occupational health hazards and injuries due to poor working conditions, poor mental health, and non-communicable diseases such as obesity, T2DM and hypertension (Gushulak & MacPherson, 2006).

Prevalence of non-communicable diseases among migrants

Data from different Western countries have consistently shown that many migrant groups have significantly higher susceptibility to various non-communicable diseases and its metabolic complications. For instance, national statistics from Canada show that migrants who have lived in the country for more than 10 years have similar prevalence of disability

and chronic diseases to the Canadian-born population (Dunn & Dyck, 2000). These datahave also shown that health deteriorates more in women than men even among individuals with similar ethnic backgrounds (Vissandjee, Desmeules, Cao et al., 2004). Similarly, other Western countries have reported that first generation migrants and future generations tend to have a markedly increased prevalence of obesity, hypertension, CHD, and T2DM in comparison to the host population (Bos, Kunst, Keij-Deerenberg et al., 2004, Darmon & Khlat, 2001). Studies in the US have shown that overweight and obesity among Asian and Latino migrants are associated with a longer duration of residence in the host country (Bates, Acevedo-Garcia, Alegria et al., 2008, Goel, McCarthy, Phillips et al., 2004).

In Europe, Surinamese, Moroccan and Turkish migrants to the Netherlands have higher prevalence of overweight and obesity, hypertension and T2DM compared to the ethnic Dutch population (Dekker, Snijder, Beukers et al., 2011). In Britain, it is well documented that SAs and ACs have a higher prevalence of T2DM and CHD than the native population (Misra & Ganda, 2007, Pomerleau McKeigue & Chaturverdi et al., 1999, Agyemang & Bhopal, 2004). AmongSAs, the prevalence of CHD is approximately two times higher (Tillin, Hughes, Mayet et al., 2013a, Chowdhury & Lasker, 2002),and the prevalence of T2DM is fourto six times higher in comparison to the native British population (Williams, 1995, Wild, Fischbacher, Brock et al., 2007). Among Bangladeshis, studies have found that they have a similar negative metabolic profile than other SA groups such as Indians and Pakistanis, including glucose intolerance, hyperinsulinaemia, and dyslipidaemia (McKeigue, 1992).

The prevalence of T2DM is almost as high in ACmigrants as it is in SAs; however, the lipid response to the insulin resistance syndrome is different between these groups, which may account for the significant lower risk of CHD among ACs (McKeigue, 1996, Tillin, Forouhi,

McKeigue et al., 2006, Forouhi & Sattar, 2006). On the other hand, Caribbean-born individuals have higher rates of stroke and renal complications which are strongly associated with their three-to four-fold increased risk of hypertension in comparison to the British average (Cappuccio, Barbato & Kerry, 2003, Tillin, Forouhi, McKeigue et al., 2012). Moreover, the difference between African-descendants and the European population in hypertension mortality is even more marked among women than men (Chaturvedi, McKeigue & Marmot, 1993, Sharp, Chaturvedi, Wormald et al., 1995).

Obesity and body fat distribution

The prevalence of overweight and obesity amongmigrant groups is also more marked in women than in men, even after adjusting for socio-economic status and education (Evans, 2001). For example, the inverse association between obesity and socio-economic status in minority ethnic groups in the UK has been reported in women, but not in men (Pomerleau et al., 1999). Wardle and colleagues (2002) found that lower occupational status was associated with higher rates of obesity only in women, suggesting that unskilled manual jobs may be more physically demanding for men than for women. Moreover, it is possible to assume that having a healthier lifestyle is difficult to achieve with poor work conditions where higher rates of work stress and low income may limit dietary and PA choices (Wardle, Steptoe, Oliver et al., 2000).

Body fat distribution also differs between minority ethnic groups and White Europeans. Abdominal adiposity is more common in both SA and ACs, although it is more prevalent in SAs (Cappuccio, Cook, Atkinson et al., 1997, Deurenberg, Yap & Van Staveren, 1998, Tillin, Hughes, Godsland et al., 2013b). Abdominal obesity also tends to appear at a younger age

amongSAs than in the White European population (Lean, Han, Bush et al., 2001)Similarly, the waist-to-hip-ratio (WHR) is higher in Asian population than in White individuals even within the same body mass index (BMI) categories (Sniderman, Bhopal, Prabhakaran et al., 2007, Forouhi, Sattar & McKeigue et al., 2001, Aarabi & Jackson, Tillin et al., 2015). Given this, changes to the definition of disease risk associated with a given BMI, waist circumference and WHRhave been recommended in order to more accurately reflect the elevated disease risks at lower BMI, waist circumference, and WHR values for the Asian population (See Tables 3 and 4) (Barba, Cavalli-Sforza, Cutter et al., 2004, IDF, 2006).In addition, in SA women, abdominal obesity is more strongly associated with insulin and triglyceride levels rather than overall obesity defined by BMI (McKeigue, Pierpoint, Ferri et al., 1992, Chowdhury, Lasker & Mahfuz, 2006).

Table 3. World Health Organization definition of obesity

Classification	BMI (kg/m^2)		Risk for comorbidities
	European population	**Asian population**	
Underweight	<18.5	Same as European	None related to obesity
Normal	18.5–24.9	18.5–23.0	Low to moderate risk
Overweight	25.0–29.9	23.1–27.5	Moderate to high risk
Obesity	≥30.0	≥ 27.6	High tovery highrisk
Class I	30.0–34.9		
Class II	35.0–39.9		
Class III	≥ 40.0		

Source: WHO Expert consultation 2004

Table 4. Ethnic specific values for waist circumference and waist-to-hip ratio

Risk of metabolic complications	Waist circumference (cm)				WHR (cm)			
	Caucasian		Asian Population		Caucasian		Asian Population	
	Men	Women	Men	Women	Men	Women	Men	Women
Increased	≥94	≥80	≥78	≥72	≥0.95	≥0.85	≥0.88	≥0.80
Substantially increased	≥102	≥88	≥90	≥80				

Source: International Diabetes Federation consensus worldwide definition of the metabolic syndrome

Furthermore, abdominal obesity contributes to the incidence of the metabolic syndrome, as it is associated with increased rates of impaired glucose homeostasis, dyslipidaemia and cardiovascular disease (CVD) (Misra, Misra, Wijesuriya et al., 2007, Ritchie & Connell, 2007). Cross-sectional data in the UK showed that both SA and AC women have approximately three times higher prevalence of the metabolic syndrome than native British women defined by both the WHO and the National Cholesterol Education Program (NCEP) (Tillin, Forouhi, Johnston et al., 2005). The increased prevalence of overweight and obesity in both SA and AC women has important health implications, as they are more susceptible to metabolic complications of obesity at any given BMI (Dhawan and Bray, 1997, Tillin et al., 2015). Although the Irish migrants to Britain represent one of the largest migrant groups in any European country, many studies of ethnicity and health tend to exclude them. Similar to some of Britain's other minority groups, Irish people may face some of the social and health disparities that are common in minority groups (Ryan, 2004). It has been suggested that the 'healthy migrant effect' seen in non-European populations does not occur with Irish migrants (Harding, Rosato & Teyhan, 2008). The increased mortality of CHD and poor health of Irish individuals may be explained by their socio-economic position rather than cultural and genetic factors (Nazroo, 2003) (See Figure 2).

Figure 2. Prevalence of obesity, raised WHR, CVD and T2DM by ethnic group among women 55 years and older living in England
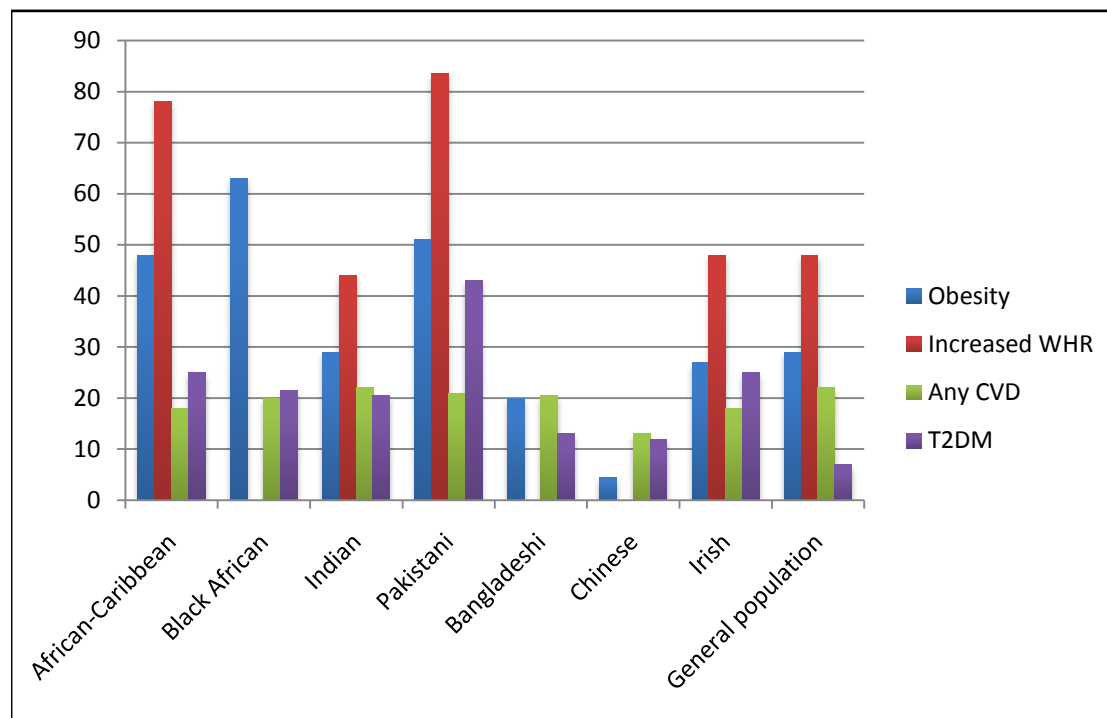
Source: Health Survey for England 2004. The Health of Minority Ethnic Groups.
Obesity: BMI ≥30
Raised WHR: ≥0.85 for women. Data not available for Bangladeshi and Chinese ethnic groups.
T2DM: Only diagnosed by a doctor
Any CVD: angina, heart attack, heart murmur, stroke, abnormal heart rhythm and other.
General population: Comparative data for the general population is not available for 2004;
data have been taken from the 2003 survey.

Dietary behaviours

This section firstly focuses on important determinants of dietary behaviours in older adults.

Then, determinants of dietary behaviours are reviewed for migrant or ethnic

populationsincludingculture and body weight perceptions. Lastly, a review on dietary

assessment in migrant populations is presented.

Dietary behaviours in older adults

Dietary behaviours among older adults are influenced by a myriad of factors including health status and changes in physiological function that are mediated by contextual influences (Payette & Shatenstein, 2005). Personal factors include gender, level of education, socio-economic status, lifestyle practices, early dietary influences, knowledge, psychological attributes, and culture (Devine, Wolfe, Frongillo et al., 1999, Sharkey, Johnson & Dean, 1999, Timpini, Facchi, Cossi et al., 2011). External factors such as food shopping environment, adequate social support, and provision of effective dietary promotion strategies (e.g., healthy eating messages) are also important determinants influencing dietary choices and eating habits in this population (Sahyoun, Pratt & Anderson, 2005, Payette and Shatenstein, 2005).

Old age has been associated with a decline in energy intake due to physiological factors such as reduction in lean body mass, a lower metabolic rate, poor dentition, gastrointestinal disorders, decreased levels of PA, and more (Hickson, 2006). Malnutrition is of particular concern for older adults and is defined as the deficient (under-nutrition), excessive (over-nutrition) or imbalanced consumption of nutrients (Stratton, Green & Elia et al., 2003). In the UK, it has been estimated that at any time under-nutrition affects an estimated of 3 million people (The Advisory Group in Malnutrition, 2009). In addition, recent estimates suggest that 0.3% of older adults aged 65-74 years and 1% of those ≥75 years are underweight (The Information Centre for Health and Social Care, 2011). Concurrently, overweight and obesity is a growing concern in older adults as it exacerbates the age-related physical decline and contributes to increased mortality, impaired quality of life and premature death (Villareal, Apovian, Kushner et al., 2005). National data indicates that the prevalence of obesity in the

UK is 35% in women aged 65-74 years and 26% in those 75 years and older (Bates, Lennox & Prentice2014).

Diet plays a crucial role in the development and management of obesity and chronic conditions such as CVD, T2DM and certain cancers (WHO, 2003, Department of Health, 2005). In the UK, the Government has set several action plans to promote healthy eating among the population,focusingon increasing the consumption of fruits and vegetables (F&V) and decreasing fat and salt consumption. These include public health strategies such as '5-a-day', 'The Eat Well Plate', '8 tips for health' and the 'Change4Life programme' that promotes not only healthy eating but regular PA (Craig & Mindell, 2008, Roberts, 2014). Nonetheless, it is estimated that only a third of older adults (≥65 y) in England are meeting the daily recommendations forF&V consumption but they are exceeding the recommendations for saturated fat (less than 11% food energy) (Bates, Lennox & Practice, 2011).Although women consume more F&V than men, less than 30% of women 55 years and older consume '5-a-day',with consumption tending to decrease with age (Roberts, 2014).

Data from minority ethnic groups was reported in the 2004 Health Survey for England (HSE) (Sproston & Mindell, 2006). The survey indicatesthat the traditional diets of SA (Indian, Pakistani and Bangladeshi) and Black Caribbean communities have lower consumption of dietary fat than the White population. Regarding meeting the '5-a-day' recommendation, with the exception of Bangladeshi women, the proportion of women meeting these guidelines was higher among all ethnic groups in comparison to the general population (Figure 3). Vegetable consumption increased with age among women in the general population and of Black Caribbean origin. In addition, fruit consumption increased with age

among women in most of the minority ethnic groups, except for Black African, Pakistani and

Bangladeshi women.

Figure 3. Proportion of women consuming 5 or more portions of fruit and vegetables per day by ethnic group in the UK
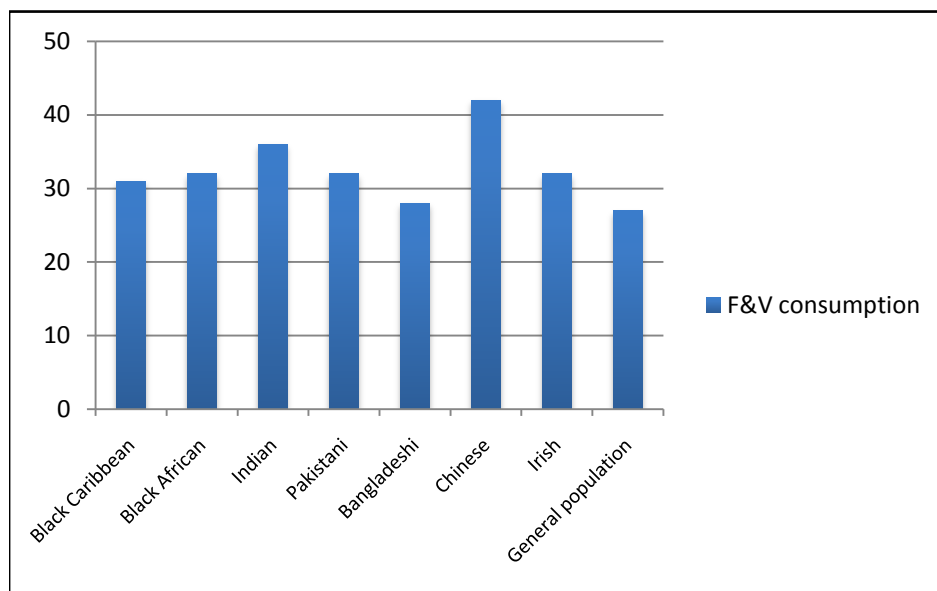
Source: Health Survey for England 2004. The Health of Minority Ethnic Groups

Determinants of dietary behaviours in migrant populations

Migration to a new country, especially when it is from a low-income to a high-income

country, is accompanied by a new availability and affordability of, and exposure to, high-

energy dense foods and beverages as well as an inevitable decrease in PA levels(Kumanyika,

Taylor, Grier et al., 2012). Changes in both diet and PA may explain, in part, the escalating

trends of diet-related health problems among non-European migrant populations including

SA, South Eastern Asians, African-origin and Latino/Hispanic populations (Dekkernet al.,

2011).Yet, it has been suggested that unhealthy dietary changes have stronger negative

effects on migrants' health than changes in their PA. Population movements often produce

health behaviour changes, and dietary habits are not the exception (Satia-Abouta, Patterson, Neuhouser et al., 2002). Available data have shown that dietary changes are a consequence of diverse factors including availability, convenience, socio-economic position, country of origin, religion, and cultural beliefs related to food consumption such as festivities and healing properties (Sharma & Cruickshank, 2001, Gilbert & Khokhar, 2008).

An increasing number of studies have reported negative dietary changes among minority ethnic groups in Western countries. Data from the US has shown that Latinos/Hispanics, consumed healthier diets in their home countries in comparison to their diets in the US(Dixon, Sundquist & Winkleby, 2000). Among women, those more acculturated (adapted to the new culture) tend to consume more fatty foods and less fibre than those less acculturated (Neuhouser, Thompson & Solomon, 2004). Similarly, the diet of more acculturated Hispanic older adults (≥60 years) has been observed to closely follow the dietary pattern of non-Hispanicolder adults, including an increased consumption of fast food (Lin, Bermudez & Tucker, 2000, Bermudez, Falcon & Tucker, 2000).

In Europe, migrant groups tend to change their traditional healthy dietary components such as fruits, vegetables and complex carbohydrates for more processed foods which are energy dense and contain higher levels of fat, sugar and salt(Gilbert & Khokhar, 2008). Studies conducted in AC populations living in Britain have reported an increased consumption of processed foods such as bakery products and sweetened breakfast cereals in young individuals (Donin, Nightingale, Owen et al., 2010). In contrast, a study on Jamaican adults (25-74 y) living in Manchester showed that little change had occurred in their traditional diets composed primarily of rice and peas, starchy vegetables, hard-dough bread and soups (Sharma, Cade, Jackson et al., 1996). Older age as well as the increased availability of traditional Jamaican produce in the UK suggests that it is easier for adult migrants to adhere

to their traditional dietary practices, which include a higher consumption of fruits, vegetables, complex carbohydrates and a lower consumption of total fat (Sharma, Cade, Riste et al., 1999). However, when comparing Jamaican individuals living in Jamaica and abroad, the diets of individuals living in Jamaica were healthier than Jamaicans living in Britain. For instance, saturated fat consumption was as twice as high among older women (≥60 years) living in Manchester than those in women living in Jamaica (Mennen, Jackson, Sharma et al., 2001).

From the same sample, Sharma and colleagues (1999) compared nutrient intake of ACs with data from the National Diet and Nutrition Survey (NDNS). They found that older ACs (65-79 y) consumed less energy from fat and alcohol but more from carbohydrates and total energy compared to the British native population. Among women, ACs consumed 32.6% (95% CI: 31.7-33.5) of total energy from fat in comparison to 39.5% (95% CI: 38.9-40) from White older women. They also found that in general, the consumption of fruit and green vegetables was higher in ACs. These findings support the hypothesis that even when the quality of the AC diet follows the dietary recommendations, the high prevalence of obesity in this population could be more related to the imbalance between energy consumption and level of energy expenditure (Cruickshank, Mbanya, Wilks et al., 2001). Interestingly, they reported that fat consumption among younger generations is higher than that of their White-British counterparts, which suggests that age and immigration generation play an important role in dietary behaviour change among this ethnic group (Sharma et al., 1999).

Culture and diet

For migrant groups there is an underlying cultural factor that is associated with changes in their dietary habits (Smith, 2012). Previous studies, particularly in Asian and African groups living in Western countries, have highlighted the emotional value of traditional food in their cultures (Vallianatos & Raine, 2008, Anderson & Lean, 1995, Garnweidner, Terragni, Pettersen et al., 2012). Cultural attitudes, beliefs and traditions are a key factor in dietary habits and preferences because culture is often expressed through food (Bramble, Cornelius & Simpson, 2009, Beagan, Ristovski-Slijepcevic & Chapman, 2010). For instance, cooking traditional meals 'from scratch' for their families and guests has been described as a way of keeping their identity and a continued connection to their country of origin (Nicolaou, Doak, Van Dam et al., 2009, Bush, Williams, Bradby et al., 1998).

For some cultures, foods do not have the Western categorisation commonly used in nutritional guidelines. In contrast, beliefs about the properties of foods are a main component of the daily diet among different cultures. For example amongIndians, it is common to refer to 'cold' and 'hot' foods. 'Cold' foods are seen as bad and making their body feel sick, whilst 'hot' foods make them avoid illness and make them feel better (Ramakrishna & Weiss, 1992). These beliefs have been passed on for generations and frequently older adults refer to traditional food as good for their health because it provides satiety, energy and strength (Chapman, Ristovski-Slijepcevic & Beagan, 2011). In the same way, many Bangladeshis classify their food both as 'strong/weak' and 'digestible/indigestible'. 'Strong' foods include foods that are seen as unhealthy in the Western diet such as ghee, rich curries, solid fat and white sugar, whilst boiled and grilled foods are considered as 'indigestible' despite being healthier than fried foods (Greenhalgh,

Helman & Chowdhury, 1998). Also, among Bangladeshis the use of plants and food items to treat diseases is still common and thus, the concepts of 'healthy foods' and nutritional practices have a different meaning than that of Western societies (Jennings, Merrell, Thompson et al., 2015). Given these beliefs, nutritional advice can represent a challenge when cultural perceptions of food and health recommendations are not consistent between one's beliefs and the standard health recommendations (Jennings, Thompson, Merrell et al., 2014).This is particularly salient for individuals with chronic conditions such as diabetes and hypertension (Greenhalgh et al., 1998).

Religious beliefs are also an important influence on dietary behaviours, particularly for migrant populations since religiosity can promote a feeling of unity and cohesion within a group (Shatenstein & Ghadirian, 1998). Food traditions importantly reinforce ethnic identity and religious beliefs and thus, they potentially affect the psychological well-being of individuals. Dietary regulations based on religious beliefs may have beneficial (e.g., vegetarianism) or harmful effects (e.g., believing that acquiring diseases such as diabetes is not under one's own control but in fate) (Tan, Chan & Reidpath, 2014, Netto, McCloughan & Bhatnagar, 2007). Recognising their importance is crucial as food traditions and practices are transmitted from one generation to another.

Dietary heterogeneity between traditional migrant groups and changes after migration

It is important to mention that in UK studies the term 'African-Caribbean' is used to describe individuals, who originate from different islands of the Caribbean, also referred to as the West Indies. Although the AC group is composed of mainly Jamaican immigrants, this group is also comprised of people from Barbados, St Kitts and Nevis, St Lucia, Guyana, Montserrat and Trinidad and Tobago (Sharma & Cruickshank, 2001). Given the diversity of origin within

this group, caution should be taken when generalising dietary practices even though their diets share common staple foods such as potato, yam, cassava, plantain, rice, corn and wheat (Landman & Cruickshank, 2001).

Similarly, when referring to 'South Asians' it is important to consider the heterogeneity of this group originated from the Indian subcontinent. The main sub-groups come from India, Pakistan and Bangladesh. In addition, within the different countries there are other subgroups such as Hindu, Punjabi, Gujarati and Ismaili Muslims (Sevak, Mangtani, McCormack et al., 2004). The heterogeneity of this particular group is important because their dietary practices vary not only by place of origin but also by dietary laws and religion(Kassam-Khamis, Nanchahal, Mangtani et al., 1999, Williams, Bhopal & Hunt, 1994).For instance, Gujarati Hindus are traditionally vegetarian while Punjabi Sikhs and Muslims do not eat beef and pork, respectively. In addition, Muslim groups have specific food laws such as consumption of meat that has been ritually slaughtered (Halal) and alcohol consumption is forbidden (Church, Gilbert & Khokhar, 2006, Kassam-Khamis, Judd & Thomas, 2000).

The traditional SA meal is cereal-based with staple foods consisting of chapatti, paratha, puri, roti, naan bread, and rice, which are accompanied by a meat or vegetable curry (Church et al., 2006, Chappiti, Jean-Marie, Chan et al., 2000). Consumption of staple foods may also vary according to region of origin. Pulses are an important component of SA food including chick peas, moong, toor, urad, masur, channa, black-eyed beans and kidney beans (Kassam-Khamis et al., 1999). Traditional fruits and vegetables may include okra, cauliflower, aubergines, courgettes, dodi, spinach and tropical fruits such as papaya, mango, passion fruit, melon and pears (Khokhar, Ashkani, Garduno-Diaz et al., 2013). There is a debate

regarding the fat intake of this population; whilst some authors have described a high consumption of fat from whole fat milk, ghee (clarified butter) and fried snacks such as samosas and bhajia (Lip, Malik, Luscombe et al., 1995), others have suggested that traditional SA food is high in fibre and low in fat (Smith, Knight, Sahota et al., 1993, McKeigue, Adelstein, Shipley et al., 1985).

The SA diet after migration has been characterised as being higher in total energy and fat, containing more meat, sugar and fast food in comparison to a more traditional diet rich in vegetables, fish and dairy products (Holmbee-Ottesen & Wandel, 2012). It has been reported that the main dietary changes in this ethnic group irrespective of age and gender have been in the areas of snacks (e.g., chips, crisps and cakes) and sugary products (e.g., fizzy drinks and ice cream) (Chapman et al., 2011, Simmons and Williams, 1997, Wandel, 1993). The only exception appears to be among older women whose specific gender role as family carers promotes traditional cooking and gives them certain status. Ready meals and fast-food meals may be less appealing to them since food freshness is greatly valued in traditional cooking (Nicolaou, Doak, Van Dam et al., 2009).

Migration has also impacted this ethnic group. Comparisons between SA groups living in the UK and those living in their homeland have shown that those living in the UK have a worse metabolic profile (Higgins & Dale, 2010, Ngo et al., 2009). For instance, Gujaratis (25-79y) living in the West Midlands have higher BMIs, blood pressure, fasting serum lipids, and C-reactive protein in comparison to Gujaratis matched by age, gender and caste living in Indian villages. The British Gujarati sample had significantly higher total dietary intake (1690 vs. 1210 Kcal/day) as well as higher dietary intake from fat (39.5 vs. 31.7 Kcal/day) than their native counterparts (Patel, Vyas, Cruickshank et al., 2006).

Body weight perception

Body weight perception is another important factor that can influence dietary behaviours amongmigrant populations. Traditionally, some Western-cultures are more accepting of larger body sized because overweight and obesity are positively related to health, wealth and fertility (Ofosu, Lafreniere & Senn, 1998, Nicolaou, Benjelloun, Stronks et al., 2012). In particular, women from African-descent have reported that being overweight is advantageous because men find thin women unattractive (Bramble et al., 2009). For instance, in one study, women reported that *"in their eyes"* the definition of obesity differs from the common Western definition of obesity (having a BMI >30). In this study, women described that obesity was based on how they perceive themselves rather than how the Western society viewed them (Bramble et al., 2009). If we take into account women's perceptions, it is possible that many of them start to be conscious about their weight status when they are already obese and diagnosed with a nutrition-related disease. In this group, in particular, a prevention period could be missed if women perceive health problems when it is more difficult to intervene. Identifying women when they are at risk of overweight or even while they are still in the overweight category would be a better period of time for action. On the other hand, amongSA women, the concept of obesity as a sign of health and fertility may be changing. Several studies have reported a higher weight consciousness and an association between large body size and dissatisfaction, predominantly in young women (Grace, Begum, Subhani et al., 2007, Greenhalgh, Chowdhury & Wood, 2005). However, compared to European women there are still differences in body size perceptions (Lean et al., 2001, Netto et al., 2007).

It is possible that similar cultural factors influence the nutrition behaviours of women irrespective of their age. However, data from older women (≥60 years) is missing in order to understand if important cultural factors and traditions that govern nutrition behaviours in young women differ from those of older women. Until now, research on older women has focused on experiences of menopause and breast cancer (dos Santos Silva, Mangtani, McCormack et al., 2002, Miller, Sorokin, Wilbur et al., 2004).Yet, it is important to recognise that the ageing process has different attributes in different cultures and thus, investigating how we can make this process healthier for them remains a challenge (Choudhry, 2001, Lagacé, Charmarkeh & Grandena, 2012).This is particularly important because in comparison to the European population, the ageing process seems to occurat an earlier chronological age for migrant populations (Bajekal et al., 2004).

Dietary assessment in migrant populations

As previously mentioned, dietary intake varies among different sub-groups of the population such as minority ethnic groups (Gilbert & Khokhar, 2008, Patel, et al., 2006). However, assessing diet in these subgroups poses a significant challenge not only because studies have used diverse methodologies, but also because the socio-cultural component needs to be addressed in order to get meaningful and useful dietary information (Ngo et al., 2009, Landman & Cruickshank, 2001, Satia-About a et al., 2002).

Since the 1990s, researchers have been developing and validating dietary instruments in order to make it possible to assess diet in minority groups (Jackson, Walker, Cade et al., 2001, Sharma et al., 2001, Kassam-Khamis et al., 1999, Garduno-Diaz & Khokhar, 2013). Some of the difficulties that researchers have found while collecting dietary data in this groups include lack of knowledge of the researcher/health professional about the foods and

dietary practices of diverse groups, limited information on ethnic foods and recipes, difficulty in estimating portions sizes and consumption of uncommon foods among different ethnic groups, and challenges in accurately assessing dietary intake in those who eat from a shared container or pot (Kruger, Stonehouse, Von Hurst et al., 2012).

High-quality dietary assessment is paramount for establishing associations between diet and disease and to establishing reliable outcomes to influence interventions and policies at both individual and population levels (Sharma, 2011). Migrant groups are usually excluded from research studies due to a lack of validated and culturally-tailored dietary assessment instruments; however, insight into their food and dietary habits is critical for the development of nutritional policies and interventions to target the well-recognised health disparities between these groups and the general population (Beagan et al., 2010, Satia-About a et al., 2002). This is particularly important because food habits play an important societal, symbolic and religious role in keeping harmony in the daily lives of migrant or minority groups (Lawton, Ahmad, Hanna et al., 2008, Popovic-Lipovac & Strasser, 2015).

In nutrition research, there are different methods that can be used to measure nutrient intakes at an individual and population level. Food-frequency-questionnaires (FFQ) are the most common dietary tool used in studies evaluating dietary intake in minority ethnic groups (Scott, 1998, Wild et al., 2007, Kassam-Khamis et al., 1999). They are also popular in epidemiological studies of health and nutrition because they provide an estimate of long-term usual intake (Bhakta, dos Santos Silva, Higgins et al., 2005). Researchers have also been using FFQs because they are relatively inexpensive and can be adapted to a specific population. However, FFQs per se might not be the best tool to use when the population includes a new group of immigrants, or for those individuals who do not speak the language

of the host country and even more, when they are not literate in their own language (Khan, Owens, Bruce et al., 2009).

Dietary food records can provide accurate information of foods and beverages consumed during the recording period (from 3 to 7 days). Although they are considered as highly reliable for dietary data collection, they have a number of limitations. Firstly, participants need to be trained to accurately report the food and amount consumed as well as the preparation technique. Secondly, participants' fatigue after 4 days of recording has been associated with low adherence and respondent burden (Brunner, Stallone, Juneja et al., 2001, Thompson & Subar, 2008). For researchers, food records are a challenge when managing and coding the data because dietary information is not consistently reported from participant to participant. Keeping a food record requires both literacy and motivation and thus, their use in some sub-groups of the population such as older adults and migrants is questionable (Thompson & Byers, 1994).

The 24-hr dietary recall has been used to obtain dietary data of vulnerable sub-groups and for those individuals whose dietary practices are not well known (Ngo et al., 2009). In addition, 24hr recalls provide the researcher/interviewer with the opportunity to obtain detailed information of specific recipes, including all ingredients and preparation techniques used, that are difficult to obtain with other methods (Adamson, Collerton, Davies et al., 2009, Garduno-Diaz, Husain, Ashkanani et al., 2014). This method has the limitation of relying on the participants' memory and needs to be conducted by well-trained interviewers with knowledge about foods and preparation techniques, including ethnic foods. Standardised in-depth probing needs to be conducted to help participants remember what

they ate the day before and not lead the participant to give an answer when the participant can't recall the foods and/or the amount eaten (Thompson, 2008).

To date, food records, 24-hr recalls and FFQ are the most common methods used to measure food and nutrient intake of individuals, but they are only a crude estimate of food consumption as they rely on the respondents' memory and ability to estimate portions sizes. Biomarkers of nutrient intake in biological samples are a more reliable tool to measure dietary intake; however they are invasive and expensive, and are thus difficult to use in community settings or larger samples due to financial constraints (Sharma, 2011).

Physical activity

PA has been defined as any body movement produced by skeletal muscles that requires energy expenditure and thus, enhances health and well-being (U.S. Department of Health and Human Services, 1996). In conjunction with diet, PA is recognised as a major modifiable health behaviour that can reduce morbidity and premature death (Stafford, Cummins, Ellaway et al., 2007). According to the WHO (2010), physical inactivity, which is defined as "a state in which bodily movement is minimal and energy expenditure approximated the resting metabolic rate," was rated as one of the principal causes of mortality in developing countries and emerging economies.

Both the WHO and the UK Department of Health recommend at least 150 minutes of moderate or 75 minutes of vigorous activity spread across the week in bouts of 10 minutes and more (WHO, 2010, UK Department of Health, 2001). Nonetheless, the 2008 HSE indicated that only 40% of men and 28% of women in England self-report adhering to these

guidelines. These national data also confirmed that PA progressively decreases with age. In women, for example, less than 40% aged 55-64 years, only 30% of those aged 65-74 years, and approximately 15% of those aged 75 years and older self-report engaging in moderate PA for more than 10 consecutive minutes (Craig, Mindell & Hirani, 2009).

Furthermore, findings from a sub-sample of the 2008 HSE with objective measures of PA (accelerometry) showed that 0% of older women (≥65 years) adhere to the PA recommendations. The discrepancy between self-reported and accelerometry data was later confirmed among a group of older adults with history of cardiac disease. In this study, approximately 63% of individuals who answered the HSE PA interview over-reported their PA levels (Orrell, Doherty, Coulton et al., 2007). It is noteworthy that the population sampled in this survey was mainly White-British and thus, accelerometry data of older adults from diverse ethnic backgrounds adults is still missing. More recent national data, although self-reported, showed that 27% and 61% of women aged 65-74 and 75-84 years old, respectively, were classified as physically inactive (See Figure 4) (Scholes & Mindell, 2013). While the health benefits of PA have been long recognised, it was more recently that the importance was emphasised in older adults.

Figure 4. Self-reported physical activity levels among women 55 years and older
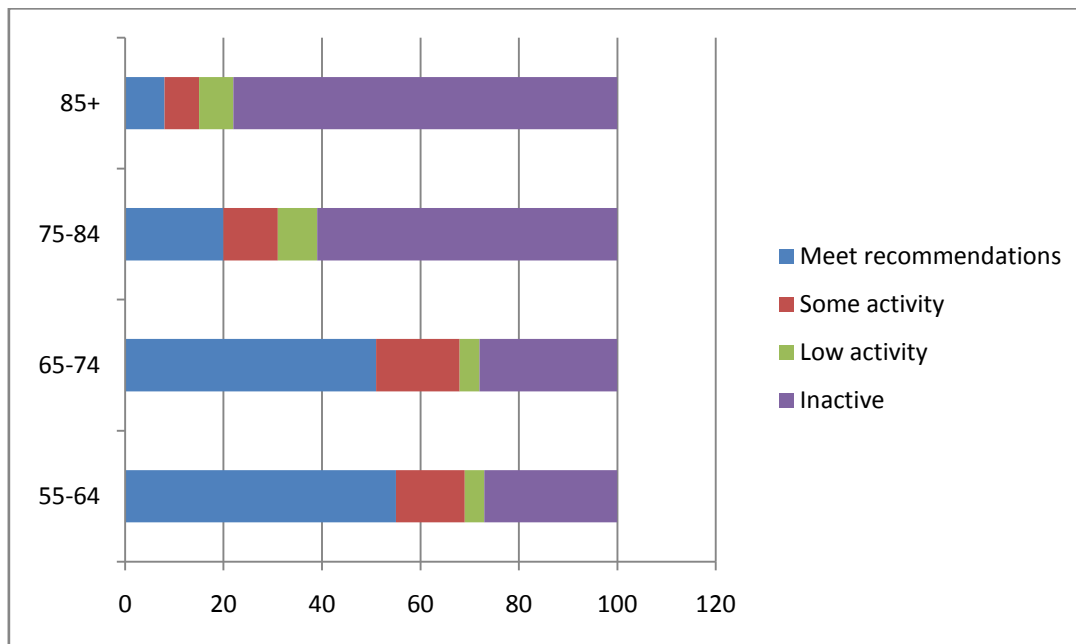
Source: Health Survey for England 2012

Physical activity in old age

Although it has been recognised that changes in PA behaviours may result in better health outcomes when they are instituted early in life, adopting a more active lifestyle can also have positive effects in old age. For instance, PA can be used as a secondary prevention strategy to prevent progression and future complications of obesity, hypertension, T2DM, CVD and certain cancers (Chernoff, 2001). Until now, little attention has been paid to the worldwide increasing prevalence of overweight and obesity among older adults. In the past, research has focused on preventing and treating malnutrition and underweight in this population group.Therefore, controversy of whether the benefits of intentional weight loss outweigh the riskshas prevented health care professionals addressing this escalating health concern of excessive weight in this population (Houston, Nicklas & Zizza, 2009, Rossner, 2001). In England, the prevalence of overweight and obesity rose from 68% to 71%

amongwomen between 55-84 years old from 2004 to 2012 (Moody, 2013). Overweight and obesity have important implications for both health and social services, as they have not only been related to physical disability but also to cognitive disability, frailty, fall-related injuries, higher risk for dependency, institutionalisation and mortality among older adults (Blaum, Xue, Michelon et al., 2005, Beydoun, Beydoun & Wang, 2008).

In addition, PA has been suggested as a preventive mechanism for mental illness such as depression and dementia, including Alzheimer's disease (Lautenschlager, Cox, Flicker et al., 2008, Rolland, van Kan and Vellas, 2008, Strawbridge, Deleger, Roberts et al., 2002b, Fox, 1999). Engagement in leisure and structured PA has been associated with increased social networks, better mood and higher self-esteem that positively affect the well-being and physical functioning of older adults (Elavsky, Mcauley, Motl et al., Weuve, Kang, Manson et al., 2004). Loss of muscle mass, which produces musculoskeletal frailty and reduced locomotory function, has been recognised as a normal process in old age; however, physical inactivity can accelerate this process and importantly contribute to functional decline (Taylor, Cable, Faulker et al., 2004). Therefore, an active lifestyle may counteract the age-related decrease in lean body mass and concomitant fat mass increase better known as sarcopenia (Hunter, McCarthy & Bamman, 2004, Villareal et al., 2011). Moreover, since PA enhances bone mass and improves physical functioning, it can also reduce the risk of osteoporotic fractures that predominatein older women (Borer, 2005).

Even though is difficult to quantify the financial impact of physical inactivity, it has been estimated that the burden physical inactivity places on health care services and its effect on the population's life expectancy is high (Kohl, Craig, Lambert et al., 2012, Allender, Foster, Scarborough et al., 2007).It is estimated that over 3% of Britain's morbidity and mortality

was attributable to physical inactivity during 2003and 2004 (Allender et al, 2007). For the UK National Health Service (NHS), physical inactivity was translated into a direct health cost burden of approximately £1 billion (Scarborough, Bhatnagar, Wickramasinghe et al., 2011).Furthermore, the Department of Health has estimated that the total direct and indirect costs (e.g., days lost to sickness and disability) of physical inactivity in England are over £8 billion per year (Hillsdon, 2004). Given this, promoting an active lifestyle among older adults is crucial, as the greatest health care utilization occurs during the final years of life (Duff, 2001).Older women are a particular high-risk group as they tend to live longer than men and are more likely to experience poverty and poor health at an old age (Marmot et al., 2007, Oksuzyan, Crimmins, Saito et al., 2010).

Determinants of Physical Activity

Previous studies have documented numerous obstacles to promotingregular PA amongolder adults. Barriers to PA in older adults include low socio-economic status, lower educational levels,living alone, lack of social support, fear of falling, pain, illness, lack of skills and knowledge, lack of time and motivation (King, Castro, Wilcox et al., 2000, Chrisler & Palatino, 2016). Environmental barriers such as personal safety, transport, weather, built environment and rural area residence have been cited as negative influences for engaging in PA (Schutzer & Graves, 2004, Brawley, Rejeski & King, 2003, Stathi, Gilbert, Fox et al., 2012).Obese individuals may have further barriers to perform PA such as low self-esteem and confidence, embarrassment, lack of self-efficacy (confidence in one's ability), lack of proper information from health professionals (e.g., what type of PA and what frequency), poor mobility due to excessive weight, lack of visible and immediate results related to weight loss, discomfort or

pain, boredom and low tolerance related to poor fitness (Hills & Byrne, 2006, Ball, Crawford & Owen, 2000, Costello, Kafchinski, Vrazel et al., 2011).

Research conducted amongolder adults has identified differences related to variables such as gender, age, diagnosed diseases and ethnicity. For instance, engagement in structured PA is more common in younger age groups and in those who do not have any diagnosis of chronic conditions such as arthritis (Drewnowski & Evans, 2001). In comparison to men, previous studies have found that women tend to be more sedentary and to be involved in caregiving duties that prevent themengaging in PA (King et al., 2000).

Ageism could also represent another obstacle to tackle, as discrimination due to their chronological age may also prevent them participating in any PA (Ory et al., 2003, Chrisler & Palatino, 2016). For instance,health professionals can importantly contribute to the misconception that PA decline is normal in older patients (Minichiello, Browne & Kendig, 2000). Misinformed older patients may interpret the normal effect of performing PA such as sweating, muscle soreness, and shortness of breath as negative or unhealthy effects of performing moderate-to-vigorous PA (MVPA) (Schutzer & Graves, 2004).

Physical activity and migration

Previous studies have shown that migration to a more industrialised country may also affect PA levels where access to motorised vehicles, services, and domestic appliances have encouraged more sedentary lifestyles. For example, studies conducted in the US have consistently shown disproportionate physical inactivity levels between non-Latino White and Latino women (47% to53% vs. 22% to 38%, respectively) (Crespo, Smit, Andersen et al., 2000).As seen with dietary behaviours, 'acculturation' also has been strongly related to

decreased levels of PA among migrant populations (Abraido-Lanza, Chao & Florez, 2005, Salant & Lauderdale, 2003).

Similarly to the prevalence of obesity and other chronic diseases, physical inactivity is more marked in women than men (Higgins & Dale, 2009). In the UK, physical inactivityhas been reported among SA groups, but Pakistanis and Bangladeshis have been found tobe more inactive than Indians (Hayes, White, Unwin et al., 2002, Pomerleau et al., 1999). Recently, findings from a longitudinal study with follow-up mortality data from NHS registries showed that self-reported low levels of PA accounted for more than 20% of the excess of CHD mortality in SA adults (>35y) in comparison with White British population. This study also showed that SA experience cardiovascular events 10 years earlier than their White counterparts even after adjusting for socio-economic status, smoking, diagnosed diabetes and CHD (Williams, Stamatakis, Chandola et al., 2011).

Cultural norms and social expectations partially explain the difficulties SA women face when they are involved in PA. For example, taking time to engage in exercise could be seen as a negative thing to do within their communities because it would be viewed as neglecting their women's role responsibilities such as caretaking duties (Sriskantharajah & Kai, 2007). Religious-related barriers have also been found to prevent participation in PA. Forexample, Western facilities such as sports centres may not be congruent with their religious way of life, in part, because modesty could be put at risk in mixed-sex facilities (Sriskantharajah & Kai, 2007, Anderson & Lean, 1995). Outdoor exercising and the use of sport clothing would not be religiously approved for some women as they could be showing their figure to men (Grace, Begum, Subhani,et al., 2008, Scott, 1998). As previously discussed, the perception that at an old age one needs "*to rest or slow down*" or that "*it is too late to change*" can also represent a barrier for some cultures (Jepson, Harris, Bowes et al., 2012).

Another important barrier reported among SA groups is the fear of going out or joining PA programmes if individuals are not fluent in the host country's language (Horne, Skelton, Speed et al., 2013). Fear of leaving their neighbourhood owing to safety issues, racism, weather conditions and the fear of aggravating an already diagnosed condition by doing exercise were also barriers reported among SA (Lawton et al., 2008).For some specific groups, the sole concept of PA is an issue from the researchers' point of view. In the Bangladeshi Sylheti language, which is an exclusively oral language, there is not a direct translation from English or a phrase that can describe what PA means and thus, it may be difficult to translate recommendations of PA in their daily life for this particular SA group(Greenhalgh et al., 1998). This is important in the UK context, as the majority of Bangladeshis who immigrate to the UK from Bangladesh are from the Sylhet region (Garbin, 2005).

Importantly, cultural differences among diverse ethnic groups should not be viewed as a barrier in itself, but how health professionals interpret these differences may be a barrier for effective medical advice (Horne et al., 2013). Stereotypes and assumptions have the potential to prevent older people from ethnic backgrounds from engaging and adhering in PA, as health professionalstend to treat minority groups as a homogenous group. Therefore, it is crucial for health professionals to recognise that minority groups have different experiences and beliefs and thus, attention should be paid to communication styles to facilitate uptake and adherence to PA (Horne and Tierney, 2012).

Differences in PA between minority ethnic groups and the UK's mainstream population are mostly recognised amongSA (Babakus & Thompson, 2012); however, there is little literature on other minority groups (Higgins & Dale, 2009). For instance, in the case of Chinese, their

lower prevalence of obesity and related chronic diseases may contribute to the lack of data

from this population (Wild et al., 2007). In their culture, PA is likely to be seen as important

for one's health and longevity. Contrary to SA, diagnosis of a disease could become a

facilitator for participating in PA instead of acting as a barrier (Belza, Walwick, Shiu-

Thorntonet al., 2004). According to the 2004 HSE, ACsself-report similar or greater

adherence to the PA guidelines than the British-native population. Among women, Black

Caribbean, Black African, Chinese and Irish women self-report having greater adherence to

the PA guidelines than White-British women (See Figure 5) (Sprotson & Mindell, 2006).

Moreover, as previously mentioned, socio-cultural factors need to be explored in detail since

cultural and spiritual beliefs may also influence PA similar to their influence on dietary

practices and body image. For instance, a Dutch study conducted among African-descent

hypertensive migrants reported that PA is discouraged because participants highly valued a

large body frame (Beune, Haafkens, Agyemang et al., 2010). Consistently with those barriers

reported in SA, financial constraints, weather, old age, lack of social support, fear of lethal

consequences of exercise, caregiving responsibilities and women's role are also very strong

barriers for African-descent women to engage in PA (Sriskantharajah et al., 2014).

Figure 5. Percentage of women 55 years and older self-reporting meeting physical activity guidelines by ethnic group in the UK
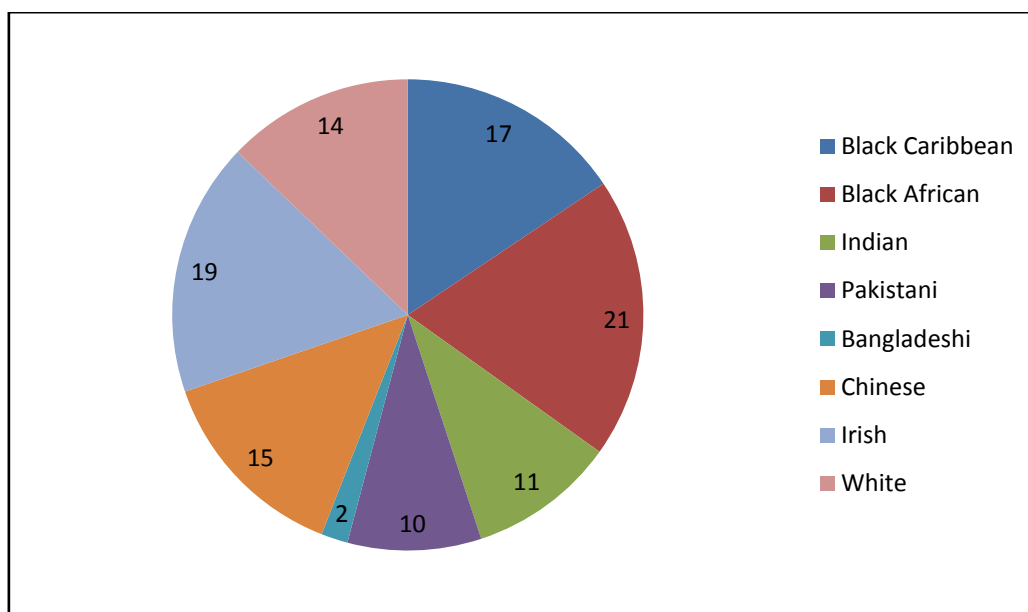
Source: The Health of Minority Ethnic Groups. Health Survey for England 2004

Although both quantitative and qualitative studies have investigated PA behaviours among

SAs, there is still inconsistent data about the effectiveness of strategies targeting this

population. To date, there are no randomised controlled trials conducted in SA women that

provide enough evidence to draw conclusions about PA levels, and there are also few studies

that have measured sedentary time (ST) in this specific population (Curry & Thompson,

2014). In addition, it is difficult to determine whether or not PA in women from different SA

groups differs, as studies have used different methods to assess PA as well as different PA

domains (e.g., leisure or occupational PA) (Babakus & Thompson, 2012). Health promotion in

this particular population has a strong socio-cultural component and thus, promoting PA

requires a comprehensive understanding of beliefs and attitudes towards PA to guide public

health strategies. The answer to why SAs tend to self-report such low levels of PA may be a

combination of non-cultural and cultural barriers, and a lack of cultural contextualisation

around PA which impacts their ability to accurately self-report their PA and ST (Curry,

Thompson & Duda, 2015, Babakus-Curry & Thompson, 2014, Horne & Tierney, 2012); each of these factors need to be explored in more depth. Above all, there is a lack of information about PA and ST in older women from diverse ethnic backgrounds. This information is critical to our understanding of how to promote healthy ageing in this population.

Measurement of Physical Activity

Accurate assessment is needed in order to evaluate PA levels of any population.In epidemiology studies, PA has commonly been measured by self-report methods, which by nature are susceptible to bias (e.g., overestimation of PA and participant recall) (Sallis & Saelens, 2000). Self-report involves the use of questionnaires to collect data ontype, frequency and duration of the activity and some questionnaires include ST (Craig et al., 2003). The advantage of self-report is that questionnaires are a non-expensive and easy tool to apply in large epidemiologic studies. Given that this method is not only prone to bias but has validity and reliability issues, researchers have increased their interest in objective measures of PA such as doubly labelled water, heart rate monitors, pedometry and more recently, accelerometry (Prince, Adamo, Hamel et al., 2008, Hansen, Kolle, Dyrstad et al., 2012, Babakus-Curry & Curry, 2014).

The doubly labelled water method is the 'gold standard'used to accurately assess PA and validate other assessment methods; however, its use is limited due to the high research costs. In addition, information on the intensity, frequency and duration of activity performed cannot be estimated (Sallis & Saelens, 2000). Similarly, heart rate monitors and pedometers are unable to assess characteristics of the activity performed as well as being unable to estimate energy expenditure (Corder, Brage & Ekelund, 2007). Moreover, these devices are

only useful when assessing aerobic activities and walking, respectively. Some studies conducted in hospital patients have recorded and monitored PA through direct observation. Although this method can provide important data including the context in which the activity occurs, its main limitations are that this method is time consuming, resource intensive and prone to observer bias (Patterson, Blair, Currie et al., 2005).

Accelerometry is a non-invasive method that provides real-time estimates of the intensity, frequency and duration of free-living activity in a sequential period of time so patterns of PA can be identified (Trost, Mciver & Pate, 2005, Cheung, Gray & Karunanithi, 2011). The accelerometer device is worn around the waist, near the hip and allows for estimates of intermittent and spontaneous intensity-specific PA (Hansen et al., 2012). The use of accelerometry has been increasing in the last two decades across all age groups. Amongolder adults it is particularly useful given that self-reported PA may have other biases this population such as cognitive ability, fluctuation in mood, anxiety and reduced information processing speed (Davis & Fox, 2007). Moreover, older adults tend to engage in different types of PA than younger population groups and questionnaires, even if adapted for older adults, may fail to accurately estimate light intensity activities such as leisure walking, golf and gardening (Drewnowski & Evans, 2001). Limitations of this method include failing to capture upper body movements such as those involved while cycling, rowing or doing weightlifting. In addition, the devices are expensive and their use in population-level settings may not be feasible (Dishman, Heath & Lee, 2013).

Acculturation research in health behaviour

The study of acculturation has its roots in the onset of the 20th century. However, over the last four decades, it has been widely used to study health disparities amongmigrant populations and the host country's population (Zambrana & Carter-Pokras, 2010). In the field of public health, acculturation is defined as "adoption and assimilation by a person or social group of the cultural customs, traditions, practices and behavior of what previously had been for them an alien culture" (Perez & Padilla, 2000).

The measurement of acculturation is highly controversial and fiercely debated, because many current theories and quantitative scales disregard important factors that influence the process in which individuals integrate into the host/dominant culture such as societal and historical factors (Cabassa, 2003). In addition, the concept of 'culture' is vague and can be interpreted very differently, as every person may have a personal understanding of what constitutes a culture, what characteristics are descriptive to the mainstream or dominant versus the ethnic culture, and what it takes to adapt to a new culture (Hunt, Schneider & Comer, 2004).

Multicultural appropriateness

Although there are several acculturation models, many of the available data come from studies measuring acculturation through simple variables such as proficiency in the host country's language, time of residency, and access to health care and neighbourhood (Lara, Gamboa, Kahramanian et al., 2005). Other studies have used acculturation scales exclusively developed for a specific population such as the 'Bidimensional Acculturation Scale for

Hispanics' (Marin & Gamba, 1996)or 'The Suinn-Lew Asian Self Identity Acculturation Scale'(Suinn, Rickard-Figueroa, Lew et al., 1987). These scales have been commonly used when measuring large samples in common areas, but it would be impossible to create a single scale to address all groups in all locations due to the diversity of the ethnic groups and the host countries. For instance, the Latino/Hispanic population in the US comes from a variety of countries from the Caribe and Latino America that would make it inappropriate to group their health behaviours (e.g., diet and PA patterns) intoone cluster (Perez-Escamilla & Putnik, 2007, O'Driscoll, Banting, Borkoles et al., 2013). Another example is the SA population where individual characteristics vary from geographical location to religious practices (Kassam-Khamis et al., 2000).

Moreover, and as mentioned before, migrant or ethnic groups are not homogenous. Migrants have such different migration experiences between each other that their process of adaptation and settlement to a new country could be totally different even if they belong to the same ethnic group (Blakemore & Boneham, 1994). For instance, acculturation studies have reported that more acculturated migrants tend to have higher levels of leisure PA (Neighbors, Marquez & Marcus, 2008, Mejean, Traissac, Eymard-Duvernay et al., 2009). On the other hand, studies conducted in refugees have shown a negative effect on PA levels associated with post-traumatic stress due to the migration process (Caperchione, Kolt, Tennet et al., 2011, Barnes & Almasy, 2005).

Furthermore, the measurement of acculturation in health research may be biased by ethnic stereotyping rather than being based on authentic representations of cultural differences (Hunt et al., 2004). Notably, studies measuring acculturation rarely take into account or measure explicitly culture or migration experiences, which complicates comparisons

between studies or make it difficult to attribute findings or even to make comparisons between different migrant generations from the same ethnic group (O'Driscoll et al., 2013). In research involving behavioural changes among super-diverse communities, the complex interaction between demographic, socio-cultural, and environmental factors that influence health behaviours in migrant populations may only be truly determined by understanding the role of the contextual influences in the target population (Kumanyika et al., 2012). Due to the limitations and contentious nature of measuring acculturation in migrant groups, this construct was not examined in this PhD research.

Study rationale

This literature review confirms a paucity of researchexploring nutrition and PA behaviours within the context of migrating to, and ageing in, the UK. A substantial body of literature has consistently shown that many ethnic or migrant groups living in Western countries have higher prevalence of non-communicable diseases including obesity and its metabolic complications (Misra, Khurana, Isharwal et al., 2009, Gilbert & Khokhar, 2008), but less is known about the prevalence of physical decline or frailty among these groups and its association with diet and PA.

Furthermore, there are a number of complex factors that prevent researchers from includingminority ethnic populations in research (Betancourt, Green, Carrillo et al., 2003). Marginalising thesegroupsresults in poor descriptive studies that fail to explore in more detail the effect of diversity on health and well-being (Gill & Redwood, 2013, Plumridge et al., 2012). Research that develops knowledge that can be used to plan for sensitive and appropriate public health strategies, whatever the cultural background of individuals is

warranted given the contemporary demographic changes of Western countries such as the UK. This is crucial since the way health problems are conceptualised and understood will certainly affect the way problems are defined and prioritised in the health agenda (Papadopoulos, 2006). This, in turn, is likely to influence the amount of resources being directed to minority ethnic health disparities and promotion of healthy lifestyles.

Until now, little is known and even less has been understood about the needs of older adults living in super-diverse communities. This is particularly true for first generation migrant women whose migration experiences can lead to changes in their roles and familial structure, whichin turn may influence the way they operate in the society at large. These changes do not necessarily have to be negative, they may also bring benefits to them, their families and their communities; however, the lack of understanding about these changes can lead to missing important opportunities to promote healthy ageing.

The present PhD research project contributes to addressing some of theexisting gaps in the literature related to nutrition and PA behaviours among migrant older women and how these relate to their physical function. In addition, exploring experiences and perceptions of ageing from the perspective of older women from diverse ethnic, socio-economic and migrant backgrounds will provide useful insights that may be used in future health strategies that can optimise their life expectancy and quality of life by reducing risks for physical decline, nutritional risk, chronic diseases and their associated negative health outcomes.

CHAPTER 2

METHODOLOGY

In this chapter the methodological approach taken to exploring nutrition and PA behaviours and its association with frailty within the context of ageing in, and migrating to, the UK is described and justified. The chapter begins with a discussion of the research paradigm, including the ontological and epistemological framework that justified the choice of a mixed-methods approach. A detailed description of the quantitative and qualitative methods is also presented.

The Research Paradigm

A paradigm is a set of beliefs or assumptions that guide the way research is conducted. According to Guba (1990), paradigms are characterised through their ontology (the nature of reality), epistemology (the nature of knowledge), and methodology (how we gain knowledge). These characteristics create a holistic view on how we view knowledge and justify the methodological strategies we use to discover it. Epistemology also influences whether the knowledge is developed 'inductively' or 'deductively' (Gray, 2014, Neuman, 2003). Deductive reasoning is seen as reasoning from the general to the particular involving formulation of hypotheses followed by designing a research strategy to test those hypotheses (Gray, 2014). In contrast, as explained by Neuman (2003, p.51) inductive reasoning moves "*from detailed observations of the world towards more abstract generalisations and ideas*" in order to reach conclusions or generate theories.

Examples of worldviews include positivism and constructivist (Creswell & Plano Clark, 2011, Denzin & Lincoln, 2011). The postpositivst approach denotes that an objective reality exists external to the researcher. Therefore, researchers from a postpositivst perspective will begin formulating and testing a hypothesis using a deductive approach and a quantitative methodology to develop 'true statements' that better describe the casual relationships of interest (Gray, 2014, Tashakkori & Teddlie, 2003). In contrast, researchers from a 'constructivist' perspective believe that knowledge is socially constructed and seek to make sense of the meanings of others have about the world. Instead of starting with a hypothesis or theory, researchers use an interactive and qualitative enquiry to develop theories or models via an inductive approach (Creswell, 2013, Denzin & Lincoln, 2011).

The present thesis was underpinned by a more modern epistemological approach where the study design emerges from the research questions being explored, known as pragmatism (Creswell & Plano Clark, 2011, Patton, 2002). Pragmatism is a philosophical position that originated with the work of historic pragmatists such as Charles S. Peirce, William James and John Dewey (Johnson & Onwuegbuzie, 2004). More recently, Teddlie and Tashakkori (2003) described this worldview as:

> *"A deconstructive paradigm that debunks concepts such as 'truth' and 'reality' and focuses instead on 'what works' as the truth regarding the research questions under investigation. Pragmatism rejects either/or choices associated with the paradigm wars, advocates for the use of mixed methods in research, and acknowledges that the values of the researcher play a role in interpretation of results". (p.713)*

Johnson and Onwuegbuzie (2004) argue that pragmatism narrows the divide between quantitative and qualitative purists, which view their own paradigms as the best way to carry out research. For more than a century both set of purists supported the 'incompatibility thesis', which posits that each type of data have different epistemological, ontological, and methodological assumptions that should not be mixed (Tashakkori & Teddlie, 2003). This 'paradigm debate' helped to set the stage for the emergence of MM research as the 'third paradigm for research' (Denscombe, 2008). As MM research emerged, researchers have claimed that its 'methodological eclectism' allows the researcher to select the most appropriate techniques to answer research questions that may evolve during the research process instead of choosing between quantitative (positivist/post positivist) or qualitative (constructivism and its variants) traditional methods (Creswell & Plano Clark, 2011). Given this, the MM approach has its origins in the applied fields of social and behavioural sciences rather than in pure human sciences due to the pragmatic and broader data sources needed to answer practical inquiries (Broom & Willis, 2007).

It is worth mentioning that the goal of a MM approach is not to replace either quantitative or qualitative paradigms but to build upon the strengths and minimise the weaknesses of both, as Creswell and Clark (2011) pointed out in their MM research definition:

"Mixed methods research is a research design with philosophical assumptions as well as methods of inquiry. As a methodology, it involves philosophical assumptions that guide the direction of the collection and analysis of data and the mixture of qualitative and quantitative approaches in many phases in the research process. As a method, it focuses on collecting, analysing, and mixing both quantitative and qualitative data in a single study or series of studies. Its central premise is that the use of quantitative and

qualitative approaches in combination provides a better understanding of research

problems than either approach alone" (p. 5).

In the fields of nutrition and PA, data collection and analysis are traditionally quantitative in nature (Swift & Tischler, 2010). However, the MM research design is becoming more popular in the social and health-related sciences, including chronic disease prevention and PA promotion (Harris, Gleason, Sheean et al., 2009, Stathi et al., 2012). For instance, a MM approach can be more useful when the aim is to understand complex phenomena such as factors influencing lifestyle behaviours in minority ethnic communities (e.g., intentions, culture and attitudes) (Johnson & Onwuegbuzie, 2004, Creswell & Plano Clark, 2011).

The present thesis sought to gain a better understanding of the current dietary and PA behaviours of first generation migrant women and the factors that influence these lifestyle behaviours. Therefore, and as a consequence of its pragmatic approach, a MM methodology was employed to explore these behaviours in more depth.

Mixed-methods design

This MM study followed a sequential explanatory design (Creswell & Plano Clark, 2011). This allowed for obtaining different types of complementary data to address the research questions. Given that this research design has two parallel components that are complex to conduct simultaneously by a solo researcher, data collection was collected in two sequential phases (See Figure 1). However, due to busy schedules of participants and difficulties in arranging a second visit for women who needed to be accompanied by a family member or an interpreter, data collection was done concurrently in some cases (n=15). Equal priority was given to the quantitative and qualitative components of the study as a combination of

these provided a richer insight into the phenomenon under study (Tashakkori & Teddlie, 2003). Both components of the study were integrated in the interpretation of the results in three of the empirical chapters (Chapters 3-5). For the purpose of Chapter 6, only qualitative data were reported.

Different research methods were selected to respond to the research questions, which will be described in the procedures of data collection and methods of data analysis.

Figure 1. Mixed-methods design

Data collection	Data analysis	Interpretation

PHASE I. QUANTITATIVE
Convenience and purposive sampling
First-generation migrant older women
(≥60 y).

Identify current nutrition and PA behaviours:
- Socio-demographic questionnaire
- 24-hr recall interview
- Accelerometry
- Physical test and function: anthropometry & frailty phenotype.

- Descriptive statistics
- Correlations and regression analysis to explore the association between nutrition and PA behaviours and function.

Connecting quantitative and qualitative data

PHASE II. QUALITATIVE
Sub-sample purposively sampled based on socio-demographic characteristics

Semi-structured interviews
- Explore their meaning of ageing in a super-diverse city.
- Lived experiences and perceptions of the phenomenon and how it influences their nutrition and PA behaviours.
- Link between diet, PA and physical function (frailty)

Inductive thematic analysis

- Enhanced understanding of key influences on current nutrition and PA behaviours and their association with function (frailty) in the context of migration and ageing in a super-city among a group of older women.
- Further directions for future intervention strategies

Procedures of data collection, processing and analysis

The following section will describe in more detail methods of data collection as well as data processing and analysis.

Recruitment and participants

Free-living first generation migrant women who were at least 60 years of age, born outside the UK, with no medical conditions affecting memory (e.g., dementia), and the ability to walk 15ft with no or minimal assistance (i.e., use of a walking stick) were invited to take part in the study. A convenience sampling strategy was followed for the early recruitment stages via word-of-mouth and snowballing. Later on, the socio-demographic characteristics of the already included participants (n=25) guided further recruitment strategies. Maximum variation sampling was utilised to achieve the goal of recruiting a sample of women across the ranges of age, migration backgrounds, socio-economic status, and main ethnic groups living in the geographic region (Patton, 2002). This was achieved by consulting the most recent Birmingham census data (Birmingham City Council, 2011).

Community centres serving specific migrant and older adult groups were contacted and informed about the study. Those in leadership roles in the contacted centres granted access to the communities so that potential participants could be approached and informed about the purpose of the study. Recruitment locations included: the New Life Weslyan Church, the Church of God Prophecy, the Irish Centre, the Halesowen Asian Elderly Association, the UK Asian Women's Centre, the Women's Awareness Association, the Afro-Caribbean Millenium Centre, the Lozells Methodist Church Centre, the Afro-British Support Services 'Impact', and

the Muath Trust. Data recruitment took place from January 2013 to June 2014 and November 2014 to June 2015.

Ethical considerations

The University of Birmingham Ethics Committee approved ethical clearance for this study (reference No. ERN_13-0557), and participants gave verbal and written informed consent. Migration can be a highly sensitive topic for some women, especially those who came to the UK fleeing political unrest in their home countries (e.g, Somalia, Eritrea, and Sierra Leone). As such, one of the researcher's priorities was to assure potential participants that the study was voluntary and that they were under no obligation to answer any questions they were not comfortable with, and that they could terminate their participation at any time. They were also informed that excerpts from the interview might be used in reports or publications arising from this study. All interviews were audio recorded with permission from the participants.

When collecting data at the participants' homes, specific steps related to the researcher's safety (and necessary to receive ethical approval for the study) were followed. This included informing a member of the SportExR postgraduate group of the participant's name, location of the interview, time of the interview and expected duration. This member of the postgraduate group was contacted before and after the interview was finished. In addition, both supervisors were always available to discuss any issues that may have arisen during data collection sessions and provide guidance on handling potentially difficult scenarios.

Data protection

Confidentiality was maintained at all times, all participants were given a unique numeric ID,

and all identifying information (e.g., places, names, etc.) was omitted from the transcripts. Audio recordings were saved in a password-protected computer and then uploaded to the University's secure server. Recordings were subsequently erased from the audio device. Questionnaires with socio-demographic information were stored in a locked filing cabinet and labelled with the participant's ID. The contact details of the participants were stored in a locked filing cabinet separately from the questionnaires, with both filing cabinets stored in a locked room.

Phases of data collection

Data collection was divided in two phases, which will be described below.

Phase I. Quantitative phase of data collection

After providing detailed information about the study, verifying eligibility, and obtaining participants' signed consent, a visit was scheduled at the location and time of choice of every participant. During this visit (visit 1), participants were asked to complete a socio-demographic questionnaire, the International Physical Activity Questionnaire-Short Form modified for the elderly (IPAQ-E, Appendix 5),a 24-hr dietary recall interview, and a physical test to assess frailty status. Since diverse education and literacy levels were expected in this sample, the researcher administrated all questionnaires so that further details could be provided when participants needed further clarifications to any of the questions. This technique also increases the quality of the answers and decreases the risk of skipping questions that are common in self-administered questionnaires (Hallal, Gomez, Parra et al., 2010).

Measures and instruments for phase I

This section describes de different measures and instruments used for phase I of the study.

Socio-demographic questionnaire

Descriptive data included age, self-reported ethnicity, religion, education, migration history, marital status, religion, health/disease status, and participant's postcode (which was used to assign an area deprivation score using the Index of Multiple Deprivation (IMD)) (Communities and Local Government, 2011) (Appendix 3).

Dietary assessment

A face-to face multiple-pass 24-hr dietary recall interview was conducted to gather quantitative food intake data using a standard protocol (Adamson et al., 2009) (Figure 2), in addition to a semi-structured interview featuring prompts focusing on eating behaviours and key influences on food choices and cooking methods. All foods and beverages consumed in the previous 24-hours were recorded in writing by the researcher. The 24-hr dietary recall interview was audio-recorded to ensure accuracy of quantitative data entry and to allow for the collection of additional qualitative information on eating behaviours and key influences on dietary choices. Portion sizes were estimated using a photographic food atlas (Nelson, Atkinson, Meyer et al., 1997). When participants indicated that the previous day did not reflect their habitual diet, a second 24-hr was conducted (n=5).

Information about micronutrient supplement use was also obtained during the dietary interview, including brand and quantity. When the participants were not able to report brand names, the micronutrient content of most commonly consumed single nutrient and multi-vitamin/mineral supplements were used as the default.

Figure 2. Multiple pass 24-hr dietary
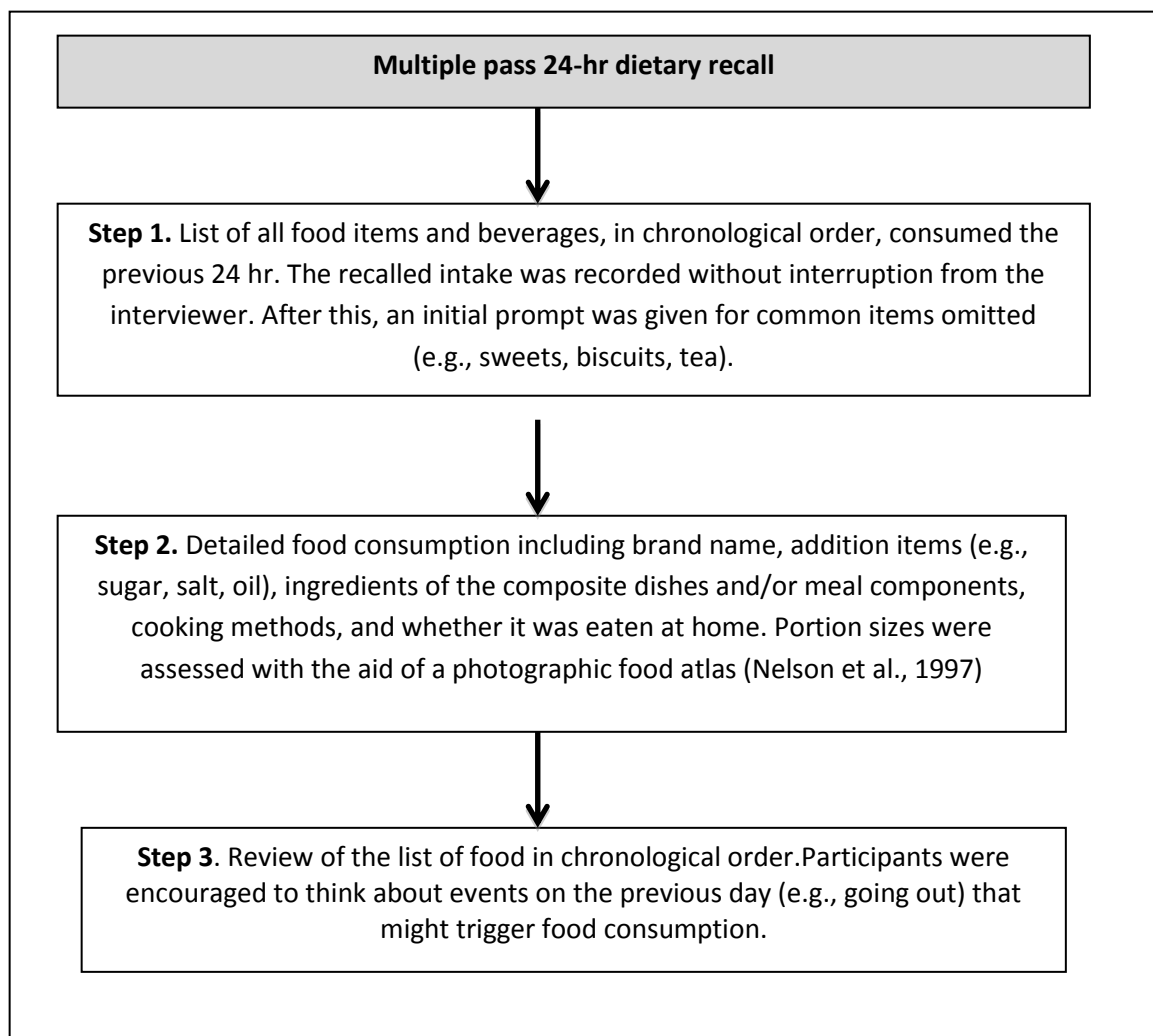
Adapted from Adamson et al., 2009

24-hr dietary recalls data processing

All dietary data from the 24-hr dietary recalls were entered into DietPlan 6.0 software (Forestfield software Ltd 2006, Horsham, UK). To determine the energy, macro- and micronutrient composition of food and beverages, each item was individually entered into the DietPlan searching tool and a list of corresponding items were displayed. An item was selected if it was identical or very similar to the item described by the participants. DietPlan allows the entry of single items (e.g., semi-skimmed milk) or composite dishes (e.g., potato curry). The software includes standard and supplemental food composition databases that cover the range and ethnic diversity of foods consumed in the UK. However, when composite dishes were not found in the database, recipes of dishes were entered as new items into DietPlan. Supplement information was entered into DietPlan so that the total energy and macro- and micronutrient intake could be computed. Portion sizes (in g and mL) estimated using a food atlas (Nelson et al., 1997) were entered along with the consumed item.

Physical test and frailty

Anthropometric measures included height measured to the nearest mm (SECA 213 Portable Stadiometer), weight measured to the nearest 0.1 kg (SECA 899 digital scale), and hip and waist circumference measured to the nearest cm using an extractable measure tape. All anthropometric measurements were taken wearing the least amount of clothing possible. Body mass index (BMI) was calculated as weight divided by height squared (kg/m^2) and waist-to hip-ratio as waist (cm) divided by hip circumference (cm). The WHO BMI cut-points

for Asian populations were used for Arab, Bangladeshi, Indian, and Pakistani participants (WHO, 2004).

In addition, a physical function test was completed to assess participants' frailty status following a slightly modified version of the 5-item Frailty Phenotype (Fried et al., 2001) including:

1. Exhaustion: Assessed by self-reported fatigue using two questions from the Center for Epidemiological Studies-Depression (CES-D) depression scale (Radloff, 1977): 1) "I felt that everything I did was an effort"; 2) "I could not get going." Participants who reported having these feelings for more than 3 days over the previous week to either of both questions received positive scores for exhaustion.

2. Slow walk: Highest quintile of the time needed to walk a distance of 15 feet, adjusted by height.

   >14.5 seconds for height ≤ 157.7 cm

   >9.7 seconds for height > 157.7 cm

3. Grip strength: The lowest quintile (adjusted by BMI) or those unable to perform the test using a JAMAR hand-held dynamometer received a positive score for weakness.

   Strength ≤ 12 kg for BMI ≤25.8

   Strength ≤ 11 kg for BMI >25.9- 29.6

   Strength ≤12 kg for BMI >29.7- 31.6

   Strength ≤14 kg for BMI >31.7

4. Low level of PA: Based on the IPAQ-E the PA score was calculated in metabolic equivalent minutes per week and expressed in Kcal using the following equation:

MET-min*(weight in kg/60 kg). Participants with a caloric expenditure of <60

Kcal/week (lowest quintile) scored positive for low levels of PA.

5. Poor nutritional status: was defined as a low intake of >3 out of 9 nutrients (protein

    <30 g, vitamin D <0.5 µg, vitamin E <2.5 mg, retinol <101 µg, vitamin C <32 mg, folate

    <127 µg, iron <5.6 mg, calcium <349 mg, and zinc <3.6 mg) based on the 24-hr

    dietary recall. Poor nutritional status was used in this PhD research in the definition

    of frailty instead of unintentional weight loss, as it has been shown to be a better

    measurement of dietary inadequacy (Bartali et al., 2006).

From the 5-item phenotype, individuals with three or more positive criteria were

categorised as frail, those with one or two criteria were categorised as pre-fail, while those

with zero positive criteria were categorised as non-frail.

Objectively measures of PA (accelerometry)

The Actigraph GT3X accelerometer (ActiGraph, Pensacola, FL, US) was used to collect

measures of PA and sedentary time (ST). This device was chosen because it is increasingly

used for epidemiological research and has been previously validated in in different age

groups including older adults (Troiano, Berrigan, Dodd et al., 2008, Pruitt, Glynn, King et al.,

2008, Copeland & Esliger, 2009, Freedson, Melanson & Sirard, 1998). In addition, the limited

evidence of PA in migrant populations has shown that women tend to underreport their PA

and thus, an objective measurement of PA is needed (Curry & Thompson, 2014).

Participants were instructed to wear the device on an elastic belt for 7 consecutive days,

positioned over the right hip during waking hours except when bathing, swimming and

sleeping (Davis & Fox 2007). They were asked not to change their typical activity levels

during that period and to complete a simple pictorial log to record the start time and time

the device was put on and taken off each day of the 7-day period. The pictorial log included

the instructions on how to wear the accelerometer and contact details of the researcher in

case assistance was needed. Phone calls or text messages by the researcher/interpreter

were used as a strategy to increase adherence to the wear time criteria (Curry & Thompson,

2014).

Activity was recorded using 60-second epochs. A valid day of data was defined as a recording

of at least 600 minutes (10h) of registered time. Based on the literature, at least 3 days of

valid data, including one weekend day, reflect usual and important fluctuations in activity

among older adults (Evenson, Buchner & Morland, 2012, Babakus & Thompson, 2012). To

gather as complete of a dataset as possible, participants were asked to re-wear the

accelerometer if an assessment contained either <3 valid days (n=13) or if the device had

malfunctioned during data collection (n=1).

The accelerometers were initialised and downloaded using the ActiLife software (ActiGraph

LLC) set to ignore runs of 90 min of zero, allowing for up to 2 consecutive nonzero minutes.

Given that older adults are more sedentary than any other age group, a 90-min window has

been shown to prevent sedentary activities from being misclassified as non-wear time (Choi,

Ward, Schnelle et al., 2012). Data were checked for spurious values and periods of non-

wear. Sedentary time was defined as <100 min of zero counts (Gorman, Hanson et al., 2014).

The Copeland threshold was used to define low-light (LLPA: 100-1,040 counts/minute), and

high-light PA (HLPA: 1,041-1,951 counts/minute) since this threshold has been developed

specifically for older adults (Copeland & Esliger, 2009). Finally, MVPA was defined using the

≥1,952 counts/minute cut point, which is commonly used in the literature, therefore

ensuring the findings from this study are comparable with other populations, including older

adults (Trayers, Lawlor, Fox et al., 2014, Buman, Hekler, Haskell et al., 2010, Fox, Hillsdon,

Sharp et al., 2011).

Accelerometry for sub-sample

Of the total 76 participants originally recruited to participate in the study, 16 were excluded

due to dropping out of the study for health reasons (n=1), losing the accelerometer (n=1),

trust issues (n=1), lost to follow-up (n=6), and failing to meet the minimum wear criteria

(n=7). This resulted in a total sub-sample of 60 women. The most common reason for

participants failing to wear the monitor for at least 600 minutes/day was health problems

and forgetting to wear the monitor.

Phase II. Qualitative phase of data collection

This section describes the instruments used for data collection in Phase II of the study.

Semi-structured interviews

For this phase (visit 2), participants were purposively sampled to participate in a semi-

structured interview based on their socio-demographic characteristics to ensure variation

across cultural, socio-economic and migration backgrounds (Teddlie & Yu, 2007). Given the

nature of the study sample, face-to face interviews were chosen instead of focus groups, as

the aim of the study was to provide the situation in which participant's experiences and

perceptions could be explored in more depth according to their personal characteristics

(e.g., cultural and migration background). It was also felt by the research team that

individual interviews would allow women to express views and relay experiences that they may otherwise not feel comfortable expressing in a group situation.

The design of the interview schedule was guided by the Community Energy Balance (CEB) Framework (Kumanyika et al., 2012) (See Figure 3). This framework proposes that lifestyle behaviours affecting energy balance among migrant populations are not exclusively the result of individual behaviour but are influenced by important historical, political, and structural contexts throughout the life course. These contextual factors may potentially produce a negative health effect on individuals experiencing social disadvantages and/or cultural changes such as ethnic or migrant groups living in Western societies. Given that The CEB Framework takes a life course perspective which is particularly important for older adults, aspects from this framework were considered appropriate to explore individual and external factors that have influence over nutrition and PA behaviours, which in turn may potentially influence migrant women's healthy or successful ageing.

Figure 3. The Community Energy Balance Framework
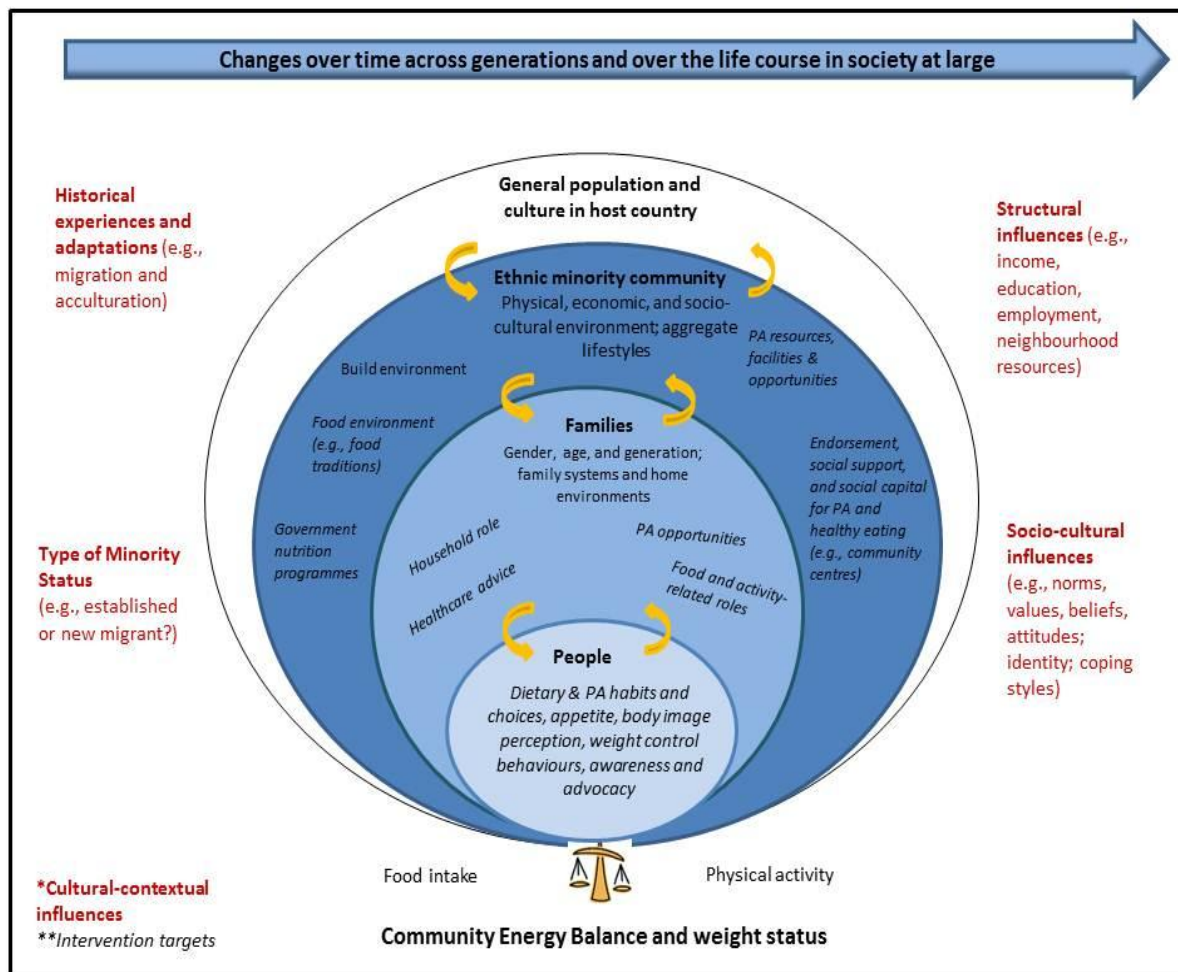
Adapted from Kumanyika, et al., 2012

Questions were open-ended and additional prompts or questions were used to add clarification or further detail where appropriate. The interview finished by asking participants if they wished to ask any questions or to add further information. The interview schedule (see Figure 4/ Appendix 8) was pilot-tested prior to the study and was further revised via an iterative process throughout the data collection to allow for further questions to develop from the dialogue that could enrich the findings of the study. In addition, it was modified to explore particular areas of interest that arose from the quantitative phase.

Figure 4. Topics covered by semi-structured interview schedule

- Reasons to migrate to the UK, time they have been living in the UK.

- Meaning and perceptions of 'successful ageing' (happy at an old age)

- Advantages and disadvantages of ageing in Birmingham.

- Household and family environment changes influencing their food and PA decision-making processes

- Past dietary behaviours and PA experiences

- Perceptions about the link between diet, PA and physical function

- Knowledge about what constitutes a healthy diet and perceptions of their diets.

- Knowledge about PA recommendations and perceptions of their activity.

- Important changes in their diets and PA due to ageing.

- Barriers and facilitators to healthy eating and regular PA.

Interview setting

Interviews lasted between 30-78 minutes and were conducted at either the participant's home or a community centre, with the exception of one interview that was held in a private room at the University of Birmingham. The fact that only one participant agreed to be interviewed at the University suggests that women felt more comfortable in a familiar, 'safe' and personal environment. Nonetheless, this setting also had some disadvantages such as disruptions from family or other community members, telephones, etc. When interruptions occurred, the audio recording was paused and resumed following the disruption.

Use of interpreters

Poor English literacy may result in the exclusion of migrant or ethnic groups in research due to limited resources that make it difficult to recruit interpreters when needed (Plumridge et al., 2012). However, given the increasing number of individuals migrating to the UK who

speak little or no English, it is imperative to consider the use of interpreters to give a voice to these groups, which are commonly under-represented in research (Murray, 2001). Given that one of the aims of this study was to recruit women from diverse ethnic backgrounds, the use of female interpreters was required at all stages of data collection and to conduct 16 complete interviews (including dietary, PA and ageing topics). The interpreters were recruited to participate in the study with the help of community leaders who were familiar with their work. This ensured that they had participated in community-based research before and were familiar with the research process.

Prior to data collection, all interpreters were briefed about the purpose of the study and were given the study questionnaires as well as the interview guide to familiarise themselves with the topics of the interview. This also helped to identify concepts or words that needed to be rephrased so they could be clearer for participants. For example, the term 'physical activity' does not have a direct translation in certain languages (Greenhalgh et al., 1998) therefore, interpreters were instructed to discuss PA in terms of any activity participants engage in from housework (e.g., hoovering, gardening, walking, etc.) to formal exercises in community centres, walking groups or leisure centres.

Two of the interpreters also helped to identify potential participants for the study given their role as gatekeepers or 'community brokers'. It could be argued that external interpreters are preferable; however, known interpreters were necessary for close-knit communities where more time is needed to build rapport (Spring, Westermeyer, Halcon et al., 2003), such as with the Bangladeshi, Yemeni and Somali communities. Simultaneous translation into English was done during the interviews that were conducted in the participant's first language (Punjabi, Bengali, Arab or Somali).

Although using an interpreter to identify potential participants was advantageous, it also proved to have some limitations. In this study, six participants were lost to follow-up given the obstruction of the gatekeeper/interpreter (see Reflexivity section below). This was particularly important in the context of the accelerometry data, as the gatekeeper intentionally failed to monitor if women were wearing the device or if they had any doubts about using it. This obstruction also limited the possibility of asking women to re-wear the device or to recruit more participants from that specific community.

Furthermore, it is worth noting that given the funding and time constraints, it was not possible to account for the effects of the different interpreters on the data. This may have limited the cross-language trustworthiness of the translated data by compromising its credibility and transferability (Squires, 2009). Nevertheless, feedback and clarifications from interpreters, community leaders, and across members of the research team (all with experience working with migrant/minority populations in the US and the UK) were sought to interpret the data and come to a consensus on the results.

Reflexivity

For transparency and trustworthiness it is necessary to provide a brief background of me, the researcher. This section of the thesis is the only part written in the first person.

I am a dietitian with a professional background in both clinical and community-based research. In the past, I have worked as a fieldworker and research assistant in two research projects evaluating longitudinal changes in the prevalence of nutrition-related chronic diseases among adult women (19-49y) and older adults (≥65y) in urban low-income communities in Mexico City. I then moved to California, US to work in a study aimed at preventing gestational diabetes in obese pregnant women through a dietary intervention. The target population was women with low socio-economic status and although it was an ethnically diverse sample, almost 60% of the participants were Mexican or Centro-American migrants. Unfortunately, the dietary intervention did not yield the results that were expected, as adherence to the diet was difficult to achieve. Factors influencing adherence to the diet were out of the scope of the study and thus, there were no data that could have shed any light on the reasons why the diet intervention was not successful. Only basic socio-demographic data were collected given the characteristics of the participants (many were illegal immigrants), and the high risk of compromising their participation if more information was requested.

From my point of view, cultural influences, as well as the difficult social context migrant women faced upon their arrival to a new environment were important barriers to dietary behaviour change. Given that during my time in the US I experienced the challenges of adapting to a new environment, I developed an interest in studying contextual factors influencing lifestyle behaviours such as nutrition and PA. In particular, I was interested in

issues related to ageing and migration, as these factors have not been studied in-depth in relation to diet and PA.

For the present study, I was aware of the limitations of not sharing the same cultural background as the participants. For that reason, a literature review of traditional foods, dietary practices and cultural principles of the participants in the study population was performed prior to interviews. I was aware of the high proportion of the Muslim population in Birmingham and surrounding areas and thus, the dress code was addressed by wearing what I considered to be modest and respectful to those of Islamic faith. Nonetheless, this dress code was considered with all participants irrespective of their religious beliefs.

Being a migrant myself from a non-Western country was sometimes helpful, and I felt some participants were more receptive and cooperative because of that reason. However, I felt this was also a limitation for other women who saw me as an 'outsider' coming from a different country, and also coming from an academic background. Given this, I made sure to explain (or asked the interpreter to do it for me) to potential participants the purpose of the study and the importance of their participation. I also explain very clearly that all information was going to be anonymous and confidential and that this was going to be part of my thesis as a PhD student at the University of Birmingham.

Given my own migrant status, I felt I had to be as objective as I could, being careful to keep my own biases and opinions aside. Bracketing my own perceptions and opinions was challenging when participants expressed feelings of 'being from away'. For example, when talking about healthy foods, some participants were very nostalgic of their home countries and tended to criticise the food environment in the UK. This resonated with my own personal experience of trying to adapt to a new and different food environment. It was only

by becoming aware of these similarities during the interviews and also by discussing this with the research team that I felt able to separate my own migrant experience to that of the participants.

Furthermore, I was conscious that English is not my first language and that my accent could cause confusion to some participants or interpreters. Therefore, when communication issues arose during the interviews, I rephrased the statements or gave examples that helped to overcome any misunderstandings. Also, when I could not understand a word or a statement whilst transcribing the interviews, I asked a native English-speaker colleague to assist me with that particular section of the interview.

Maintaining control of the interviews when the interpreters or the family members were exerting control over myself and the environment surrounding the interview was challenging at times. For example, among the Bangladeshi and Somali communities, the family members answered or intervened in many of the questions that were asked. Even though the interpreter and I tried to focus on the participant, we realised that with some women this was going to be the only way of obtaining the information. Having an interpreter with a more active role during the interview was advantageous in some cases as they made very interesting points, which resulted in enriching the findings.

It is worth noting that I had the experience of dealing with an unprofessional interpreter who did not comply with the initial arrangements for data collection. This interpreter (who was also the gatekeeper of the community) was recommended by one of the community leaders who has links with many communities in Birmingham and thus, I trusted her and failed to establish a formal contract for her services. After we started collecting data in one specific community, she suddenly decided that the agreed payment was not enough for her

and she stated she did not want to continue assisting with the study if I did not comply with her requests. This resulted in being unable to complete data collection with six participants, and at one point resulted in me being denied the opportunity to recover the accelerometers that participants were given to measure their PA. Fortunately, I was fully supported by my supervisors and other colleagues working with this particular community, and the monitors were recovered by asking the community leader to intervene in the situation. I discovered through this process that the interpreter was not willing to compromise her relationship with the community leader because she represented an 'authority,' while in the community the interpreter was the 'authority' and I was an 'outsider' who could not communicate with the participants and as such, had no power and limited control in this scenario.

After this experience I realised that working in the community setting involves a very careful consideration of trust issues between all parties involved in the study. Therefore, when I had to work with an interpreter in a newly approached community, I made sure everything was registered as a written statement and/or by email. In addition, I tried my best to arrange for the prompt payment (from the seed-corn funding I was awarded by the Institute for Research into Superdiversity) for the interpreters, since payments processed through the University are not made by cash and can take up to a month (or more) to be processed. By explaining the payment process and making a contract with the interpreters, I did not experience any other problems moving forward. Although it was a tough way of learning a lesson, I will embrace this, as an invaluable learning experience that I am sure will be very helpful in my future career.

All observations and reflective notes were hand written in a journal during and after each interview. These included notes related to the setting, participant's body language, and

interactions with other members of the family that were very useful during the analysis process.

Methods of qualitative data analysis: Thematic Analysis

Given the exploratory nature of the study, an inductive thematic analysis (Braun & Clarke, 2006) was used in order to identify themes strongly linked to the data rather than fitting themes to a pre-existing theory. Transcripts from the interviews were analysed following guidelines provided by Braun and Clarke (2006). These steps involved:

1. The researcher's familiarisation of the content of the interview transcripts by transcribing most of them, as well as reading and re-reading all transcripts. Notes taken in the field were also part of this process, which facilitated an initial understanding, and navigation of each interview as a whole.

2. An initial coding of any passage of text identified as meaningful was carried out using qualitative analysis software (QSR NVivo, version 10). As shown in Table 1, meaningful passages of text were highlighted and assigned an initial code. After coding all the data, data that were identified by the same code were collated and combined.

Table 1. Example of data extract with initial codes applied

Data extract	Coded for
So, what changes have you done to your dietary habits and food choices related to age? *I think in this age we should give up this food which we were when [being] young or in middle-age because in this time we are having health problems, we should think first of all about health and eat those things, which we can eat and which are not good for our health, it is my thinking, because they will make you worst…we have changed [husband and her], the food that we are eating it is changed now, before you know at a young age we were eating fatty food, fried food and this type and now we stop completely these things, no, because our activities are not like that as in our young age and we can't just eat these things, will make your health worst. Otherwise in old age they are eating, eating, too much eating is not very good…you should eat little you know, that you can digest easily, to eat full stomach and after that you can't digest this because your digestive system is not the same. Try to eat as much as you can digest! (Pakistani, 63y, P11).*	1.Health problems (diabetes & CVD) 2. Lifestyle changes related to age (not as active) 3. Digestion problems (can't eat as much as they used to)

3. Once the interview transcripts were initially coded and collated, data were analysed at a broader level. All codes developed were organised into potential themes. These themes were ordered into higher and lower levels. A thematic map of this early stage can be seen in Figure 5 (example from Chapter 3).

Figure 5. Initial thematic map, showing four main themes (Chapter 3)

Factors influencing dietary behaviours

Awareness of healthy eating

Knowledge

GP/nurse advice

Personal factors

Obesity

Perceptions of their diets

Digestion problems

Appetite loss

Cultural factors

CVD & diabetes

Changes in physical activity

Social factors

Household changes

Fasting practices

Family members affected by disease

Home environments

Less responsibility

Eating alone

Lost interest in cooking

4. Revision of themes to ensure they were supported by relevant coded extracts. Data were reviewed at two levels: at the level of coded data extracts and at the level of main themes to code any additional data. During this process some themes were removed, merged or divided as appropriate (Figure 6).

Figure 6. Final thematic map, showing two main themes (Chapter 3)

Factors influencing dietary behaviours
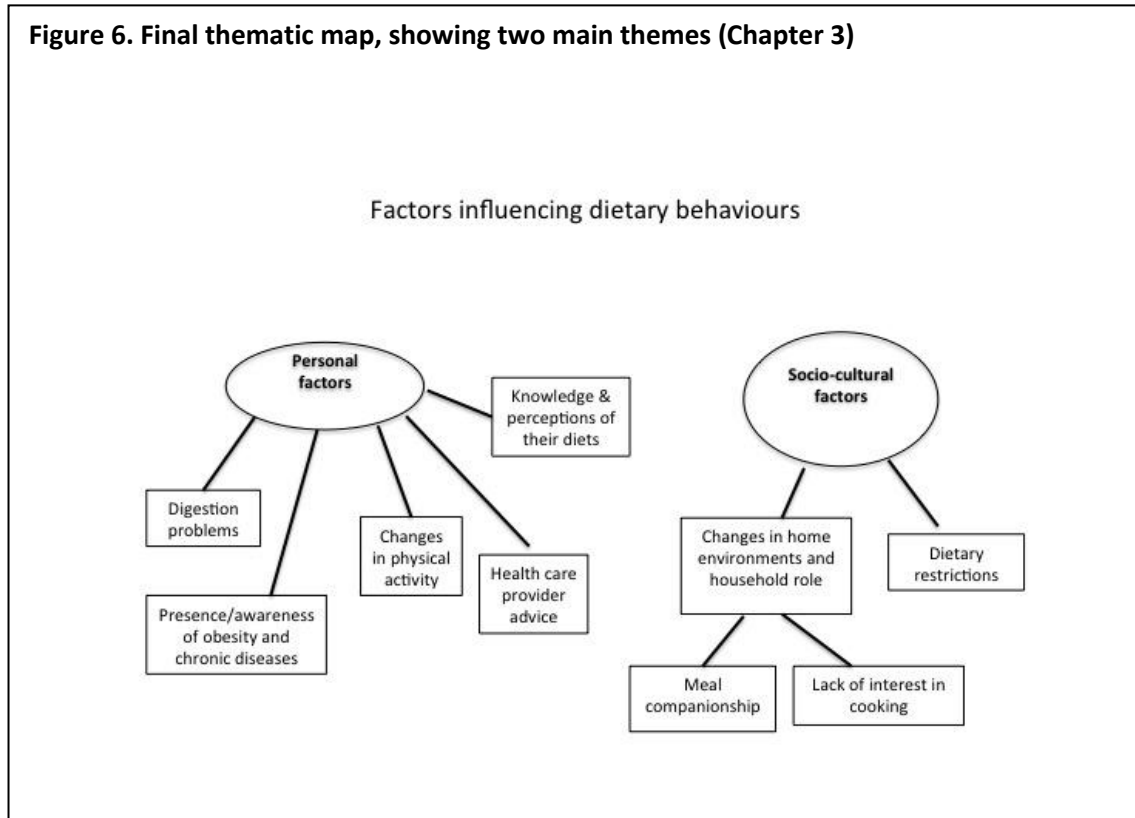
5. Through an on-going analysis, themes were refined and each theme was given a name and a clear definition. To assure reliability of the coding and analysis process, themes and categories were reviewed in joint discussions between the authors to ensure the accuracy of interpretation and internal consistency of the data. Table 2 shows an example of a category from the final coding frame for Chapter 3.

Table 2. Example of a category from the final coding frame

	Themes	Sub-themes	Data extracts
Key influences on current dietary intake	**Personal factors** Factors which relate to a particular individual and influence behaviour	**Knowledge and perceptions of their diets** Perceptions about their diets and Information/education about what constitutes a 'healthy diet' or healthy foods.	*'[Healthy foods are] vegetables and fruit, raw or cooked, the fruit is obviously raw anyway…I would think fish and less high carbohydrate'* (Pakistani, 62y, P22)
		Increased awareness of obesity and chronic diseases Experience of others influencing behavioural change or own experiences of disease.	*'When my husband was diagnosed a diabetic I had to change few things…First of all I cut down the sugar all together, we don't have puddings and things.. fresh fruit and fresh salad and those sort of things a little bit more and instead of red meat, prefer to have chicken and fish'* (Indian, 74y, P5)
		Digestive problems Dietary restrictions (including cooking methods) due to indigestion, reflux and gastritis.	*'She stopped eating a lot of food now she just eats like basically simple food, eggs, breads, croissants, she can't digest it basically'* (Bangladeshi, 81y, P49)
		Changes in their PA Impact/outcome of low energy expenditure related to physical decline or changes in lifestyles.	*'She cannot eat as much as she could before…and she slowed down so she doesn't feel…hungry or anything'* (Bangladeshi, 65y, P56).

Trustworthiness

In order to improve trustworthiness several procedures were followed. Firstly, a subset of transcripts (n=7) were read and individually coded by the researcher and two independent researchers, with subsequent discussion and refinement until consensual agreement was reached between the student research team. An initial coding frame was developed between the team, which formed the basis of broader data coding and analysis. Secondly, further refinements to the coding frame were made after discussions with the academic team until consensus was reached. These discussions and insights from experienced researchers (academic team) served as a triangulation of evidence by several investigators (Morse, Barrett, Mayan et al., 2002).

Thirdly, rich description of the methodology employed during the study (i.e. participants, setting, and data analysis) will allow the readers to determine whether the study can be transferable to other similar settings (Creswell & Miller, 2000). Specific and compelling excerpts from participants were included in the results in order to enabler the readers to judge the accuracy of the author's conclusions. Finally, clarifying the role of the researcher by exposing past experiencesand orientations that could have introduced bias in the interpretation (Ellingson, 2006) were discussed in this chapter and were recorded in a journal the researcher kept throughout the data collection and analysis.

Summary of methods

This chapter provided detailed description of the methodology used to answer the research questions of this PhD research project. Consideration was also given to issues of validity, reliability as well as trustworthiness (e.g., reflexivity, ethics, etc.) throughout the process. Findings from the study will be presented in the following four chapters.

CHAPTER 3

DIETARY INTAKE, NUTRIENT STATUS, AND FACTORS INFLUENCING EATING BEHAVIORS IN OLDER MIGRANT WOMEN WITH VARYING FRAILTY STATUS

This paper has been submitted to the journal *Appetite*. As this is a U.S.-based journal, the language used throughout the paper is American English. In this chapter the following research questions are addressed:

1. What are the current energy and dietary intakes of a sample of free-living older women from ethnically diverse backgrounds living in the UK?

2. Are there differences in energy and nutrient intakes between women of varying frailty status?

3. What are the key factors identified by participants as influencing their current dietary intake?

Abstract

Inadequate dietary intake among older adults is common, increasing the risk for the development of frailty. However, little is known about the nutritional status and dietary behaviors influencing dietary adequacy of migrant older women. We examined nutrient intakes in comparison to the UK's recommended nutrient intakes (RNIs), examined differences between women with varying frailty status, and explored key factors influencing current eating behaviors among a sample of community-dwelling first generation migrant women living in the UK. Using a mixed-method approach, seventy-six women completed a 24-hr dietary recall; frailty status was assessed using a modified version of the frailty phenotype. Semi-structured interviews were conducted with a sub-sample (n=46) and analyzed using thematic analysis. Energy intake was significantly lower than the UK RNIs (1225 vs. 1877 Kcals/d, p<0.001). Main micronutrients of concern were vitamin D, magnesium, potassium, copper, selenium, and retinol (p<0.05). Frail participants had significantly lower intakes of folate and selenium than pre-frail and non-frail participants (p<0.05), while zinc intake was different between non-frail and frail women and protein intake was higher in non-frail as compared to pre-frail participants (p=0.01). Although women were knowledgeable about what constitutes a healthy diet, personal factors such as presence and awareness of obesity and chronic diseases, socio-cultural factors related to changes to home environments and household roles, as well as dietary restrictions related to religious beliefs were identified as key influences on participants' dietary intake. Findings from this study provide useful insights for the development of future interventions designed to encourage and facilitate healthy eating among migrant older women living in the UK.

Introduction

Adequate diet and regular physical activity (PA) are recognized as key modifiable lifestyle factors that may delay the onset of disease and frailty in older populations (Young, Bunn, Trivedi et al., 2011). Inadequate dietary intake among older adults contributes not only to the progression of existing chronic diseases, it also increases the risks for functional decline, impaired quality of life, and premature mortality (Volkert, Kreuel, Heseker et al., 2004). Several studies exploring the nutritional adequacy of community-dwelling older adults have shown that they often fail to meet current nutrition guidance (Houston, Nicklas, Ding et al., 2008, Marshall, Stumbo, Warren et al., 2001). A limited number of previously published studies have reported that poor nutritional status and low protein intake are associated with a greater risk of frailty, putting older adults at higher risk of morbidity and premature mortality (Bartali, Frongillo, Bandinelli et al., 2006, Beasley, LaCroix, Neuhouser et al., 2010).

Although some dietary adequacy studies in the US have included minority groups in representative samples (Lee & Frongillo, 2001, Marshall, Lopez, Shetterly et al., 1999), information about the adequacy of the diet of older adults from ethnically diverse backgrounds in the UK is lacking. This is particularly important, as it has been estimated that by 2051, there will be 3.8 million minority ethnic people aged 65 and older, and 2.8 million aged 70 and older in England and Wales; a larger proportion of this population will be women (Lievesley, 2010). In addition, older adults from ethnically diverse backgrounds are disproportionately affected by poor health and many long-term conditions, increasing their risk for frailty and reducing quality of life in comparison to the general population (Williams, Tillin, Whincup et al., 2012).

Previous studies assessing nutrient intake and food choice conducted in migrant groups in the UK have primarily focused on exploring dietary behaviors that may help explain the disproportionately high rates of obesity and chronic diseases in comparison to the general population (Garduño-Diaz & Khokhar, 2014, Sharma, Cade, Riste et al., 1999). However, little is known about the association between dietary intake and frailty among older women from ethnically diverse backgrounds, especially using standard definitions of frailty. Fried and colleagues (2001) have proposed a standard definition of frailty characterized by the presence of three or more of the following criteria: unintentional weight loss, exhaustion, weakness, slow walking speed, and low PA. The predictive validity of the frailty phenotype has been confirmed in several cohorts of older women (Woods, LaCroix, Gray et al., 2005, Ensrud, Ewing, Taylor et al., 2007).

Furthermore, eating behaviors are complex and involve a myriad of psychological, biological, personal and environmental factors (Johnson-Askew, Fisher & Yaroch, 2009, Sobal & Bisogni, 2009). In addition to understanding what individuals eat, there is a need to understand the drivers of eating behaviors among older women from ethnically diverse backgrounds to allow for the development of appropriate dietary advice and behavior change interventions. To address these gaps in the literature, the three aims of this cross-sectional, mixed-methods study were to: 1) examine energy and nutrient intakes in a sample of migrant older women from ethnically diverse backgrounds; 2) compare energy and nutrient intakes between women with varying frailty status; and 3) obtain a greater understanding of key factors influencing their current dietary intake and eating behaviors.

Methods

Study design

The present study employed a mixed-method approach, using 24-hr dietary interview recalls and semi-structured interviews to gain rich insights into the nutrient intakes of a population group for which there is little previous evidence to guide research and intervention development. Thus, a combined approach can provide a better understanding of the phenomenon of interest that might be missed by using only a single method (Teddlie & Tashakkori, 2009).

Study population

Seventy-six older women were recruited to participate in the study using maximum variation sampling to achieve our goal of recruiting a sample across the range of age, migration backgrounds, level of deprivation, and predominant ethnic groups living in the geographic region (Teddlie & Yu, 2007). Access to different ethnic groups was obtained by contacting local community leaders and individuals at community centers and places of worship. Women were eligible to participate if they were aged 60 years and older, were born outside the UK, with no medical conditions affecting memory (e.g., dementia), and the ability to walk 15ft with no or minimal assistance.

Four local interpreters were available during all phases of recruitment and data collection for non-English speakers. Ethical approval was granted by the University of Birmingham Ethics Committee (reference No. ERN_13-0557), and written informed consent was obtained for all participants.

Data Collection

Socio-demographic variables

Demographic information including age, years living in the UK, self-reported ethnicity, religion, level of education, migration status, living arrangements, self-reported health, and medical history was collected via a researcher-administered questionnaire. The English Index of Multiple Deprivation (IMD) was used as a socioeconomic indicator and was determined based on residential postcodes (Department for Communities and Local Government, 2011).

Dietary assessment

A single 24-hr dietary recall was conducted following a standardized protocol (Garduno-Diaz, Husain, Ashkanani et al., 2014), enhanced by an in-depth interview to obtain detailed information on all food and beverages consumed, in addition to information on factors influencing eating behaviors and food choices. Portion sizes were estimated using a photographic food atlas (Nelson, Atkinson, Meyer et al., 1997). A second 24-hr dietary recall was conducted when there were inconsistencies between the dietary interview and the initial 24-hr dietary recall or had an implausible energy intake (<400 Kcal/day) (n=5). The first author (DCG), a nutritionist trained in dietary assessment, conducted all 24-hr recalls. Data coding and processing was conducted by DCG, with oversight from JLT. These procedures enabled a standardized data entry and analysis process. Nutrient analysis was conducted using DietPlan 6.0 software (Forestfield software Ltd 2006, Horsham, UK) that included a supplement database containing commonly consumed ethnic foods in the UK. In addition, recipe information and dietary supplements were added into the database. Information about supplement use was obtained at the time of the dietary interview, including brand and quantity for supplement taken. When the participants were not able to report brand

names, the micronutrient content of the most commonly consumed single nutrient and multi-vitamin/mineral supplements were used as the default. Participants' nutrient intake data were compared to the UK's reference nutrient intake values (RNI) for older women (>65yrs) (Department of Health, 1991, Scientific Advisory Committee on Nutrition, 2012).

Frailty and anthropometry assessment

Frailty was assessed using a modified version of the 5-item frailty phenotype (Fried et al., 2001). Exhaustion was based on self-report of "I felt that everything I did was an effort" and "I could not get going' from the CES-D questionnaire (Radloff, 1977). Participants responding yes for >3 days over the previous week to either or both questions received a positive score for exhaustion. Weakness was measured in kg using a Jamar hand-held dynamometer (Sammons Preston Rolyan, Bolingbrook, Illinois, US), adjusted for BMI (≤25.8 for ≤ 12kg; >25.9- 29.6 for ≤ 11 kg; >29.7- 31.6 for ≤12kg for ≥31.7, and ≤14 for 14kg). Slow walking speed was assessed by a 15ft walk at usual pace adjusted for height (>14.5 seconds for height ≤ 157.7 cm and >9.7 seconds for height > 157.7 cm). Low PA (< 60 kcal/week) was estimated using the International Physical Activity Questionnaire modified for the elderly (IPAQ-E) (www.ipaq.ki.se). Poor nutritional status was defined as a low intake of >3 out of 9 nutrients (protein <30 g, vitamin D <0.5 µg, vitamin E <2.5 mg, retinol <101 µg, vitamin C <32 mg, folate <127 µg, iron <5.6 mg, calcium <349 mg, and zinc <3.6 mg) based on the 24-hr dietary recall. We used poor nutritional status in the definition of frailty instead of unintentional weight loss, as it has been shown to be a better measurement of dietary inadequacy (Bartali et al., 2006).

Consistent with the original frailty phenotype, cutoffs for a positive score for weakness, slow walking, low PA, and low nutrient intakes were set at the lowest 20% of the sample.

Participants with >3 positive criteria were categorized as frail, while those with 1-2 and 0 were classified as pre-frail and frail, respectively.

Height was measured to the nearest mm (SECA 213 portable stadiometer) and weight to the nearest 0.1 kg (SECA 899 digital scale) according to a standard protocol. Body mass index (BMI) was calculated as weight divided by height squared (kg/m^2). The BMI cut-points for the Arab, Indian, Pakistani and Bangladeshi participants were those recommended by the World Health Organization for Asian populations (WHO, 2004).

Semi-structured interviews

A purposive sub-sample of participants (n=46) across the range of ethnic groups, deprivation, and age took part in a semi-structured interview exploring both dietary and PA behaviors within the context of migrating and ageing in a multicultural community. For the purpose of this study, we report the qualitative data examining factors that influence their eating behaviors and dietary intake. All interview recordings were audiotaped and transcribed verbatim. Where interviews were conducted in a language other than English, translations were done during the interview process (n=16).

Data analysis

Statistical analysis

Descriptive data (Mean ± SD and proportions) were generated for the sample. One-way ANOVA for continuous variables and χ^2 or Fisher's test were used for categorical variables to examine difference between frailty groups and potential confounders. Energy and nutrient intakes were reported as median and interquartile range (the difference between the 25th and 75th percentiles) due to the skewed nature of the data. Median nutrient intakes for the

full sample were compared to the UK's RNI using the one-sample Wilcoxon signed rank test. The 95% confidence intervals of the difference between the median intakes of participants and the RNI were calculated following the method by Campbell & Gardner (2011). Nutrient density was calculated by dividing absolute nutrient intake by total energy intake. Analysis of covariance with Bonferroni post-hoc tests were used to test the differences in energy and nutrient densities between frail groups controlling for confounding factors. Dietary log-transformed data were used in order to improve linearity and homoscedasticity. All data analyses were conducted using SPSS (Version 21.0, IBM Corp, Armonk, NY, 2012). Significance was set at $p < 0.05$.

Qualitative data analysis

Given the exploratory nature of the study, inductive thematic analysis was used to identify themes strongly linked to the data rather than fitting themes to a pre-existing theory. Guidelines by Braun & Clarke (2006) were followed during the analysis. Initially, the first author and two independent researchers coded a set of transcripts. An initial coding frame was developed in which codes were organized into higher and lower level themes. All of the transcripts were subsequently coded by DCG. Finally, the coding was reviewed and refined in several discussions with all authors until consensual validation was reached. NVivo qualitative analysis software (QSR International Pty Ltd, Melbourne, Australia) was used to organize the data.

Results

Table 1 presents the demographic characteristics of the sample. Participants identified as frail were significantly older ($p=0.04$) and had more diagnosed diseases ($p=0.03$) in

comparison to non-frail and pre-frail participants. A greater percentage of frail participants were widowed in the frail group (61.5%) than in the non-frail (43.8%) and pre-frail (25.8%) groups. In addition, frail participants self-reported poorer health than non-frail and pre-frail women (p<0.001).

Table 1. Participant demographic characteristics (n=76)

Variable	Not frail n=31	Pre-frail n=32	Frail n=13	p values
Age (y)	68.1 ± 5.7	71.4 ± 7.9	74.1 ± 9.6 [b]	0.04
Residency in the UK (y)	37.7 ± 18.5	38.1 ± 16.9	42.7 ± 14.8	0.45
No. of diseases	2.1 ± 1.5	2.2 ± 1.6	3.3 ± 1.3 [b]	0.03
Polypharmacy	9 (29)	10 (31.3)	7 (53.8)	0.11
Self-reported ethnicity				
Caribbean	8 (25.8)	8 (25)	5 (38.5)	0.42
Indian	8 (25.8)	9 (28.1)	3 (23.1)	
African	5 (16.1)	5 (15.6)	0 (0.0)	
Arab	3 (9.7)	3 (9.4)	2 (15.4)	
Pakistani	4 (12.9)	3 (9.4)	0 (0.0)	
Bangladeshi	0 (0.0)	2 (6.3)	3 (23.1)	
Irish	3 (9.7)	2 (6.3)	0 (0.0)	
Religion				
Muslim	13 (41.9)	14 (43.8)	6 (46.2)	0.40
Christian	11 (35.5)	11 (34.4)	5 (38.5)	
Hindu	4 (12.9)	3 (9.4)	0 (0.0)	
Sikh	3 (9.7)	4 (12.5)	2 (15.4)	
Migration status				
Family reunion	17 (54.8)	16 (50)	9 (69.2)	0.89
Economic migrant	9 (29)	11 (34.4)	4 (30.8)	
Refugee/asylum seeker	5 (16.1)	5 (15.6)	0 (0.0)	
IMD quintile				
1 (most deprived)	16 (51.6)	22 (68.8)	11 (84.6)	0.88
2	4 (12.9)	6 (18.8)	1 (7.7)	
3	5 (16.1)	2 (6.3)	0 (0.0)	
4-5 (less deprived)	6 (19.4)	2 (6.3)	1 (7.7)	
Level of education				
No qualifications	8 (25.8)	11 (34.4)	7 (53.8)	0.61
Primary school	3 (9.7)	3 (9.4)	2 (15.4)	
Secondary school	9 (29)	7 (21.9)	2 (15.4)	

Tertiary	11 (35.5)	11 (34.4)	2 (15.4)	
Marital status				
Single/separated/divorced	3 (9.6)	6 (18.8)	3 (23.1)	0.04
Married	20 (64.5)	12 (37.5)	2 (15.4)	
Widowed	8 (25.8)	14 (43.8)	8 (61.5)	
Living alone	8 (25.8)	14 (43.8)	4 (30.8)	0.34
Self-reported health				
Excellent	3 (9.7)	4 (12.5)	0 (0.0)	<0.001
Good	19 (61.3)	17 (53.1)	0 (0.0)	
Fair	9 (29)	6 (18.8)	5 (38.5)	
Poor	0 (0.0)	5 (15.6)	8 (61.5)	
BMI	29.2 ± 3.9	29.6 ± 5.6	29.6 ± 5.7	0.94
Normal	4 (12.9)	5 (15.6)	0 (0.0)	
Overweight	9 (29.0)	9 (25.0)	6 (46.2)	
Obese	18 (58.1)	18 (53.8)	7 (53.8)	
Supplement use	14 (45.2)	12 (37.5)	4 (30.5)	0.63
Interpreter [a]	9 (29.0)	10 (31.3)	7 (53.8)	0.28

Data reported as mean ± SD or n (%), [a] 24-hr dietary recall conducted with the aid of an interpreter, [b] Significantly different from non-frail participants only (p<0.05)

Energy and nutrient intake

A comparison of the median nutrient intakes to the UK RNI values is shown in Table 2.

Energy intake was significantly lower (1225 vs. 1877 Kcals/d, p<0.001) than the estimated

average requirement for older adults (>65yrs), based on the needs of a general population

with a low PA level (Scientific Advisory Committee in Nutrition, 2012). We used a low PA

level as a reference based on the self-reported measured PA level of the study sample, who

reported being highly sedentary. Although several of the UK RNI values were met, intakes of

retinol (p<0.001), vitamin D (p=0.02), magnesium (p<0.01), potassium (p<0.001), copper

(p<0.01), selenium (p<0.001), and monounsaturated fatty acids (p<0.001) were significantly

lower than the recommendations. In contrast, sodium intake (p<0.001) and the

contributions of total fat (p=0.02), and trans-unsaturated fatty acids (p<0.001) to total

energy intake were significantly lower than the RNI values and thus, met current

recommendations.

Table 2. Median nutrient intakes (including supplementation) compared to the UK Reference Nutrient Intakes (RNIs)

Nutrient	RNI[a]	Median intake (IQR) n=76	Median difference from RNI	95% CI of the difference	p values
Energy (Kcals)[b]	1673-1745	1225.0 (840-1557.3)	-519.0	-798.0 to -428.0	<0.001
Protein (g)	46.5	46.8 (34.7-67.9)	0.3	-6.8 to 5.80	0.34
Total fat (% TE)	33	29.8 (21.2-37.8)	-3.3	-6.2 to 0.3	0.02
Energy from SFA (%)	10	8.3 (5.6-13.8)	-1.7	-2.5 to 1.3	0.53
Energy from MUFA (%)	12	8.5 (5.6-11.8)	-3.5	-4.8 to -1.9	<0.001
Energy from TFA (%)	<2	0.4 (0.2-0.9)	-1.59	-1.7 to -1.4	0.02
Retinol (µg)	600	191.8 (109.3-301)	-438.5	-462 to -406	<0.001
Vitamin D (µg)	10	2.6 (0.7-11.4)	-7.4	-8.6 to -0.04	0.02
Vitamin E (mg)	5	4.3 (2.9-7.3)	-0.70	-1.9 to 0.76	0.90
Vitamin C (mg)	40	89.5 (39.2-158)	49.5	15.0 to 66.0	<0.001
Thiamine (mg)	0.8	0.9 (0.7-1.4)	0.13	-6.2 to 0.3	<0.001
Riboflavin (mg)	1.1	0.9 (0.7-1.5)	-0.2	-0.3 to 0.04	0.59
Niacin (mg)	12	9.2 (5.4-17.9)	-2.7	-4.7 to -0.2	0.34
Folate (µg)	200	195.5 (137.5-331.5)	-4.5	-29.0 to 41.0	0.29
Vitamin B6 (mg)	1.2	1.3 (0.8-2.4)	0.1	-0.2 to 0.6	0.01
Vitamin B12 (µg)	1.5	2.3 (0.8-5.5)	0.8	-0.3 to 1.6	<0.001
Calcium (mg)[c]	700	566.5 (381.3-938.0)	-133.5	-229.0 to 56.0	0.25

Nutrient				
Magnesium (mg)	270	221 (157.5-272.8)	-49.0	-82.0 to 27.0	<0.01
Phosphorus (mg)	550	863.5 (608.8-1124.3)	313.5	242.0 to 416.0	<0.001
Potassium (mg)	3500	1766.0 (1343.0-2573.0)	-1734.0	-1887.0 to -1347.0	<0.001
Manganese (mg)	1.4	2.7 (1.8-4.0)	1.3	0.8 to 1.5	<0.001
Iron (mg)	8.7	9.1 (6.5-14.3)	0.4	-1.20 to 1.89	0.13
Copper (mg)	1.2	1.0 (0.7-1.3)	-0.22	-0.4 to -0.13	<0.01
Zinc (mg)	7	5.7 (4.1-9.2)	-1.3	-2.3 to -0.6	0.53
Selenium (µg)	60	22.4 (10.4-52.6)	-37.7	-43.4 to -23.5	<0.001
Sodium (g)[d]	2.4	1.4 (0.8-2.1)	-1.0	-1.3 to 0.3	<0.001
Dietary fiber (g)	12-24	15.5 (8.9-21.0)	3.5	1.1 to 4.8	0.01

Results shown as median (IQR= interquartile range, the difference between the 25th and 75th percentiles), [a] Department of Health (1991) and Scientific Advisory Committee on Nutrition (2012), [b] Estimated Average Requirement for females 50+ yrs, [c] For older adults 65+ yrs, [d] The RNI for sodium is the amount that is sufficient for 97 per cent of the population, CI= Confidence interval, %TE=percentage of total energy, SFA= saturated fatty acids; MUFA= monounsaturated fatty acids, TFA= trans-unsaturated fatty acids.

Table 3 presents the reported median energy intake and nutrient densities (per Kcals) of participants according to their level of frailty. After controlling for age, number of diseases, marital status and interpreter use, energy intake was lower in participants categorized as frail in comparison to non-frail and pre-frail participants, respectively (750.5 vs. 1229.0 and 1318.0 Kcals/d, p<0.01), as were nutrient densities of folate (166.1 vs. 180.4 and 179.9 μg/d, p=0.02) and selenium (13.5 vs. 19.2 and 24.7 μg/d, p=0.02). Zinc intake was different between non-frail and frail women (4.5 vs. 5.5 mg/d, p=0.01), and protein intake was different between non-frail and pre-frail participants (41.7 vs. 37.9 g/d, p=0.01).

Table 3. Comparison of energy and nutrient density between groups of varying frailty status

Nutrient	Non-frail Median nutrient density (IQR) n=31	Pre-frail Median nutrient density (IQR) n=32	Frail Median nutrient density (IQR) n=13	ANCOVA *p* values[a]
Energy (Kcals)	1318.0 (1077.0-1608.0)	1229 (862.5-1841.0)	750.5 (602.5-882.5)[b]	<0.001
Protein (g)	41.7 (33.0-54.3)	37.9 (32.3-43.4)[c]	40.2 (25.2-50.9)	0.01
Retinol (µg)	150.5 (51.8-308.2)	136.6 (91.0-283.8)	102.8 (35.2-221.6)	0.14
Vitamin D (µg)	1.8 (0.9-9.0)	3.2 (0.3-8.1)	1.2 (0.2-7.2)	0.69
Vitamin C (mg)	46.4 (17.4-109.2)	76.4 (33.3-114.4)	24.0 (14.0-59.2)	0.09
Vitamin E (mg)	4.2 (2.9-6.2)	3.5 (2.1-7.3)	2.7 (1.7-3.7)	0.06
Thiamine (mg)	0.9 (0.7-1.1)	0.7 (0.6-1.2)	0.9 (0.5-1.0)	0.11
Riboflavin (mg)	0.8 (0.6-1.3)	0.7 (0.6-1.4)	0.9 (0.5-1.0)	0.47
Niacin (mg)	7.0 (4.6-15.1)	8.2 (4.0-12.7)	7.9 (4.3-12.1)	0.33
Folate (µg)	179.9 (126.7-260.5)	180.4 (112.1-233.8)	166.1 (88.2-242.1)[b]	0.02
Vitamin B6 (mg)	1.1 (0.8-1.6)	1.0 (0.7-1.7)	1.1 (0.7-1.6)	0.83
Vitamin B12 (µg)	1.5 (0.7-4.2)	2.1 (0.8-5.5)	0.9 (0.3-3.7)	0.23
Calcium (mg)	455.2 (339.2-720.1)	523.8 (337.8-664.5)	471.4 (274.7- 1239.5)	0.08
Magnesium (mg)	197.3 (161.1-227.5)	172.3 (131.9-218.3)	175.1 (112.8-258.8)	0.33
Phosphorus (mg)	763.2 (646.2-839.9)	707.9 (581.8-774.2)	730.3 (484.1-1034.3)	0.11
Potassium (mg)	1662.1 (1286.5-2061.4)	1588.2 (1330.9-1931.9)	1382.3 (1219.9-2270.1)	0.53

Manganese (mg)	2.7 (2.0-3.4)	2.1 (1.4-3.3)	2.0 (1.7-3.3)	0.72
Iron (mg)	7.8 (6.0-9.4)	8.0 (5.3-11.3)	7.1 (4.8-8.6)	0.07
Copper (mg)	0.9 (0.7-1.1)	0.8 (0.6-1.0)	0.8 (0.6-0.9)	0.20
Zinc (mg)	5.5 (4.2-7.2)	4.7 (3.3-7.1)	4.5 (3.5-8.1)[c]	0.01
Selenium (µg)	24.7 (15.3-44.9)	19.2 (7.6-25.8)	13.5 (7.1-46.2)[b]	0.02
Sodium (g)	1.4 (0.8-1.6)	1.1 (0.7-1.6)	1.2 (0.9-1.6)	0.77

Results shown as median (IQR= interquartile range, the difference between the 25th and 75th percentiles). [a] Adjusted for age, number of diseases, marital status, and interpreter use, [b] Significantly different from non-frail and pre-frail women (p<0.05), [c] Significantly different from non-frail women only (p<0.05)

Interview findings

The analysis of participants' transcripts revealed two major themes influencing their current

dietary intake: 1) personal, and 2) socio-cultural factors. Table 4 includes an overview of the

major themes and sub-themes. Specific excerpts are reported for each theme to support the

findings. Excerpts in the third person were those from an interview conducted with the aid

of an interpreter.

Table 4. Key themes from interviews (n=46)

Themes	Sub-themes
Personal factors	Knowledge and perceptions of their diet
	Increased awareness of obesity and chronic diseases
	Digestion problems
	Changes in PA
	Health care provider advice
Socio-cultural factors	Changes in home environments and household roles
	Meal companionship
	Lack of interest in cooking
	Dietary restrictions

Personal factors

The sub-themes related to personal factors affecting current dietary intake included

knowledge and perceptions of their diet, increased awareness of obesity and chronic

diseases, digestion problems, changes in PA, and health care provider advice.

Knowledge and perceptions of their diets

Overall, there was a good knowledge and awareness about what constitutes a healthy diet and current nutritional guidance, as one participants described: "Checking out your fats and carbohydrates...and your proteins, make sure that you get enough of each of them." (Irish, 72y, non-frail, P59). Similarly, participants reported foods they considered as healthy: "Healthy eating is brown bread, fruits and vegetables, fish and low-fat" (Yemeni, 77y, frail, P30). In general, most participants described their diet and nutrient intake as being healthy:

> I am eating healthy, I don't eat that much chips [French fries]... I don't eat chocolates... I eat lots of vegetables and I know I like chapattis, but I even eat boiled food as well. (Pakistani, 61y, frail, P12)

Increased awareness of obesity and chronic diseases

The therapeutic restrictions on their diets as a consequence of a medical condition was particularly salient for frail participants who had a higher presence of chronic diseases and who tended to self-report poorer health than non-frail participants:

> I had a problem with my kidney...they [doctors] said "you have high potassium so you have to control not to take this food" and I was very fed up! I said what should I eat nowadays? [Is there] anything left? You can't eat mushroom, you can't eat banana, many things I can't do any more. What should I eat? (Pakistani, 75y, frail, P19)

Many participants reported that they feel that at an old age it is imperative to make dietary changes and to try to lose weight. This was based on previous experiences as a carer for a family member with diabetes, as well as a high prevalence of diabetes among acquaintances and in some cases being personally at risk (i.e., glucose intolerant or obese):

Only older I am aware of these things. But before at a young age, they weren't in my mind these things, we didn't know about it, blood pressure, we didn't know at all what is diabetes, no! Yeah, but now we are hearing these things and then, I worry about it. (Pakistani, 64y, non-frail, P1)

Reducing their energy intake overall, or reducing intake of certain food items (i.e., sugar, fat, salt, and red meat) were reported as common strategies:

That is why [to prevent diabetes] I am cutting the things [oily foods and sweets] and I am trying to lose weight…you have to, when you see some people are like this you know, suffering, you have to do that, you never know if you can catch [develop] it or not at this age. (Pakistani, 62y, non-frail, P10)

Digestion problems

Digestion problems appeared to be a key factor affecting not only the amount of food consumed, but also the cooking methods and the type of foods they were consuming. Spices, oily foods and staple foods [e.g., chapattis] were common food items being cut down or removed from their diets to avoid indigestion, gastritis and reflux:

You should eat little you know, that you can digest easily, to eat [to a] full stomach… you can't, because your digestive system is not the same. (Pakistani, 63y, frail, P11)

Changes in their PA

Participants also identified a loss of appetite, emphasizing that they eat because they 'have to' and not because they are hungry. This appetite loss was commonly related to changes in their daily activity level compared to when they were younger and more physically active:

> She cannot eat as much as she could before…and she slowed down so she doesn't feel…hungry or anything. (Bangladeshi, 65y, pre-frail, P56)

Women who migrated more recently associated appetite loss with the sedentary lifestyle they had in the UK in comparison to their home countries, where a lack of access to public or motorized transport and physically demanding housework kept them more active:

> She is eating because she has to, so she decreased the amount of food she is taking and also she is thinking about her weight…In this country you sit all the time but in Somalia you eat a lot, but you walk all the time…there is no public transport. (Somali, 74y, pre-frail, P33)

Health care provider advice

Given the high prevalence of obesity and related chronic diseases across the study sample, participants commonly reported receiving dietary advice to encourage the maintenance of normal blood glucose levels and a healthy body weight. However, very few reported receiving any specific advice towards nutrient adequacy unless this was part of a medical treatment (e.g., anemia, heart disease). Awareness of nutrient deficiencies was not commonly highlighted, although 40% of the sample reported taking a nutrient supplement on a regular basis. Some participants reported taking multivitamins following encouragement from family members. The exception was calcium/vitamin D supplements (25% of the sample consumed vitamin D/calcium supplements) that were commonly prescribed by their general practitioner (GP). Notably, there were some participants (n=8) that mentioned having supplements at home but reporting not taking them regularly. A common concern among frail participants was that of taking too many medications (i.e.,

polypharmacy). In some instances women would not take any supplements unless they were specifically instructed to do so by their GP, as the following excerpt exemplifies:

> One time I was getting a little bit, not worried, but I needed to do something about [weakness] because I am not taking any supplements… I hate taking tablets so I went along and they [GPs] said, "Look you really need to take some iron tablets" so I started taking it eventually. (Indian, 75yrs, frail, P19)

Socio-cultural factors

This theme included key factors related to the changes in participants' home environments and household role as well as dietary restrictions women adopt related to their religious beliefs.

Changes in home environments and household role

Changes in their home environments (i.e., not living in multi-generational households) resulted in the reduction of daily responsibilities of many participants. Not having company or the duty of cooking for other family members as they were used to, led them to lose interest and enjoyment in cooking and eating. In some cases, participants prefer to eat out or skip their meal rather than cooking food for only one person or eating alone, as the following excerpts illustrate:

> I used to do a lot of cooking. When my children were young, I used to bake my own bread as well...Now, [I cook] very little and very simple…nothing sophisticated. You know, if I am out I might eat out. (Indian, 63y, non-frail, P2)

If my husband is not there, then I'll skip meals. But because we two sit down together

you know, I never skip my meal with him around…but otherwise I would eat

whatever is there, I wouldn't bother [to prepare food]. (Indian, 62y, non-frail, P27).

Variety in their diets appeared to be compromised by the reduction in the number of meals

and the time spent cooking. For instance, women reported cooking one day and using

leftovers for the following days, especially those living alone:

She cooks every other day and what is leftover she puts it in the fridge to have

tomorrow because she doesn't want to cook everyday, it's a little bit tiring…[to cook

for] herself. (Somalia, 75y, pre-frail, P34)

Dietary restrictions

Some participants reported dietary restrictions linked to religious beliefs (e.g., vegetarianism

and fasting practices). Although periods of fasting were related to important calendar events

in the religious calendar, some participants continued to fast regularly. Fasting practices

throughout the year were reported by Hindu and Muslim women. For example, a Hindu

participant explained how she followed a fasting pattern, which included the reduction of

the number of meals and/or the prohibition of certain food items throughout the year:

I fast every Monday…I have only dinner in the evening, that's all. Sometimes I fast on

Wednesday or Thursdays, but this [fasting] Monday is regularly. I have only one

meal… Last month I was fasting, I was eating without salt, no salt in my food for a

month. (Indian, 65y, non-frail, P8)

Also, Muslim women tended to fast once or twice per week in addition to the period of

Ramadan when they fast for a longer period of time. These women in particular considered

fasting practices as rewarding and beneficial for their health, and strongly believed the fast gave them more energy:

> Ramadan, that's a month [in duration] but she does it [fasting] every Monday and Thursday of the week…that gives her more energy and she goes and does a lot of walking. She does fasting and [it] makes her lighter and she goes for a walk. (Yemeni, 90y, frail, P28)

In addition, some women reported experiencing weight loss during Ramadan, which was perceived as an additional health benefit:

> When we are fasting in the Ramadan my weight is alright [goes down]… it's very good for me and my health is alright, no problem with my health. (Pakistani, 63y, non-frail, P14)

Discussion

The results from this study provide unique insights into dietary intake and key factors influencing the eating behaviors of a sample of first generation migrant women living in the UK. Dietary analysis indicated inadequate intake of energy and various nutrients, with higher inadequacies than those previously reported among European older adults in the UK (Vikstedt, Suominen, Joki et al., 2011, Bailey, 1997). Similarly, the energy and nutrient intake of the women in the current study were lower than those reported for young and middle-aged SA and AC adults in the UK (Garduño-Diaz, 2014, Sharma, Cade, Riste et al., 1999). These differences are likely due to the fact that our sample was older, inactive, and included only first generation migrant women from diverse ethnic backgrounds. There is limited research conducted among migrant older adults from ethnically diverse backgrounds in

Western countries. However, dietary inadequacy has been previously reported in migrant older adults from Cambodian, Latin-American, Vietnamese, Polish, and Chinese origin living in Canada (Garcia & Da, 2011, Johnson & Garcia, 2003).

Energy consumption and nutrient intake by women in the present study were significantly lower than the UK RNIs which were more pronounced in frail participants. Low nutrient densities of vitamin D, magnesium, potassium, copper, selenium, and low intake of retinol were the main nutrients of concern. Frail participants had significantly lower intakes of energy, folate and selenium in comparison to pre-frail and non-frail women, while frail participants had significantly lower intake of zinc, and pre-frail participants had lower intake of protein than non-frail women. Among older adults, insufficient intake of these nutrients has been associated with important biochemical and physiological changes that may pose potential negative health outcomes by increasing the risks for cardiovascular disease (Brown & Arthur, 2001, Ma & Betts, 2000), osteoporosis (Tucker, 2009), impaired immune function (Marian and Sacks, 2009), cognitive decline, and oxidative injury that may lead to a decline in physical function (Cesari, Pahor, Bartali et al., 2004).

Among this sample of first-generation migrant women, there were determinants of dietary intake that were different from those previously reported in other populations of community-dwelling older adults. For example, socio-economic factors and availability of traditional foods that have consistently been associated with dietary intake and consumption of fruits and vegetables in previous studies (Lee & Frongillo, 2001, Garcia & Da, 2011) were not commonly reported in the present study. Also, levels of deprivation and education did not differ between frail and non-frail participants. Similarly, dentition (Lee, Weyant, Corby et al., 2004) did not emerge as an important factor influencing their dietary

intake. Instead, both the presence and awareness of chronic diseases (58% with obesity, 38.2% with diabetes and 55.3% with hypertension) and digestion problems were common factors influencing not only the amount of foods eaten, but also the cooking methods used and the types of food eaten. Thus, dietary restrictions imposed by attempts to lose weight and meet disease-specific recommendations appeared to compromise energy and nutrient intake.

It is important to emphasize that some of the dietary changes participants made due to increased awareness of obesity and chronic diseases can also be considered as facilitators for the adoption of healthier diets. For instance, many women reported having made changes that can potentially benefit their health, such as changing butter for a vegetable spread, or cooking with vegetable oil instead of animal fat. As confirmed by the 24-hr dietary recalls, reductions in salt and fat consumption resulted in adherence to the UK RNI values for sodium, total fat, and percentages of saturated and *trans* fat across the sample. This finding is in contrast to the higher intakes of salt and saturated fat reported among mainly White British older adults in the UK (Bates, Lennox and Prentice, 2011).

The relationship between a decline in PA and appetite loss in older adults has been reported in previous studies (Ashe, Miller, Eng et al., 2009). In this study, some women perceived their low dietary intake to be a consequence of their low energy expenditure. The results from the present study thus reinforce the need for lifestyle interventions designed for older women that include an emphasis on both dietary and PA behaviors to help maintain a healthy energy balance and optimize nutrient intake (Kumanyika, Taylor, Grier et al., 2012).

Furthermore, findings from the interviews indicated that some participants that would benefit from nutrient supplementation did not consume them regularly. This appeared to be

particularly important for some women whose fears of taking too many medications influenced their supplement use. Although there is a lack of research exploring dietary intake and supplement use among migrant groups, research conducted among older adults in the general population has reported that individuals with poor diets consume fewer or inappropriate dietary supplements (Brownie & Rolfe, 2004, Payette & Gray-Donald, 1991). Additionally, other investigations have reported that overweight and obese individuals have lower rates of supplement use in comparison to normal-weight individuals (Radimer, Bindewald, Hughes et al., 2004). In the present study, calcium and vitamin D were the most commonly consumed supplements. The fact that these supplements were commonly prescribed by their GP highlights the importance of receiving dietary advice regarding potential nutrient deficits from a qualified and respected health professional. It is important for these professionals to recognize that the advice they give to these individuals needs to address concerns women might have of taking supplements along with other medications, and the importance of taking supplements only when needed. This is particularly relevant for frail participants as previous investigations have suggested that older adults with chronic diseases and high medication use may have energy needs even higher than current recommendations (Akamine, Filho & Peres, 2007).

Among free-living older people, the association between dietary intake and social support is somewhat controversial. Some studies have found that meal companionship positively influences dietary intake (Gustafsson & Sidenvall, 2002, Dean, Raats, Grunert et al., 2009), while others have reported diet quality to be unaffected by a lack of social support (Pearson, Schlettwein-Gsell, van Staveren et al., 1998). In our sample, the majority of participants come from cultures where multi-generational households are common and where the

grandparents are taken care of as they age (Mellin-Olsen & Wandel, 2005). However, as described by the women in the present study, this familial system is changing and many extended families are being divided into nuclear households, which can result in the older parents or widowed/separated women living alone. Thus, for some participants, meal preparation and the eating process have been relegated to a *"survival"* activity rather than being viewed as a social, family-oriented activity. This finding differs from what has been previously reported in younger migrant women where cooking for their family remains a major responsibility (Nicolaou, Doak, van Dam et al., 2009). In addition, the reduction and simplification of meals prepared at home may potentially impact the variety of foods included in participants' diets if they are eating very similar meals during the week; this pattern has previously been associated with diet inadequacy in other elderly populations (Marshall et al., 2001). Therefore, future strategies targeting migrant older women should consider the social component of cooking and eating, especially for those women who have lost their partners and are living alone.

Besides therapeutic and self-imposed restrictive diets (e.g., to promote weight loss), several women in the present study followed religious dietary practices that may potentially impact on their energy and nutrient intakes. Although older adults, particularly those diagnosed with chronic diseases such as diabetes, are exempt of fasting practices (Azizi, Siahkolah, Shahraz et al., 2003), some of the women chose to follow major religious observances (e.g., Ramadan and Diwali) as well as fasting once or twice per week. These food practices are important to highlight, as choosing to fast regularly in addition to major religious observances may be unknown to health professionals.

Irrespective of frailty status, women in the present study indicated a good level of knowledge and awareness regarding what constitutes a healthy diet. However, eating is a process that is influenced by many factors and thus, knowledge may not necessarily translate into dietary behaviors that promote optimal health and function (Johnson-Askew et al., 2009). Given the importance and wide range of food beliefs among migrant populations, interventions focusing on dietary behaviors need to consider not only targeting nutrition education, but also discussing the importance of family environments as well as food beliefs and traditions (e.g., fasting practices) and how these can be honored while promoting healthy dietary patterns. Interventions may be more successful if they are built upon and respect the existing beliefs of migrant populations, while sensitively correcting any misunderstandings about what constitutes a healthy diet.

The limitations of the present study include the difficulties inherent in dietary data collection. A single 24-hr dietary recall is commonly used in samples with low literacy levels and where participant burden needs to be minimized (e.g., women who need to be accompanied by a family member) (Johnson & Garcia, 2003, Jonnalagadda & Diwan, 2002). It could be argued that the energy and nutrient inadequacy found in this study was due to under-reporting, which has been suggested to be as high as 30% of energy intake and is more common in older adults, women and overweight individuals (Poslusna, Ruprich, de Vries et al., 2009). However, efforts were made to increase reliability and accuracy of the dietary data by enhancing the 24-hr dietary recalls with an in-depth qualitative interview. Given the cross-sectional nature of this study and the use of self-report tools, further research including dietary biochemical markers needs to confirm the nutritional risk found in this study. It is worth mentioning that the majority of the women who participated in this

study were overweight/obese, and many were recruited from community centers where health information has been provided. Thus, this could have influenced their responses regarding their eating behaviors.

In addition, female interpreters were required for 16 participants, which were selected due to their close connection with the participating communities. Given the limited resources available for this study (e.g., time and funding), we were unable to account for the effects of the interpreters on the qualitative part of the study, which may have limited the language trustworthiness of the translated data. Regarding the quantitative analysis, we added interpreter use as a covariate to address this issue.

The present study benefits from the inclusion of a population that is commonly under-represented in research (Gill & Redwood, 2013), and is at high risk of obesity and related chronic diseases (Kumanyika et al., 2012). The mixed-methods approach allowed for the examination of dietary intake in community-dwelling, first generation migrant women, and provided a platform to explore the shared and culturally specific factors across older women with varying categories of frailty as well as diverse ethnic, socio-economic and migration backgrounds.

Conclusions

Our findings suggest that older migrant women living in the UK have inadequate intakes of several nutrients despite having high rates of overweight and obesity. Frail women who tended to be older and have more chronic diseases were at highest risk of inadequate intakes of energy and specific nutrients. Key personal and socio-cultural factors influencing dietary intake that were identified in this study may provide useful insights for the

development and evaluation of future interventions designed to encourage and facilitate

healthy eating among migrant older women from ethnically diverse backgrounds living in the

UK.

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CHAPTER 4

LOW NUTRIENT INTAKE AND FRAILTY AMONG OVERWEIGHT AND OBESE MIGRANT WOMEN FROM ETHNICALLY DIVERSE BACKGROUNDS AGED 60+ YEARS: A MIXED-METHODS STUDY

This chapter includes the second paper from this PhD research that has been accepted for publicationin the journal *Nutrition Education and Behavior*. The results reported in this chapter answer the following PhD research questions:

1. Are energy and nutrient intakes associated with frailty among a sample of predominantly overweight and obese first generation migrant women aged ≥60 years?

2. Are low intakes of energy and nutrients stronger predictors of frailty than unintentional weight loss and indices of overweight and obesity (e.g., body mass index, waist circumference and waist-to-hip circumference) in this sample?

3. How do first generation migrant women aged ≥60 years, with high prevalence of overweight and obesity, perceive their dietary intake in relation to their body weight and physical function?

Abstract

Objective: Toexamine associations between energy/nutrient intakes and frailty in older migrant women, and to explore perceptions of body weight, dietary intake and physical function.

Design: Cross-sectional mixed-methods study.

Setting: Birmingham, UK.

Participants: Seventy-six first generation migrant women ≥60 years.

Main Outcome Measures: Energy/nutrient intakes (assessed by 24-hr dietary recall), frailty (using the frailty phenotype), and links between perceptions of body weight, dietary intake, and physical function (via semi-structured interviews).

Analysis: Bivariate and logistic regression analyses examined associations between frailty and low energy/nutrient intakes. Interviews were analyzed using thematic analysis.

Results: Seventy-six women completed a 24-hr dietary recall; 46 participated in a semi-structured interview. Low energy intake was associated with frailty (OR: 11.71, 95% CI: 2.36-57.97). After adjusting for energy and other confounders, a low intake of >3 nutrients was associated with frailty (OR: 6.58, 95% CI: 1.01-43.08). Qualitative data suggest that dietary intake was influenced by concerns about body weight and perceptions that unhealthy foods reduce mobility.

Conclusions and Implications: Among older migrant women with high prevalence of overweight/obesity, an inadequate dietary intake may be a stronger predictor of frailty than

weight loss. Dietary interventions should focus on healthy weight maintenance and optimization of nutritional adequacy and physical function.

Introduction

Frailty has become the focus of extensive research due to the ever-increasing aging of the global population. Frailty is characterized as a disorder of multiple physiological systems in which homeostatic mechanisms start failing, increasing the risk of declines in cognitive and physical function.[1-3] Furthermore, longitudinal studies have demonstrated a greater prevalence of cardiovascular disease and diabetes among frail older people,[4] and a greater frailty burden for women in comparison to men.[5,6] Therefore, identifying and treating individuals at risk of frailty may help delay its negative consequences and reduce the financial, social, and personal burdens these consequences place upon individuals, families and societies.[7,8]

One of the most widely used definitions of frailty is the frailty phenotype proposed and validated by Fried and colleagues.[2] This battery of tests identifies people as frail when they meet three or more of five criteria: relatively weak grip strength, unintentional weight loss, self-reported exhaustion, slow walking speed and low levels of physical activity. The inclusion of unintentional weight loss is used as a proxy measure of dietary inadequacy, which is congruent with the conceptualization of frailty as a wasting disorder.[2-3] However, obesity can also be linked with frailty, as indicated by the greater risk of physical function decline and pro-inflammatory state commonly found among older adults who are obese.[9]

In older adults, the use of unintentional weight loss in the definition of frailty is problematic as this measure may not be sensitive enough to reflect reduced energy and nutrient intakes.[8] Weight loss will not occur if energy intake matches energy expenditure, however a diet that is adequate in energy can still be deficient in certain nutrients, increasing a person's

risk for frailty. Therefore, we hypothesize that a low intake of energy and selected nutrients is a stronger predictor of frailty in overweight/obese older women from diverse ethnic backgrounds than unintentional weight loss. There is limited evidence examining the association between frailty and nutrient intakes, and this has been conducted in predominantly White older adults.[8] Thus, very little is known about these associations in older adults from diverse ethnic backgrounds. In addition, to develop interventions that can effectively delay or prevent frailty in older women from diverse ethnic backgrounds, more information is needed to explore if there are links between perceptions of body weight, dietary intake and physical function in a population with disproportionately higher rates of overweight and obesity.

Therefore, the aims of this study were to: 1) examine the associations between dietary/nutrient intake and frailty in a sample of older women (≥60 years) from diverse ethnic backgrounds living in the UK; 2) to gain a greater understanding of the potential links between women's perceptions of body weight, dietary intake and physical function.

Methods

Study Design

A cross-sectional, mixed-methods design was employed, using 24-hr dietary recall interviews that were enhanced with the addition of a qualitative semi-structured interview in a sub-sample (n=46). These methods allowed for the quantitative estimate of energy/nutrient intake and its association with frailty, as well as providing insights into women's perceptions of their body weight, dietary intake and physical function.

Recruitment and Participants

A convenience sample of first generation migrant women from Ireland, Jamaica, Montserrat, St Kitts and Nevis, India, Pakistan, Bangladesh, Yemen, Sierra Leone, Somalia, and Eritrea were recruited to participate in the study. Inclusion criteria included being at least 60 years of age, with no medical conditions affecting memory (e.g., dementia), and the ability to walk 15ft with no or minimal assistance (i.e., use of a walking stick). Community-dwelling women living on their own or with family members were recruited using maximum variation sampling[10] to achieve our goal of recruiting a sample across the ranges of age, migration backgrounds, socio-economic status, and main ethnic groups living in the geographic region. Community centers serving various ethnic, migrant, and older adult groups were contacted and informed about the study. Those in leadership roles at these centers facilitated access to potential participants so they could be approached and informed of the purpose of the study. Participants were recruited via word-of-mouth and snowballing.[11]Ethics approval was granted by The University of Birmingham Ethics Committee (reference No. ERN_13-0557). All participants provided written informed consent.

Data Collection

Data were collected at the participants' time and location of choice (e.g., homes or community centers). For participants not fluent in English, trained interpreters fluent in Punjabi, Bengali, Arabic and Somali provided simultaneous translation during recruitment and data collection. Socio-demographic information was gathered via a researcher-administrated questionnaire.

Dietary Intake

A multiple-pass 24-hr dietary recall interview was conducted to gather data on the types and amounts of foods consumed on the previous day via a standard protocol.[12] Information was also obtained on nutrient supplement use. A photographic food atlas assisted with the estimation of portion sizes.[13] The first author (DCG), a dietitian, trained in dietary assessment conducted all 24-hr dietary recalls. Data coding and processing was conducted by DCG, with oversight from JLT who has extensive expertise in dietary assessment. These procedures enabled a standardized data entry and analysis process. The dietary recall interview was audio-recorded to ensure accuracy of quantitative data entry and to facilitate the collection of additional qualitative information. When participants stated that the previous day did not reflect their habitual diet (e.g., they had engaged in fasting practices), the 24-hr dietary recall was repeated later in the same week on a day that was identified by participants as being representative of their habitual intake. This occurred in 5 participants. Data were not gathered during periods of major religious observances (e.g., Ramadan, Diwali). All recalls were conducted during weekdays, excluding Monday. Nutrient analysis was completed using DietPlan 6.0 software (Forestfield software Ltd 2006, Horsham, UK), which included standard and supplemental food composition databases that covered the range and ethnic diversity of foods consumed in the UK.

Similarly to methods reported by Bartali and colleagues[8], low intake was defined as the lowest quintile of the distribution of energy (<13 kcal/kg) and specific nutrients: protein <30 g, vitamin D <0.5 μg, vitamin E <2.5 mg, retinol <101 μg, vitamin C <32 mg, folate <127 μg, iron <5.6 mg, calcium <349 mg, and zinc <3.6 mg. A nutritional score was obtained by summing the number of nutrients categorized as low intake. This nutritional score was

subsequently categorized into a low intake of 0, 1-3, or >3 nutrients. A low intake of >3 nutrients was classified as poor nutritional status.

Anthropometric measures and assessment of frailty

Anthropometric measures included height measured to the nearest mm (SECA 213 portable stadiometer), weight to the nearest 0.1 kg (SECA 899 digital scale), and hip and waist circumference (WC) measured to the nearest cm using an extractable tape measure. All anthropometric measurements were taken with the participant wearing light clothing and no shoes. Body mass index (BMI) was calculated as weight divided by height squared (kg/m^2), and waist-to hip-ratio (WHR) as waist circumference divided by hip circumference (cm).

Frailty status was assessed using a modified version of the original frailty phenotype.[2] This included: 1) Exhaustion, defined using self-reported fatigue from two questions from the Center for Epidemiological Studies-Depression (CES-D) depression scale ("I felt that everything I did was an effort," and "I could not get going.") Participants who reported having these feelings for ≥3 days over the previous week to either or both questions received positive scores for exhaustion; 2) Slow walking speed, with the highest quintile of the time needed to walk a distance of 15 feet, adjusted by height (>14.5 seconds for height ≤ 157.7 cm and >9.7 seconds for height > 157.7 cm); 3) Weak grip strength was defined as the lowest quintile for adjusted grip strength using a JAMAR hand-held dynamometer (Sammons Preston Rolyan, Bolingbrook, Illinois, US), adjusted by BMI. Participants met the criteria for weak grip strength if their BMI and grip strength were ≤25.8 kg/m^2 and ≤ 12 kg; >25.9- 29.6 kg/m^2 and ≤ 11 kg; >29.7- 31.6 kg/m^2 and ≤12 kg; and ≥31.7 kg/m^2 and ≤14 kg. A low level of

physical activity was defined as the lowest quintile of caloric expenditure (< 60 kcal/week) using the International Physical Activity Questionnaire short-form modified for the elderly.[14]

Since the purpose of this study was to examine the association between dietary intake and frailty, similar to Bartali's study, unintentional weight loss (>10 pounds in the last year) was excluded from the original frailty definition.[8] Therefore, participants with >2 positive criteria were categorized as frail, while those with ≤1 positive criteria were categorized as not frail.

Semi-structured interviews

A purposive sub-sample (n=46) across the range of age, ethnic groups and socio-economic status was invited to participate in an interview that was guided by a list of topics related to migration histories, dietary intake and eating behaviors, and engagement in physical activity (migration histories and physical activity data not reported here). For the purpose of this study, dietary topics centered on participants' perceptions of their diets in relation to their body weight and frailty status (referred to as physical function during the interviews). The interview schedule was pilot-tested prior to the study. All interviews were audio-taped and transcribed verbatim, with the interviews conducted with participants who were not fluent in English being translated from their native language into English by a trained interpreter during the interview process (n=16).

Data Analysis

Quantitative data analysis

Descriptive characteristics (means, SDs, and percentages) were calculated for socio-demographic variables. To identify potential confounding factors, independent t-tests or Mann-Whitney U tests (for non-parametric data) were conducted to examine any significant

differences in continuous variables between those classified as frail or not frail, with Chi-squared or Fisher's exact tests conducted for categorical variables. Point-biserial correlations (r_{pb}) were used to determine the association between frailty status (dichotomous variable), weight loss, and indices of overweight/obesity (e.g., BMI, WC and WHR). Multiple logistic regressions were used to evaluate the association between frailty status and each of its components with low energy intake and poor nutritional status. Separate models were conducted to test the association between nutrient intakes with frailty adjusting for confounding factors and energy intake. All statistical analyses were performed using SPSS version 21.0 (IBM Corp, Armonk, NY, 2012); alpha was set at $p < 0.05$.

Qualitative data analysis

An inductive thematic analysis of the interview transcripts was conducted, allowing for the identification of themes being driven by participants' perspectives of their diets in the context of their body weight and physical function/frailty status rather than fitting the data into a pre-existing theoretical framework[15]. Initially, a subset of transcripts were read several times by the first author and two independent researchers to identify predominant topics across the data. An initial coding frame using qualitative analysis software (QSR NVivo, version 10) was developed which formed the basis of broad coding and analysis. All of the transcripts were then coded by the first author. The coding frame was discussed and refined by all authors until consensus was reached. Data saturation was considered to have been achieved when no new or relevant information emerged from each of the various ethnic groups included in the study.[16]

Results

Table 1 includes the demographic characteristics of participants. On average, participants (mean age= 70.5 ± 7.6 years) reported having 2.3 ± 1.5 diseases previously diagnosed by a doctor, with hypertension, arthritis and type 2 diabetes the most common. Over 88% of the sample was classified as overweight or obese. BMI cut-points for overweight and obesity among the Arab, Indian, Pakistani and Bangladeshi participants were those recommended by the World Health Organization for Asian populations.[17] Although participants came from all socioeconomic levels, 79% were categorized as being in the two most socio-economically deprived quintiles based on the English indices of deprivation.[18] Seventeen participants (22.4%) presented ≥2 positive criteria of the frailty syndrome, and were classified as frail. Frail participants were older and had a higher number of diagnosed diseases; these were the only demographic variables that were statistically different between frail and non-frail participants.

Table 1. Participant demographic characteristics

Variable	Mean ± SD or % Total n=76	Mean ± SD or % Non-frail n=59	Mean ± SD or % Frail n=17	p values
Age (y)	70.5 ± 7.6	69.9 ± 6.5	74.1 ± 9.3	0.04
Residency in the UK (y)	38.73 ± 17.1	37.2 ± 17.8	44.1 ± 13.5	0.10
No. of diseases	2.3 ± 1.5	2.1 ± 1.5	3.3 ± 1.2	<0.001
Ethnicity, %				
African-Caribbean	21 (27.6)	14 (23.7)	7 (41.2)	0.06
African	10 (13.2)	10 (10.6)	0 (0)	
Arab	8 (10.5)	5 (8.5)	3 (17.6)	
Indian	20 (26.3)	17 (28.8)	3 (17.6)	
Pakistani	7 (9.20	6 (10.2)	1 (5.9)	
Bangladeshi	5 (6.6)	2 (3.4)	3 (17.6)	
Irish	5 (6.6)	5 (8.5)	0 (0)	

IMD quintile, %				
1 (most deprived)	49 (64.5)	34 (57.6)	15 (88.2)	0.20
2	11 (14.5)	10 (16.9)	1 (5.9)	
3	7 (9.2)	7 (11.9)	0 (0)	
4-5 (less deprived)	9 (11.8)	8 (13.6)	1 (5.9)	
Education, %				
No qualifications	26 (34.2)	16 (27.1)	10 (58.8)	0.07
Primary school	8 (10.5)	6 (10.2)	2 (11.8)	
Secondary school	18 (23.7)	15 (37.3)	3 (17.6)	
Tertiary	24 (31.6)	22 (37.3)	2 (11.8)	
Marital status, %				
Married	34 (44.7)	31 (52.5)	3 (17.6)	0.60
Widowed	30 (39.5)	21 (35.6)	9 (52.9)	
Single/ separated/divorced	12 (15.8)	7 (11.9)	5 (29.4)	
Living alone, %	26 (34.2)	20 (33.9)	6 (35.3)	0.60
BMI (kg/m^2)	29.3 ± 4.9	29.1 ± 4.8	30.2 ± 5.3	0.43
Normal, %	9 (11.8)	9 (15.3)	0 (0)	
Overweight, %	23 (30.3)	16 (27.1)	7 (41.2)	
Obese, %	44 (57.9)	34 (57.6)	10 (58.8)	
WC (cm) [a]	98.8 ± 10.8	97.8 ± 11.1	102.0 ± 9.3	0.15
WHR [a]	0.92 ± 0.8	0.92 ± 0.1	0.92 ± 0.6	0.70
Unintentional weight loss, %	9 (11.8)	6 (10.2)	3 (17.6)	0.41
Supplement use, %	30 (39.5)	24 (40.7)	6 (35.3)	0.46
Energy intake (Kcals)	1243.5 ± 524.4	1379.9 ± 507.9	819.7 ± 262.5	<0.01
Number of frailty components, %)				
0	36 (47.4)	36 (61)	0 (0)	N/A
1	23 (30.3)	23 (39)	0 (0)	
≥2	17 (22.4)	0 (0)	17 (100)	

[a] n=68, BMI= Body Mass Index, IMD= Index of Multiple Deprivation, WC= waist circumference, WHR= waist-to-hip ratio, N/A=not applicable.

Frailty and low nutrient intake

Among frail participants, 82.3% had a low nutrient intake of at least one selected nutrient

(Table 2). The percentage of women with frailty increased with the greater number of

nutrients classified as low intake. Logistic regression analyses indicated that low energy

intake was independently associated with frailty (odds ratio [OR]: 11.71, 95% confidence

interval [CI]: 2.36-57.97). After adjusting for energy, age and number of diseases, poor

nutritional status (>3 low nutrient intakes) was significantly associated with frailty (OR: 6.58,

95% CI: 1.01-43.08) in comparison to those women who did not have a low intake of any

nutrients. After adjusting for energy and other confounding variables, only slow walking

speed was significantly associated with poor nutritional status (OR: 1.86, 95% CI: 1.31-3.07).

Table 2. Association Between Frailty Syndrome and Frailty Criteria According to the Number of Nutrients with Low Intake (n=76)

Number of nutrients with low intake				Adjusted Odds Ratios [a]	
Variables	0	1-3	>3	Low intake of 1-3 nutrients compared to 0	Low intake of >3 nutrients compared to 0
	%	%	%	OR (95% CI)	OR (95% CI)
Frailty syndrome	17.6	29.4	52.9	3.11 (0.56-17.35)	6.58 (1.01-43.08) [b]
Frailty criteria:					
Exhaustion	24.2	26.9	35.3	0.92 (0.26-3.17)	1.12 (0.17-7.20)
Low PA	9.1	19.2	47.1	2.30 (0.46-11.33)	5.26 (0.72- 38.10)
Weak grip strength	18.2	26.9	17.6	0.57 (0.15- 2.16)	1.23 (0.14-10.26)
Slow walking speed	6.1	15.4	47.1	0.85 (0.11-6.79)	1.86 (1.13-3.07) [b]

[a] Adjusted for low energy intake, age and number of diseases; [b] p< 0.05

In addition, a low intake of retinol (OR: 10.33, 95% CI: 1.55- 68.94) and zinc (OR: 8.47, 95%

CI: 1.04-68.80) were significantly associated with frailty after adjustment for energy intake

and other confounding variables (Table 3). Self-reported weight loss (p=0.3 for Fisher's exact

test), BMI (r_{bp}= 0.09, p=0.4), waist circumference (r_{bp}= 0.2, p=0.1), and WHR (r_{bp}= 0.03, p=0.8) were not associated with frailty.

Table 3. Frailty Syndrome Associated with Specific Low Nutrient Intakes (n=76)

Nutrient intake [a]	Frailty syndrome [b] OR (95% CI)
Protein (g/day)	0.76 (0.09-5.99)
Retinol (µg/day)	10.33 (1.55- 68.94) [c]
Vitamin D (µg/day)	0.96 (0.18-5.19)
Vitamin E (mg/day)	0.98 (0.17-5.68)
Vitamin C (mg/day)	3.82 (0.67-21.64)
Folate (µg/day)	0.78 (0.12- 5.06)
Calcium (mg/day)	3.87 (0.65-22.85)
Iron (mg/day)	0.94 (0.17- 5.19)
Zinc (mg/day)	8.47 (1.04-68.8) [c]

[a] Defined as the lowest quintile of each selected nutrient, [b] Adjusted for low energy intake, age and number of diagnosed diseases, [c] p<0.05

Qualitative Interview Results

Two main themes which linked women's perceptions of body weight, dietary intake and physical function were identified. They were: 1) concerns about weight and body image; and 2) perceptions about negative effects of unhealthy foods on physical function and health. Specific excerpts from participants have been used to demonstrate the themes outlined above.

Weight and body image concerns

Weight and body image emerged as two issues that were particularly important to participants. Data suggest that these women have become more aware of their weight as

they have aged. Furthermore, some participants emphasized that their weight status worried them more than getting older or other health problems as the excerpts below indicate:

> *I am very careful that I don't eat too much, though I am very hungry but I will leave [the food uneaten]… I never say I want to eat more, no! … I do not want to put on weight, that is in the back of my mind, I never think of the heart [problem], I think of my weight* (Indian, 73y, P3).

> *It doesn't bother me [the age], but when somebody says you are fat, then it hurts me!* (Indian, 62y, P27)

Participants' narratives also highlighted a difficult relationship between their diets and body weight, leading to feelings of frustration and shame:

> *My thinking was always eating healthy, but…I don't know how I put on so much weight so quickly and I've been trying [to lose weight] for many years now, it's not going down. I don't know what happened… I have gained so much I can't even get rid of it… since I've put on weight and I am out of size as well, I think 'Oh God people, don't see me!' …That stops me from going out, dressing up as well, meeting people or going into places.* (Pakistani, 62y, P1)

Given pervasive concerns about weight gain, many participants described modifying their diets in an effort to lose weight. However, adopting more restrictive diets have led some women to link these changes with a negative impact on their strength:

When you are getting older is hard to lose weight …well, I used to cut down my food and then I think I was falling apart, I was getting weak… so I just said, "I'll just continue [as normal]". (African-Caribbean, 79y, P48)

Other participants who have also tried to reduce their food intake mentioned that they occasionally complement their "light diets" with certain food items in order to meet their perceived dietary requirements:

*When I feel I haven't had enough protein… and need to rebuild some of the cells, dying cells, …then I would consciously have fish or chicken and try to eat a large portion to try to convince myself that I'm eating enough protein…but no, I do a lot of light days [of decreased consumption of fat and animal products]. (*African-Caribbean, 68y, P38)

Perceptions about negative effects of unhealthy foods on physical function and health

Participants' perceptions about the link between diet, physical function and general health were mainly driven by their beliefs about the negative effects unhealthy foods have on their mobility. For instance, some participants mentioned that eating "fattening food" decreases their ability to be more active, as the following examples illustrate:

If I had fried food and I walk, I feel breathless yeah, so I keep in line what I ameating.(Indian, 60y, P63)

Like…when you eat chips [French fries] you feel so heavy and you don't feel like moving, you don't feel like running you know. (Indian, 74y, P4)

Overall, women felt that the quality of the food they eat is associated with their general health, and that a healthy diet is an important component of healthy aging:

> *Health is related to what you put in your body, you are what you eat and if you put healthy food in your body, you can expect to be healthy at this age. (African-Caribbean, 69y, P45)*

Discussion

The present study examined the association between dietary intake and frailty in a group of free-living first generation migrant older women using a mixed-methods approach. Findings from this study indicated that having a low energy intake was associated with frailty, and a poor nutritional status was significantly associated with frailty after adjusting for energy and other confounding factors. Poor nutritional status was also associated with slow walking speed, one of the criteria of the frailty syndrome. The findings also provided rich insight into participants' perceptions about the links between their body weight, dietary intake, and physical function.

Our findings support existing evidence associating frailty and its components to nutrition at the nutrient level.[8] Poor nutritional status and low serum levels of several nutrient biomarkers (serum carotenoids, α-tocopherol, 25-hydroxyvitamin D, and vitamin B6) have been found to be related to an increased risk of frailty among predominantly White older adults.[19-21] These data, in addition to the findings from the present study, suggest that an inadequate diet plays a crucial role in the physical function of older adults. This is of particular importance due to the body composition changes associated with old age leading

to loss of muscle mass (sarcopenia) that can contribute to morbidity and decreased quality of life.[3]

There are multiple pathways in which micronutrient deficiencies can increase the risk of frailty in older adults by promoting conditions commonly associated with older age such as oxidative stress, impaired immunity, muscle and bone metabolism, and inflammation.[22] In our study, only retinol and zinc were independently associated with frailty, suggesting that these two nutrients may be of particular concern in this sample. Retinol is suggested to protect cell membranes from oxidative damage related to aging,[23] while both retinol and zinc play an important role in maintaining the integrity of the immune system.[24] Although malnourishment is typically associated with underweight, this study confirms that overweight/obese individuals can also be malnourished due to consuming a poor quality diet.[25] Thus, an individual can be frail and not necessarily experience significant weight loss.[8]

Among this sample, body weight concerns emerged as a key factor influencing energy and nutrient intake. Therefore, the majority of participants were more conscious about eating in moderation in order to lose weight, and did not identify being concerned with how their dietary intake would affect nutrient adequacy. Although it is well known that body dissatisfaction is highly associated with dietary intake in younger adults, it is only recently that this has been reported in older adults, especially in women.[26] Among women from minority ethnic groups, body weight perceptions have been reported to be more positive and accepting of larger figures and a body weight consistent with medically defined overweight or obesity.[27] However, our findings indicate that the women in this ethnically diverse sample are concerned about their body weight and the negative consequences associated with overweight/obesity. These concerns may potentially lead them to adopt

restrictive eating practices that may cause more harm than good. Although body dissatisfaction has been previously reported in younger migrant women,[28] to our knowledge, this is the first time that this has been found in a sample of older migrant women with high rates of overweight/obesity.

Regarding the negative effects of unhealthy foods on physical function and health, a few studies have found that an unhealthy diet (i.e., poor consumption of fruits and vegetables, low adherence to a Mediterranean-type diet) is associated with mobility limitations and disability in older adults, particularly in women.[29-31] Although this association has been found to be stronger in non-obese individuals,[30] in our study women felt that unhealthy foods, particularly fatty foods, were negatively related to their mobility. Thus, in overweight/obese older women, healthier diets may be perceived as a means of ameliorating mobility loss and further physical decline.

Given pervasive concerns about weight gain, findings from this study suggest that older women from ethnically diverse backgrounds with a high prevalence of overweight/obesity need dietary advice that promotes both the maintenance of a healthy body weight and nutrient adequacy. Particularly, because both excess weight and nutritionally inadequate diets are important determinants of morbidity and premature mortality.[32]

The major strength of the present study is the inclusion of a population commonly under-represented in research,[33] and little is known about dietary intake, eating behaviors, and frailty in older migrant women. The MM methodology is also a strength, as it allowed for the examination of dietary intake and its association with frailty as well as providing important insights into women's perceptions of their dietary intake and its link with body weight and

physical function. In addition, the interview sample size was relatively large for a MM study, and data saturation was reached in all participants across the range of age and ethnic groups.

Finally, some limitations of the study need to be considered. Due to the cross-sectional study design and a relatively small sample size for the quantitative data, causal inferences cannot be made and findings may not be generalizable to the wider population of first generation older migrant women living in the UK. In addition, almost 90% of the sample was overweight or obese. Although this could be considered a strength as the sample reflects the higher prevalence of overweight/obesity in ethnic groups in the UK,[34] the findings do not include data from participants who were underweight. This could have limited the potential of finding an association between frailty, protein and other micronutrients consistently found in previous studies.[8, 21,35] In addition, BMI was used as a measure of weight status. This is problematic as BMI does not distinguish between lean tissue and fat mass, and cannot take into account the height loss that occurs with older age.[32] Studies including a larger sample of older women from ethnically diverse backgrounds using an accurate measure of body composition and nutritional biomarkers are needed to confirm our findings. A larger sample will also allow for the examination of significant differences between ethnic groups.

Another important limitation was the use of a single 24-hr dietary recall, a limitation shared with other studies conducted with older adults and 'hard to reach' populations.[36] This method was considered the most appropriate as it minimized participant burden and allowed participants with limited English literacy to fully participate in both the quantitative and qualitative aspects of the study. Limitations in willingness of participants to participate in a second 24-hr dietary recall interview, in addition to budgetary constraints, prevented

the use of repeated 24-hr dietary recalls. In the present study, energy intake was relatively

low and as such, under-reporting cannot be ruled out. Under-reporting has been found to be

associated with female gender, higher age, lower socio-economic status, and

overweight/obesity.[37] Because of the day-to-day variability in dietary intake, the single 24-

dietary recall provided data for the sample rather than an estimate of an individual's dietary

intake. The interviews were conducted by a trained nutritionist, and when necessary with

the aid of interpreters with the same ethno-cultural background who were familiar with the

participants' dietary habits. In addition, we enhanced the 24-hr dietary recall with an in-

depth probing interview that allowed for a rich exploration of habitual dietary behaviors not

possible with a standard 24-hr dietary recall. Low dietary and nutrient intakes in older adults

are not uncommon given important changes in body composition, intestinal absorption and

decreased levels of physical activity.[38] In our study, women were highly sedentary, which

could have also influenced their energy intake. Nevertheless, misreporting may have

occurred and as such, our results should be interpreted in light of this limitation.

Implications for research and practice

Findings from this study indicate that among a group of mainly overweight/obese migrant

women from ethnically diverse backgrounds, poor nutritional status is an independent

predictor of frailty. Given that weight loss may not necessarily be present in community-

dwelling older women, low energy and nutrient intakes make important contributions to the

development of frailty. Therefore, assessing dietary intake may assist with screening for, and

treating, frailty. Moreover, the mismatch found between body weight and dietary

inadequacy may potentially cause older women to engage in self-imposed dietary

restrictions that could cause further health problems. Future strategies to prevent and

detect frailty in this sub-group of the population should focus on maintenance of a healthy

body weight as well as in the overall nutritional quality of the diet.

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CHAPTER 5

PHYSICAL ACTIVITY, SEDENTARY TIME, AND FRAILTY IN OLDER WOMEN FROM ETHNICALLY

DIVERSE BACKGROUNDS: A MIXED-METHODS EXAMINATION

This paper has been submitted to the Journal of Aging and Physical Activity (JAPA). As per

the journal's requirements, the language used throughout the paper is American English. In

this chapter the following research questions are addressed:

1. What are the current PA/ST patterns of older women from ethnically diverse

   backgrounds living in the UK?

2. Are physical activity (PA) and sedentary time (ST) predictive of frailty in older women

   from ethnically diverse backgrounds living in the UK?

3. What are the key factors identified by participants that influence their PA behavior,

   specifically related to their physical functioning?

Abstract

This mixed-methods study examined: 1) patterns of physical activity (PA) and sedentary time (ST) across frailty status in older women from ethnically diverse backgrounds living in the UK; 2) the association between objectively measured PA/ST and frailty, and 3) key factors influencing PA. Sixty older migrant women aged ≥60 years. Participants were inactive and highly sedentary irrespective of their frailty status. Multiple linear regression analyses indicated that only accelerometer-derived MVPA was associated with frailty (assessed using the frailty phenotype). Participants spent 69% of their waking time engaged in ST; 15% of the sample met the weekly PA recommendations. Semi-structured interviews (n=36) revealed that health-related and socio-cultural factors were common barriers to achieving PA recommendations. Maintaining independence, preventing physical decline and depression were key factors promoting PA. Understanding the challenges and needs of this population can help to inform health promotion strategies to promote PA and thus optimize physical function.

Key words: accelerometry, frailty, ethnicity, mixed-methods.

Background

Due to the burgeoning ageing population, there is an increased focus on strategies to improve older adults' health and well-being (Rechel, Grundy, Robine, Cylus et al., 2013). Age-related physical decline and high prevalence of chronic diseases often result in higher risks of developing frailty and consequently, losing the ability to live independently (Christensen, Doblhammer, Rau, & Vaupel, 2009). Conceptually, frailty has been defined as a pathological condition that results in a cumulative decline in multiple physiological systems over the lifetime (Clegg, Young, Iliffe, Rikkert et al., 2013). The most widely used definition was proposed by Fried et al. (2001), which identifies someone as frail by the presence of three or more of five criteria (unintentional weight loss, exhaustion, weakness, slow walking speed, and low PA). Previous investigations have shown that frailty is associated with increased risks of falls, fractures, disability and premature death among older women (Boyd, Xue, Simpson, Guralnik et al., 2005; Ensrud, Ewing, Taylor, Fink et al., 2007). Despite the fact that increased physical activity (PA) and decreased sedentary time (ST) contribute to preventing chronic diseases and decreasing disability, there has been limited research investigating the link between PA/ST and frailty (Blodgett, Theou, Kirkland, Andreou et al., 2015).

Current PA guidelines advise older adults to engage in at least 150 minutes per week in moderate-to-vigorous PA (MVPA) in bouts of 10 minutes or more, or in 75 minutes of vigorous PA per week, or a combination of both (Department of Health, 2011). However, PA declines with age and consequently, older adults tend to engage in many hours of ST (time spent sitting or lying), which has been associated with adverse health outcomes such as cardiovascular disease, mental illness and obesity (Katzmarzyk, Church, Craig, & Bouchard, 2009; Matthews, Moore, Sampson, Blair et al., 2015). In the United Kingdom, (UK) older

adults (≥55 years) from minority ethnic backgrounds, especially women, report being less likely to meet the recommendations of PA than their White counterparts (Sproston & Mindell, 2006). Thus, PA has been suggested as an important contributor to the disproportional prevalence of cardiovascular disease, type 2 diabetes and mental health issues between certain minority ethnic groups and the general British population (Caperchione, Kolt, & Mummery, 2009).

In addition, previous studies have identified diverse personal and environmental factors that contribute to sedentary behavior among mainly White older adults. Some of these factors include: poor physical health, low motivation, lack of knowledge, an unsupportive built environment, and lack of social support (Costello, Kafchinski, Vrazel, & Sullivan, 2011; Stathi, Gilbert, Fox, Coulson et al., 2012). Although previous studies have also found important determinants of PA among minority groups living in the UK, they mainly focus on the former Commonwealth populations (Babakus & Thompson, 2012; Horne & Tierney, 2012). As such, data from immigrants from less established groups are still scarce and often overlooked in studies conducted in minority (or migrant) populations.

The limited PA/ST literature published in minority groups is mainly self-reported data, with very few studies using objective measures of PA/ST (Curry & Thompson, 2014; Kolt, Schofield, Rush, Oliver, & Chadha, 2007). Yet self-reported methods have been shown to have important limitations such as recall bias and overestimation of PA. The use of accelerometers can overcome these limitations by providing objective and detailed measurements of the duration, intensity, and frequency of PA, as well as estimating ST (Copeland & Esliger, 2009).

To our knowledge, there are no published studies assessing objectively measured PA/ST and

frailty among a group of older migrant women from different ethnic, socio-economic and migration backgrounds living in the UK. In addition, complementary exploration of their PA/ST patterns and factors influencing PA will contribute to our understanding of where and how we could effectively target interventions to promote PA in order to prevent or delay the onset of frailty among this vulnerable sub-group of the population.

Therefore, this study aimed to: 1) examine patterns of PA/ST across frailty status in older women from ethnically diverse backgrounds living in the UK; 2) examine whether objectively measured PA/ST are predictive of frailty; and 3) identify key factors influencing PA in this sample.

Methods

Study design

A mixed-methods (MM) approach was used in this study to enhance our understanding of PA/ST patterns of older first generation migrant women and their associations with frailty. The quantitative phase of the study involved assessing objectively measured PA/ST and frailty status. The qualitative phase used semi-structured interviews to identify key factors influencing PA behaviors in this sample. The University Ethical Review Committee of the University of Birmingham granted approval for the study (reference No. ERN_13-0557B). Written informed consent was obtained from all participants. Data were collected between January 2013 and June 2015.

Participants

This convenience sample consisted of 60 first generation migrant women who were recruited for a larger study exploring dietary and PA behaviors within the context of migrating to, and ageing in, the UK. Participants were recruited using maximum variation sampling (Teddlie & Yu, 2007) to achieve our goal of recruiting a sample across the range of age, migration backgrounds, level of deprivation, and predominant ethnic groups living in the geographic region. Recruitment was initiated with contacts in the community and snowballing, with additional purposive sampling done via community centers in [city name] and surrounding areas. A sub-sample (n=36) was purposively sampled, based on socio-demographic characteristics, to participate in semi-structured interviews.

Objective assessment of PA and ST

PA and ST levels were measured using Actigraph GT3X accelerometers (Actigraph, Pensacola, FL) programmed to record activity in 60-s epochs. Participants were instructed to wear the device on the hip for a period of 7 days, only removing for bathing, swimming and sleeping. To be included in the analysis, participants had to wear the device for at least 3 days including one weekend day, and for at least 10h/day of valid wear time (Curry & Thompson, 2014).

PA data were downloaded to a computer and analyzed using ActiLife software (version 6.2, Actigraph) to provide counts per minute (CPM), minutes of low-light activity (LLPA), high-light activity (HLPA), MVPA, and ST. Data were checked for spurious values and periods of non-wear. Non-wear time was defined as a period of 90-min or more when the accelerometer recorded zeros, with allowance for 2-min intervals of nonzero counts (Choi, Ward, Schnelle, & Buchowski, 2012). Based on the published literature in older adults, ST

was defined as <100 min of zero counts. The Copeland threshold was used to define LLPA (100-1,040 counts/minute) and HLPA (1,041-1,951 counts/minute) (Copeland & Esliger, 2009). MVPA was defined using the ≥1,952 counts/minute cut point that is commonly used in the literature, therefore ensuring the findings from this study are comparable with other populations, including older adults (Buman, Hekler, Haskell, Pruitt et al., 2010; Fox, Hillsdon, Sharp, Cooper et al., 2011). The patterns of PA/ST examined between frail groups were: 1) proportion of participants meeting the PA recommendations (engaging in at least 150min/week of MVPA in bouts of >10min); 2) overall PA intensities and total ST; and 3) activity differences between weekdays and weekend days.

Frailty

Frailty was determined following a slightly modified version of the original frailty phenotype (Fried et al., 2001). Exhaustion was based on self-report of "I felt that everything I did was an effort" and "I could not get going' from the CES-D questionnaire (Radloff, 1977). Participants responding yes for >3 days over the previous week to either of both questions received a positive score for exhaustion. Weakness was measured in kg using a Jamar hand-held dynamometer (Sammons Preston Rolyan, Bolingbrook, Illinois, USA), adjusted for BMI. Slow walking speed was assessed by a 15ft walk at one's usual pace, adjusted for height. Low PA (expressed in Kcal) was estimated using the International Physical Activity Questionnaire modified for the elderly (IPAQ-E) (www.ipaq.ki.se). Poor nutritional status was defined as low intake of >3 out of 9 nutrients (protein, vitamin D, vitamin E, retinol, vitamin C, folate, iron, calcium, and zinc). We used poor nutritional status in the definition of frailty instead of unintentional weight loss, as it has been shown to be a better measurement of dietary inadequacy in this sample (Castaneda-Gameros, Redwood, Thompson 2016., in press).

Cut-offs for a positive score for weakness, slow walking, low PA, and low nutrient intakes were set at the lowest 20% of the sample. Participants with >3 positive criteria were categorized as frail, while those with 1-2 and 0 were classified as pre-frail and non-frail, respectively.

Other characteristics

Descriptive data included measured weight (to the nearest 0.1 kg) and height (to the nearest mm). Body mass index (BMI) was calculated as weight divided by height squared (kg/m^2). The World Health Organization BMI cut-points for Asian populations were used for the Arab, Bangladeshi, Indian, and Pakistani participants (WHO, 2004).

A researcher-administered questionnaire provided information on the following: age, self-reported ethnicity, religion, marital status, and health/disease status. Each participant's postcode was used to assign an area deprivation score using The English Index of Multiple Deprivation (IMD) as a socioeconomic indicator (Department for Communities and Local Government, 2011).

Semi-structured interviews

The interview guide was designed to guide the exploration of: 1) perceived barriers to engage in sufficient PA; 2) views about the official PA recommendations; and 3) perceived link between PA and physical function. Interviews were carried out with women from all ethnic groups until data saturation was reached (Guest & Johnson, 2006). Since different translators were used depending on the participants' language needs, they were instructed to discuss PA in terms of any activity participants engaged in, from housework, to general walking, to formal exercises in walking groups or community and/or leisure centers. The interview guide was piloted and further revised via an iterative process throughout data

collection.

Statistical analysis

Descriptive statistics (means, SDs, percentages) were calculated for all socio-demographic variables. One-way ANOVAs or Chi-square/Fisher's exact tests were used to compare differences between frailty groups. One-way ANCOVAs with Bonferroni's post hoc tests were used to compare differences in PA/ST between frailty groups adjusted for age and wear time. Multiple regression analyses were performed to examine if PA/ST were predictive of frailty after adjustment of confounding factors, in which the total number of components of the frailty phenotype (excluding self-reported PA) was the outcome variable (frailty score). Potential confounders were selected based on the literature and the purpose of the study. As MVPA and CPM were skewed, data were log-transformed for analysis. All statistical analysis were conducted using SPSS version 21.0 (IBM Corp, Armonk, NY, 2012); alpha was set at $p< 0.05$.

Qualitative data analysis

Data were analyzed using thematic analysis based on the recommendations of Braun & Clarke (2006) in which themes are drawn from the data inductively, rather than fitting into a pre-existing theory. Initially, the first author and two research assistants read and re-read a set of transcripts to familiarize themselves with the data. Initial coding was carried out using NVivo qualitative analysis software (QSR International Pty Ltd, Melbourne, Australia). The coding was reviewed and discussed by the research team to allow for the development of a coding framework. All of the transcripts were then coded by DCG. The coding framework was refined in joint discussions with JLT and SR until consensus was reached.

Results

Out of the total 76 participants originally recruited to participate in this study, 16 were excluded for the following reasons: dropping out of the study for health reasons (n=1), losing the accelerometer (n=1), trust issues (n=1), lost to follow-up (n=6), and failing to meet the minimum wear criteria (n=7). Ten participants (17%) were classified as frail, while 23 (38%) and 27 (45%) were classified as pre-frail and non-frail, respectively. Table 1 shows the socio-demographic characteristics of the study sample. The mean age of participants was 70.8 (SD=8.1 years). Frail participants were older than non-frail participants (p=0.03) and more likely to be widowed (p<0.01). Over 88% of the sample was classified as overweight or obese. Participants wore the accelerometer for an average of 5.7 (SD=1.3 days), for an average of 778.3 (SD=71.9 min/day). Only 15% of the sample met the recommended ≥150 minutes of MVPA per week in bouts of at least 10-min duration (Department of Health, 2011). None of the frail participants met the MVPA recommendations.

Table 1. Participant socio-demographic characteristics

Variables	All (n=60)	Non-frail (n=23)	Pre-frail (n=27)	Frail (n=10)
	M (SD)			
Age (years)	70.8 (8.1)	67.8 (5.6)	71.6 (8.6)	75.5 (9.4) [a]
Number of comorbidities	2.4 (1.6)	2.0 (1.5)	2.3 (1.7)	3.2 (1.3)
BMI (kg/m^2)	29.4 (4.8)	29.0 (4.1)	29.9 (5.7)	28.9 (3.4)
	n (%)			
BMI category				
Normal	7 (11.7)	3 (13.0)	4 (14.8)	0 (0.0)
Overweight	18 (30.0)	8 (34.8)	6 (22.2)	4 (40.0)
Obese	35 (58.3)	12 (52.2)	17 (63.0)	6 (60.0)
Self-reported Ethnicity				
African-Caribbean	20 (33.)	7 (30.4)	8 (29.6)	5 (50.0)

Indian	16 (26.7)	6 (26.1)	8 (29.6)	2 (20.0)
Arab	8 (13.3)	2 (8.7)	5 (18.5)	1 (10.0)
Pakistani	6 (10.0)	4 (17.4)	2 (7.4)	0 (0.0)
Irish	4 (6.7)	3 (13.0)	1 (3.7)	0 (0.0)
Bangladesh	3 (5.0)	0 (0.0)	1 (3.7)	2 (20.0)
African	3 (5.0)	1 (4.3)	2 (7.4)	0 (0.0)
Religion				
Christian	25 (41.7)	10 (43.5)	10 (37.0)	5 (50.0)
Muslim	22 (36.7)	9 (39.1)	9 (33.3)	4 (40.0)
Sikh	7 (11.7)	1 (4.3)	5 (18.5)	1 (10.0)
Hindu	6 (10.0)	3 (13.0)	3 (11.1)	0 (0.0)
Migration status				
Family reunification	34 (58.3)	14 (60.9)	15 (55.6)	4 (40.0)
Economic migrant	22 (36.7)	8 (34.8)	10 (37.0)	6 (60.0)
Refugee/asylum seeker	4 (5.0)	1 (4.3)	2 (7.4)	0 (0.0)
Marital status				
Partner (yes)	30 (50.0)	16 (60.9)	13 (55.6)	1 (10)[b]
IMD quintile				
1	37 (61.7)	15 (56.5)	13 (55.6)	9 (90.0)
2	9 (15.0)	2 (8.7)	7 (25.6)	0 (0.0)
3	6 (10.0)	2 (8.7)	4 (14.8)	0 (0.0)
4-5 (least deprived)	8 (13.3)	6 (26.1)	2 (3.7)	1 (10.0)
Meeting PA weekly recommendations	9 (15.0)	3 (13.0)	5 (22.2)	0 (0.0)

BMI=body mass index; IMD= index of multiple deprivation; PA= physical activity;
[a] Different from non-frail participants only (p=0.03), [b] Different from pre-frail (p=0.01) and non-frail (p<0.01) participants

Differences in CPM, PA intensities and ST across frailty groups are presented in Table 2. Only MVPA was significantly different between frailty groups (F=5.21, p<0.01) after controlling for age and wear time.

Table 2. Accelerometer derived variables between frail groups

Variables[a]	All (n=60)	Non-frail (n=23)	Pre-frail (n=27)	Frail (n=10)	Sig. (p)
CPM[b]	213.2 (114.4)	229.9 (112.3)	229.2 (111.3)	131.3 (101.2)	0.20
ST (min/day)	536.8 (87.9)	523.7 (85.7)	533.1 (85.7)	576.7 (7.0)	0.48
Low-light (min/day)	198.6 (64.8)	207.4 (57.8)	204.9 (66.7)	161.4 (68.7)	0.51
High-light (min/day)	26.9 (17.2)	27.1 (13.6)	29.8 (17.2)	18.4 (23.0)	0.36
MVPA (min/day)[b]	16.0 (17.9)	18.4 (19.9)	18.7 (17.6)	3.4 (4.5)[c]	<0.01

Data are presented in *M (SD)*; CPM= counts per minute; ST= sedentary time; MVPA= moderate-to-vigorous activity; [a]Adjusted for age and wear time; [b] Log-transformed data were used for analysis, actual means included for clarity of interpretation, [c] Different from non-frail (p=0.02) and pre-frail participants (p<0.01)

Associations between frailty, various PA intensities, and ST

Multiple regression models examining factors predicting frailty indicated that ST, LLPA, and HLPA were not associated with frailty (data not shown). Table 3 shows the results of the significant models for frailty when MVPA and potential confounders were included. After adjustment for age, number of comorbidities, marital status, and wear time (Model 1), MVPA was inversely associated with frailty (t=-2.22, p=0.03). This inverse association remained significant after further adjustment for BMI, IMD, religion, and ST (Model 2) (t=-2.21, p=0.04), with models explaining 38% and 37% of the variance in frailty, respectively.

Table 3. Regression models examining significant predictors of frailty[a]

Model	Variable	B	SE (B)	β	t	Sig. (p)	Adj. R^2
1	Age	0.01	0.02	0.07	0.54	0.59	0.384
	No. comorbidities	0.17	0.07	0.26	2.32	0.02	
	Marital status[b]	-0.85	0.22	-0.42	-3.93	<0.001	
	Wear time	0.00	0.00	0.07	0.64	0.53	
	MVPA[c]	**-0.46**	**0.21**	**-0.29**	**-2.22**	**0.03**	
2	Age	0.02	0.02	0.15	1.09	0.28	0.370
	No. comorbidities	0.14	0.07	-0.46	1.86	0.07	
	Marital status[b]	-0.92	0.23	0.22	-4.04	<0.001	
	BMI	-0.00	0.03	-0.02	-0.17	0.86	
	IMD	0.00	0.01	0.04	0.29	0.77	
	Religion[d]						
	Hindu	-0.05	0.41	-0.02	-0.13	0.89	
	Sikh	0.14	0.37	0.04	0.37	0.71	
	Christian	-0.47	0.28	-0.23	-1.69	0.09	
	Wear time	0.00	0.00	0.07	0.44	0.66	
	ST	-0.00	0.00	-0.05	-0.29	0.77	
	MVPA[c]	**-0.53**	**0.24**	**-0.34**	**-2.21**	**0.04**	

MVPA= Moderate-to-vigorous activity; BMI= body mass index; IMD= index of multiple deprivation; ST= sedentary time; [a] Frailty score (total number of components of the frailty phenotype excluding self-reported PA); [b] Marital status (Reference: with partner); [c] log transformed for analysis; [d] Religion (Reference: Muslim).

PA patterns and ST across levels of frailty

Figure 1 shows weekly patterns of PA/ST across the day. As shown in Figures 1a-1b, a higher percentage (on average 69%) of each hour during weekdays and weekend days was spent in ST and LLPPA, while very little time was spent in HLPA and MVPA across all groups. Percentage of time spent in MVPA was statistically different between frail and pre-frail/non-frail groups during both weekdays (0.7% vs. 2.7% and 2.4%, p<0.01) and weekend days (0.4% vs. 1.8% and 2.3%, p<0.01).

Hour by hour CPM for weekdays (Figure 1c) indicate that frail participants were significantly less active than pre-frail (p=0.01) and non-frail participants (p<0.01). For all groups PA intensity was higher during the mornings (6:00-12:00hrs); frail and pre-frail participants appeared to be more active early in the morning (8:00-9:00hrs) while PA intensity peaked during 11:00-13:00hrs for non-frail participants. After 13:00hrs, PA intensity decreased for frail and pre-frail groups. Similarly, during weekends (Figure 1d), frail participants were less active than pre-frail and non-frail participants with the exception of between the hours of 19:00-20:00, where they were similarly active. PA intensity peaked during 12:00hrs for non-frail and frail participants, while pre-frail participants were, as during weekdays, more active between 8:00-9:00hrs.

a. Wear time (%) spent in ST and PA intensities during weekdays

b. Wear time (%) spent in ST and PA intensities during weekends

c. Average counts per minute across the day during weekdays

d. Average counts per minute across the day on weekend days

Figure1. Weekly ST and PA patterns across frailty status. (a) Per cent of wear time spent in ST and PA intensities for weekdays. (b) Per cent of wear time spent in ST and PA intensities for weekends. (c) Intensity activity (CPM) across the day during weekdays. (d) CPM across the day during weekends.

Semi-structured interviews

Two main themes were identified from the qualitative interviews, which linked women's

perceived barriers and motivators to meet the PA guidelines (Table 4). Excerpts from

participants' interviews are used to illustrate the themes and sub-themes. Excerpts in the

third person are those from an interview that was conducted with the aid of an interpreter.

Table 4. Key themes from interviews (n=36)

Themes	Sub-themes
	Health-related
	Physical limitations and pain
	Different physical abilities
	Weight issues
Perceived barriers to meeting	**Socio-cultural factors**
PA guidelines	Conflicting schedules
	Language barriers
	Cultural priorities
Motivators to engaging and	Preventing physical decline
maintaining regular PA	Avoiding depression
	Maintaining independence

Perceived barriers to meeting PA guidelines

There were three important health-related barriers that limited PA engagement across the

sample including: physical limitations and pain, different physical abilities, and weight issues.

Physical limitations and pain– Consistent with accelerometry data, frail participants tended

to perceive themselves as inactive and commonly reported physical limitations, fears of

falling and joint pain as reasons for not engaging in PA:

I don't call myself active... before I had fallen, before that I was ok because I ran up and down, now I can't, I am scared I might slip... I lose balance; that is why I can't sort of try myself to be a bit active. (Pakistani, 79y, frail, P17)

Although walking was identified as the activity that was often recommended by their General Practitioner (GP), some women felt it was more important to follow what they believed their body could do rather than following their GP's advice: "The doctor's saying [to walk] but if I can't do it even if the doctor's saying, how can I do it?" (Bangladeshi, 81y, frail, P49).

In other cases, women have stopped exercising because of perceived negative effects of the exercise:

I used to exercise more...I used to go swimming 'cause the doctor used to say to swim once a week, but I just stopped it... sometimes if I go down [to swim], my knees give me a lot of trouble. (African-Caribbean, 83y, frail, P44)

Different physical abilities– When commenting about official PA recommendations some women felt that not all older adults have the same physical abilities and thus they felt it would be difficult for many to adhere to the official guidelines, as one participant explained:

Well, I suppose for some people it isn't if you can't move, yeah. It is an individual thing... you can't just say that everybody has to do it! (Irish, 62y, pre-frail, P62)

On the other hand, there were women with higher physical function who reported that activities provided for their age group were "boring" and needed to be more intense, as the following excerpt exemplifies:

Yesterday I went to do exercise, but at first they [members of the community center] were sitting down because some of them have aches and pain so I think… sit for a while but after that get up and start, even throw the ball, throw it to the side, pass it over your head or something…. I'd prefer zumba. (African-Caribbean, 77y, non-frail, P46)

Weight issues– Excessive weight was highlighted as a physical and psychological factor, limiting their ability to engage in and maintain a more active lifestyle, as the following excerpts illustrate:

Her weight is more than her bones, so that is why she has less mobility and has to use a walking stick. She is trying her best but she can't [do PA]. (Yemeni, 77y, pre-frail, P30)

I feel fat whenever I go to the gym…because I see everybody… they are all fit and whatever. I feel like Gosh! Every time I looked at them I sort of felt massive! (African-Caribbean, 68y, frail, P38)

Socio-cultural factors

This theme addresses factors related to societal expectations of women and cultural norms that prevent engagement in leisure PA including conflicting schedules, language barriers, and cultural priorities.

Conflicting schedules– For some participants taking time to engage in leisure PA was not an easy task, especially if the activities they preferred intervened with their household responsibilities. Having to neglect their housework was perceived as problematic, and in

some cases women had to prioritize family responsibilities rather than time for themselves:

> They have [swimming lessons] but they've got those times, which are not
> appropriate. In the evening, that is the time when the husband is coming home, like
> 7-8 o'clock... I had to come home... not having a shower either, rushing, worrying... I
> have to cook for him. (Pakistani, 62y, non-frail, P22)

In addition, even when some women did not have major responsibilities, participants explained their preference to complete all their leisure activities during the mornings and have a "quieter" time during the evenings: "I am trying to finish everything before morning time and after that it's my prayer time and you know, other things I am doing." (Pakistani, 61y, pre-frail, P11).

Language barriers– Although many women in this sample were fluent in English, the negative influence of language barriers was reported in those who migrated later in life, and for women who did not have the opportunity to learn English given their focus on taking care of their families. Not being able to communicate and relying on others to accompany them if they want to go out of their homes had limited the opportunities they can engage in PA, as one participant commented: "I can't speak English; I can't go wherever I want by myself. Back home I knew where to go and what to do." (Somali, 67y, pre-frail, P25)

Cultural priorities– For Muslim women in particular, certain specifications were commonly reported as additional barriers to PA initiation and maintenance. Although not all Muslim participants felt uncomfortable with mixed facilities, in general, they reported a preference for gender-segregated activities:

Yeah [only ladies facilities] and specially when I am dressed like this [full-length dress], even if I go to physiotherapy, I can't [be] with a man [who is not a family member]. (Yemeni, 60y, non-frail, P34).

Also, some women reported faith-related issues that prevented the uptake and maintenance of PA:

I used to [go] but I don't like the music because it's not allowed in the religion [Islam], so that's why…. you haven't heard this music; they say "put some music on, we are lazy!" They [other women] won't do the jump because of the rhythm of the music! (Pakistani, 79y, frail, P17).

Motivators to engaging and maintaining regular PA

This theme describes the perceived positive aspects of PA. Preventing physical decline, improving mental health as well as maintaining independence were key factors acting as motivators to PA.

Preventing physical decline– The influence of PA on their physical function was discussed as a motivator to engage and sustain an active lifestyle. Many participants reported that "weakness" and "stiffness" were a result of physical inactivity and thus, they were aware of the benefits of PA to improve their physical health: "I'm feeling better since I started exercising, my joints are getting better as well." (Pakistani, 61y, frail, P12)

Avoiding depression– Apart from keeping the body *"going"*, preventing depression was perceived as one of the most important benefits of PA. Women felt that by attending community exercise sessions they were able to socialize and meet new people: "I think when we sit down we have nothing to do, negativity comes in you know, so keep moving, go

out, meet people!" (Indian, 70y, pre-frail, P4)

Maintaining independence– Irrespective of frailty status or socio-demographic characteristics, participants felt that by being active as long as possible they could avoid having to go to a nursing home, which appeared to be their main fear at an old age: "Just the idea of being stuck and people looking after you, that is the scariest bit, you want to be independent." (Indian, 62y, non-frail, P2).

Although some participants are still expecting that their family will look after them if they lose independence, many women explained that their family structure has changed (they are not living in multi-generational households) and therefore, they can't expect their children to look after them:

> Nobody is there to look after you; you have to look after yourself. If I start getting bigger and fatter and don't do any exercise, I will be sitting here doing nothing and nobody is going to give me [anything], not even a glass of water! (Indian, 62y, pre-frail, P27).

Discussion

This study has explored the patterns of PA/ST and their associations with frailty among older first generation migrant women living in the UK. One major finding from our study is that, among this sample, MVPA was inversely associated with frailty after controlling for confounder factors. This association between MPVA and frailty is consistent with previous studies indicating that individuals with lower levels of MVPA are more likely to be frail, have higher levels of disability, lower limb function and higher healthcare usage (Blodgett et al., 2015: Marques, Baptista, Santos, Silva et al., 2014; Trayers, Lawlor, Fox, Coulson et al., 2014).

Contrary to other investigations, we did not find an association between ST and frailty (Blodgett et al., 2015; Santos et al., 2012); this could be due to our relatively small sample size and the similarly high proportion of time spent in ST across frailty groups. It has been argued that for sedentary individuals such as overweight/obese women from ethnic minority communities, decreasing ST by increasing light PA may be a more feasible strategy than increasing PA intensity sufficiently to meet current recommendations for MVPA (Curry & Thompson, 2014). However, among older individuals, lifestyle activities such as housework and low-intensity walking have not been found to provide sufficient health benefits to prevent/delay physical decline in comparison to active individuals (Peterson, Giuliani, Morey, Pieper et al., 2009). Our results suggest that this may be the case for older women from ethnically diverse backgrounds.

It is worth noting that although our sample was highly sedentary, 15% of the sample met the recommendations of 150 min/week in consecutive 10-minute bouts of MVPA, which is higher than the 0% of the general population of women ($\geq$65 years) reported in the Health Survey for England (Craig, Mindell, & Hirani, 2009). This finding is consistent with the few studies that have explored objective measured PA among women from ethnic minorities (mainly South Asians) in Western countries (Curry & Thompson, 2014; Hotl et al., 2007). Thus older women from ethnically diverse backgrounds may be more active than indicated via studies using self-reported PA.

Our study also revealed key barriers for meeting the PA guidelines. Consistent with the literature, physical limitations and pain are major barriers for women to engage in and maintain regular PA (Babakus & Thompson, 2012; Horne, Skelton, Speed & Todd, 2013). Walking was the most common leisure activity recommended by their health providers, and in many cases this was the only activity in which women engaged. However, lack of

awareness regarding sufficient and safe levels of intensity and duration of various forms of

PA resulted in some women feeling that walking at their own pace to avoid exertion or injury

was the best way for them to do any activity. This negative perception of a high potential

risk for injury while participating in PA highlights the fact that women may not be aware of

the type of activities that can safely produce health benefits. This is particularly important

for the women in this study, as most were overweight or obese, and excessive weight can

cause joint pain and prevent these women from being more active. Regular PA could be

promoted not only as a way to prevent frailty and functional decline, but also as a way to

achieve a healthier weight or optimize physical function at a given level of overweight.

Identifying patterns of PA/ST is important so that future interventions can be targeted

accordingly. In agreement with other studies of older adults, participants were more active

during weekdays in comparison to the weekends (Baruth, Sharpe, Hutto, Wilcox et al., 2013;

Blodgett et al., 2015; Curry & Thompson, 2014). Notably, women were the most active in the

mornings and the most sedentary in the evenings. Data from the interviews confirmed that

women prefer engaging in leisure PA, such as participating in exercise sessions in community

centers in the mornings, which is more accommodating with their household

responsibilities. Regarding these exercise sessions, both observations from the field and the

accelerometry data confirmed that these formal exercise sessions addressed strength,

flexibility and balance, but did not address the intensity component of PA sufficiently in

order to meet current PA recommendations. Whether community centers can provide

higher intensity activities (e.g., dancing) is uncertain, as community-based exercise provision

needs to be inclusive and meet the needs of participants across a wide range of functional

abilities. Offering a range of classes across various functional abilities would require additional resources (including appropriately trained staff and the offer of more classes).

For the majority of the participants, keeping active was seen as a strategy to maintain their independence, delay physical decline and prevent depression through social support. Previous qualitative studies conducted in older adults from minority backgrounds have largely recognized that the social component of PA may be even more important than the physical health benefits such as managing chronic diseases (Caperchione et al., 2009; Horne et al., 2012). Similarly, maintaining independence is a major motivator in engaging in regular PA and it is particularly important in this population, as some women have familial expectations that are different from those of Western countries (Harper & Levin, 2005). Namely, moving older adults into nursing homes as they age is considered culturally unacceptable according to some of the participants in the present study.

As the UK and other developed countries become increasingly diverse, it is important to ensure the health and well-being of migrant groups. While some women may be comfortable in using PA services already available for older adults (e.g., walking clubs), many others may face important barriers such as lack of English proficiency and cultural norms that have been consistently reported in ethnic minorities living in the UK (Greenhalgh, Helman, & Chowdhury, 1998; Horne & Tierney, 2012; Sriskantharajah & Kai, 2007). Consideration should also be given to how older women are able to negotiate their responsibilities towards their families. This is important to address in future strategies that encourage women to engage in leisure PA, as programs that do not interfere with their household responsibilities may be more attractive and acceptable to older migrant women.

The mixed-methods design used in this study provided a detailed picture of objectively measured PA/ST, their association with frailty, and identified important factors influencing PA in a sub-group of the population that is under-studied. Despite these strengths, we acknowledge that this study has some limitations. First, the cross-sectional design and relatively small sample size for the quantitative data limits generalizability and causality cannot be determined. Accelerometry compliance in our study was lower (79% vs 91%) than what has been reported in an earlier study of women conducted among South Asian women in the UK (Curry & Thompson, 2014). We employed several strategies to improve compliance such as text messages, calls and a pictorial log as well as employing interpreters of the same ethno-cultural and gender as the participants. Nonetheless, compliance from non-English speakers was lower than for women with English literacy (63% vs. 88%).

Although we employed interpreters to include voices of 'hard-to-reach' migrant groups (e.g., Somali, Bangladeshi and Arabic women), which is considered a strength, this had some disadvantages. For instance, six women were lost to follow-up due to an obstructive gatekeeper/interpreter, and one participant refused to wear the monitor due to trust issues. Recruiting participants from close-knit communities poses additional challenges as members are suspicious of outsiders (Spring, Westermeyer, Halcon, Savik et al., 2003). Although investing in communities to build rapport requires time and additional resources, the disproportionate health disparities these groups face indicate the need to ensure they are included in research (Redwood & Gill, 2013). Given the limited time and resources available, we were unable to engage longer with these communities. Similarly, we were unable to account for the effect of the interpreters on the qualitative phase of the study, which may

have limited the language trustworthiness and consequently, the transferability of the translated data (Squires, 2009).

Conclusions

This sample of first generation migrant women was highly sedentary irrespective of their frailty status. The finding that MVPA is associated with frailty suggests that increasing MVPA may promote healthy ageing by decreasing the risk of frailty. Housework activities and light-intensity walking were the main activities participants engaged in; however, these activities may not be sufficient to promote health benefits among this population. Future interventions to promote active lifestyles for older women need to provide detailed information on specific activities that are both safe and of sufficient intensity to optimize health and physical function. This study also provided useful insights into the PA/ST patterns and key barriers and motivators to adhering to PA guidelines. By understanding key factors influencing PA behaviors in older migrant women from ethnically backgrounds, PA strategies can be tailored to this population in order to maximize their effectiveness.

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CHAPTER 6

EXPERIENCES AND PERCEPTIONS OF AGEING AMONG FIRST GENERATION OLDER MIGRANT WOMEN: IMPLICATIONS FOR HEALTHY EATING AND PHYSICAL ACTIVITY PROMOTION IN A SUPER-DIVERSE UK CONTEXT

This paper is in preparation to be submitted to the journal *Ageing& Society*. In this chapter the following research questions are addressed:

1. What does ageing mean to a group of older women from diverse ethnic, socio-economic and migration backgrounds living in a super-diverse city?

2. How does this phenomenon shape perceptions of old age and participants' dietary and physical activity behaviours?

Abstract

Purpose: To explore experiences of ageing of first generation migrant women from ethnically diverse backgrounds and how these shape perceptions of ageing as well as nutrition and physical activity (PA) behaviours.

Design and methods: Semi-structured interviews were conducted with 46 first generation migrant women (≥60 years and older) living in Birmingham, United Kingdom (UK). Data were analysed using inductive thematic analysis and constant comparison techniques.

Results: On the basis of women's perceptions and experiences of ageing, four categories of ageing were identified:*1) optimistic – accepting and adapting to ageing; 2) living in the present – carrying on with life; 3) accelerated ageing – early onset of disease, and 4) inward-looking – contemplative ageing*. Perceptions and attitudes towards ageing appeared to be strongly linked with women's experiences of migration. Social support from family and/or friends, staying connected and engaged with their communities, faith, and maintaining independence were commonly mentioned as components of a 'good' old age. In addition, receiving culturally competent care was a salient issue for some participants. Although eating and PA behaviours were perceived as important mediators to ageing successfully, motivations to engage in healthier lifestyle behaviours differed between categories of ageing.

Implications: Despite commonalities across ethnic groups, factors such as migration backgrounds, age at migration, and English language proficiency, chronic diseases, among others, appear to play a key role in successful ageing. Health promotion needs to take these factors into account when planning health strategies for older women living in an ever-

increasingly super-diverse UK context. Interventions to promote successful ageing through

healthy eating and PA in migrant older women need to be targeted at both the community

and family levels.

Introduction

Ageing and migration

Decreased fertility rates and the increase in life expectancy have led to the ageing of the worldwide population. The global population aged 60 or over is expected to increase from 900 million in 2015 to 2 billion by 2050 (WHO, 2015). In the UK, there are now 14.9 million people aged 60 or over and this number is expected to rise to over 20 million by 2030 (ONS, 2015). Furthermore, it has been estimated that by 2051, there will be 6.6 million older adults from diverse ethnic minority backgrounds aged 65 and older living in England and Wales (Lievesley, 2010).

Across Europe and the UK, the population is ageing and becoming increasingly more diverse due to a sharp increase in the number of people moving between countries (Patel, 2015). This unprecedented phenomenon has been labelled 'super-diversity,' and describes a situation where migrants differ according to a multitude of factors, such as ethnicity, gender, age, faith, socio-economic and migration statuses, and associated rights and entitlements (Vertovec, 2007). These demographic changes have made it necessary to start planning for an ageing population in an ever-increasing super-diverse UK context (Birmingham Policy Commission, 2014).

The study of health related to ethnicity is not a new phenomenon; however, the specific focus on older individuals from minority ethnic groups is relatively recent despite these individuals having complex health needs (PRIAE, 2013). For instance, these groups experience significantly higher rates of morbidity and premature mortality than the general population in Western countries (Tillin, Forouhi, McKeigue et al., 2012). While genetic

factors may explain some of the health inequalities found between minority ethnic groups and White populations, key modifiable behaviours such as eating behaviours and PA play an important role in the onset of chronic diseases such as cardiovascular disease and type 2 diabetes (T2DM) (Gilbert & Khokhar, 2008). Sustaining a healthy nutritional status and engaging in regular PA are recognised as major contributors to preserving cognitive function, delaying functional decline and thus enhancing quality of life (Schuit, 2006). However, minority ethnic groups experience a plethora of barriers including socio-cultural, economic and environmental factors that have a cumulative impact on how a person ages. Importantly the environments in which ethnic minorities live may influence the uptake and maintenance of healthy lifestyle behaviours and consequently impact on healthy or successful ageing (Garcia & Da, 2015).

Successful ageing in ethnically diverse older adults

A major challenge for both policy and research is how to optimise both the duration and quality of life in super-diverse ageing populations by reducing risks for chronic diseases and physical decline. While researchers have been trying to find ways to understand and define successful ageing since the second half of the 20th century (Havighurst, 1961), there is little agreement on a definition, a standardised term (e.g., healthy ageing, good old age, active ageing, ageing well, etc.), or the components of successful ageing (Romo, Wallhagen, Yourman et al., 2013).

The most popular model of successful ageing, developed by Rowe and Kahn (1997) focuses on objective criteria. This model proposes that individuals who age successfully are those avoiding long-term diseases and risk factors for disease, with high levels of physical and

mental health, as well as an active engagement in life. This model has been widely criticised

for failing to take into account attitudes, experiences and perceptions of older adults

(Crowther, Parker, Acenbaum et al., 2002). These factors are crucial in understanding

successful ageing when disease-free older age is unrealistic for the majority of the

population (Bowling &Iliffe, 2006).

On the other hand, psychosocial models characterise ageing as a dynamic and adaptive

process with less emphasis on physical health (Baltes & Baltes, 1990). For instance, previous

studies exploring lay perceptions of successful ageing have found that adaptive attitudes,

financial security, social engagement, and support and self-reported good health are

important contributors for successful ageing even in the presence of physical disability

(Reichstadt, Depp, Palinkas et al., 2007). More recently, scholars have argued that successful

ageing should focus on an individual's life story. This biographical approach proposes that

each individual may interpret success according to their own experiences of ageing, taking

into account changing resources, events and abilities throughout one's lifetime (Chapman,

2005).

To date, the body of literature on successful ageing has been built predominantly on findings

involving a homogenous older adult population (e.g., primarily White relatively healthy older

adults) and has overlooked under-represented sub-groups of the population (Cosco, Prina,

Perales et al., 2013, Troutman, Nies and Mavellia, 2011). Furthermore, cross-cultural

research has mainly been conducted in the US (Laditka, Corwin, Laditka et al., 2009, Romo et

al., 2013), but research of this type is limited in the UK (Cook, 2010). It is important to gain

an understanding of successful ageing in older migrant women given that women tend to

live longer and have a higher prevalence of disability and chronic diseases than men at an older age (WHO, 2007).

Therefore, in order to address the paucity of research into successful ageing in a super-diverse context, this study aimed to explore experiences of ageing of first generation migrant women from diverse ethnic, socio-economic and migration backgrounds. It explores how different experiences shape perceptions about good old age and attitudes towards lifestyle behaviours in relation to nutrition and PA, and how these in turn, influence successful ageing.

Methods

Data collection

Participants were recruited from a larger study (n=76) designed to explore nutrition and PA behaviours within the context of being a migrant to the UK and getting older. Forty-six women were purposively sampled based on their socio-demographic characteristics. We employed snowballing and maximum variation sampling (Teddlie and Yu, 2007) strategies so that the findings could reflect a wide range of views and perspectives from women from diverse backgrounds. Recruitment occurred through contacts with members of the community as well as outreach to community centres serving older adults from minority ethnic groups. The study was approved by The University of Birmingham Ethics Committee (reference No. ERN_13-0557), and participants gave written informed consent prior to participation.

Interviews

Semi-structured interviews were conducted at participants' location of choice (e.g., homes or community locations), with a duration of 30-78 minutes. Interpreters were available during recruitment and data collection for women not fluent in English, and they provided simultaneous translation in 16 of the 46 (34.8%) interviews. A semi-structured interview guide was used, allowing flexible exploration of salient issues. The interview schedule was initially pilot-tested with two participants of similar characteristics to the participants in our sample; modifications to the question wording were also made when terms could not be directly translated into English. For instance, 'successful ageing' was probed as 'good or happy old age' during the interviews.

Additionally, socio-demographic information was gathered via a researcher-administrated questionnaire. Participants' postcodes were used to determine the Index of Multiple Deprivation (IMD) for England ranking as an indicator of socio-economic background (Communities and Local Government, 2011).

Data analysis

All interview recordings were audiotaped and transcribed verbatim by the first author. Interview transcripts were analysed using inductive thematic and constant comparison analysis (Braun and Clarke, 2006). Transcripts were studied carefully and re-read several times. Then, the first author and two research assistants coded a subset of transcripts in order to develop a coding strategy that reflected the aims of the study. This coding framework was used to code all the remaining transcripts using NVivo V.10 qualitative data management software (QSR International Pty Ltd, Melbourne, Australia). The next stage involved re-reading the interview transcripts in order to construct a case summary for each

interview. This approach allowed the data to be analysed in terms of cross-cutting themes. The last stage of analysis involved grouping participants' responses into four categories of ageing in an attempt to discover how different experiences of ageing shape perceptions of good old age and attitudes towards healthy eating and PA. To assure reliability of the coding and analysis process, identified themes and categories were reviewed in joint discussions between the authors to ensure the accuracy of interpretation and internal consistency of the data.

Results

Table 1 shows the socio-demographic characteristics of respondents. The sample included 46 first generation migrant women born in Africa (Somalia and Sierra Leone), Bangladesh, India, Ireland, Pakistan and West Indies (Jamaica, Montserrat, and St Kitts and Nevis). Thirty-nine per cent of Indian and Pakistani women were born in East Africa (Kenya or Uganda). Participants' ages ranged from 60 to 92 years old, with the majority being in their late 60s and early 70s. The majority of them migrated via family reunification (63%), have lived in the UK for more than 40 years (52%) and are pensioners (59%). Although participants came from all socioeconomic levels, 72% were categorized as being in the two most socio-economically deprived quintiles based on the IMD for England (refer to Table 1 for socio-demographic characteristics of the sample).

Table 1. Socio-demographic characteristics of participants (n=46)

Characteristics	Total
Age (years)	
60-64	14 (30.4)
65-74	20 (43.5)
75+	12 (26.1)
Years living in the UK	
≤ 10	7 (15.2)
11-40	15 (32.6)
>40	24 (52.2)
Number of comorbidities	
0	6 (13)
1-3	31 (67.4)
≥ 4	9 (19.6)
Self-reported ethnicity	
Indian	16 (34.8)
Pakistani	7 (15.2)
African-Caribbean	7 (15.2)
Arab	5 (10.9)
African	5 (10.9)
Bangladeshi	4 (8.7)
Irish	2 (4.3)
Religion	
Muslim	24 (52.2)
Christian	10 (21.7)
Hindu	7 (15.2)
Sikh	5 (10.9)
Migration status	
Economic migrant	12 (26.1)
Family reunification	29 (63.0)
Refugee/asylum seeker	5 (10.9)
Marital status	
Married	19 (41.3)
Single/separated/divorced	8 (17.4)
Widowed	19 (41.3)
Education	
No qualifications	13 (28.3)
Primary	2 (4.3)
Secondary	15 (32.6)
Tertiary	16 (34.8)
IMD score	
1 (most deprived)	28 (60.9)

2	5 (10.9)
3	5 (10.9)
4-5 (least deprived)	8 (17.4)
Job status	
Retired	27 (58.7)
Never-worked	18 (39.1)
Self-reported health status	
Excellent	6 (13)
Good	20 (43.5)
Fair	13 (28.3)
Poor	7 (15.2)

Values are numbers (percentages) of respondents; IMD= Index of Multiple Deprivation for England

Categories of ageing

Based on participants' experiences and perceptions of ageing in the UK, four overarching categories were identified: 1) *optimistic – accepting and adapting to ageing*; 2) *living in the present – carrying on with life*; 3) *accelerated ageing – early onset of disease*; and 4) *inward-looking – contemplative ageing*. Each category of ageing is presented below, giving a brief overview of the salient features, followed by a discussion of the relationship with each of the cross-cutting themes: perceptions of old age, experiences of ageing in the UK, components of good old age, and attitudes to healthy eating and PA (see Appendix 9). Interview excerpts are used to illustrate each category and highlight the relationship with the cross-cutting themes. Interview excerpts that appear in the third person were those from an interview conducted with the aid of an interpreter.

1) Optimistic – accepting and adapting to ageing

a. Overview

Responses identified as pertaining to this category related to the acceptance and adaptation to ageing by engaging in activities that keep them busy, healthy and independent. Although

old age was seen as an expected decline in physical health, later life was seen as being free of previous responsibilities and thus, the time to do whatever they wanted to do. Most of the women in this category had lived in the UK for more than 40 years and were retired and entitled to a pension in the UK, which was related to the financial security perceived in terms of opportunities and services available for older adults in the UK such as the free health service and concessionary bus passes.

b. Perceptions of old age

Although it was recognised that ageing involves "slowing down", participants' responses highlighted the fact that old age represents a window of opportunity to do things they did not have time to do due to full-time employment and/or raising a family. A 62-year-old Indian participant explained:

> *Ageing is a greater reduction of your energy and all that, but also… [is] giving scope to do certain things that you didn't have time to do before, when you were working… so it is like a window has been opened up for you and you can do whatever you want to do, you are your own boss.* (P39)

How one approaches later life appeared to be more important than the actual age. It was commonly expressed that age does not necessarily means one needs to stop, but involves adapting and having a positive attitude towards growing older, as a 65-year old Indian participant explained: "For me [ageing is], having your mind young. That makes the difference… Who says you can't get up and dance on the floor*?*" (P8)

c. Experiences of ageing in the UK

Experiences were commonly reported in comparison to "others" (e.g., women similar to themselves) living in their country of origin. Common responses referred to the perception that older adultsin the UK are still active and independent even after retirement. Growing older in the UK was also regarded as positive since women do not necessarily have to fulfil some societal expectations (e.g., going out unaccompanied) that are attributed to older women in their home countries. This is illustrated with the following excerpt:

> *The old here would probably be when you are 75, 80+ and there [India], you are old by 50+, in here you're an individual and you're free, there is so much on offer here for us, to be us!... I feel is so good here, you can do anything you want without feeling being judged*. (62-year-old, Indian, P2).

Another factor commonly referred to as beneficial to ageing in the UK was the sense of financial security provided by pensions received after decades of full-time employment in the UK. A longer residency in the UK was also related to an increased awareness as well as an appreciation of the different opportunities and services that are available for older women in comparison to their home countries. For instance a 63-year old Pakistani participant commented:

> *If you work you get a pension and everything, they [health service] look after you, the doctors, the hospital, but our country [Pakistan] is very poor, they don't...you get a lot older there.* (P10)

d. Components of good old age

Several factors were mentioned in relation to what participants perceived as components of good old age including: positive thinking, being healthy and independent, and keeping busy. The latter was related to being engaged in diverse activities that keep them connected to their faith, friends and communities. These components were perceived as a way to be happy at an old age, as the following excerpt illustrates:

> *I do a lot of voluntary work and that is part of my fitness or my living happily so it's just like investing back into [the society], I like to help people around. Two things, keep moving rather than just sitting at home and watch television all the time.* (63-year-old, Indian, P7)

Although participants expressed a sense of being comfortable with growing older in a different country, there are still some salient issues that were suggested as important to address for migrant older women, such as receiving cultural competent care when maintaining independence is not possible or when family members would not be able to provide special care for them. For instance, a 60-year old Indian participant highlighted fears about cognitive decline and the implications for migrants and the health service:

> *One thing is dementia...I was reading in the paper... if you come from an ethnic background, dementia affects your language because you stick to the past. They were talking about the interpreters, how much money they are spending on migrants... people suffering stroke or dementia are using their language. Though I spoke English in India as well, my main language is Punjabi so I am a little worried.*(P63)

e. Attitudes to healthy eating and PA

Healthy eating and PA were recognised as two key mediators of keeping independence and cognitive well-being at an old age. For instance, PA was seen as a good way to ameliorate joint pain that on many occasions could be more effective than any medication, as a 62-old Indian participant commented:

> *I have arthritis and when I go to the gym and go in the water, it releases all the pain so I feel much better when I come out... normally I don't take anything [medication], I just go to the gym*. (P27)

In addition to reporting that old age is an opportunity to enjoy life, it was also seen as a time to be more aware of health including weight, diet, PA, medication, and to prevent or avoid further complications of existing conditions:

> *You have to look after your health so that in the old age you don't get dependent on anybody...so if you are looking after your health, you are eating good, healthy food and having your medicine on time there is no reason that you fall sick all day... the more you keep yourself active then, you can spend your old days very well.* (74-year old, Indian, P3)

Enjoying retirement and the freedom associated with it was not only seen in women who expressed a more optimistic view of ageing; however, the positive attitudes towards engaging in healthier lifestyles are distinctive to this category.

2) *Living in the present – carrying on with life*

a. Overview

Old age in this category was perceived as a continuation of life. Busy lifestyles were common even after having retired from full-time employment. Helping others, including their families (e.g., grandchildren) as well as being engaged in their community and faith organisations, was referred to as essential components of good old age. Notably, the feeling that old age is time to enjoy and for resting, as well as the sense of contentment in later life as it is, prevents the need to focus on healthier lifestyles as part of successful ageing.

b. Perceptions of ageing

Old age in this category was commonly perceived as something that one should not be concerned about: "it comes to all of us, so why to worry?" (69-year old, African-Caribbean, P45). Contentment of having reached old age after a life of hard work and plenty of responsibilities for their families was commonly highlighted. For instance, a 73-year old African-Caribbean commented:

> *It's not so bad because it's something that you have to be happy with, you've got to be thankful you've got to that age and you are still pretty active, for me [old age] is not a big thing.* (P9)

c. Experiences of ageing in the UK

In line with the optimistic category, the benefits of living in a country that provides social security to its older population (e.g., health system, pensions, etc.) were highly appreciated. The busy lifestyles throughout their life were viewed as a positive influence for one's physical health in comparison to older women living in their countries of origin:

In India they've got servants to do for them, they don't move. They've got blood pressure high, they've got this high, you see? We have to do everything ourselves. If you don't use your body you are sitting and ageing, that is no good for us. (71-year old, Indian, P6)

d. Components of good old age

Good familial relationships and community engagement were frequently reported as essential components of a good, happy old age. Assisting at community centres was important to getting involved in religious activities. Above all, it was an opportunity to avoid loneliness by socialising, making new connections, feeling involved and a useful member of the community, as a 70-year old Indian participant explained:

You don't see a lot of people over here, visiting your home all the time. Now, everybody is selfish... [going to the community centre] just means getting out of the house to join the [ladies] group, not to get depressed in this house.(P16)

e. Attitudes to healthy eating and PA

Healthy eating and PA were acknowledged as beneficial for health and well-being. However, in general, there was a perception that at an old age it is not necessary to focus on diet and PA if one is relatively healthy and free of major health problems. Again, busy lifestyles were described as the way to keep active without engaging in more structured PA. One 75-year-old Indian woman emphasised how her busy schedule leads to her being physically active:

I am always physically active, I get up in the morning and carry on with one thing or the other, I don't go for special exercises or anything, but I am working all day in the

house or outside, picking children up or dropping somebody else and going to the

temple. (P5)

In addition, the perception that at this time of their lives they are entitled to enjoy their life after working very hard appeared to be a barrier to considering changing their lifestyle behaviours, as a 62-year old Irish women expressed:

Probably I'm eating at the wrong times and not doing enough [physical] activities but then again what the hell?...I think I'm beyond encouragement… I worked really hard all my life. (P62)

The on-going sense of keeping busy and active contrasts with the next category in which old age is governed by physical limitations and imposed lifestyle changes due to illness.

3) Accelerated ageing – early onset of disease

a. Overview

Responses about old age in this category were strongly linked with experiences of illness and physical decline. Dramatic lifestyle changes (e.g., early retirement) due to the early onset of disease dominated experiences and perceptions of ageing. With physical health affecting many aspects of one's life, staying connected with significant others and with the community have become essential components of old age. Changes in lifestyle behaviours had already been adopted on medical advice.

b. Perceptions of old age

Experiences of illness and health complications such as losing mobility and strength, and experiencing long-periods of hospitalisation and rehabilitation, strongly influenced perceptions about old age. In this category, old age was perceived predominantly in a

negative way. For instance, a participant with T2DM who reported suffering seven "heart attacks" said: "ageing means a lot of disease and discomfort… you cannot grow older with dignity" (74-year old, Indian, P35).

In addition, there was a common view that ageing is occurring at a more accelerated pace than expected. A 68-year-old African-Caribbean woman described how her life dramatically changed after suffering a stroke, which forced her to retire early from a highly-skilled job*:*

> *I feel that I got old before my time, because I had my stroke in my early 50s and that restricted me in a way that you know, I found it very difficult to adjust, particularly, given that I was extremely active*. (P38)

c. Experiences of ageing in the UK

Notably, there was a perception that diseases such as obesity, hypertension and T2DM are as prevalent in older women living in the UK as it is in women living in their countries of origin. However, in general, it was recognised that medical treatment was better and more helpful in the UK. The early onset of disease in this category was mainly explained by having stressful jobs, conflictive familial relationships and or/financial difficulties as well as having unhealthier lifestyle behaviours, as a 75-year old Pakistani women explained:

> *In my middle-age I didn't care about my diet at that time. I was nearly 11 stone (154 lbs or 70 kg), that is why my heart trouble started.* (P19)

d. Components of good old age

Staying connected with their families and/or communities was a major factor to having a good old age. Joining community centres or faith organisations as members or as volunteers had provided an opportunity to feel productive and share their culture and religious beliefs

with younger generations born in the UK. Most importantly, this involvement was perceived as a good way of avoiding feelings of depression and isolation as they are more limited to get out and about by themselves:

> *The community centre is very good and very important, especially for religious ladies, we enjoy it very much… if I just stay all week in the house, I'll get depressed.* (61 year-old, Pakistani, P12)

e. Attitudes to healthy eating and PA

Having a healthier lifestyle in terms of adopting a healthier diet and attending exercise sessions targeted for older adults was already part of their disease management. Dietary changes in particular were not seen as enjoyable, but as essential to their well-being. In general, there was the belief that following healthier lifestyles related to diet and PA has the potential to ameliorate further health complications, as a 63-year old Pakistani participant commented:

> *So many things [food] I am not having due to diabetes, so many things I am not having for blood pressure, so many things I am not having for cholesterol and, definitely the person has to change… I am very careful about my diet… and I know as well [that] exercise is very necessary for the people, the people who are not doing [it], that is the reason they are going on wheelchair*. (P11)

Negative perceptions of old age were linked to an early onset of disease, but not necessarily related to the experience of ageing in the UK. This is in contrast to the following category in which migrating to the UK was seen as negative for their health and their ability to have a happy, good old age.

3) Inward-looking – contemplative ageing

a. Overview

Participants who expressed views related to this category reported migrating to the UK either through familial reunification or as refugees/asylum seekers. With the exception of two women, they were not fluent in English and were not previously employed in the UK. Among this group, approximately three-quarters were widowed. Perceptions and experiences of old age were associated with feelings of nostalgia for the old times and the lifestyle that was left behind after migrating to the UK.

b. Perceptions of old age

Responses were contradictory, with reaching old age being perceived as a blessing and as something to be thankful for, but also identified as a stage of life where there were not many things to look forward to. In particular, there was a sense of 'loss of usefulness', which was related to widowhood and changes in their households that resulted in them not being able to contribute to family life as they used to do. As one participant explained: "She is saying with age her mood has gone down, not happy… she doesn't have someone to share a life with, that's why" (74-year old, Bangladeshi, P60). Another participant reiterated this feeling: "I am 79 years of age, what I am going to live for?" (African-Caribbean, P55).

c. Experiences of ageing in the UK

Women commonly referred to the UK as a foreign environment with cold weather, a foreign language and what they considered unhealthy food. This foreign environment was perceived as the main difference between ageing successfully and "being weak". The lack of self-grown, "fresh" food and "clean" water as well as the lack of "real" physical demanding

lifestyles (e.g., farming) was perceived as having a negative effect on their physical and mental health as the following excerpts illustrate:

> *I used to do everything for the whole family... [now] I feel so stiff, so lazy. I can't even sleep because of this less activity, I used to walk miles and miles and now I do feel that my health you know, is going down.* (72 year-old, Somali, P25)

> *The water here is recycled and added chloride so it's not clean at all.... she thinks that the water in the food is affecting long-term memory… if she goes to her village… [the water] it's all clear, she would feel better, in her own house, growing her own food, she will lose weight because there is sunshine… [she would be] more active and healthier.* (77 year-old, Yemeni, P30)

Notably, when comparing old age between the UK and their countries of origin, there was a clear distinction before and after migrating to the UK, particularly for those who migrated later in life. For instance one participant said: '*In Africa, I didn't have hypertension, I didn't have this inhalator [for asthma], I've never known of it*' (African, 62-year old, P40). When making comparison with others, a 90-year old Yemeni participant commented:

> '*In those days an old lady wouldn't have a walking stick, so she would be old but she wouldn't need it… she would go up and down the hill without a stick*' (P28).

d. Components of good old age

Responses related to what constitutes good old age were strongly linked with being surrounded by their families. Community engagement, so strongly linked with happiness and feelings of productivity in other categories, was more limited in this group, in particular for women with an interdependent family network where social interaction happened mainly

within their own families. Additionally, faith *'more than anything'* appeared to be of comfort

for many of them when thinking about the future: *"everything is in the hand of God…what*

happens tomorrow is in the hands of Allah, I don´t stress anything about it" (74 year-old,

Somali, P33).

Given that among some cultures, multi-generational households are still common and older

adults are looked after by other family members, the more individualistic UK society (older

adults living alone) was perceived as a potential threat to the traditional way of life.

Responses commonly emphasised the cultural difference in 'elderly care' between the

British society and collectivistic societies (extended family networks). This is illustrated in the

following excerpts:

> *The White population don't feel this like us Asians…our people shouldn't leave their*
>
> *elders in [nursing] homes, old people help you, they look after your kids, they should*
>
> *be at home.* (60-year old, Pakistani, P13)

> *We don't even have special places for older people… if that person is going to live for*
>
> *300 years the family are gonna keep him [or her].* (72 year-old, Somali, P25)

Changes in familial networks were also seen as worrying, as not all older migrant women are

characterised by, or will remain living in, extended family systems. For instance, a 76-year

old Yemeni women highlighted the importance of receiving culturally competent care and

the fear that this would not be provided by the UK government:

> *It would be better if there's a Muslim home, where she would feel comfortable, just*
>
> *Muslim females… 'cos they would understand the culture rather than being with the*
>
> *big society… [older women] are put into a multi-cultural society but the thing is that*

she's worried that the government thinks "these are Muslims, we just segregate them

and leave them on their own [being the responsibility of their own families]."(P29)

e. Attitudes to healthy eating and PA

The awareness of the role of healthy eating appeared to be less evident in this category. This was primarily because in the past, their lifestyles were so physically demanding (e.g., farming, living in rural areas) that the food eaten was intended to provide enough energy to carry out the hard work. Thus, it was common for participants to express that a focus on healthy eating is something relatively new. A 77-year old Bangladeshi participant stressed that the older generation "don't even think about it"(P54). This was echoed by another participant who mentioned: "in her generation, they didn't really have that worry as much, there are more illnesses and stuff now so people are more aware"(74 year old, Bangladeshi, P61).

Regarding PA, it was perceived to be an important link between being inactive and physical decline referred to "weakness" and "stiffness". However, there were key barriers to engage in more active lifestyles. Given that leisure PA was not common, walking was the only means of engaging in PA. Fears about safety, lack of company, cold weather and feelings of discrimination were mentioned among this group. Thus, it appears that some women have refrained from going out, limiting their opportunity to be more active. For instance, the reason why a 71-year-old Somali women did not like to go outside her house was pointed out by her daughter: "what makes her stay inside the house is people looking at her which makes her angry"(P24).

Participants' perceptions of ageing in the UK as well as attitudes toward healthy eating and PA appeared to be related to feelings of being strangers in their adopted home. Responses

from this group highlighted the importance of contextual factors that influence their ability to age well.

Discussion

To our knowledge, this is the first study to explore and report the experiences of ageing and how they have shaped perceptions about good old age and attitudes to healthy eating and PA in older women with diverse ethnic, migration and socio-economic backgrounds living in the UK. Perceptions and attitudes towards ageing were strongly linked with women's experiences of migration. More optimistic perceptions about ageing were identified among participants who tended to be fluent in English, lived for longer in the UK, and have had paid employment in the UK.

In line with previous qualitative studies exploring lay perceptions of successful ageing, an active social life, being connected with their faith, and freedom to engage in new pursuits were considered key components of good old age for the majority of participants (Mccann Mortimer, Ward & Winefield, 2008, Hsu, 2007). Contributing to their communities as a volunteer or helping neighbours and acquaintances was commonly attached to a sense of 'usefulness' and meaning in life at an old age despite personal losses and physical decline (Duay & Bryan, 2006, Reichstadt et al., 2010, Laditka et al., 2009, Boneham and Sixsmith, 2006).

In parallel to what has been found in other older adults from minority ethnic groups, health is also an important component of successful ageing (Troutman et al., 2011, Laditka et al., 2009). This is particularly important, as chronic diseases including obesity, hypertension, T2DM, and cardiovascular disease, disproportionally affect minority ethnic groups,

contributing to their spending more years of their old age in poor health (Tillin et al., 2012). Therefore, addressing health disparities between migrant groups and the host society is necessary in order to promote successful ageing (Patel, 2015).

Maintaining independent functioning has been cited before as a major component of successful ageing (Hsu, 2007, Duay & Bryan, 2006). In the present study, healthy lifestyle behaviours in relation to nutrition and PA were recognised as two mediators to potentially prevent or ameliorate health problems including physical decline. However, the interest of engaging in healthier lifestyles varied across categories of ageing. While responses belonging to the *optimistic – accepting and adapting to ageing* category illustrated a sense of empowerment to grow older in the best way possible by preventing major health problems, healthy eating and PA appeared to have acquired more importance after the diagnosis of chronic diseases for women within the *accelerated ageing– early onset of disease* category. On the other hand, the sense of contentment with life minimised the importance given to these behaviours, which was demonstrated by a lack of interest and motivation to engage in healthy eating and regular PA. This particular characteristic within the *living in the present – carrying on with life* category resonated with the study of Dionigi and colleagues (2011) in which older women who reported an inactive lifestyle appeared to focus less on the biological aspects of ageing and thus, disregarded the need for engaging in leisure PA pursuits in order to age successfully.

Although the majority of participants recruited for this study come from more collectivistic societies in which older adults have an important role in the society and would be taken care of by members of their own families (Cook, 2010), many of the women have accepted and adapted to a more individualistic approach to ageing that values autonomy and

independence. Not being a burden to their busy families, and trust in the host country's public provision have also been reported in other collectivistic cultures such as South Asians (particularly Indians) living in the UK as well as Latinos and Chinese in the US (Sin, 2007, Romo et al., 2013). Again, it is important to consider that length of residency and language proficiency may play a crucial role in the ability of individuals to navigate the welfare and health systems available in the host country (Lebrun, 2012, Dwyer & Papadimitriou, 2006), which in this study was perceived as a positive aspect of ageing in the UK.

Within the *inward-looking – contemplative ageing* category, a familial dependant network was identified as a key influence in one's ability to age successfully. Although family interdependence will potentially allow older women to remain living in the community (Golden, Conroy & Lawlor, 2009), the limited social contact outside their household has made it difficult to find activities to replace the 'usefulness' some women felt they have lost, leading to feelings of isolation and depression, as well as inactive lifestyles. This finding resonates with the stories of Somali late-life migrants reported by Cook (2010) in which women viewed the lack of autonomy and their weakened role in their families and society as negatively affecting their health and well-being.

In this category, suspicion about the UK food environment (e.g., use of pesticides, water processing) was also pointed out as affecting one's physical and mental health. Given that this was commonly mentioned when comparisons between their home countries and the UK were made, it appears that these perceptions about food reflected views about growing older in a foreign environment. Feelings of ageing "out of place" among migrants, in particular late-life migrants, have been previously reported (Sadarangani & Jun, 2015, Park & Kim, 2013, Cook, 2010). In this study, both late-life and long-term migrants who were less

immersed in UK society (e.g., lack of previous formal employment) also appeared to have this perception. It is possible that, as Fenton (1987) argues, migrants tend to feel most deeply the pain of separation from the country of birth as they reach old age in their host country. Thus, it is possible that the more they long for their country, the more resistant they will become to adapt to the UK and the more difficult it will be for them to grow old successfully in a foreign environment (Fenton, 1987, Gardner, 2002).

For this study, we aimed to recruit women not only from diverse ethnic backgrounds, but also from diverse socio-economic and migration backgrounds. We found that although there are commonalities among ethnic groups, drawing upon Vertovec's (2007) super-diversity definition, it is imperative to acknowledge the diversity within ethnic groups (e.g., language, religion, migration experiences, etc.). Most of the research conducted with migrant populations assumes that group values reflect individual orientations (Sin, 2007). However, ethnicity or group affiliation does not necessarily define successful ageing. In accordance with a more biographical ageing model (Chapman, 2005), other factors such as migration backgrounds, age at migration, language proficiency, experiences of discrimination, living arrangements and socio-economic position may play a more important role in successful ageing among migrant populations (Wray, 2003, Clarke & Warren, 2007, Moriarty & Butt, 2004, Torres, 2001). For example, this is the first study to integrate views from Muslim women from different ethnic groups (Pakistani, Indian, Bangladeshi, Yemeni, and Somali), and although the majority of their responses resembled a more *inward-looking - contemplative* old age, there were also Muslim women with very optimistic views and positive ageing experiences. Thus, researchers need to be careful not to pathologise ethnic groups but to develop a more nuanced understanding of differences within ethnic groups.

It is important to mention that while the majority of participants highlighted the desire to remain living independently in the community, not all women will have the opportunity to do so and some will eventually need to access care services such as nursing homes. The expressed fears of going to a nursing home where cultural norms and language barriers may not be taken into account, highlights the importance of listening to the needs of this growing segment of the population and to move away from the assumption that minority ethnic groups "take care of their own" (Sin, 2007, Fenton, 1987). Instead, services for older adults need to be planned to accommodate an increasingly diverse ageing population.

Implications

Increased knowledge of older migrants' experiences of old age and how they shape perceptions of old age and lifestyle behaviours presents a window of opportunity for the planning and implementation of strategies to promote successful ageing in this population. In the present study, community centres and/or faith organisations for various ethnic groups appeared to provide a supportive environment for women to engage in social and health related activities and thus, they are important means by which women are motivated to engage in healthier lifestyles. As previously reported in other qualitative studies, these venues also provide the space for women to replace "lost roles" and maintain cultural values and beliefs (Maynard, Afshar, Franks et al., 2008, Cook, 2010, Wray, 2004).

Given Birmingham's super-diverse context, the Birmingham Policy Commission on Healthy Ageing (2014) has recently recognised the need to provide education and better access to different resources that support healthy ageing as a process instead of only managing diseases and complications. As such, better access to information on healthy eating and support to engage and maintain active lifestyles would be of great benefit across diverse

communities, while special attention should also be paid to specific cultural issues (e.g., only female facilities). This study demonstrated that non-governmental organisations play a critical role in meeting these needs. However, social and community services for older adults have been deeply hit by austerity (Centre for Local Economic Strategies, 2014), which will likely affect the promotion of healthy ageing among older migrant women, unless voluntary organisations are supported, or replaced by governmental actions.

Furthermore, findings from this study suggest that interventions to promote successful ageing through healthy eating and PA may need to be targeted not only at the community, but also at family level. These interventions may be more successful for women with familial dependant social networks. Involving whole families in health promoting interventions should be considered, as this could not only benefit older women, but may potentially benefit men and younger generations living in the same household.

While the present study provided useful insights on the experiences of ageing among first generation migrant women from diverse socio-economic, migration and cultural backgrounds, this study has a number of limitations. Given the nature of the sample, it was necessary to work with interpreters. Due to the range of languages spoken by the participants, different terms were used to refer to 'successful ageing' (e.g., being happy at an old age, good old age) and thus it is possible that there were different conceptualisations of meaning across languages. Although the use of interpreters is criticised because meanings attached to language can vary greatly from one ethnic group to the other, the inclusion of women who otherwise would have been excluded in research outweighs the disadvantages of relying on interpreters (Wray, 2004). In addition, it is worth mentioning that among Somali and Bangladeshi participants, the contribution of their families was greater than expected, as family members would not let the participants be alone with the researcher

and interpreter during the interviews. Thus, it is impossible to know the extent in which the families influenced participants' responses.

Finally, while purposive sampling was conducted in order to include women with a diverse range of ageing experiences according to their socio-economic, cultural and migration backgrounds, resources constraints meant we were unable to recruit Chinese women, who represent a growing segment of the migrant population in Birmingham. Nonetheless, the insights gained into women's perspectives and experiences of ageing in a super-diverse community provide useful information that may potentially guide policy on helping older migrant women to overcome important barriers for successful ageing in relation to nutrition and PA behaviours.

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CHAPTER 7

GENERAL DISCUSSION

This chapter summarises findings from the four studies presented in this thesis. By using a MM design, this study provided an opportunity to better understand the current dietary and PA behaviours of first generation migrant women and the factors that influence these lifestyle behaviours. It also provided new evidence regarding the association of these behaviours with frailty that has not been previously examined among minority ethnic groups in the UK. This thesis also provided contemporary evidence on experiences of ageing of first generation migrant women and how these shape perceptions of ageing as well as current dietary and PA behaviours. These findings are timely and important as the UK older population is becoming increasingly diverse and living longer in poor health. A discussion of the strengths and limitations, and the implications for future research and practice concludes this chapter.

Summary of Research findings: Study 1

As stated in the literature review (Chapter 1), there is limited evidence examining the dietary intake of minority ethnic groups in the UK, especially among older adults. Therefore study 1 (Chapter 3) sought to examine energy and nutrient intakes in a sample of migrant older women from ethnically diverse backgrounds, to compare energy and nutrient intakes between women with varying frailty status, and to obtain a greater understanding of key factors influencing their current dietary intake and eating behaviours.

Findings from this study suggest that participants had an inadequate intake of energy and various nutrients in comparison to the age and gender specific RNIs for the UK. Overall, energy was significantly lower (1225 vs. 1877 Kcals/d, p<0.001) than the estimated average requirement for older adults (>65 yrs) based on the needs of a general population with low PA levels such as the women in this sample (Department of Health, 1991, Scientific Advisory Committee on Nutrition, 2012). Main micronutrients of concern were vitamin D, magnesium, potassium, copper, selenium, and retinol. When participants were categorised according to their frailty status, frail participants had significantly lower intakes of folate, iron, zinc and selenium than pre-frail and non-frail participants, while protein intake was higher in non-frail as compared to pre-frail participants.

Important personal and socio-cultural factors influencing dietary intake among this sample were identified via semi-structured interviews with a sub-group of the study sample (n=46). Personal factors were health-related such as increased awareness of obesity and its complications (mainly diabetes and hypertension), and changes to a more sedentary lifestyle as they have aged. Participants emphasised digestion problems and presence of chronic diseases as main factors influencing not only the amount of food they eat, but also the cooking methods and ingredients (e.g., oil, spices) they use. Reductions in salt and fat consumption resulted in adherence to the UK RNI values for sodium, total fat, and percentages of saturated and trans fat across the sample. Advice from health providers was also important among this sample. For instance, women tended to consume supplements if a GP prescribed them. Concerns about taking supplements in addition to already prescribed medication have prevented some women from consuming supplements on a regular basis.

Although the factors identified as influencing dietary behaviours in this sample have been found in other older adult populations (Ashe, Miller, Eng et al., 2009, Locher, Ritchie, Roth et al., 2005, Payette et al., 2005), this study highlighted key socio-cultural factors. Important changes in household roles due to shifts in family systems, and the decreased responsibilities for their families have led to the reduction and simplification of meals prepared at home that appeared to influence the variety of foods consumed, which has been previously associated with diet inadequacy in other older adults populations (Marshall et al., 2001). In addition, in this study there were women who engaged in fasting practices not only during major religious observances (e.g., Ramadan, Diwali) but also once or twice per week, a practice that may not be well known by health professionals but crucial to take into account when dietary recommendations are given.

Overall, Chapter 3 indicated that older migrant women living in the UK have inadequate intakes of several nutrients, which are more pronounced in women categorised as frail. Important attention should be given to health-related factors influencing dietary intake, as well as to the social component of cooking and eating among migrant older women as this can negatively impact their dietary intake.

Summary of Research findings: Study 2

Chapter 4 sought to explore if the reported low energy and low nutrient intakes found in Chapter 3 were associated with frailty, assessed with a slightly modified version of the frailty construct developed by Fried and colleagues (2001) which was suitable to use in the community setting. Previously Bartali and colleagues (2006) suggested that low nutrient intake is an important component of frailty in White European older adults. However, to the best of our knowledge this association between low nutrient intake and frailty has not been

previously explored in ethnic minorities living in the UK. Thus, the first aim of this study was to examine the associations between energy/nutrient intake and frailty in a sample of older women (≥60 years) from diverse ethnic backgrounds living in the UK.

Our findings support existing evidence associating frailty and its components to nutrition at the nutrient level in White European older adults (Bartali et al., 2006). Among a sample of first generation migrant older women we found that having a low energy intake (OR: 11.71, 95% CI: 2.36-57.97) was associated with frailty. Furthermore, after adjusting for energy, age and number of diseases, a low intake of retinol (OR: 10.33, 95% CI: 1.55- 68.94) and zinc (OR: 8.47, 95% CI: 1.04-68.80), as well as having a poor nutritional status (>3 low nutrient intakes) were significantly associated with frailty (OR: 6.58, 95% CI: 1.01-43.08). In addition, slow walking speed, a component of the frailty syndrome, was significantly associated with poor nutritional status (OR: 1.86, 95% CI: 1.31-3.07). In this study neither self-reported weight loss nor indices of overweight/obesity were associated with frailty.

A second aim of this study was to gain a greater understanding of the potential links between women's perceptions of body weight, dietary intake and physical function among a population in which there is little evidence to guide research. Although there were several important factors affecting dietary intake among this sample (explored in Chapter 3), body weight kept emerging as an important concern for women when discussing their physical function (e.g., strength, mobility). Overall, weight status was a main concern for women in this sample and many appeared to be more concerned about it than in how their dietary intake would affect nutrient adequacy. Given these pervasive concerns (e.g., feelings of frustration and shame) about weight gain, many have modified their diets in order to lose weight. 'Fattening foods' in particular were not only perceived as unhealthy but were also

perceived as negatively having an impact on their physical function (i.e., mobility).

Importantly there was a negative perception of overweight/obesity related to overall health

and physical decline (e.g., mobility), contrasting with a more accepting perception of larger

body size that has been reported among women from minority ethnic groups (Lynch & Kane,

2014, Rguibi & Belahsen, 2006).

Given the health profile (high prevalence of obesity and chronic diseases) of the study

sample, findings from this study suggest that older women from ethnically diverse

backgrounds would greatly benefit from receiving dietary advice that promotes both the

maintenance of a healthy body weight and nutrient adequacy.

Summary of research findings: Chapter 5

Given the little evidence on PA/ST among minority ethnic groups living in the UK, especially

in older women, one of the aims of Chapter 5 was to examine patterns of PA/ST across

frailty status in older women from ethnically diverse backgrounds living in the UK. In

addition, similarly to Chapter 4, this study examined whether objectively measured PA/ST

were associated with frailty. Finally key factors influencing PA among first generation

migrant women were identified via semi-structured interviews.

For this study, a sub-sample of the study population (n=60) provided objectively measured

PA/ST data, and a sub-sample of 36 participated in semi-structured interviews.

Accelerometry data indicated that on average, participants spent 69% of their waking time

engaged in ST with only 15% of the sample meeting the official recommendations of

MVPA/week (Department of Health, 2011). Importantly, none of the women classified as

frail met these recommendations. It is worth mentioning that accelerometry data at a

national level in the UK has indicated that 0% of older women met the PA guidelines (Craig,

Mindell & Hirani, 2008). Similarly to studies conducted among women from ethnic minorities, although still low, PA levels may be higher than what it is assumed (Kolt et al., 2007, Curry & Thompson, 2014). In addition, it has been suggested that women from ethnic minorities (especially from South Asian backgrounds) tend to under-report their PA (Curry & Thompson, 2014) making the use of objective measures invaluable in this field of research.

When comparing ST/PA levels across frailty status, only MVPA was significantly different between non-frail (18.4 ± 19.9 min/day), pre-frail (18.7 ± 17.6 min/day) and frail (3.4 ± 4.5 min/day) participants. Multiple regression analysis showed that MVPA was inversely associated with frailty after adjustment for confounders. Findings from this study add to the limited previous evidence suggesting that increasing MVPA levels may promote healthy ageing by decreasing risks of frailty. This study failed to show a significant association between ST and frailty consistently shown in previous studies (Peterson et al, 2009, Santos, Silva, Baptista et al., 2012, Blodgett et al., 2015). Patterns of PA indicated that promoting physical activities during the weekday mornings might be an ideal time frame to create opportunities for women to engage in PA.

Perceived barriers to meeting PA guidelines included weight issues, physical limitations and pain. Cultural factors that may act as barriers identified in this study are related to gender expectations and cultural norms such as conflicting schedules and language barriers. Although not relevant for all Muslim participants, mixed facilities and dressing code represent a barrier to participating in leisure PA. Important motivators to engaging and maintaining regular PA included improving mental health (e.g., depression) by socialising with other women and 'keeping the body' going to remain independent and avoid going to a nursing home, which was seen as culturally inappropriate for some women. Given that

cultural norms have been consistently shown to be important barriers for women from ethnic minority backgrounds (Babakus & Thompson, 2012, Caperchione et al., 2009, Lawton, Ahmad, Hanna et al., 2006), health professionals and policy makers need to accommodate for this in order to make PA more inclusive for diverse communities of migrant older women.

Summary of research findings: Chapter 6

As previously found (Chapter 4-5), dietary intake and PA are associated with frailty and therefore, potential mediators to promote healthy ageing in this population. Since there is little understanding of how ageing is perceived and experienced by non-White populations, the final empirical Chapter of this thesis sought to explore experiences of ageing of first generation migrant women from diverse ethnic, socio-economic, and migration backgrounds and how these experience may shape perceptions of good old age as well as nutrition and PA behaviours.

Perceptions and attitudes to ageing were strongly influenced by participants' experiences of migrating to the UK. As such, women who have lived in the UK for longer, who were fluent in English, are more familiar with the health and social services available in the UK, and have been employed previously (pensioners) appeared to have a more optimistic perception of old age. Echoing previous qualitative studies, an active social life, faith, and freedom to engage in new pursuits were considered key components of good old age for the majority of participants (Mccann Mortimer, Ward & Winefield, 2008, Hsu, 2007). Physical health was particularly important for those women who suffered major medical and consequently physical decline.

Despite the fact that healthy eating and in particular, regular PA were seen as two important mediators to prevent and ameliorate health problems including physical decline, this did not translate into engaging in healthier lifestyle behaviours across the sample. Contentment with life as it is and feeling that old age is time to enjoy oneself after many years of engaging in a busy lifestyle prevented some women from being more motivated to make lifestyle changes as a way to age successfully. In other cases, this engagement was more profound once health was compromised and illness had developed.

Being independent and living with, or close to, families was important for the majority of participants. However, changes in familial networks were also seen as worrying, as not all older migrant women are characterised by, or will remain living in, extended family systems. Fears of using services that do not take into consideration their cultural norms and language requirements make it necessary to start planning to accommodate the needs of a growing segment of the UK population that is likely to use special care in the future.

In this study there were women who resembled a more *inward – contemplative* old age. This was described as being strongly linked with interdependent familial networks and feelings of 'ageing out of place'. Important changes in their household both due to ageing and migrating have reduced their sense of 'usefulness' in the society. Although many women in this sample commonly mentioned feeling productive by helping others and contributing to their communities, those women with familial interdependency have little contact outside their homes, which prevents them from finding activities that help them to remain being socially and physically active. Migrating later in life or being less immersed in society (e.g., language barriers, previous employment) has negatively influenced perceptions of old age.

It is worth mentioning that although there were commonalities among ethnic groups, these groups are also very diverse (i.e., different faiths, socio-economic status and migration experiences). Hence, group affiliation does not necessarily define successful ageing. Other factors such as migration backgrounds, age at migration, language proficiency, presence of chronic diseases, and financial resources play an important role in successful ageing among migrant populations (Wray, 2003, Clarke & Warren, 2007, Moriarty & Butt, 2004, Torres, 2001). These factors need to be taken into account in order to avoid categorising specific ethnic groups as homogenous, and consequently, failing to understand the needs of super-diverse communities.

Strengths and Limitations

Each study in this thesis has increased the body of knowledge and helped to fill gaps in the literature. Nonetheless, it is important to acknowledge the limitations of this PhD research and suggested areas of inquiry that deserve further exploration.

Conducting research among 'hard-to-reach' populations is challenging and this project is not exempt to the methodological limitations inherent to studies of this nature. These include the use of a small, convenience sample recruited to participate in the study. Therefore, this sample is not representative of first generation migrant women living in super-diverse communities in the UK. Additionally, all MM studies included in this thesis adopted a cross-sectional design and consequently, evidence regarding cause and effect and the direction of the relationships of the association found between diet, PA and frailty could not be discerned.

Additionally, some of the women were recruited from community/faith organisations that already provide access to health information and PA opportunities. As such women in this sample may be more aware of the benefits of healthy eating and PA, which could have influenced their responses during the interviews by responding more positively about their current dietary and PA behaviours as well as successful ageing. In line with this, women from SA and AC backgrounds are over-represented in this study, which reflects the population statistics in Birmingham. However, this was also due to their higher literacy of the English language. It is important to mention that by using snowballing as one of the recruitment techniques, we were able to reach out women who did not belong to any community centre or were less engaged with their communities. Moreover, the majority of women recruited to participate in this project were either overweight or obese; consequently, the nutritional, PA and frailty profile of women who are underweight or normal weight are not represented in this study.

Another limitation is the use of interpreters; however, we considered it important to include non-English speakers so that women from diverse migration and ethnic backgrounds could participate in the study. Given the lack of resources (e.g., time and budget constraints), we were unable to account for the effects of the interpreters on the data, which may have limited the trustworthiness of the translated data. Efforts were made so that interpreters could help to clarify terms that were not possible to translate to different languages such as 'physical activity' and 'successful ageing'. Clarification during and after the interviews was sought by the student researcher to help with the interpretation of the data. It is worth noting that if interpreters had not been used, this study would have excluded those women of which there is little data to guide health promotion strategies and that are commonly

under-represented in research. Future research may need to include Chinese participants as this group represent a growing segment of Birmingham's population. This is important, as it is well known that PA and diet are strongly linked with longevity among Chinese (Belza et al., 2004) and thus, their views about lifestyle behaviours and ageing may be different from the women recruited in this study.

A further issue related to the reliability of the qualitative data is the migrant status of the student researcher. Although her non-Western background could have been viewed as a strength as this may have resulted in participants feeling more comfortable engaging with a non-White researcher, this could also be viewed as a limitation. The first author's status could have resulted in her being viewed as an 'outsider' coming from a different country than the study participants, and also coming from an academic background. In addition, both supervisors are migrants to the UK and thus, it is possible that researchers with differing migration histories could have coded and interpreted data differently, resulting in subtle differences in the analysis of the qualitative interviews. To address this limitation, feedback and comments from community leaders, interpreters, and across members of the research team (all with experience working with migrant/minority populations in the US and the UK) were sought to interpret the data and come to consensus on the results.

Another limitation was the use of a single 24-hr dietary recall to assess dietary intake. As mentioned previously in this thesis, resources constraints plus the difficulties in planning a second visit for women who needed to be accompanied by a family member and/or an interpreter prevented multiple recalls. It is usually assumed that older people have free time to contribute to research; however, many of the women in this sample were active members of their communities or families and thus, their social commitments did not allow them to

engage in a longer period of data collection. In addition, in population such as migrant groups, the use of a 24-hr dietary recall has the advantage of being easy to administrate through a standardised interview, it is cost effective and has low respondent burden and thus, is suitable for respondents with low literacy or English language skills (Johnson & Garcia, 2003). Well-conducted recalls can provide reliable estimates of dietary and nutrient intakes of a group of research participants (Garcia & Da, 2011, Jonnalagadda & Diwan, 2002). In addition, this study adopted an interview based 24-hr dietary recall by a trained dietitian aimed at minimising errors. Nevertheless, under-reporting cannot be ruled out in particular because this tends to be higher among individuals with higher BMIs, lower socio-economic, and females (Poslusna et al., 2009). Future research will benefit from using multiple 24-hr dietary recalls as well as adapting/validating assessment methods to examine diet in super-diverse communities such as the development of a FFQ for under-studied ethnic groups in the UK (e.g., Arabic, Somali, Chinese).

Furthermore, findings from Chapter 3 & 4 need to be confirmed with a larger sample and using a better indicator of nutritional risk such as nutritional biomarkers. Moreover, future research needs to go beyond the nutrient level to further explore food groups that need to be targeted in migrant groups. Although it was not the aim of the study to compare dietary intakes and PA between ethnic groups, future research could explore if there are important differences that need special attention in specific groups.

This study benefits from a purposive sample of first generation migrant women to ensure variation across cultural, socio-economic and migration backgrounds. This sampling allowed gaining a range of perspectives on diet, PA, physical function, and ageing among a vulnerable sub-group of the population that is disproportionally affected by obesity and its negative

consequences. The use of objective measures of PA (Chapter 5) is another strength of this thesis, as studies conducted in ethnic minorities are not only limited in number - the majority are also based on self-reported data. Findings from this study, despite the small sample, contribute to the growing body of literature exploring dietary intake and PA among migrant older women. It is also important to mention that to the best of the researcher's knowledge, this is the first study to include data from migrant older women from ethnically diverse backgrounds and not only from the biggest minority groups such as SA and AC. Future efforts need to be made to include larger samples as well as including community researchers who can act as cultural brokers and thus, increase participation and minimise methodological issues inherent to cross-cultural research (e.g., translated data and trust issues).

Conclusions and implications

Findings from this study have several implications for future research and practice. Both dietary intake and PA (MVPA) were found to be associated with frailty in this sample of first generation migrant women. Therefore, health promotion strategies should focus on preventing physical decline through healthy eating and regular PA and not only in the prevention and management of chronic diseases. Weight concerns were a salient concern among this population affecting both nutrition and PA behaviours, irrespective of their ethnic, socio-economic and migration background. As such, we need to pay more attention to providing appropriate advice to promote a positive body image but also focusing on the overall nutritional quality of the diet to avoid harmful or counterproductive dietary restrictions. The fact that minority ethnic groups are disproportionally affected by

overweight/obesity may mask the nutritional risk older women could be experiencing as a consequence of chronic diseases or self-imposed restrictions due to body weight concerns. As such, nutritional assessment may be a useful tool in detecting and preventing frailty among older women.

Regarding PA, older adults are often recommended to perform light activities to avoid injury or overexertion. However, findings from this study echoed other studies by confirming that PA intensity is important in order to gain greater benefit (Blodgett et al, 2015, Peterson et al, 2009). Health professionals and policy makers need to be aware of this and guide older adults in which activities are safe and at the intensity needed in order to improve their health. Maintaining independence and focusing on the social benefits of engaging in community exercise groups are two arenas that can be targeted in future interventions as these are important motivators for older women irrespective of their ethnic, socio-economic and migrant backgrounds. In addition, exploring ST and frailty among older adults from minority ethnic groups is an area that requires further exploration in studies including larger samples. Reducing ST by increasing light-PA may be more feasible than increasing the time older women engage in MVPA (Curry & Thompson, 2014, Buman et al., 2010).

Health professionals and policy makers need to be aware that while recommendations are targeted to individuals, eating and being physically active are two lifestyle behaviours that are greatly influenced by the social environment and significant others. In this study, social support and social capital for nutrition and PA healthy lifestyles were predominantly provided via community/faith organisations that offered the space for older women to be social, stay connected with their faith and community, as well as receiving health information and participating in PA opportunities – all are important components of

successful ageing. Therefore, greater and more sustained support for these organisations is warranted. Family-oriented interventions should be considered in future research, as home environments and household roles were important in all the arenas explored in this research project. Therefore, family-oriented strategies could be a better target for women with deeply situated norms and valuesand/or those who have interdependent familial networks.

Research on ageing and ethnicity has indicated that as people grow older their needs and preferences may become more culturally pronounced and thus, cultural factors will remain to be important among minority ethnic groups (Patel 2015, Fenton, 1987). Given the contemporary super-diverse context of the UK, it is crucial to start planning to accommodate the needs of the increasingly diverse older population (Birmingham Policy Commission, 2014). Thus, cultural sensitivity must be at the forefront of health strategies planned for older women from diverse ethnic backgrounds.

Since there is little research conducted in older migrant populations in relation to nutrition, PA, and ageing, it is hoped that the present research project will encourage more research in this field. By understanding the unique challenges of older migrant women's needs, interventions can be tailored to this vulnerable sub-group of the population in order to promote healthy ageing by reducing risks for obesity, nutritional risk, frailty, and their associated negative health outcomes.

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