Physical activity, social isolation and loneliness in later life: A focus on rural areas in the UK

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Physical activity, social isolation and loneliness in later life: A focus on rural areas in the UK

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“You don't stop laughing because you grow old.

You grow old because you stop laughing.”

Michael Pritchard

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v. Previously submitted material

Publications

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Withall, J., Thompson, J., Kenneth, F., Davis, M., Selena, G., de Koning, J., Lloyd, Liz, Graham, P., 2016. Participant and public involvement in refining a peer-led active ageing intervention: Project ACE (Active, Connected, Engaged). The Gerontologist, gnw148.

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*Chapter 4 presents the same analysis and results as in this publication, however some edits and additions have been made to the introduction, methods, results and discussion sections to allow the chapter to be better integrated into this thesis.

Oral presentations

de Koning, J.L., Stathi, A.S. and Richards, S.H., 2016. Physical activity types and coping strategies versus activity barriers by rural-living older adults: a mixed methods analysis. In: The 12th annual conference of the UK Society for Behavioural Medicine, Cardiff.

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Poster presentations

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** Third prize in a postgraduate poster competition

*** First prize in Young Scientists' poster competition

vi. Abstract

This thesis explored the predictors of and relationships among loneliness, types of social isolation (SI) and physical activity (PA) in rurally-living older adults in the UK using interdisciplinary, sequential mixed-methods.

Regression analysis was used to explore socioecological predictors of loneliness, family SI and community SI in 844 adults (mean age=71.5, SD=8.2). Each additional 10 years of residence lowered the likelihood of loneliness (OR=0.80, 95% CI=0.68-0.94), family SI (OR=0.71, 95% CI=0.63-0.80) and community SI (OR=0.85, 95% CI=0.75-0.96).

Regression analysis was used to explore associations between loneliness and SI from family, friends or neighbours, accelerometer-measured light (LPA), moderate-to-vigorous (MVPA) and total PA (TPA), and everyday pursuits in 112 adults (mean age=72.8, SD=6.6). 4.5% were often lonely and 7.1% socially isolated. Loneliness and SI types were not associated with PA levels. However, volunteering related to MVPA (B=41.84, 95% CI=17.57-66.12) and lower odds of neighbour SI (OR=0.23, 95% CI=0.06-0.91). Accompanying others related to LPA (B=88.47, 95% CI=16.68-160.26) and lower odds of family SI (OR=0.39, 95% CI=0.22-0.68). Sports/exercise related to MVPA (B=37.86, 95% CI=18.23-57.50) and lower odds of friend SI (OR=0.56, 95% CI=0.33-0.97).

Directed content analysis of semi-structured interviews was used to explore the diversity in SI and loneliness in 12 active (mean age=70.8, SD=4.5) and 12 inactive adults (mean age=75.3, SD=6.6). Family disruption related to emotional loneliness in active participants, while lack of social integration and overwhelming work or caring responsibilities related to social loneliness in inactive participants.

Loneliness and SI seem similarly prevalent in rurally-living, versus urban-living, older adults in the UK. Recent migration to a rural area predicts loneliness and SI. Objectively-measured PA levels seem unrelated to loneliness and SI, although specific activities may increase both PA and social contact. Not meeting expectations of contact/relationships with family, friends or community members, may result in emotional or social loneliness, regardless of PA level.

vii.Abbreviations

AMSTEL	Amsterdam Study of the Elderly
BLSA	Bangor Longitudinal Study of Ageing
BMI	Body Mass Index
CI	Confidence Interval
ELSA	English Longitudinal Study of Ageing
ESS	European Social Survey
GaPL	The Grey and Pleasant Land study
GP	General medical practitioner
IPAQ	International Physical Activity Questionnaire
IPAQ-E	International Physical Activity Questionnaire modified for the elderly
LPA	Light physical activity
LSI	Life Space Index
LSNS	Lubben Social Network Scale
LSOA	Lower Super Output Area
MVPA	Moderate-to-vigorous physical activity
NICE	National Institute for Health and Care Excellence
NIHR	National Institute for Health Research
ONS	Office for National Statistics
OPAL	The Older People and Active Living study
OR	Odds Ratio
PA	Physical activity
PACS	Physical Activity Cohort Scotland
PAQ	Physical activity questionnaire
PPI	Public and Patient Involvement
R-UCLA	Revised University of California, Los Angeles loneliness scale
SD	Standard Deviation
SELSA	Socio Emotional Loneliness Scale for Adults
SHARP	The Staying Healthy and Active in Rural Places study
SI	Social isolation
SOA	Super Output Area
SPPB	Short Physical Function Battery
TILDA	The Irish Longitudinal Study of Ageing
TPA	Total physical activity
UCLA	The University of California, Los Angeles loneliness scale
UK	The United Kingdom
WoE CRN	West of England Clinical Research Network

Chapter 1. General introduction

1.1 Setting the scene

In England and Wales the population of adults aged 65 and over is projected to increase by 19.4% between 2015 and 2025, from 10.4 million to 12.4 million (Guzman-Castillo et al., 2017). An ageing population is the outcome of improved living standards and medical care over the years, which means that more people are living with better health and wellbeing than before (Department of Health, 2016; Government office for Science, 2016). It brings both opportunities (increased numbers of individuals with many years of life and professional experience contributing to society through voluntary or continued paid work) as well as challenges (increased health and social care needs for more individuals when they reach advanced older age) (Ready for Ageing Alliance, 2016).

Understanding how best to maintain good health in the growing older population is important as, without significant improvements in health, UK population ageing will increase the amount of ill-health and disability (Government Office for Science, 2016). Indeed, statistical models using Office for National Statistics projection data and prevalence data from the English Longitudinal Study of Ageing (ELSA), predict that there will be a 25% increase in the number of older people living with disabilities between 2015 and 2025 (Guzman-Castillo et al., 2017). With this demographic shift comes the need to design and implement appropriate and effective programmes and policies to support the best possible continued health and wellbeing into older age (Department of Health, 2016; Ready for Ageing Alliance, 2016). Research which increases the public, practitioner and policy makers' understanding of the best ways to support health-related behaviour in older age is, therefore, strongly warranted (Department of Health, 2016; Government Office for Science, 2016).

1.1.1 A focus on rural areas in the UK

Rural areas in the UK are defined as settlements with a population below 10,000 and are further differentiated into rural categories depending on their spatial characteristics (Office for National Statistics, 2013). National Census data between 2010 and 2015 shows that there was a net internal migration within the UK to predominantly rural areas for the middle and older adult population, with close to 11 thousand adults aged 65 and above migrating from urban to rural areas (Office for National Statistics, 2016c). As a consequence, rural areas in the UK have a larger and faster growing proportion of residents over the age of 65 than do urban or suburban areas, with Census data from 2014 showing that 23% of rurally-living populations were aged 65 and over, while this figure was 17% in urban areas (Office for National Statistics, 2015b). This population shift is occurring due to the out-migration of younger adults to find education and employment opportunities in urban or suburban areas, the ageing in-situ of long-term rural residents and the increasing trend of middle-aged and older adults moving to the countryside for retirement (Lowe & Phillipson, 2006). It has been argued that, due to this growing rurally-living older population segment, the consequences of demographic ageing, such as increased health and social care needs, will be felt first and most strongly in rural areas (Stockdale, 2011).

Given the recent and projected growth in the rurally-living older population, it is important for policy makers, local health professionals and community leaders to know whether and how rural places in the UK support health and wellbeing of older residents. Two contrasting views are held regarding the suitability of rural areas for retirement. The first view argues that a lack of amenities and services and an existence of social stigma and social exclusions in rural areas raises the likelihood of social isolation and disadvantage in older age (Age UK, 2013; Watkins & Jacoby, 2007; Wenger, 2001). The second view argues that living in rural areas provides better social integration in the community and psychological benefits due to being closer to green spaces and living in a lower population density than living in urban areas (King & Farmer, 2009; Roe & Aspinall, 2011; Walters et al., 2004). It may be the case that there are both positive and negative aspects of rural places for supporting good quality of life in older age. In their

qualitative work Manthorpe, Malin, and Stubbs (2004) and Manthorpe et al. (2008) documented both positive and negative aspects regarding the maintenance of independence and wellbeing by older people in rural villages in the UK. They argued that rural ageing should not be seen as a homogenous experience, but rather as multi-faceted with both benefits and disadvantages.

It is important to provide rurally-living older people with the opportunity to continue living in their homes and communities as they enter into advanced older age, as it has been found that the attachment to place experienced by older adults may contribute to wellbeing (Burholt, 2006; Burholt & Naylor, 2005; Gilleard, Hyde, & Higgs, 2007). Regression analysis of 387 people aged 70 and above living in a dispersed farming area in North Wales, who did not want to move from their present community, found that for those living in a native community (had lived there throughout adult life) a feeling of historical attachment to place and feeling socially integrated contributed to their attachment to place (Burholt & Naylor, 2005). For those living in a retirement community (having re-located post retirement), however, these factors did not contribute to attachment to place. Using the same cross-sectional survey dataset, a different quantitative analysis identified seven key areas of attachment to place: general satisfaction with one's location, historical perspective, aesthetic and emotional components of location, social support, social integration, appropriateness of the environment, and relocation constraints (Burholt, 2006).

A cross-sectional analysis of 9,978 adults aged 52 and above from the first wave in the English Longitudinal Study of Ageing (ELSA), which includes both urban and rural respondents, also found that living in an area for a longer time and the strength of one's attachment to place were both significantly associated with wellbeing (Gilleard et al., 2007). However, a longitudinal study of 2,424 adults aged 65 and above at baseline found that those living in a rural area were more likely to re-locate their home at the follow-up, 10 years later (OR=1.39, 95% CI 0.97 to 2.00) (Wu, Prina, Barnes, Matthews, & Brayne, 2015). Two-thirds of the rural respondents who re-located in this study moved into a city or town. This may be due to the lack of, or inadequacy of, amenities such as public transport, medical care, shops and social spaces in some rural places in the UK

(Age UK, 2013; Wiltshire Council, 2013). A better understanding of the ways in which communities, health professionals and government policy can facilitate older adults to remain in their familiar rural communities as they age, is necessary.

1.1.2 Physical activity in older age

There is now consistent evidence from longitudinal, observational and experimental studies that physical activity (PA) in older age can help to maintain, and in some cases improve, physical and cognitive health (Carvalho, Rea, Parimon, & Cusack, 2014; Cheng et al., 2013; Hupin et al., 2015; Sparling, Howard, Dunstan, & Owen, 2015). PA has been defined as "body movement that is produced by the contraction of skeletal muscles and that increases energy expenditure" (Chodzko-Zajko, Proctor, Singh, Salem, & Skinner, 2009, p. 1511), and therefore includes both exercise and general movement produced from every-day tasks. In a systematic review of nine longitudinal cohort studies, totalling 122,417 participants, attaining an amount of moderate-to-vigorous intensity PA (MVPA) which was below the 150 minutes per week recommended by the UK Department of Health, resulted in a 22% reduction in mortality risk over a mean of 10 years (Hupin et al., 2015). A systematic review of 10 randomised controlled trials, 15 prospective cohort studies, one case-control study and one longitudinal observational study of adults aged 60 and above observed for a minimum of one year, also found that 26 of the 27 studies reported a positive association between PA and maintenance or enhancement of cognitive function (Carvalho et al., 2014). Another systematic review of 47 studies on exercise interventions for adults with a mean age ranging between 71 to 90 years identified as frail, found that PA had a positive impact on functional ability outcomes (Theou et al., 2011). Furthermore, a narrative review of epidemiological studies stated that there is strong evidence of a positive association between more PA and better cardiovascular health among older adults (Cheng et al., 2013).

Nevertheless, a large proportion of the older population in the UK is currently not engaging in sufficient PA to reap these health benefits. A nationally-representative health survey of 2,450 men and women in the UK aged between 70 and 93 years, found that only 7% of men and 3% of women adhered to the PA guidelines of 150

minutes/week of objectively-measured MVPA accumulated through 10-minute bouts (Jefferis et al., 2014). It is therefore a public health priority to understand how best to encourage and facilitate the maintenance of sufficient PA in older age (Department of Health, 2011).

1.1.3 Social isolation and loneliness in older age

The importance of social isolation (SI) and loneliness in society is recognised across research, practice and government policy (Age UK, 2017; Holt-Lunstad, Smith, Baker, Harris, & Stephenson, 2015; UK Government, 2015). SI is here defined as "less than weekly direct contact with family, friends and neighbours" (Victor, Bond & Bowling, 2003, p. 2), and is seen as conceptually distinct from loneliness which is defined as "the unpleasant experience that occurs when a person's network of social relations is deficient in some important way, either quantitatively or qualitatively" (Perlman & Peplau, 1981, p. 31). A meta-analysis of 70 independent prospective longitudinal studies, including 3,407,134 participants with a mean age of 66 years at baseline (SD not reported), revealed that being socially isolated at baseline gave an adjusted odds ratio (OR) of 1.29 (95% CI 1.06 to 1.56) of mortality and being lonely at baseline an adjusted OR of 1.26 (95% CI 1.04 to 1.53) of mortality over a mean of seven years (Holt-Lunstad et al., 2015). These authors concluded that the increased risk of mortality due to SI and loneliness is comparable with well-established medical risk factors such as smoking.

A more recent prospective cohort study of 466,901 participants, with a mean age of 56.5 (SD 8.1) years at baseline, also found that baseline SI was associated with an OR of 1.73 (95% CI 1.65 to 1.82), and that baseline loneliness was associated with an OR of 1.38 (95% CI 1.30 to 1.47) of all-cause mortality six years later, in models adjusted for age, sex, ethnic origin and the presence of chronic diseases (Elovainio et al., 2017). In a meta-analysis of longitudinal studies including participants aged 18 and over, having poor social relationships (using a combined measure of SI and loneliness) increased the likelihood of incident coronary heart disease (OR=1.29, 95% CI 1.04 to 1.59) across 11 independent studies, and also increased the likelihood of stroke (OR=1.32, 95% CI 1.04

to 1.68) across nine independent studies (Valtorta, Kanaan, Gilbody, Ronzi, & Hanratty, 2016).

Longitudinal associations have also been found between baseline loneliness (B= -0.05, p<0.001), SI (B= -0.05 to -0.03, p<0.001) and poorer cognitive function four years later, in adjusted regression models with 6,034 adults aged 52 and above from waves one and two of the English Longitudinal Study of Ageing (ELSA) (Shankar, Hamer, McMunn, & Steptoe, 2013). A longitudinal association was also found between baseline loneliness and a greater risk of depression three years later (B= 2.62, p<0.001) in 212 adults aged 50 to 67 years in America in an adjusted regression model (Cacioppo, Hughes, Waite, Hawkley, & Thisted, 2006). Thus, there is a strong rationale for conducting research to help understand how individuals, societies and government policy may help older adults to avoid, or alleviate, SI or loneliness.

1.1.4 Physical activity, social isolation and loneliness

Hawkley and Cacioppo (2010) have hypothesised that low levels of PA and SI or loneliness may interact in their impact upon long-term health. As part of a loneliness model, they suggested that feelings of loneliness lead to withdrawal from social situations (self-imposed SI) and therefore a reduction in the amount of PA gained from getting out and about. The reverse relationship might also exist: older people who are limited in getting out and about and in engaging in PA may become lonely because they miss the social contact which used to coincide with their active engagements. Indeed, a meta-synthesis of 132 qualitative studies with active older adults found that social interaction was a key theme relating to PA in older age (Franco et al., 2015).

A systematic narrative review of longitudinal, cross-sectional and intervention studies with sample mean ages ranging between 10.1 (SD 0.6) and 85.4 (SD 6.3) years of age, found that of the seven longitudinal studies reviewed, one showed a that a low PA level at baseline was associated with loneliness at a three year follow-up, and four longitudinal studies found that baseline loneliness was associated with a lower PA level at follow-up measures between two and six years later (Pels & Kleinert, 2016). In the

same review, the five PA intervention studies identified were found to significantly reduce loneliness compared with a control group. If SI or loneliness leads to low levels of PA in older age, then intervention programmes targeting SI or loneliness may help to increase PA or, *vice versa*, if low levels of PA lead to SI or loneliness in older age, then intervention programmes targeting PA may also help to reduce the chances of becoming socially isolated or lonely. However, as is explored fully in the literature review chapter, the literature supporting these associations in older samples has some important limitations.

1.1.5 Gaps in the literature

There is currently little academic evidence about whether living in rural areas in the UK presents more difficulties or more advantages in maintaining adequate levels of PA and avoiding SI and loneliness in older age (Burholt & Dobbs, 2012). Public opinions about suitability of rural places for older people to remain physically active and avoid SI or loneliness are currently based upon stereotypes, rather than on evidence (Burholt & Dobbs, 2012; Heenan, 2011; Wenger, 2001). A qualitative case-study comparison between 15 rurally-living and 13 urban-living adults over age 65 found that the social community provided important reasons for getting out and about frequently for the rurally-living respondents, while this was less so in the urban context (de Koning, Stathi, & Fox, 2015). However, additional rurally-focussed research is needed which uses more widely representative samples. There is a lack of recent rurally-focussed data on the prevalence and predictors of SI, loneliness and PA in rural areas, comparable to the data available for urban-living older adults. Specifically, there is a lack of observations of the naturally-occurring types of PA engaged in by rurally-living older adults, which could include non-sports or exercise related types of PA. Regarding the hypothesised association between SI or loneliness and low levels of PA there is also a lack of research which has used objective PA measurement and is relevant to people aged 65 and above. These gaps in the literature will be further discussed in Chapter 2 **(Section 2.4.3, p. 68)**.

Supporting PA behaviour and the avoidance of SI and loneliness is becoming ever more important due to the projected continued increase in the rurally-living population aged

65 and above (Office for National Statistics, 2015b; Stockdale & MacLeod, 2013). Health, social and public policy in the UK are applied on a regional-level and allow the application of tailored policies to rural and urban areas (Stockdale, 2011). Therefore, further knowledge about how people maintain good levels of PA and avoid SI or loneliness as they age in rural areas is needed to aid the design of appropriate and effective rurally-tailored health, social-care and public transport programmes and policies (British Medical Association, 2005; Stockdale, 2011).

1.2 Thesis aim and research questions

Overarching research aim

This thesis aimed to investigate the associations between SI, loneliness and levels and types of PA in rurally-living older adults in the UK.

Research questions

1. What are the prevalence and predictors of loneliness and different types of SI in rurally-living older adults? (Chapters 4 and 5)
2. What are the levels of objectively-measured PA and what types of everyday pursuits contribute to PA in rurally-living older adults? (Chapter 5)
3. Are SI and loneliness associated with levels of objectively-measured PA or with everyday pursuits which contribute to gaining PA in rurally-living older adults? (Chapters 5 and 6)

1.3 Methodology

1.3.1 Interdisciplinary research perspective

This is an interdisciplinary thesis, combining concepts and methods from Sports and Exercise Sciences (PA behaviour and its determinants) as well as Social Psychology (SI and loneliness and their determinants). This thesis adhered to the definition of interdisciplinary research formulated by Aboelela et al. (2007): “research [which] is based upon a conceptual model that links or integrates theoretical frameworks from those disciplines, uses study design and methodology that is not limited to any one field,

and requires the use of perspectives and skills of the involved disciplines throughout multiple phases of the research process" (p. 340-341). Thus, this thesis applies and integrates conceptual models of PA behaviour developed in Sports and Exercise Science research and theories of SI and loneliness developed in Social Psychology research, employs research methods selected from both these disciplines, and interprets the findings in respect to both bodies of work. The intention of studying the complex area of older adult PA behaviours in rural areas in an interdisciplinary way was to gather findings which could contribute to a more holistic view of health and wellbeing in older age than would be possible when using one discipline (Life-Long Health & Wellbeing, 2010). For a more detailed discussion about the use an interdisciplinary perspective, see Chapter 3 **(Section 3.4, p. 78)**.

1.3.2 Mixed-methods research design

Quantitative and qualitative research methods are used sequentially in this thesis, with quantitative methods applied first (Chapters 4 and 5) and qualitative applied second in order to more fully understand the quantitative findings (Chapter 6). Mixed-methods research has been defined as research in which the investigator collects and analyses data, integrates the findings and draws inferences using both qualitative and quantitative approaches or methods (Tashakkori & Creswell, 2007). The choice of using sequential mixed-methods, starting with quantitative methods, was made because the gap in research called for quantitative data of SI, loneliness and PA comparable to that available for urban-living older people. Qualitative methods were used second to further understand the quantitative findings, in relation to the main research aim: to investigate the associations between SI, loneliness and levels and types of PA in rurally-living older adults in the UK. The qualitative methods could therefore help to gather findings to elucidate and explain what would be found using the quantitative methods (Doyle, Brady, & Byrne, 2009). For a more detailed discussion about this methodology approach see Chapter 3 **(Section 3.3, p. 75)**.

1.3.3 Theoretical approach

A biopsychosocial perspective of PA was used throughout this thesis, which recognises that that PA is associated with physical health, psychological factors (e.g. wellbeing, loneliness) and social factors (e.g. relationships, social isolation) (Meisner, Dogra, Logan, Baker, & Weir, 2010). Within this perspective, a theoretical framework of PA behaviour-modifying factors was applied to PA, SI types and loneliness: the adapted socioecological model (Bauman et al., 2012). This model recognises the salience and interaction of personal, social and environmental factors across the life-course in determining current PA behaviour. Within the adapted socioecological model, two theories of loneliness are applied: the cognitive theory of loneliness, which sees loneliness as arising from personal factors, such as one's expectations of relationships (Perlman & Peplau, 1981) and the deficit theory of loneliness, which sees loneliness as arising from social factors, such as the absence of particular relationships (Weiss, 1973). Cacioppo and Hawkley's (2010) loneliness model, in which the association between loneliness and low levels of PA is hypothesised, is based upon the cognitive theory of loneliness. For a more detailed explanation of these theories see the Chapter 3 **(Section 3.5.3, p. 83)**.

1.4 Chapter outline

This introductory chapter has provided the contextual background concerning the challenges of an ageing population, the rationale for focussing on gaining a better understanding of SI and loneliness and the levels and types of PA in older people living in rural areas of the UK, and a brief account of the methodology and theoretical perspectives used throughout this thesis. Chapter 2 presents a more detailed and critical review of the literature on SI, loneliness and PA in older populations of the UK and provides a fuller account of the gaps in the literature. The methodology and selected theoretical frameworks and theories used throughout this thesis are presented in full in Chapter 3.

The first empirical study, presented in Chapter 4, sets the scene regarding the prevalence and predictors of loneliness and SI from different sources in rurally-living older adults. This study used quantitative methods to analyse the dataset from the Grey

and Pleasant Land (GaPL) study. It also explored how a range of self-reported PA predictors are associated with SI types and loneliness. The next empirical study addressed an important limitation of the GaPL study; the lack of objectively-measured PA. Thus, Chapter 5 presents a quantitative analysis of the Staying Healthy and Active in Rural Places (SHARP) dataset, designed and collected by the PhD candidate. This study describes the objectively-measured levels of PA, as well as specific types of every-day activities engaged in by rurally-living older people. It builds on the previous chapter's exploration of the associations between levels of PA and SI or loneliness by exploring these using accelerometer-measured and activity-diary recorded PA data. The last empirical study, presented in Chapter 6, is a qualitative exploration of interview data collected in the second phase of the SHARP study, aiming to add a deeper understanding of the findings presented in Chapter 5. Lastly, Chapter 7 contains a discussion of the key findings and how these answered the research questions, the contributions to the literature and to theory, the methodological strengths and limitations, and the implications for further research based on the three original studies conducted for this thesis.

Chapter 2. Literature review

2.1 Introduction

This chapter presents a review of the research available on topics explored in this thesis, relating to older people living in rural areas of the UK:

1. Social isolation (SI) and loneliness;
2. Physical activity (PA); and
3. The association between SI, loneliness and PA.

The purpose of this review is to identify gaps in the published research on these topics which will be addressed in the studies presented in this thesis.

2.1.1 Basic definitions

Older adults

In this review older adults are classified as aged 65 and above, consistent with the definition employed in most developed countries (World Health Organisation, 2017) and by the National Institute for Health and Care Excellence (NICE, 2016). The age of 65 is roughly the age at which individuals take retirement from paid work. As one's schedule of activities usually changes upon retirement, people may experience different social networks and social interactions, as well as different levels of PA gained from getting out and about, compared with pre-retirement. Nevertheless, available evidence including adults younger than 65 years old is cited where no similar studies are available for adults aged 65 and above. However, these studies are critiqued as not sufficiently representative of the older population focussed upon in this thesis. As will become apparent, the heterogeneity of the mean ages of study samples within the literature limits direct comparison between studies in this review.

Rural places

While the definition of rural places in the UK constitutes a population settlement of fewer than 10,000 inhabitants (Office for National Statistics, 2013), due to the scarcity of research on these topics in this context, any study using the term 'rural' and mentioning a focus on older adults in the UK was selected for inclusion.

Social isolation and loneliness

SI is defined as "less than weekly direct contact with family, friends and neighbours" (Victor et al., 2003, p. 2). However, the studies reviewed do not always adhere to this definition, and in these cases this difference is discussed. Loneliness is defined as "the unpleasant experience that occurs when a person's network of social relations is deficient in some important way, either quantitatively or qualitatively" (Perlman & Peplau, 1981, p. 31) and seen as a distinct concept from SI (Peplau & Perlman, 1982). While means of measuring loneliness differ between studies, there is general agreement about this basic definition (Dykstra & Fokkema, 2007).

Physical activity

PA has been conceptualised as "a complex and multidimensional behaviour that does not stand in isolation from other related constructs, including sedentary behaviour, and physical fitness" (Gabriel, Morrow & Woolsey, 2012, p. S12). Thus, any activity contributing to the avoidance of sedentary behaviour, even without the intention of being physically active (e.g. shopping or socialising), is also relevant in the current review of PA for older people (Eckert & Lange, 2015). Therefore, this review includes literature concerning light PA (LPA), such as that gained from any non-sedentary activity such as socialising and shopping (Davis et al., 2011a), moderate-to-vigorous PA (MVPA), such as that gained from exercise and sports pursuits (Ainsworth et al., 2000), and total PA (TPA), including any non-sedentary activity regardless of intensity.

2.1.2 Review methods

Study selection

The process of searching for, and selecting, studies to review is described here to provide transparency. Relevant literature was found by using the search words 'older' paired in different search attempts with 'physical activity', 'social isolation' or 'loneliness' in the electronic search database Google Scholar. The search words 'review' and 'rural' were also added to each search. Reference lists of the selected publications were checked for other relevant papers. The Google Scholar function, which provides a list of the studies that have cited an identified publication, was also used, and another search conducted for relevant publications in these lists.

Due to the wealth of empirical work in the fields of SI, loneliness and PA, including good evidence that there is cultural variation in many concepts/measures, a detailed account of every relevant study is beyond the scope of this review. Where possible, UK-based studies have been selected due to nation-specific differences in determinants of SI, loneliness and PA in older age (Van Dyck et al., 2013; Victor & Yang, 2012).

Critical appraisal

Where available, this review presents findings from published systematic reviews, because a good quality systematic review is able to draw out key messages from the international literature and moderate the strength of its findings based on the quality of available evidence (Balshem et al., 2011). However, where systematic review evidence is absent for a particular topic, or not relevant to older people, this review draws on the next best quality evidence available to address the topic area: observational studies (Balshem et al., 2011; Petticrew & Roberts, 2003). This review draws on longitudinal observational studies in preference to cross-sectional data. Longitudinal designs have greater internal validity and are at less risk of bias when exploring the direction of relationships between variables (Petticrew & Roberts, 2003).

However, even in prospective, longitudinal observational designs inferences to causal relationships are problematic due to the inherent risk of selection bias. Cross-sectional

studies are particularly limited in this respect. Unless otherwise noted, the findings presented are from regression models adjusted for other important confounding variables. Another common limitation is that many studies measure SI, loneliness and PA concepts differently and often adjust the regression models for different confounding variables. These differences in definitions and methodology often limit the direct comparability of published studies. While acknowledging these important limitations to the interpretation of data, findings from large scale observational studies provide important insights and are directly relevant to the studies in this thesis.

Qualitative evidence is also included in this literature review as this thesis uses a mixed-methods approach. Qualitative studies are able to complement the knowledge gained from quantitative studies by adding a deeper understanding of individual experiences and circumstances, and allowing the observation of unexpected findings (Lincoln & Guba, 1985). Where possible, the selection of qualitative meta-syntheses was prioritised as these are able to draw together qualitative findings from varied samples and produce an understanding that is greater than the sum of its parts (Finlayson & Dixon, 2008). However, meta-syntheses were not identified on SI, loneliness and PA in rurally-living older adults the UK. Therefore, individual qualitative studies regarding older people's experiences of living in rural areas in the UK are presented and critiqued in this review, if the findings are relevant to the topics of SI, loneliness or PA in this population.

Evidence synthesis

The relevant quantitative and qualitative studies identified for this review are presented in a narrative overview. Quantitative evidence is presented and discussed first in most sections, although for the rural-specific sections qualitative literature is presented in equal measure, due to the dearth of quantitative research using representative rural UK samples.

2.2 Social isolation and loneliness

This section presents and critiques the state of current literature about SI and loneliness in older age in the UK. The shortcomings of current research relating to rurally-living older adults are highlighted and the rationale for the focus of this thesis on SI and loneliness is presented.

2.2.1 Conceptualisation and measurement

Conceptualisation of social isolation and loneliness

SI has been defined as "those without weekly direct contact with family, friends or neighbours" (Victor et al., 2003, p.3). Being socially isolated, however, is not in all cases a negative experience (Wenger & Burholt, 2004). Loneliness has been defined as "the unpleasant experience that occurs when a person's network of social relations is deficient in some important way, either quantitatively or qualitatively" (Perlman & Peplau, 1981, p. 31). It is therefore, by definition, a negative psychological state. Some view loneliness as the "social equivalent of physical pain, hunger and thirst" (Hawkley & Cacioppo, 2010, p.210). Loneliness can be long-lived, lasting over two years (chronic loneliness), brief and occasional occurring from time to time (transient loneliness) or only occurring at a specific crisis or life transition (e.g. re-location, or widowhood) (situational loneliness) (Young, 1982). It is widely recognised that loneliness and SI are associated but conceptually and empirically distinct (Cornwell & Waite, 2009; Havens, Hall, Sylvestre, & Jivan, 2004; Peplau & Perlman, 1982; Victor et al., 2003; Wenger & Burholt, 2004). Two prevalent theories of the dimensions and aetiology of loneliness will be presented and discussed in Chapter 3 **(Section 3.5, p. 80)**.

Measurement of social isolation

SI has been measured in three ways: by counting social contacts; describing social networks; and counting social activities (Victor et al., 2003). Some authors have also used unique composite measures of other variables (e.g. telephone use by Wenger and Burholt (2004)), however this renders their study findings incomparable with others.

Regarding the counting of social contact frequency, researchers have either counted the frequency of contact over a week or month (Victor et al., 2003) or counted the number and nature of contacts one has over a month (as with Life Space Index [LSI] and the Lubben Social Network Scale [LSNS]). The LSI is based on an estimate of social interactions with family (both living in the same household and elsewhere), friends, neighbours, co-workers, and others in the community (Cumming & Henry, 1961). In contrast, the LSNS scale assesses the extent of perceived supportive social contact (seen or heard) on a monthly basis (Lubben, 1988; Lubben et al., 2006). Both these scales, however, incorporate a subjective rating of the quality of contact, deviating from the objective perspective of SI which counts only the frequency of social contact. Measuring SI as the frequency of social contact over a specified time period, in which SI is defined as 'less than weekly contact with family, friends or neighbours' and severe SI as 'less than monthly contact with family, friends or neighbours', maintains the objective nature of the concept (Victor et al., 2003). This measurement of SI is employed in this thesis, and also in some (although not all) studies using data from the English Longitudinal Study of Ageing (ELSA), the largest nationally-representative longitudinal dataset available on older adults in England (aged 52 and above at baseline) (Jivraj, Nazroo, & Barnes, 2012). Using an objective measure of SI allows the conceptual distinction between SI and loneliness.

Another means of measuring social contact is the description of social networks, which gives an indication of with whom individuals have contact and what support is received (Wenger, 1991, 1997; Wenger, Davies, Shahtahmasebi, & Scott, 1996). Wenger (1991) identified five social network types when surveying 534 older people (age 65 and above) living in rural North Wales in 1979, and a repeated survey of 108 of the original respondents four years later who had been aged 75 and above at baseline. The 'local family dependent' network indicated a reliance on local family support, whereas a 'local integrated' network indicated integration with both local kin and community members. A 'local self-contained' network indicated presence of local family but the individual being largely self-reliant, while a 'wider community focussed' network indicated active relationships with both distant relatives and local friends and neighbours. Finally, a 'private restricted' network indicated a low level of family and community contacts and

an adaptation/resignation to low social contact. Although an important reconceptualization of social interaction when first proposed, the Wenger network typology has been critiqued for not being generalisable outside rural North Wales (Victor et al., 2003). The Wenger network typology was further developed by Litwin (1998) in a cross-sectional national-probability sample of 4,214 Israelis aged 60 and over. This typology contains five types of network: 'diverse'; 'friend'; 'congregant' (composed mostly of contact from religious groups); 'family'; and 'restricted'. The 'diverse' network represents the most sociable individuals, and the 'restricted' network the most socially isolated individuals. In a cross-sectional analysis of 1,462 older Americans (aged 65 and above), having a 'diverse', 'friend', or 'family' network significantly predicted less anxiety, and the 'diverse' network predicted less loneliness, in regression models adjusted for age, gender and socio-demographic variables (Litwin & Shiovitz-Ezra, 2011). While network typologies lead to an understanding of the social patterns of older people, perhaps their major limitation is that they are not as useful in identifying who has infrequent overall social contact, and thus in identifying SI.

Finally, some measures of SI incorporate social participation as well as frequency of social contact (Cornwell & Waite, 2009; Shankar, Hamer, McMunn, & Steptoe, 2013; Steptoe, Shankar, Demakakos, & Wardle, 2013). This perspective conceptualises SI as a lack of social contact at the one extreme and high levels of social participation at the other end (de Jong Gierveld & Havens, 2004). However, including the level of participation in social groups broadens the concept of SI, as it includes an active social component (Tilvis et al., 2012). For instance, one can see friends, family and neighbours frequently around the home environment (not socially isolated) but not be engaged in social group activities. The addition of social participation in the SI definition may have led to the conflicting findings regarding the relationship of SI to mortality in large population studies. The longitudinal analysis by Steptoe et al. (2013) found that SI (including social participation) was strongly predictive of mortality over seven years in 6,500 respondents of the ELSA study (aged 52 and above). However, SI was not strongly predictive of mortality over 10 years in 4,004 adults aged 65 and above in the nationally-representative Amsterdam Study of the Elderly (AMSTEL), or over seven years in 3,858 adults aged over 75 years in Finland (Tilvis et al., 2012), both of which used the narrower

objective concept of SI. This discrepancy could also be explained by cultural differences or the differences in age ranges in these large population studies.

Measurement of loneliness

As loneliness is defined as a subjective experience, this can only be measured through participant self-report. There are two major approaches towards measuring loneliness: direct and indirect self-reported questionnaire items. The direct rating usually includes a single item such as ‘‘please tell me how much of the time during the past week you felt lonely” (Yang & Victor, 2011, p. 1375). The indirect, multiple-item ratings use a range of questions around the concept of loneliness, but do not mention the word loneliness. Two multi-item scales have been adopted and used in older populations; the University of California, Los Angeles (UCLA) loneliness scale (Russell, 1996) and the Loneliness Index (de Jong-Gierveld & Kamphuis, 1985). Other multi-dimensional items have also been developed, although they have not been as prominent in research with older populations; e.g. the Socio Emotional Loneliness Scale for Adults (SELSA) (DiTommaso & Spinner, 1993). The single item and multi-item scales both have advantages and disadvantages.

The single-item direct loneliness question has been used widely across UK-based studies (Victor & Bowling, 2012; Victor & Yang, 2012) and international research such as the comparative SHARE dataset of adults aged 50 and above from Austria, Belgium, the Czech Republic, Denmark, France, Germany, Greece, Ireland, Italy, the Netherlands, Poland, Spain and Switzerland (Fokkema, De Jong Gierveld, & Dykstra, 2012), as well as large population studies of older people in Finland (Tilvis et al., 2012) and the US (Shiovitz-Ezra & Ayalon, 2010). The single item direct loneliness question is considered an acceptable measure of loneliness in epidemiological studies with one of its merits being the high completion rates seen in direct interview and self-completion surveys (Yang & Victor, 2011). However, the direct loneliness question has been critiqued for depending on the participants’ understanding of the concept of loneliness and admitting to feeling lonely in the face of the social stigma attached to it (Shiovitz-Ezra & Ayalon, 2010; Victor, Scambler, Bowling, & Bond, 2005b).

Indirect, multiple-item scales are advantageous for their ability to circumvent, to some extent, the stigma of admitting loneliness, as questions do not directly mention the word loneliness (Shiovitz-Ezra & Ayalon, 2012). The revised three-item UCLA Scale (R-UCLA) (Russell, 1996) is one of the most widely used scales of loneliness in studies with older adults, conducted in the United States (Cacioppo, Hawkley, & Thisted, 2010; Hawkley, Thisted, & Cacioppo, 2009) and the English ELSA and Irish TILDA nationally-representative datasets (Kamiya, Doyle, Henretta, & Timonen, 2013; Shankar et al., 2013; Shankar, McMunn, Banks, & Steptoe, 2011). The original 20-item and revised three-item self-report UCLA scale treats loneliness as a unidimensional construct, and asks questions about the frequency of particular feelings related to loneliness. Both the original and shortened version have good psychometric properties (Hughes, Waite, Hawkley, & Cacioppo, 2004). A different indirect measure, the Loneliness Index (de Jong-Gierveld & Kamphuis, 1985) contains 11-items and treats loneliness as a two-dimensional construct, dividing loneliness into social loneliness and emotional loneliness (Weiss, 1973). Social loneliness relates to the perceived absence of a broad, engaging social network while emotional loneliness relates to the perceived absence of an intimate relationship (e.g. with a partner or best friend). A reliable shortened 6-item Loneliness Index has also been developed, with an alpha coefficient between 0.70 and 0.76 and a high correlation with the original scale ($r = 0.93$ and 0.95, $p<0.001$) (de Young Gierveld & Van Tilburg, 2006).

The direct and indirect measures seem to capture loneliness in different demographic groups of individuals. Comparing responses to a single-item direct question with responses to the three-item R-UCLA scale by 2,190 older Americans (age 50 and above) revealed a high level of inconsistency: only 45% of those classified as lonely by the direct measure were also classified lonely by the dichotomised R-UCLA measure (Shiovitz-Ezra & Ayalon, 2012). These authors found that education level and age predicted loneliness measured by the direct and indirect methods differently, and therefore concluded that the methods measure loneliness in different demographic groups and that researchers should employ both approaches. Regardless of type of loneliness scale used, the use of relative intensities of loneliness can cause some issues. It is thought that the middle

category (‘sometimes lonely’) in the single-item loneliness measure is inconsistent due to different interpretations of the term ‘sometimes’ by respondents (Victor, Grenade, & Boldy, 2005a). Similarly, deducing what is ‘moderate loneliness’ from a loneliness scale created through asking multiple indirect loneliness questions is also inconsistent because researchers often decide upon different cut-off points to separate ‘moderately lonely’ from ‘not lonely’ and ‘severe loneliness’ (Victor et al., 2005a). Thus, using a dichotomous classification of ‘lonely’ and ‘not lonely’ may lead to more comparable results between different measurement types. Finally, for both a direct question and the indirect Loneliness Index (de Jong-Gierveld & Kamphuis, 1985), the feeling of loneliness was seen to vary within a short time-frame (between seasons and time of day) in a 12-month, repeated-measures study of 34 older adults aged 65 to 93 (Victor, Sullivan, Woodbridge, & Thomas, 2015). Thus, loneliness is a dynamic concept and all studies are confounded by season and time of day of measurement, which may lead to over- or under-estimations of loneliness.

2.2.2 Prevalence of social isolation and loneliness

Data available on older adults in the UK

An understanding of prevalence of loneliness and SI, and how this changes with on-coming age, in the UK can be gained from studies using the ELSA dataset of 11,391 adults aged 50 and over at baseline, which has published seven waves to date between 2002 and 2015 (English Longitudinal Study of Ageing, 2017). Similarly, studies using the Office for National Statistics (ONS) Omnibus Survey dataset of 999 adults aged 65 and over at baseline, of whom 287 surviving participants completed a postal survey eight years later, also provide an understanding of the prevalence of loneliness (Victor & Bowling, 2012). The ELSA dataset included adults aged 52 and above at baseline (cohort one core members, 2002-03) and added a ‘refresher’ sample of adults aged 50 and above at each subsequent wave (Cheshire, Hussey, Phelps, & Wood, 2012). Thus, while the baseline age is therefore below the definition of older adult used in this thesis, the latest ELSA waves include a larger sample of those aged 65 and above, given the retention of the cohort one core members who age as the study progresses. For instance, at wave five in 2010-11, 67.5% of the sample were cohort one core members who would be aged 60

and above (Cheshire et al., 2012). The Omnibus Survey, in contrast, is relevant directly to adults aged 65 and over (Victor & Bowling, 2012). However, as only 287 out of 583 surviving participants (a 58% response rate) followed-up after eight years, there is a risk of selection bias.

The prevalence of social isolation

The prevalence of SI in older adults in the UK is currently estimated to be low, although the use of a variety of measurement constructs makes comparison between studies difficult. In wave five of ELSA (2010-11), 5% of adults aged 52 years and over were socially isolated (termed detachment from social networks in their study) (Jivraj et al., 2012). In contrast, 7% reported maximum possible scores on a SI index using wave two of ELSA, although this SI index incorporated a measure of social participation (Shankar et al., 2011). The prevalence of SI was stable between waves one to five in the ELSA data, with 90% of individuals remaining either constantly isolated or constantly not isolated over the years (Jivraj et al., 2012). Thus, while entrenched views in society suggest that SI is common, and that it is inevitable for people to become socially isolated in later life (Cuddy, Norton, & Fiske, 2005; Dykstra, 2009), only a small percentage (~5%) of the older population in the UK are, according to the objective definition, socially isolated from family, friends and neighbours. Nevertheless, even a low percentage translates into a large number of people on a population level. For instance if 18% of the total UK population in 2016 (65,648,054 people) were aged 65 and above (11,816,650 people) then 5% of socially isolated individuals equates to 590,832 older adults in the UK (Office for National Statistics, 2017).

The prevalence of loneliness

Several large observational studies provide evidence of the prevalence of loneliness in older people in the UK, however, measurement differences, and differences in definitions of older adults limit direct comparisons. In the 999 adults aged 65 and above in the Omnibus Survey, 9% classified themselves as feeling lonely ‘most of the time’ or ‘all of the time’ (frequent loneliness) (Victor & Bowling, 2012). A study using the European Social Survey (ESS) dataset found 7.4% reported frequent loneliness (using a

direct loneliness question) in a sample of 2,394 adults aged 60 and over in the UK (Yang & Victor, 2011). The lower proportion seen in the ESS compared with Omnibus dataset may be due to the inclusion of adults aged 60 to 64 in the former. Yang and Victor (2011) found that the UK's proportion of frequent loneliness was among the lowest in the 25 European countries surveyed, at joint 7th lowest place. However, within the northern European nations, the UK had the second highest loneliness prevalence, as in Denmark, Switzerland and Norway only 3.2 to 5.0% of adults aged 60 and over reported frequent loneliness. The ELSA dataset does not provide comparable loneliness prevalence data, as it used the R-UCLA measurement construct which provides a scale between 3 and 9. Even so, an analysis of wave two of ELSA (mean age 66.9 years) reported a mean loneliness score of 4.2 (SD 1.4) on the 3 to 9 scale, with 2% of participants estimated to feel lonely all the time (Shankar et al., 2011). As a minority of older people in the UK feel often or always lonely (~9%) (Victor & Bowling, 2012), the common stereotype of 'lonely older people' seems to be misguided (Cuddy et al., 2005; Dykstra, 2009). Nevertheless, as with SI, even a low percentage translates into a large number of people on a population level, with 9% equating to 1,063,498 adults aged 65 and above who report feeling frequently lonely in the UK, when using 2016 population statistics (Office for National Statistics, 2017).

Data available for rurally-living older adults in the UK

There are currently few analyses exploring whether rurally-living older adults in the UK are at more, less, or equal risk of SI, compared with their urban-living counterparts. The study by Jivraj et al. (2012) using ELSA data is currently the only longitudinal rural-urban comparison study using a nationally-representative sample of older adults in England, although this includes adults aged 50 and above. Another longitudinal study which provides insight into social isolation and loneliness in a rural sample is the Bangor Longitudinal Study of Ageing (BLSA). This study surveyed 534 older adults in rural North Wales (aged 65 and over) in 1979 and interviewed 47 survivors of the sample 20 years later, in 1999 (Wenger & Burholt, 2004). This study defined SI using a composite measure of variables, such as living alone and having no phone, which has not been used in other studies. It is therefore not comparable with the proportions of SI found in the

ELSA data which used the more common measure of low frequency of contact with friends, neighbours and family (Jivraj et al., 2012). Nonetheless, Wenger and Burholt's (2004) study provides the only report of longitudinal changes in SI and loneliness in a rural sample. However, the small number of survivors at the follow-up (n=47), and geographical confinement to North Wales, limits the generalisability of this data to other rural places in the UK. Wenger's (1995) comparison of social network types between adults aged 65 and over living in rural North Wales (n=240) and in Liverpool (n=4,736) also provides an idea about levels of social contact in rural areas of the UK, but this data is limited by the lack of direct SI and loneliness measures.

Social isolation in rurally-living older adults

There is reason to believe that rurally-living older people may be at a higher risk for SI than their urban counterparts. A longitudinal analysis of 11,391 ELSA respondents between waves one and five found an odds ratio (OR) of 1.38 ($p<0.05$, 95% CI not published) for those living in rural areas compared with urban areas (Jivraj et al., 2012). The study using the BLSA dataset found that for 47 survivors of the 20 year study starting with 534 older adults, the proportion of people 'moderately' isolated (scoring 2 or 3 from a list of 8 indicators of isolation) remained stable between baseline (28% in 1979) and nine years later (28% in 1987), but increased after almost 20 years (55% in 1995) when participants were aged 81 and above (Wenger & Burholt, 2004). The proportion who were 'very' isolated (scoring 4 or more from a list of 8 indicators of isolation), however, did not vary much over these time points (6%, 6%, and 4%, respectively).

Arguments supporting a higher risk of social isolation

There are several reasons why living in a rural area might predispose older people to SI, although these are based upon dated quantitative evidence and limited qualitative reports. Contact with younger family was typically less frequent for rural-dwelling older adults, as seen between a North Wales (n=240) and Liverpool sample (n=4,736) of adults aged 65 and over (Wenger, 1995). Wenger (1995) also found that retirees who had moved to a rural area (compared with older adults who has always lived in rural places) were at a heightened risk of small, unsupportive social networks, having not formed

social contacts over many years residence in the neighbourhood. While these findings are now dated, being almost 30 years old, studies using more recent data on this comparison could not be found.

Rural areas in the UK have been subject to demographic changes over the last decades. The population aged 15 to 19, and 20 to 24 years has decreased in rural areas (-26.9% and -1.1%, respectively) while the population aged 65 and above increased in rural areas (+10.8%) between 2002 and 2015 (Office for National Statistics, 2016c). It has been argued that the younger population has migrated (and continues to do so) from rural to urban areas due to a lack of education and employment opportunities, and increasing house prices in rural areas (Le Mesurier, 2003; Wenger, 2001). In contrast, working-age adults preparing for retirement, who commute to work in nearby cities, as well as older adults have been moving to rural areas in pursuit of an 'idyllic' retirement environment (Le Mesurier, 2003; Wenger, 2001). Qualitative findings from 23 adults aged 55 and over in the Scottish highlands indicated that the loss of younger generations contributed to a loss of the social fabric of communities (King & Farmer, 2009).

A qualitative analysis of interviews conducted with 22 residents (aged 69 to 91 years) across three case-study sites in rural Ireland and Northern Ireland observed that older people sometimes found it difficult to adjust to the demographic changes, such as an increase in commuting population and an increase in migrant population in their villages (Walsh, O'Shea, Scharf, & Murray, 2012). While not measured, it could be speculated that such demographic changes in rural areas are diminishing older people's local social networks. Lastly, literature summaries report that rural areas in the UK are subjected to the loss of post offices, local shops and pubs, long distances to the nearest services, poor access to public transport, and higher living costs (Age UK, 2013; Le Mesurier, 2003). These factors could also put rural-dwelling older people at increased risk of SI by decreasing the natural meeting points for older people and their ability to reach further social destinations.

Loneliness in rurally-living older adults

It is unknown whether rurally-living older adults in the UK are at more, less or equal risk of loneliness than those who live in urban areas. In Wenger and Burholt's (2004) analysis BLSA data of adults aged 65 and above living in North Wales, 9% of 534 older adults felt very lonely and 29% moderately lonely at the baseline measure in 1979. In 47 survivors surveyed, the proportion feeling moderately lonely increased over three time points (23% in 1979, 28% in 1978, 47% in 1995), but the proportion reporting feeling very lonely stayed stable over these time points (9%, 6%, 9%, respectively). This figure of 9% feeling very lonely, is consistent with that found in the nationally-representative Omnibus sample of 999 adults aged 65 and over (Victor & Bowling, 2012). However, the latter study used response categories relating to frequency of loneliness, which differs from the use of categories 'very lonely' and 'moderately lonely' in the BLSA dataset. Thus, direct comparison of loneliness prevalence is not possible between the BLSA and the Omnibus sample. A more recent cross-sectional telephone survey of 383 Irish older adults (aged 65 or above) reported that living in a rural area was a predictor of experiencing loneliness from both friends and from family (Drennan et al., 2008). However, Drennan et al. (2008) used different constructs of loneliness (social, family and romantic loneliness) from those used in studies providing UK nationally-representative data on loneliness, and so direct comparison of prevalence is, again, not possible. Nevertheless, the greater risk of two sub-types of loneliness (from friends and from family) seen in rural places compared with urban places in the Irish sample, warrants investigation into whether older adults in other rural areas in the UK are at greater risk of loneliness, using more standardised measures of loneliness.

Arguments supporting a higher risk of loneliness

The same reasons which may increase the risk of SI in rural settings may increase the risk of loneliness in rurally-living, compared with urban-living, older adults. However, this evidence is based on qualitative observational studies and narrative reviews. These reasons include the scarcity of public services, shops and places for social meetings, and pockets of rural poverty, which are argued to present barriers for social activities, visiting friends and family and general mobility to get out and about (Age UK, 2013; Le Mesurier,

2003; Milbourne & Doheny, 2012; O'Shea, Walsh, & Scharf, 2012; Philip & Gilbert, 2007). Wenger (2001) theorised that the outmigration of children to find better education and employment could predispose older adults in rural areas to become socially isolated and/or lonely, especially if they have a low income and no property possession. Individuals who have unusual personal circumstances (e.g. individuals with disabilities, who are childless or have a broken relationship), may also find it difficult to integrate into tight-knit rural communities, as seen in an ethnographic study of an English village selected for its perceived 'idyllic' rural appearance and amenity availability (Watkins & Jacoby, 2007). This study conducted 30 semi-structured interviews with a range of residents and key stake holders and observed that individuals who did not fit into the community's perceived 'rural idyll' experienced social stigmatisation. Although not measured in this study, such stigmatisation may lead to feelings of loneliness in these individuals. Studies using larger samples and a more representative recruitment strategy are needed to confirm this.

Arguments supporting a lower risk of social isolation and loneliness

Nevertheless, there is also evidence, mostly qualitative, that rurally-living older people in the UK experience close social community ties, which may fuel an argument that they may be at a lower risk of both social isolation and loneliness than their urban-counterparts. The case study of three small rural villages in the UK, including 72 adults (women aged 60 and above, men aged 65 and above) observed a high prevalence of perceptions of a rural community spirit and good neighbourliness, with 42% citing good neighbours as a key aspect they liked about their area (Manthorpe, Malin, & Stubbs, 2004). A participatory public consultation study, including 713 people aged 50 and above living across 10 rural areas in England, found that, despite participants' reports of various negative changes in service availability and social dynamics over time, they held positive views of the supportive voluntary schemes and good neighbourliness in their areas (Manthorpe et al., 2008). In another qualitative study of 13 participants living in a small village and 15 participants living in an urban city in the South West of England (all aged 65 or above), the rurally-living older people recalled their local social community to be a key instigator of frequent trips out of the house for either errands or socialising,

while the urban-living participants mentioned a higher reliance on family contact (de Koning et al., 2015). Furthermore, in a sample of 387 people aged 70 and over living across six rural settlements in North Wales, social integration was the most commonly cited reason for feeling attachment to place (Burholt & Naylor, 2005). Most of the evidence is, however, small-scale and qualitative, or gathered through non-probability samples which may present an unbalanced outcome, or is not generalisable to other rural areas in the UK.

Summary of rural-based evidence of social isolation and loneliness

In summary, there is observational quantitative and qualitative evidence, of varying quality, showing characteristics of rural places, or of rurally-living older adults, which may be linked with an increased or decreased risk of SI or loneliness, compared with urban areas in the UK. However, except for the study by Jivraj et al. (2012) using the ELSA dataset (which provides findings about SI but did not analyse the loneliness variable available in the dataset), there are no studies using standardised measures of SI and loneliness that directly compare rurally-living and urban-living older people on the prevalence of SI and loneliness. While there are nationally-representative cross-sectional and longitudinal observational studies of adults aged 65 and over (Victor & Bowling, 2012), aged 60 and over (Victor & Yang, 2012) and aged 52 and over (Jivraj et al., 2012; Shankar et al., 2011), there are no comparable rural-focussed datasets with similar measures of SI and loneliness, outside the now dated BLSA study (Wenger & Burholt, 2004). Such research is needed in order to establish whether rurally-living older people are currently at a higher, lower or equal risk of SI and loneliness compared with the available data on urban-living older adults in the UK. This knowledge could guide further research regarding the need for rural-specific policies, services or programmes aimed at reducing SI or loneliness in older people.

2.2.3 Predictors of social isolation and loneliness

Data available on older people in the UK

There are various publications reporting predictors of SI in nationally-representative older people in the UK, mostly using the ELSA dataset (Grundy & Read, 2012; Jivraj et al., 2012; Jivraj, Nazroo, & Barnes, 2016; Shankar et al., 2013; Shankar et al., 2011). Construction of SI variables varies across these studies, however, making direct comparison difficult. The literature reporting predictors of loneliness in older UK samples is more extensive, including several cross-sectional and longitudinal studies using the nationally-representative UK-based ELSA dataset (Demakakos, Nunn, & Nazroo, 2006; Pikhartova, Bowling, & Victor, 2014, 2016; Shankar et al., 2013; Shankar et al., 2011), the Omnibus survey (Victor & Bowling, 2012; Victor et al., 2005b; Victor, Scambler, Marston, Bond, & Bowling, 2006) and the UK sub-sample of the European Social Survey (ESS) (Victor & Yang, 2012; Yang & Victor, 2011). As mentioned before, longitudinal analyses including the earlier waves of ELSA are limited in their application to adults aged 65 and above, given the large proportion of adults under 60 in the baseline sample. The ESS is similarly limited in this regard. The Omnibus survey provides the most relevant UK-based older sample (aged 65 years and above) but this survey is limited by a small follow-up sample (n=287). There is also cross-sectional evidence of loneliness predictors concerning older adults living in Ireland (Drennan et al., 2008; Golden et al., 2009; Kamiya et al., 2013). However, these studies have used different measurement constructs of loneliness from the Omnibus and ELSA datasets, and the findings may relate specifically to an Irish demographic and cultural context, and may not be generalisable to the rest of the UK. These Irish-based studies are therefore not presented in the sections below.

Predictors of social isolation

The most informative analysis of the ELSA data regarding SI is a longitudinal study of 11,391 participants in the ELSA data between wave one (2002-03) and wave five (2010-11) (Jivraj et al., 2012). In regression analyses adjusted for socio-demographic status, socio-economic status, health and access to amenities, they found that women were less likely to become socially isolated over the eight years, but widows, single adults,

and those living in rural areas (at baseline) were more likely to become socially isolated (termed detachment from social networks) (Jivraj et al., 2012). This analysis found that increasing age, baseline wealth and education, and a change in health were not associated with becoming socially isolated over the eight years, in the adjusted regression models.

In a cross-sectional analysis of 8,780 participants in wave one of ELSA, it was found that having one, two or three children (compared with none) provided a higher likelihood of at least weekly contact with relatives, friends or children for men (OR=1.70, OR=1.69, OR=2.08, $p<0.001$, respectively) and women (OR=1.74, $p<0.01$, OR=1.74, OR=1.89, $p<0.001$, respectively), in regression models adjusted for socio-demographic and health-related factors (Grundy & Read, 2012). Widows and widowers (versus being married) also had a higher likelihood of seeing friends on at least a weekly basis (OR=1.71 and OR=1.90, $p<0.001$, for men and women respectively) in the adjusted models. Only women (not men) with limitations in activities of daily living or a long-term illness had a lower likelihood of seeing relatives, friends or children on at least a weekly basis (OR=0.72, $p<0.01$, OR=0.82, $p<0.05$, respectively) in the adjusted models (Grundy & Read, 2012).

Regression models adjusted for demographic and physical and mental health-related variables of 8,699 participants in wave two from ELSA showed that health-risk behaviours such as low self-reported engagement in leisure-time or occupational PA and smoking were associated with SI (Shankar et al., 2011). Engaging once a week or less in leisure-time or occupational PA increased the likelihood of SI (OR=1.15, 95% CI 1.11 to 1.19), being a smoker increased the likelihood of SI (OR=1.21, 95% CI 1.15 to 1.28), and being inactive as well as smoking increased the likelihood of SI even further (OR=1.36, 95% CI 1.28 to 1.45) (Shankar et al., 2011). However, the SI measure used in this study included social participation, deviating from the objective SI definition of contact frequency used in other ELSA studies, and making the SI measure more representative of active than passive social behaviours. As will be discussed later, the self-reported leisure and occupational PA measure also presents limitations in this analysis. Both the

analysis by Grundy and Read (2012) and Shankar et al. (2011) present associations, but cannot infer a causal relationship due to their cross-sectional nature.

Predictors of loneliness

Two cross-sectional analyses using the ESS dataset of 47,099 participants aged 15 to 101 years across 25 European countries (including the UK), give a good indication of predictors of loneliness, although the ESS sample includes people aged 60 years and over (Victor & Yang, 2012; Yang & Victor, 2011). In an exploratory and descriptive study using the one-item direct question of frequency of loneliness and examining the whole ESS sample, Yang and Victor (2011) found an age-related trend of increasing prevalence of 'frequent loneliness', while reporting being 'sometimes lonely' had a non-linear, U-shaped trend, with those under age 30 and over age 80 showing the highest prevalence. However, they also found that the nation one lived in exerted a stronger effect on predicting loneliness than age, as the correlation between age and loneliness varied widely across nations (Yang & Victor, 2011).

In another exploratory study, examining only the UK data from the ESS (2,393 people aged 15 and above), Victor and Yang (2012) found, again, that loneliness had U-shaped distribution across age groups, with more younger (30 years and under) and older (60 years and above) respondents reporting 'frequent' loneliness than the middle-aged. Using correlation statistics, Victor and Yang (2012) also found that associations with frequency of loneliness varied by age, except the association between female gender or depression and more frequent loneliness, which was apparent across all age groups. Demographic factors (being divorced or widowed, living alone, a low education level, and lacking a confiding relationship) were associated with more frequent loneliness for middle-aged and older adults, but not for younger adults. Interestingly, poor physical health as well as frequency of social contact were not associated with loneliness for older adults, but were for younger participants. Victor and Yang (2012) suggested that different factors may endow vulnerability (or protect) against loneliness at different stages of life. While these analyses help to form hypotheses for loneliness predictors in older age for people in the UK, they remain cross-sectional and did not use adjusted

regression modelling. Therefore, cohort effects may affect the age-related trends, and confounding variables may have influenced the associations.

Studies using the Omnibus dataset of 999 adults aged 65 and above at baseline, with an eight-year follow-up sample of 276 participants, provide robust and relevant findings regarding the changes in loneliness over time and its predictors in the UK (Victor & Bowling, 2012; Victor et al., 2005b). Using a direct question on frequency of loneliness, Victor and Bowling (2012) found that older age did not always bring increased loneliness, but that three patterns of loneliness were seen: stable loneliness (60%), decreasing loneliness (25%) and increasing loneliness (15%). When considering the pattern of change in loneliness, predictors were not always straight forward. Using Chi-square analyses, women were more likely to always be lonely, but also to have reduced loneliness over the eight years, than men. Men and women who were married at baseline were more likely to have increased loneliness over time, than those who were not married, while widows and single participants (at baseline) were more likely to have reduced loneliness eight years later. Victor and Bowling (2012) suggested that these results may show how those living alone or widowed can come to terms with loneliness over time, while those with a partner at baseline may be at a higher risk of loneliness at the follow-up due to recent widowhood or entry of a partner into care. In a multiple regression model adjusted for age, gender and housing tenure, a change from being married to widowed was the only significant predictor of a change in loneliness between baseline and follow-up (unstandardized B=0.443, 95% CI 0.061 to 0.136) (Victor & Bowling, 2012). Using Chi-square tests, the best mental and physical health was seen in the never lonely group, and deteriorations in health (quality of life and chronic illnesses) were seen most for those with worsening loneliness over time. Deterioration in social activity and loss of confiding relationships were also linked with worsening loneliness. This study is the only longitudinal study concerning loneliness of adults aged 65 and above at baseline in the UK, however the proportion of those with worsening loneliness may be under-estimated due to a high attrition rate (almost 50% passed away) and low response rate at the follow-up (287 of 583 survivors).

Other predictors of loneliness, outside socio-demographic and health-related factors, have also been identified in cross-sectional and longitudinal analyses of the ELSA data. A cross-sectional analysis of 8,699 participants in wave two of ELSA found that health-risk behaviours such as low self-reported engagement in leisure-time or occupational PA and smoking were associated with loneliness, measured by the UCLA scale, in regression models adjusted for sociodemographic and physical and mental health variables (Shankar et al., 2011). Engaging once a week or less in leisure-time or occupational PA increased the likelihood of loneliness (OR=1.08, 95% CI 1.04 to 1.13), being a smoker increased the likelihood of loneliness (OR=1.07, 95% CI 1.01 to 1.13), and being inactive as well as smoking increased the likelihood of loneliness further (OR=1.12, 95% CI 1.04 to 1.19) (Shankar et al., 2011). This analysis, while highly cited across the literature, is limited by its cross-sectional nature and its use of self-reported PA. The association it found therefore needs to be replicated using objective PA measurement methods.

A longitudinal analysis of 5,210 participants from waves zero to five of ELSA found a bi-directional association between loneliness and pet ownership in regression models adjusted for socio-demographic and health-related variables, but only for women (Pikhartova et al., 2014). Women who owned a pet at baseline (wave zero) were more likely to become lonely at wave two (OR=1.39, 95% CI 1.01 to 1.92), at wave three (OR=1.40, 95% CI 1.03 to 1.90), at wave four (OR=1.84, 95% CI 1.34 to 2.52), and at wave five (OR=1.50, 95% CI 1.09 to 2.05). *Vice versa*, women who were lonely during waves two, three and four were also more likely to have a pet at wave five (OR=1.30, 95% CI 1.05 to 1.61; OR=1.42, 95% CI 1.16 to 1.74; OR=1.76, 95% CI 1.43 to 2.17, respectively) (Pikhartova et al., 2014). The authors reasoned that owning a pet may be a response to feeling lonely for women, but not for men. Another longitudinal study of 4,465 participants in waves two, three and six of ELSA, found that loneliness may be a self-fulfilling prophecy for those holding negative attitudes towards loneliness in older age (Pikhartova et al., 2016). An increased likelihood of loneliness at wave six was seen for those who, at baseline, held a negative stereotype of loneliness in older age (OR=2.32, 95% CI 1.80 to 2.97), and those who had expectations of becoming lonely (OR=2.83, 95% CI 2.24 to 3.57), in regression models adjusted for sociodemographic, physical and mental health variables.

The longitudinal studies using ELSA data provide robust findings regarding predictors of different loneliness patterns over time. However, as with all the longitudinal ELSA studies, the baseline population consisted of many adults below age 60. While the 3-item UCLA loneliness scale used in ELSA limits the comparison of loneliness prevalence across other studies, its benefit is that the score between 3 and 9 provides a more sensitive variable for studies aiming to identify factors associated with loneliness, than the direct loneliness question which provides only three categories (almost never, sometimes, frequently/always).

Data available on rurally-living older adults in the UK

The longitudinal studies using data from ELSA and the Omnibus dataset constitute the best evidence so far on predictors of SI and loneliness in the general population of older adults in the UK. However, the extent to which the findings apply to rurally-living older people, especially those over the age of 65, is not known. The most relevant evidence available regarding the longitudinal predictors of SI and loneliness in rurally-living older people comes from the Bangor Longitudinal Study of Ageing (BLSA), which followed 534 adults aged 65 years and over for 20 years, culminating with a study of 47 survivors (of 65 survivors) in 1999, aged 85 to 102 (Wenger & Burholt, 2004). While many important insights can be gained from this study, the findings may not be generalisable to non-Welsh, rurally-living older adults, who may differ on a cultural and historical level, or apply to more recent socio-economic and political circumstances. Another limitation is the small sample size of the final follow-up sample in terms of statistical analysis of loneliness and SI trends and risk of selection bias of the healthiest participants.

A cross-sectional study, from which an understanding about the predictors of SI and loneliness in rurally-living older adults may be gleaned, is that regarding social network types and comparisons between rural areas in North Wales and the urban city of Liverpool (using a different dataset from the BLSA) (Wenger, 1995). However, this study did not measure SI and loneliness directly and is limited by its cross-sectional nature. Another cross-sectional analysis of the first wave of the Irish Longitudinal Study of

Ageing (TILDA) dataset (6,613 adults aged 50 and over), which assessed predictors of loneliness, is also available (Burholt & Scharf, 2013). However, this study is also limited by a cross-sectional design, and it may lack generalisability to other countries in the UK.

Predictors of social isolation in rural samples

The qualitative study of interviews with 47 survivors in the prospective 20 year BLSA study, who were living independently aged between 85 and 102 years, found that individuals who were not isolated at any time tended to be indigenous to the area, long-term residents in their communities, involved in farming, married, not living alone or had adult children living nearby (Wenger & Burholt, 2004). Those who became socially isolated over time had become bereaved of their spouse or other relatives and friends, had deteriorating health and impaired mobility, vision or hearing, or were at home for increasingly long periods during the day. Those who were classified as socially isolated, but did not report loneliness, tended to be childless, have self-sufficient personalities, and either had satisfying relationships with relatives or friends, or were lifelong isolates (preferring to be alone throughout their lives) (Wenger & Burholt, 2004).

From the cross-sectional study using surveys and interviews to investigate correlates of social network types, Wenger (1995) concluded that the correlates of social networks were not always comparable between older adults in the urban setting of Liverpool (n=4,763), and the rural setting in North Wales (n=240). Using correlation statistics, male gender was associated with having a private restricted network (a small network, the least socially supportive) in Liverpool, while in the rural setting male gender was associated with having locally-integrated and wider community-focussed networks (least socially isolated). Nevertheless, some correlates of a more socially isolated type of network, such as older age, being single and having no family living close-by were seen in both the urban and rural setting. Having a locally-integrated and family-dependent network (indicative of not being isolated) correlated with having always lived in one's community and also with having family remaining in the area in both urban and rural locations. The prevalence of locally-integrated and family-dependent networks was larger in the urban sample and the urban-living participants showed greater stability

in migration patterns, compared with the rurally-living participants. Wenger (1995) therefore suggested that the rurally-living Welsh sample was at an increased risk of less-supportive social networks due to the tendency of migrating at later ages. While this comparative study gives an important understanding about urban and rural differences in social networks, SI and loneliness were not measured. Therefore, any links between SI and loneliness and the factors found to predict certain network types are unsubstantiated, and these associations are based on correlation tests, not adjusted regression models.

Predictors of loneliness in rural samples

The study of qualitative interviews with 47 survivors in the prospective 20 year BLSA study, who were living independently aged between 85 and 102 years, found that individuals who were not lonely at any time tended to be indigenous to the area, long-term residents in their communities, involved in farming, married, not living alone or had adult children living nearby (Wenger & Burholt, 2004). As with SI, those who became lonely over time had become bereaved of their spouse or other relatives and friends, had deteriorating health and impaired mobility, vision or hearing, or were at home for increasingly long periods during the day. Those who were not socially isolated, but did feel lonely across the measurement points, tended to be widowed, to have moved to a different area upon retirement, to have moved home during the study, to have deteriorations in their health or to have a tendency not to ask for help. Overcoming loneliness, despite being socially isolated, was seen in individuals who had self-sufficient personalities, were life-long isolates (preferred to be alone) and did not have children (Wenger & Burholt, 2004).

A more recent cross-sectional analysis of the first wave of the Irish TILDA dataset (6,613 adults aged 50 and over), of which 47.7% participants were rurally-living, found that a greater number of chronic diseases predicted the incidence of loneliness, in regression-based mediation models adjusted for age, gender and education (Burholt & Scharf, 2013). Living in a rural area predicted lower social participation while it predicted greater social resources (stronger kinships and friendship ties), compared with living in urban

areas. Rurality exacerbated the negative effect of poor health on social resources, and was indirectly associated with the prevalence of loneliness in this study. Thus, the authors concluded that poor health in older age may have a stronger influence on loneliness for those who live in rural, compared with urban areas. This analysis of TILDA is more recent and relevant to loneliness (although not directly measuring SI) in rurally-living older people in the UK than the BLSA or Wenger social network studies. However, this study explored only a limited number of predictors of loneliness (health, social participation and social resources). Additionally, 57.2% of the sample was aged below 65, and therefore, as with the ELSA dataset, the findings are largely applicable to late middle-age, not older age, as defined in this thesis. Finally, the unique cultural, historical and geographical characteristics of Ireland may make the generalisability of findings to the rest of the UK population uncertain.

Summary of rural-based evidence

In summary, few UK-based studies on predictors of SI and loneliness have specifically recruited rurally-living older adults, with the key datasets available, such as the BLSA and Wenger social network studies, now being dated. There are also inconsistencies in the conceptualisation and measurement of SI and loneliness, with the BLSA using criteria for SI and a loneliness question which are not used in other UK-based datasets. Thus, the key gap is in the availability of recent datasets of representative samples of rurally-living older adults from which the prevalence and predictors of loneliness and SI may be explored. Cross-sectional evidence from 1,868 adults (aged 72 to 104) in Canada shows that the predictors of SI are widely different for older people living in rural and urban areas (Havens et al., 2004). Thus, predictors of SI or loneliness may also differ between urban/nationally-representative and rural older populations in the UK. It is important to understand which demographic, personal, social and environmental characteristics may predispose rurally-living older adults in the UK to SI and/or loneliness. Such knowledge could help design interventions and policies to avoid, or alleviate, SI or loneliness in rural communities, something which is especially important in light of the increasing trend of retirement migration to rural places (Office for National Statistics, 2015).

2.3 Physical activity

This section presents the state of current literature about PA in older age in the UK. It highlights the shortcomings of current research relating to rurally-living older adults and presents the rationale for the focus of this thesis on observing the types and levels of PA in a rurally-living older population in the UK.

2.3.1 Conceptualisation and measurement

Conceptualisation of physical activity

A common definition of PA is any bodily movement initiated by the skeletal muscles that increases energy expenditure (Chodzko-Zajko et al., 2009). As such, it can include both structured PA and exercise as well as any incidental PA which happens during daily life, such as walking around a supermarket. Nevertheless, the notion that PA occurs in structured and planned forms (i.e. planned and often using exercise equipment) has been perpetuated by many studies over the last decade, as shown in the systematic review by Paterson and Warburton (2010) of 34 longitudinal, prospective and cross-sectional studies focussed on PA or exercise programmes with a cognitive function outcome.

Most research using physical activity questionnaires (PAQs) or accelerometer measures, use an energy-based perspective that focusses on activities associated with a high energy expenditure, such as sports or leisure-time PA, while light intensity activities, such as household chores, recreational activities, such as hobbies or social activities, are not often considered as important contributors to PA (Eckert & Lange, 2015). Studies using accelerometer measurements have often focussed on moderate-to-vigorous PA in older populations (McMurdo et al., 2012; Simmonds et al., 2014; Tsai et al., 2015), as this is widely recommended for health benefits across the lifespan (Department of Health, 2011). However, light-intensity physical activities make up the majority of daily activity for older adults and may prove a safer and more realistic option for PA promotion in older age (Jansen et al., 2015; Sparling, Howard, Dunstan, & Owen, 2015). As health benefits of PA occur in a dose-response manner, the most benefit is seen when the least active individuals increase activity levels, even if they do not meet UK

government's PA guidelines of 30 minutes of moderate-to-vigorous PA in bouts of 10 minutes or more on 5 days a week (de Souto Barreto, 2015; Powell, Paluch, & Blair, 2011).

When accelerometer data is compared with PA domains in PAQs, this is often regarding broad categories of activities (e.g. 'leisure-time PA', 'work' or 'school-related' activities), not specific to any age or context, based only on the energy-output of such activities (Eckert & Lange, 2015). These generic activities may not capture activities undertaken by older people. Moreover, most PAQs are developed in urban or suburban populations, and may not accurately reflect activities performed in rural settings. For rurally-living older adults, the types of activities possible may vary due to differences in accessible infrastructure or socio-cultural norms when compared with their urban-living counterparts.

As an alternative to the energy-based expenditure, Eckert and Lange (2015) argue that functional, light-intensity PA should be standardised in terms of actual, age-specific activities using a biopsychosocial perspective. The biopsychosocial perspective was initially born out of the need for a medical model that considered the subjective experiences of patients, as well as their physical needs (Borrell-Carrió, Suchman, & Epstein, 2004). For a full description of the biopsychosocial perspective, see Chapter 3, **(Section 3.5, p. 80)**. Using a biopsychosocial perspective, older people's subjective experiences when engaging in different types of PA become important when seeking to promote PA. Specifically, two activities which stimulate the same energy-output may not be equal in their importance if one generates a higher social stimulus, and thus different subjective stimulus, than the other. The traditional measurement techniques to quantify PA, PAQs or accelerometers, must, therefore, incorporate measures of the types of activities and their psychosocial value.

Measurement of physical activity

There are many ways of measuring levels of PA, ranging from inexpensive and easily administered to costly and needing specialist researchers to administer. The simplest

method, used in many observational studies, is using subjective physical activity questionnaires (PAQs) (Strath et al., 2013). For instance the International Physical Activity Questionnaire modified for the elderly (IPAQ-E) (Hurtig-Wennlöf, Hagströmer, & Olsson, 2010) and the Physical Activity in Frail Older People (Hauer et al., 2011) are PAQs used in older adult PA research. These PAQs generally encompass items asking about pre-defined types of PA, such as occupational, domestic, transport and leisure time (Strath et al., 2013). Diary logs of PA, such as the Bouchard Physical Activity Record, have also been used, although mostly to validate other PAQs (Strath et al., 2013). While inexpensive and easy to administer, self-reported PA measurements have several limitations, such as a tendency for people to over-estimate their moderate or vigorous activity levels and underestimate light PA (Bann et al., 2015; Tucker, Welk, & Beyler, 2011). This might be explained by individual variation in interpretations of descriptive words such as 'light', 'moderate' and 'vigorous' in relation to everyday activities and relative to participants own fitness levels (Strath et al., 2013).

More robust ways of measuring levels of PA are through direct, objective measurement. These include laboratory-based techniques of indirect calorimetry and the doubly labelled water method, as well as non-laboratory methods of direct observation of PA by a researcher, heart rate monitoring and motion sensors (Strath et al., 2013). Motion sensors include pedometers or accelerometers. The accelerometer measurement method is reviewed here because it is the objective method used in this thesis. Accelerometers are small devices worn somewhere on the body, usually the hip, ankle or wrist, which measure the speed at which the body moves (Strath et al., 2013). These produce counts of movement per minute which are interpreted by computer software to equate to meaningful outputs such as the minutes of sedentary time or light, moderate, vigorous or very vigorous PA (Matthew, 2005). Various cut-off points/thresholds for categorising levels of PA have been established for different populations, for example, for children and adults (Welk, 2005). The Freedson, Melanson, and Sirard (1998) adult criteria, for instance, can be applied to older adults. However, there is such variation in the literature, regarding cut-off points for different intensities of activities using accelerometer counts, that direct comparison between studies is challenging (Gorman et al., 2013; Matthew, 2005; Welk, 2005).

2.3.2 Levels of physical activity

Physical activity by older adults in the UK

Current research using objective measures of PA shows that older adults in the UK are, on average, not meeting PA guidelines of 150 weekly minutes of objectively-measured moderate-to-vigorous PA (MVPA) accumulated through 10-minute bouts (Jefferis et al., 2014). A UK nationally-representative health survey of 2,450 men and women aged between 70 and 93 years, found that only 7% of men and 3% of women adhered to these PA guidelines when assessed using accelerometers (Jefferis et al., 2014). Similarly, another study of 238 population-representative older adults (65 years and above) in the UK using objective measurements of PA, reported that only 2.5% achieved the PA guidelines (Harris, Owen, Victor, Adams, & Cook, 2009). In this study, 89.5% of time was spent in sedentary behaviour (including sleeping), 8.1% in light PA, 1.8% in moderate PA and 0.6% in vigorous PA. From this data, the amount of any intensity of PA by older adults seems extremely low and warrants the research into ways to increase daily PA in older age.

Low estimates of PA may, in part, be due to the PA guideline's stipulation that MVPA needs to be accumulated in bouts of 10 minutes or more, as more minutes of MVPA can be accumulated in shorter bouts (Jefferis et al., 2014). For instance, in the study of 230 randomly-selected older adults from a large city in the South West of England, 150 minutes/week of MVPA (of any bout duration) was achieved by 50.6% of 70 to 74.9 year-olds, by 31.7% of 75 to 79.9 year-olds, by 13.5% of 80 to 84.9 year-olds, and by 7.1% by those aged 85 and above (Davis et al., 2011b). Using self-reported measures of MVPA the picture for older adult PA appears higher, although this is inevitably compromised by recall inaccuracies. Analysing data from 3,454 adults (aged 52 and above at baseline) across waves one to five (a mean follow- up of four years) of the nationally-representative ELSA dataset, showed that 8.9% remained inactive, 11.9% became inactive, 9% became active and 70.1% were active both baseline and follow-up (self-reported MVPA at least once a week) (Hamer, Lavoie, & Bacon, 2013). Thus, 79.1% reported either starting or continuing MVPA once a week. However, another analysis of 5,022 ELSA participants between wave one through to wave six (mean age 61 years at

baseline) found that there was an overall trend of increasing levels of inactivity and decreasing vigorous PA over a mean of 10 years (Smith, Gardner, Fisher, & Hamer, 2015). These trends are, however, limited by the use of a self-reported measure of low-, moderate- or vigorous-intensity PA in ELSA, which may overestimate the quantity and intensity of PA (Colbert, Matthews, Havighurst, Kim, & Schoeller, 2011).

Rural-urban differences in physical activity levels

Large quantitative studies of rural-urban differences in PA in older age are currently available for mainland Europe (Van Cauwenberg et al., 2012), the US (Hannon, Sawyer, & Allman, 2012; P. D. Patterson, Moore, Probst, & Shinogle, 2004) and Australia (Moore, Warburton, O'Halloran, Shields, & Kingsley, 2016), and these show that the rural effect on PA in older age may differ widely between countries. In a representative sample of 48,879 older adults (65 years and above) in Belgium, urban respondents were more likely to walk for transport than their rural counterparts (Van Cauwenberg et al., 2012). In contrast, in an Australian sample of 3,888 middle-aged adults (aged 55 to 65), rurally-living respondents reported more total PA than those in urban areas, although rurally-living respondents did report less leisure-time and transport-related PA (Cleland et al., 2015). Different again from the above findings, in a sample of 1,000 older adults (mean age ranging between 74.5 (SD 6.1) and 75.8 (SD 7.0) years between groups), in both white and African American respondents there were no significant differences between the self-reported leisure-time PA between rural and urban areas of the US (Hannon et al., 2012). All these studies used self-reported PA and are therefore a representation of differences in perceived PA between rural and urban-living older people, and not necessarily objective differences in levels of PA. Despite this, they indicate that rural-urban differences in older adult PA are likely specific to the country, culture and geography in which they are studied.

Physical activity by rurally-living older adults in the UK

It is currently unknown whether living in rural areas in the UK, compared with living in urban areas, presents an advantage or a disadvantage in the attainment of healthy PA levels for adults aged 65 and above. There are no UK-based urban-rural comparison

studies of PA, or directly comparable urban and rural datasets of PA in this age range (Sun, Norman, & While, 2013). One of the few large datasets available on rurally-living people in England is that of the Devon Active Village intervention with 2,515 adults aged between 18 and 102 (Solomon, Rees, Ukoumunne, Metcalf, & Hillsdon, 2013). This study found that 66.9% of this sample met the PA recommendations of 150 minutes of MVPA per week, but did not report the proportions meeting the recommendation in different age groups. As 34.5% of this sample was aged 65 or above, equating to 868 older adults, this presents the most recent dataset relevant to older adults in rural areas of the UK. However, this study also used a self-reported PA measure, the International Physical Activity Questionnaire (IPAQ) which, although widely recognised, cannot be compared directly to the objective data from urban samples such as that from the OPAL study (Davis et al., 2011b).

Potential rural facilitators of physical activity

There is a range of quantitative and qualitative studies providing reasons to suggest that rural areas could enhance, as well as decrease, opportunities for PA in older age. A telephone survey of 360,323 adults aged 18 and over (of whom 20% were aged 65 and over), found that self-reported overall PA, and especially the amount of walking, was higher in rural than urban local authority districts in the UK (Rind & Jones, 2011). The authors discussed that this urban-rural difference may relate to a supportive environment for recreational walking in rural areas, such as pleasant green walking areas. Indeed, a mixed-methods study of 72 people (women aged 60 and above, men aged 65 and above) living within three small rural villages in the Midlands of England found that 38% of participants praised their area for its peace and quiet and 35% for the attractive countryside, both of which were mentioned in respect to being happy to live in the area. Such a study is limited, however, by its geographical confinement to one area in the UK. Even so, a systematic narrative evidence synthesis of 33 studies of all-age adults on perceived mental and general health, and seven studies on all-cause mortality, concluded that the availability of more green space may improve mental health and reduce the risk of mortality (van den Berg et al., 2015). One possible

mechanism explaining these benefits might be a higher level of PA, although UK data for older people are currently unavailable.

Potential rural barriers to physical activity

Evidence also exists suggesting that rural areas in the UK may be less conducive to PA in older age than urban areas. An investigation of 2,041 older adults (aged 65 and over) in the UK found that respondents living in urban Nottingham reported walking significantly more than their counterparts in rural Cambridgeshire (Morgan, Armstrong, Huppert, Brayne, & Solomou, 2000). Nevertheless, this study is now dated and is limited by the use of a self-reported PA measure. Even so, it has been argued that rural areas, especially those which are most remote, are less well served than towns or cities regarding public transport, public facility maintenance (e.g. roads and pavements), affordable places to shop, social care services, luncheon clubs and day care facilities (Age UK, 2013; Le Mesurier, 2003).

The PA gained through getting out and about for social reasons may be limited in rural areas due to transport availability issues. The availability of transport was a key issue raised by older adults living in small rural villages in Scotland and England in three independent qualitative studies (King & Farmer, 2009; Manthorpe et al., 2008; Manthorpe et al., 2004). In a qualitative study of 72 people (women aged 60 and over, men aged 65 and over) in three small rural villages in the English East Midlands, the only prevalent problem or dislike about their villages was the lack of transport, which led to fear of isolation when they had to give up driving (Manthorpe et al., 2004). Access to transport was also found to be a key determinant of engaging in social activities in survey data from 920 adults aged 60 and above living in rural areas in South Wales and South West England (Shergold & Parkhurst, 2012). A study using the Physical Activity Cohort Scotland (PACS) dataset of 547 randomly-selected older adults (mean age 78.5 years), stratified across rural and urban areas of Scotland, found that the negative effect of low mean daily temperature and shortened day length was stronger for rurally-living participants than for urban-living participants (Witham et al., 2014). Thus, it could be that some characteristics of the rural environment, or the nature of types of PA activities

in this context, make it more difficult for older adults to sustain their activity in adverse weather conditions.

Other evidence suggests that the levels of types of PA may show different rural-urban trends. A nationally-representative study of the UK population, using Health Survey for England data of 31,409 adults aged between 26 and 58 years (collected between 2002 and 2004), found an association between available green space and self-reported MVPA (Mytton, Townsend, Rutter, & Foster, 2012). Living in the greenest quintile (compared with the least green quintile) of local authority districts gave a higher likelihood (OR=1.24, 95% CI 1.12 to 1.38) of achieving 30 minutes of MVPA on five days in the week, in regression models adjusted for socio-demographic factors, car access and access to local facilities (Mytton et al., 2012). Conversely, those living in the greenest areas had lowest levels of self-reported walking (when using a lower-cut off value to amount of PA), in adjusted regression models. However, this study is relevant to the younger adult population, and may not extend to rurally-living older adults, and it is also limited by the use of self-reported measure of MVPA and types of PA.

Gaps in the rural literature on physical activity

A clear gap in the literature is the availability of any objectively-measured PA data concerning a representative sample of rurally-living older adults in the UK. From a range of qualitative and quantitative, studies using samples which are mostly not representative of adults aged 65 years and above, there are reasons to suggest that rural areas may pose both challenges and advantages to remaining physically active in older age. Understanding the PA patterns in the rurally-living older population will help determine whether additional support is needed to provide/sustain opportunities for, and help overcome barriers to, engaging in PA in rural areas of the UK. This is especially important given the increasing trend of rural migration by both middle-aged and older adults retiring to the countryside (Office for National Statistics, 2015).

2.3.3 Types of physical activity

Moderate-to-vigorous physical activity

There are many longitudinal and cross-sectional observational studies showing that different intensities of PA, such as light PA (LPA) or moderate-to-vigorous PA (MVPA), are associated with health benefits in older age. Higher levels of objectively-measured MVPA by 213 adults (aged 70 and above) at baseline predicted fewer medical prescriptions (Simmonds et al., 2014) and newly diagnosed diseases fours year later in the UK-based Older People and Active Living (OPAL) study (Fox et al., 2014). Higher levels of objectively-measured MVPA were also linked to a lower incidence of cardiovascular risk factors in a cross-sectional study of 446 adults from the UK-based Whitehall II dataset (mean age of 66, SD 6 years) (Hamer, Venuraju, Urbanova, Lahiri, & Steptoe, 2012). In an eight-year follow-up of 3,454 adults (aged 52 and above) in the ELSA dataset, reporting the engagement in MVPA once a week during wave one was associated with a better overall composite score of 'healthy ageing' in wave seven, in regression models adjusted for sociodemographic variables and health risk behaviours (Hamer et al., 2013).

Overall, there is consistent evidence that engaging in MVPA is associated with both preventative and therapeutic physical health benefits in older age, as concluded from a review of experimental trials for an American College of Sports Medicine evidence statement by Chodzko-Zajko et al. (2009). A more recent meta-analysis of nine prospective cohort studies, including 122,417 participants aged 60 years and above (mean age 72.9 years, SD 4.5), found that even low doses of MVPA, which did not meet the PA recommendations, related to a reduced risk of mortality (relative risk ratio=0.78, 95% CI 0.71 to 0.87) over a mean follow-up period of 9.8 years (SD 2.7) (Hupin et al., 2015).

Light physical activity

Although PA guidelines for older adults focus on MVPA, evidence from mostly cross-sectional observational studies shows that attaining more minutes of light intensity PA (LPA) may also be beneficial to older adults' health (Sparling et al., 2015). More minutes

of accelerometer-measured LPA were associated with better self-reported physical health and wellbeing in a cross-sectional study of 765 adults aged 66 years or older in the US, in regression models adjusted for socio-demographic factors, health-risk behaviours and neighbourhood walkability (Buman et al., 2010). In an American dataset of 1,130 adults (aged 70 to 89) selected for having low mobility scores, more objectively-measured LPA and less sedentary time were associated with a lower Body Mass Index (BMI), in regression models adjusted for sociodemographic, health-risk behaviours and health-related variables (Bann et al., 2015). Engaging in more objectively-measured LPA was also associated with reduced risk of losing physical independence in a cross-sectional study of 371 Portuguese adults aged between 65 and 103 years, adjusted regression models (Marques et al., 2014).

However, the studies by Buman et al. (2010), Bann et al. (2015) and Marques et al. (2014) are limited by a cross-sectional design, and thus it could be that those with a lower BMI, or higher physical health or physical function, engage in more LPA. Studies using self-reported PA also show this association. Self-reported LPA was associated with lower fat mass in a sample of 1,162 adults in England (age 60 to 65), in adjusted regression models (Bann et al., 2014) and with a reduced risk of all-cause mortality over a 7.8-year follow-up of 10,426 adults (aged 52 and above at baseline) in the ELSA data, adjusting for important confounders (Hamer, de Oliveira, & Demakakos, 2014a). However, self-reported measures of leisure-time PA are limited in the ability to measure levels of LPA, as this may also be gained during non-sport and non-leisure activities (Eckert & Lange, 2015).

Total physical activity

Total PA (TPA), a measure of all PA engaged in regardless of intensity, has also been linked with positive health outcomes in longitudinal and cross-sectional studies with older adults. A longitudinal study of 716 older adults (mean age 82, SD 7 years) found that greater amounts of TPA measured through accelerometers predicted a reduced risk of developing Alzheimer's disease four years later, in adjusted regression models (Buchman et al., 2012). Simmonds et al. (2014) found that a higher baseline step count

(a measure of TPA) of 213 older adults (aged 70 and above) predicted reporting fewer hospital admissions four years later, in regression models controlling for important confounders. In a cross-sectional analysis of 1,253 older adults (aged 65 years and above) living in Germany, total walking duration, measured objectively, was also related to healthier levels of an array of cardiovascular biomarkers, in adjusted regression models (Klenk et al., 2013). In a longitudinal analysis of 584 older Americans (mean age 82, SD 7 years), a small amount of extra PA each day (10 accelerometer counts/day) at baseline led to a lower risk of disability (Hazard Ratio=0.75, 95% CI 0.66 to 0.84) 3.4 years later (Shah, Buchman, Leurgans, Boyle, & Bennett, 2012). Each of these studies provides consistent evidence of the association between TPA and health outcomes in older age, as they use longitudinal designs, objective measures of PA, and regression models controlling for important demographic and health confounding variables.

Broadening the view of physical activity

The inclusion of LPA and TPA in the dialogue about health-enhancing PA behaviour by older adults constitutes a conceptual shift in research about PA and exercise to one which could include other important aspects of everyday pursuits, such as focusing on activities which, as their primary objective, concern social interaction but provide LPA and TPA as a side benefit. Boudiny (2013) argues that, rather than focussing only on activities such as exercise or sport, active ageing needs to be re-defined to include other meaningful activities, such as productive and social activities, in which the oldest and health-impaired adults can also partake. The study of LPA and TPA aligns with this view, as it suggests that socially-orientated activities which may contribute to levels of LPA or TPA, could be associated with attaining healthy levels of PA for older adults. After reviewing the international literature on PA benefits in older age, Sparling et al. (2015) concluded that increasing LPA may prove more realistic than focussing on increasing MVPA, as it has lower motivational barriers and less potential for injury for more frail older adults. They suggest that first achieving more LPA may assist older adults in gaining the ability and confidence to subsequently engage in higher intensities of PA.

Everyday pursuits by older adults

To know how to encourage older people to engage in more LPA and TPA (as well as MVPA), one needs to understand which everyday pursuits contribute to incidental PA in older people's lives. However, most research on PA by older people has used self-reported questionnaire items on PA intensity, or self-reported types of leisure-time PA, or has used accelerometer-measured minutes of PA of different intensities. Such studies have not observed the every-day, non-sport and non-leisure related sources of the measured PA. For instance, the study using waves one and five of ELSA (Hamer et al., 2013), and the study using waves one through to six of ELSA (Smith et al., 2015) reported the total self-reported minutes of moderate PA or MVPA through leisure or occupational activity, but not the activity gained, for example, from shopping or socialising (Hamer et al., 2013). Equally, the population-representative study of 238 older people (aged 65 and above) in the UK reported a mean daily step-count of 6,443 (95% CI 6032 to 6853), but not which activities led to accumulating steps (Harris et al., 2009). It is necessary to look more closely and observe which every-day activities contribute to these levels of PA in order to inform effective lifestyle interventions.

There is some evidence regarding the activities which contribute to daily PA accumulated by urban-dwelling older people in the UK. A cross-sectional study of 225 older adults over age 60 living in two London Boroughs found that self-reported heavy house-work and heavy gardening (measured using the self-reported Physical Activity Scale for the Elderly: PASE) were strongly associated with meeting PA guidelines, while light house-work and light gardening, walking outside for any reason and the number of flights of stairs climbed weekly was associated with being physically active at recommended levels (Persson & While, 2012). Persson and While's (2012) study was limited by using self-reported PA and a non-probability sample of adults attending social groups. In contrast, the OPAL study of 214 randomly-selected urban-living people (aged 70 and above) was the first to measure PA both objectively (through accelerometry) and by using detailed daily activity logs completed over seven days (Davis et al., 2011a; Davis et al., 2011b). They found that most trips out of the house were made for shopping, followed by social visits, trips for entertainment and trips for personal reasons, and that

making more trips out of the house (for any reason) was associated with higher levels of objectively-measured step counts and levels of MVPA and with better physical function in regression models adjusted for important confounders (Davis et al., 2011a). However, they did not analyse whether trips for specific reasons were associated differently with objectively-measured PA.

Everyday pursuits by rurally-living older adults

There is currently no published evidence on the reasons for getting out and about for rurally-living older people in the UK, comparable to the OPAL study of the reasons for trips outside the house which lead to PA in an urban context (Davis et al., 2011a; Davis et al., 2011b) (reviewed above). The PA data collection methods used by Davis et al. (2011a) were replicated in the Physical Activity Cohort Scotland (PACS) sample of 547 older adults (65 to 80 years) living across rural, suburban and urban areas of Scotland (McMurdo et al., 2012), although no analysis of data on types of trips in this context has been published. A study using this dataset did find that owning a dog was positively associated with higher levels of objectively-measured PA, even after controlling for motivational and health-related factors (Feng et al., 2014). The published studies of older adult PA in rural areas originate from Australia (Moore et al., 2016) or the US (Olsen, 2013). However, the degree to which evidence from rural American and Australian communities can be generalised to the UK is questionable due to demographic, geographical, and cultural differences between these countries. Thus, it is important to generate country-specific knowledge about older adult PA. Van Dyck et al. (2013) illustrates this in their findings of very different environmental predictors of leisure-time PA by older adults between Europe, Australia and the US.

Given that there is generally limited access to facilities such as shops, cafés, leisure centres (Age UK, 2013; Le Mesurier, 2003; Milbourne & Doheny, 2012; O'Shea et al., 2012; Shergold & Parkhurst, 2012; Wiltshire Council, 2013) and unreliable or infrequent public transport in rural areas (King & Farmer, 2009; Manthorpe et al., 2008; Manthorpe et al., 2004), rurally-living older people may engage in different activities from urban-living older adults. In the absence of quantitative comparative evidence, a qualitative

comparison between 15 urban and 13 rurally-living older people (aged 65 and above) observed that rurally-living participants mainly made trips outside their homes for productive or social reasons, while for urban-living older adults, leisure-time PA and leisure shopping were key reasons for getting out and about (de Koning et al., 2015). This study also observed that, as well as a lower availability of amenities and facilities such as shops and leisure centres, the rurally-living older people did not desire such facilities to become available. This study, however, relied on small participant numbers and retrospective, subjective accounts of getting out and about.

Summary of gaps in the literature

A gap in the literature is the observation of naturally-occurring reasons for everyday LPA, MVPA and TPA in a representative sample of rurally-living older adults in the UK, using a combination of objective PA measurement (e.g. accelerometry) and activity diaries comparable to the methods used in the OPAL study (Davis et al., 2011a). It is currently not known whether the same types of everyday activities which lead to attainment of PA in urban contexts would be participated in by rurally-living older adults. The Devon Active Villages step-wedge PA intervention, which delivered 12 weeks of activities in 128 villages (including 4,693 intervention, 5,719 control participants), did not see a significant change in participants reaching the PA recommendations (Solomon, Rees, Ukoumunne, Metcalf, & Hillsdon, 2014). This may have been attributable to a focus on sports and fitness activities, which only engaged 4% of participants. A focus on naturally occurring PA in a rural setting may engage more individuals and may be a more fruitful intervention approach in future. Thus, knowing more about the naturally-occurring PA habits of rurally-living older adults in the UK could help in designing realistic and effective interventions to sustain or increase PA by this population.

2.4 Associations between social isolation, loneliness and physical activity

This section presents and critiques the literature evaluating whether SI or loneliness are associated with low levels of PA in older adults. A significant gap in this literature is exposed, and the purpose of this thesis is discussed.

2.4.1 Social isolation and physical activity

An association between SI and low levels of PA has face validity, given that getting out and about less often may relate to both seeing fewer people and decreasing PA. However, there is little robust evidence of this association in older adults. The only study identified in this review which tested an association between SI and PA levels in older people is a cross-sectional analysis of 8,688 adults (aged 52 and above) in wave two of ELSA (Shankar et al., 2011). This study found an association between SI and engaging in leisure and occupational PA once a week or less, in a regression model adjusting for important socio-demographic and health-related confounders. However, this study utilised a composite SI variable that included measures of social participation, and thereby widened the concept beyond that of an objective rating of social contact frequency. For instance, individuals can receive frequent social contact from family, friends and neighbours, without being socially engaged in groups and, *vice versa*, individuals can be socially engaged in a group once a month, but not see family, friends or neighbours on a weekly basis. Another important limitation of this data is its use of a self-reported measure of occupational or leisure PA. This suffers both from recall bias and an inability to measure incidental PA from every-day, non-leisure and non-occupational pursuits (Eckert & Lange, 2015).

2.4.2 Loneliness and physical activity

An association between loneliness and low levels of PA also has face validity which can be construed in several ways: a low mood due to loneliness may relate to getting out and about less often and therefore to lower levels of PA; or having fewer social reasons

to get out and about may relate to both loneliness and a low level of PA. There are several longitudinal and cross-sectional studies testing the association between loneliness and PA in older adults, although these mainly rely on self-reported PA measures. A narrative systematic review of 37 cross-sectional, longitudinal and intervention studies assessing the association between loneliness and PA reported a wide range of findings, from a negative relationship between loneliness and PA to a non-existent relationship (Pels & Kleinert, 2016). This review, however, included studies of all ages, from children and teenagers to older adults, and included just two studies using objective measures of PA. The studies which had an older adult sample and used self-rated PA measures found significant relationships between loneliness and low PA (Hawkley et al., 2009; Netz, Goldsmith, Shimony, Arnon, & Zeev, 2013; Shankar et al., 2011), while those using objective PA measures did not (Harris et al., 2009; Newall, Chipperfield, Bailis, & Stewart, 2013). The longitudinal analysis of 229 adults aged between 50 and 68 found that baseline loneliness predicted lower self-reported PA after three years, in adjusted regression models (Hawkley et al., 2009). Similarly, the cross-sectional analysis of 8,688 adults (aged 52 and above) from wave two in ELSA also found that low self-reported leisure or occupational PA was associated with a higher R-UCLA score of loneliness in fully-adjusted regression models (Shankar et al., 2011). Another cross-sectional study of a sample of 1,663 older adults in Israel also reported an association between self-reported PA and loneliness, but only in women, once adjusted for confounding variables (Netz et al., 2013). While this evidence base seems convincing, its key limitation is the use of self-reported PA.

2.4.3 Gaps in the literature

Gaps in the literature about older adults

Only two studies to date have explored the relationship between accelerometer-measured PA and loneliness in adults aged 65 and over. These found that loneliness was not associated with a lower level of objectively-measured PA in 228 older adults in Canada (Newall et al., 2013), nor in 238 older adults in the UK (Harris et al., 2009). However, Newall et al. (2013) only collected 24 hours of accelerometer data, which may not have been sufficient to overcome the 'white-coat effect' which being monitored can

have on participants, as accelerometer measurements are usually worn for seven days (Fox et al., 2011; McMurdo et al., 2012). Harris et al. (2009) assessed total step-count, not how different intensities of PA may be associated with loneliness. Both studies used a small sample size and are cross-sectional, meaning that they cannot explain any causal (or lack of causal) pathway between PA and loneliness. Therefore, these null results need to be further investigated.

Since the publication of the review by Pels and Kleinert (2016), a prospective 6.5 year follow-up study of 466,901 adults between 40 and 69 years (mean age 56.5 years, SD 8.1) found that controlling for health-behaviours (a grouped variable of self-reported smoking, alcohol intake and moderate or vigorous PA) explained 34% of the effect of SI on all-cause mortality, and 41% of the effect of loneliness on all-cause mortality (Elovainio et al., 2017). While Elovainio et al. (2017) reported that alcohol intake and smoking were independently associated with loneliness and SI, the authors did not report any data on an association between PA and loneliness, or between PA and SI. As with most available observational evidence, this study was limited by its use of self-reported MVPA, and is more relevant to middle-aged adults, than adults aged 65 and above. Overall, there is insufficient observational evidence to conclude that SI or loneliness are associated with objectively-measured levels of PA (not perceived levels of PA) in older adults. There is also no research that has used both objective PA measurement methods and has described the specific every-day sources of low PA, MVPA and total PA, and has then gone on to test their relationships to loneliness and SI in older people.

Gaps in the literature about rurally-living older adults

As there is a general paucity of PA-related research for older adults living in rural UK (Solomon et al., 2013), there is also a gap in analyses exploring whether SI and loneliness are associated with objectively-measured PA in this population. The studies which have investigated an association between SI or loneliness and low PA levels were based on nationally-representative English samples (Harris et al., 2009; Shankar et al., 2011), American samples (Hawkley et al., 2009; Patterson & Veenstra, 2010), a Canadian

sample (Newall et al., 2013) and an Israeli sample (Netz et al., 2013). The UK-based study which comes closest to evaluating a relationship between SI, loneliness and PA is that of the Devon Active Villages PA intervention in which a sample 2,415 adults aged 18 and over (mean age 58, SD 15.2) provided baseline questionnaire data, 34.5% of whom were aged 65 and over (Solomon et al., 2013). A cross-sectional analysis of the baseline data found that favourable PA social norms (measured through the items: my family is interested in physical activity/sport; people around my village all seem to be exercising these days), were significantly related to more self-reported leisure time PA. The analysis of the whole sample, however, is not directly applicable to older adults, and the concepts of SI or loneliness were not directly measured.

Thus, a clear gap in research is a study focussed on rurally-living adults aged 65 years and above which includes recognised measures on SI and loneliness, and uses the objective measures of LPA, MVPA and TPA, as well as incorporating descriptive measures of everyday sources of PA, as done in the OPAL study (Davis et al., 2011a). From analysing PA predictors in the baseline data of 2,415 participants (aged 18 to 102 years) in the Devon Active Villages community-based PA intervention delivered across 128 villages, Solomon et al. (2013) concluded that there is a need to study PA correlates independently in rurally-living and urban-living older adults. Consequently, there is also a need to evaluate how PA may be independently associated with SI or loneliness in rurally-living and urban-living older people. Understanding more about this association may facilitate the design of interventions focussing on both increasing every-day PA and reducing SI or loneliness for older people in a rural setting.

2.5 Summary

Research into SI, loneliness and PA by older adults living in rural areas of the UK is scarce, despite the high proportion of people aged 65 and over living in rural areas of the UK (Office for National Statistics, 2015), and the prediction of faster growth of this population in rural, compared with urban, areas in the UK (Office for National Statistics, 2016c). Few studies have reported the prevalence and predictors of SI and loneliness in UK-representative rural populations (Burholt & Dobbs, 2012), while cross-sectional

analyses of two independent Irish datasets found that older adults living in rural, compared with urban, areas were more likely to experience loneliness (Drennan et al., 2008; Kamiya et al., 2013) and a longitudinal analysis of ELSA data found older adults to be at increased risk of SI over time (Jivraj et al., 2012). Evidence is even more limited regarding PA levels and types of PA by rurally-living older people in the UK (Sun et al., 2013). There is no rurally-focussed evidence comparable to the objectively-measured PA levels and reasons for trips out of the house observed in the urban sample of the OPAL study (Davis et al., 2011a). Lastly, the observational evidence supporting an association between SI or loneliness and low levels of PA is limited by use of self-reported PA measures, samples unrepresentative of adults aged 65 and above, and the lack of rurally-focussed data (Pels & Kleinert, 2016; Shankar et al., 2011).

To fill these gaps, studies are needed of representative samples of rurally-living older people in the UK which:

1. Provide prevalence estimates of SI and loneliness comparable to available urban data;
2. Explore rural-specific predictors of SI and loneliness;
3. Document objectively-measured PA prevalence as well as detailed observation of types of everyday pursuits that contribute to PA, comparable to available urban data; and
4. Assess whether SI or loneliness are associated with objectively-measured low-intensity PA, MVPA or total PA, or with everyday pursuits that contribute to objective PA levels.

Addressing these outlined gaps in the literature, this thesis will inform the development of interventions for rurally-living older adults which:

1. Aim to prevent/alleviate SI and loneliness;
2. Aim to increase everyday types of PA; and
3. Aim to jointly increase PA and prevent/alleviate SI and loneliness.

Chapter 3. General methodology

3.1 Overview

The research presented within this thesis is interdisciplinary, uses a sequential mixed-methods approach, and is guided by principles of Critical Realism (McEvoy & Richards, 2003). The research aim in this thesis was to explore the association between social isolation (SI) or loneliness and low levels of physical activity (PA), given paucity of available literature regarding SI, loneliness and PA in older rurally-living populations in the UK (Burholt & Dobbs, 2012; Moore, Warburton, O'Halloran, Shields, & Kingsley, 2016; Pels & Kleinert, 2016). The findings are intended to be theory informing and to lead to further research concerning interventions to avoid or alleviate SI and/or loneliness and to support the maintenance of PA in rurally-living older adults in the UK.

3.2 Critical Realism

All components of this thesis were devised, carried out and written with a critical realist's view of the natural and social world and of the generation of knowledge. Critical Realism is a philosophical point of view which combines a realist ontology (theory of being) and a relativist epistemology (theory of knowing) (Isaac, 1990). A realist ontology proposes that a natural and social reality exists and that these are separate from human perceptions (McEvoy & Richards, 2003). This is in contrast to a relativist theory of being which infers that there is not one reality, but multiple realities constructed through each individual's own perspective (Bryman, 2015). Nevertheless, critical realists hold a relativist epistemology (theory of knowing), seeing knowledge held by researchers (or anybody) to be inevitably shaped by a researcher's own opinions, past experiences, conceptual frameworks and belief systems (McEvoy & Richards, 2003). Thus, a critical realist admits that knowledge is fallible, and can never completely represent the truth. The belief of an objective reality allows a critical realist to pursue the discovery of reality through employing rigorous research methods. However, the recognition that knowledge is fallible and will never fully reflect that objective reality, warns the critical

realist to avoid overly confident statements, and to reflect on how one's own belief systems and conceptual frameworks may influence one's work.

There are four main features of Critical Realism: 1. generative mechanisms; 2. the stratified character of the real world; 3. the interplay between social structures and human agency and; 4. a critique of the prevailing social order (Bhaskar, 2008). The first three features are directly relevant to the research questions, theoretical frameworks and theories applied in this thesis. The first feature, generative mechanisms, relates to the primary purpose for a critical realist's scientific inquiry: to obtain knowledge about underlying causal mechanisms. However, a critical realist sees mechanisms as context-dependent (McEvoy & Richards, 2003). In Chapter 4 **(p. 87)** an analysis is presented which explores the predictors of loneliness and types of SI and it is inferred that some predictors may be generative in nature. In Chapter 5 **(p. 113)**, analyses are presented which look at the various potentially generative pathways between reasons for making trips out of the house, PA, SI and loneliness.

The second feature of Critical Realism, the stratified character of the natural and social world, implies that there are several levels of influence on any phenomena or individual, such as environmental influences, social influences and personal influences (McEvoy & Richards, 2003). The third feature recognises that human behaviour is an interplay between social or physical structures (such as societal belief systems or the availability of resources) and human agency (an individual's ability to respond creatively to the circumstances in which they find themselves) (McEvoy & Richards, 2003). These two features combined are compatible with the adapted socioecological model of PA behaviour used in this thesis. The adapted socioecological model posits that PA behaviour is influenced by several interacting domains: personal biological and motivational factors, interpersonal relationships, wider social structures and environmental factors, both currently and throughout the life-course (Bauman et al., 2012). Thus, use of the adapted socioecological model in this thesis adheres to the philosophical underpinnings of Critical Realism.

The relativist epistemology of Critical Realism becomes most notably relevant in the qualitative analysis presented in Chapter 6 **(p. 161)**. Given that qualitative research requires creative input from the researcher when conducting qualitative interviews and interpreting the data (Holloway & Biley, 2011), the results of this qualitative analysis should be seen as an interpretation of reality shaped by the PhD candidate's formal education about, and personal experiences of, the health benefits of exercise and PA as well as her personal experiences with SI and loneliness. As described more fully in Chapter 6, the researcher employed several verification strategies to ensure qualitative rigour during the data collection process (Morse, Barrett, Mayan, Olson, & Spiers, 2002) and during the process of data analysis and representation (Lincoln & Guba, 1985).

3.3 Sequential mixed-methods

Quantitative and qualitative research methods were used sequentially in this thesis, with quantitative methods applied first (Chapters 4 and 5), and qualitative methods applied second in order to further explore and explain the quantitative findings (Chapter 6). While this is one recognised use of mixed-methods, there are several other uses of mixed-methods, differing in whether quantitative and qualitative methodologies are applied concurrently or sequentially, and whether both methodologies are given equal priority or not (Doyle, Brady, & Byrne, 2009). The general mixed-methods design in this thesis was sequential although there were some instances when quantitative and qualitative techniques were mixed within analyses and data presentation. For instance, a qualitative approach was used to organise open responses from activity diaries into quantitative categories of reasons for leaving the house in the quantitative analysis of the SHARP study in Chapter 5 **(Section 5.2.3, p. 121)**. Another instance is the use of the quantitative findings from Chapter 5 in the participant selection process and data presentation in the qualitative SHARP study in Chapter 6 **(Section 6.2.3, p. 169)**.

The use of both quantitative and qualitative methods is a key strength of this body of work, as each methodology has different strengths and weaknesses, and the strengths of one can overcome the weaknesses of the other respective methodology (Johnson & Onwuegbuzie, 2004). For instance, the ability of quantitative methods to find

generalisable mean values and associations in large sample sizes, controlling for important factors, is one of its strengths. However, the unique circumstances of each individual, as well as previously unlooked for and surprising variables cannot be observed using this approach. This is possible when using qualitative methods as variables do not have to be defined a-priori and a more open, flexible and responsive approach the scientific enquiry can be taken (Guba & Lincoln, 2005). However, qualitative methods cannot analyse comparably large samples or generate statistical mean values or associations. As both methods have known weaknesses (as well as strengths), it is important to purposefully use quantitative and qualitative methods to maximise their strengths, so as not to combine the weaknesses of each method. Thus, the studies in this thesis sought to explore prevalence statistics and associations in large sample sizes first, using quantitative regression method, and next, sought to explore the individual variations in experiences of SI or loneliness, using qualitative methods in a smaller sample.

The mixed-methods research paradigm emerged in response to the limitations of purist approaches in both quantitative and qualitative research paradigms (Mertens, Bledsoe, Sullivan, & Wilson, 2010). The mixed-methods field of enquiry is relatively new and, as Doyle et al. (2009) argue, has many advantages, while it is also criticised by researchers with a purist view of methodologies. The main difficulty and criticism, which has been attributed to the use of multiple methods, is the clash of different views of the truth (ontologies) and of how knowledge is gained (epistemologies), as these differ for quantitative and qualitative methodologies (Tashakkori & Creswell, 2007). There have been considerable debates about the conflict in such research paradigms when using mixed-methods (Doyle et al., 2009; Guba & Lincoln, 1988). Due to the differences in ontology and epistemology, some have argued that qualitative and quantitative methodologies are incompatible (Sandelowski, 2000), but others believe that showing methodological flexibility and using both quantitative and qualitative methods allows researchers to bridge the shortcomings of each methodology with the strengths of the other (Johnson & Onwuegbuzie, 2004).

To allow the use of quantitative and qualitative methodologies in conjunction, researchers have to hold a suitably flexible view of the world and view of how one attains knowledge. The view that is most accepting of this mix of methods is pragmatism as, with a pragmatic view, one finds the research outcome more important than the means used to gain the outcome. This, therefore, allows the mixing and matching of the most appropriate methods in order to answer a stated research question (Hanson, Creswell, Clark, Petska, & Creswell, 2005; Morgan, 2007). Such pragmatism is also aligned with the Critical Realists view taken in this thesis. The Critical Realism perspective assumes that the natural and social worlds are logically compatible and function as multi-layered, interacting systems (McEvoy & Richards, 2003). Thus, with the natural world often observed through a quantitative lens, and the social world often observed with a qualitative lens, this philosophy supports the choice of a mixed-methods approach.

There are many benefits of using a mixed-methods approach (Bryman, 2006; Creswell & Clark, 2007; Creswell, Gutmann, & Hanson, 2003). Following the results gathered using one method with additional enquiry using another method can help to elucidate different explanations of why the first result was gained. For instance, surprising quantitative results in Chapter 5 were further explored qualitatively in Chapter 6, to expose the individual variation in observed SI, loneliness and PA in such a way that a quantitative analysis could not achieve. Triangulation between quantitative and qualitative findings can also help to reach a state of data completeness in which a more comprehensive picture of a phenomenon is observed (Doyle et al., 2009). This was done in Chapter 6, in which objectively-measured PA and questionnaire-measured ratings of SI and loneliness could be compared with participants' reports of PA, SI and loneliness in the qualitative interviews **(Section 6.2.7, p. 173)**. Another benefit of using mixed-methods is the ability to answer different research questions which cannot be answered by single-methods alone (Bryman, 2006). This is especially so with regard to answering interdisciplinary research questions, such as the ones posed in this thesis (Newman, Ridenour, Newman, & DeMarco, 2003).

The sequential mixed-methods design was chosen for this thesis because the PhD candidate perceives both quantitative and qualitative methodologies to bring different, although equally important, perspectives on the topics of SI, loneliness, PA and rural living in older age. Quantitative methods have provided invaluable objective estimations of PA levels in large samples of older adults, making possible the visualisation of mean levels of PA and the possible personal, social or environmental predictors of PA (Bauman et al., 2012; Davis et al., 2011a; McMurdo et al., 2012). Qualitative studies have also added insights into the subjective meaning of PA in older people's lives (Aronson & Oman, 2004; Leavy & Åberg, 2010) and the importance of perceived personal, social and environmental factors with regard to PA behaviour (Franco et al., 2015).

Knowledge has also been gained about SI and loneliness through a variety of methods. Through the large-scale application of questionnaires it has been possible to document the prevalence and changes in loneliness of older people across several years of measurement, and to uncover some likely predictors of such changes (Victor & Bowling, 2012) and health consequences (Holt-Lunstad, Smith, Baker, Harris, & Stephenson, 2015; Holt-Lunstad, Smith, & Layton, 2010). However, as loneliness is a subjective experience, qualitative analyses have also shed light on the complexity and individually-different triggers of loneliness (Goll, Charlesworth, Scior, & Stott, 2015; Sullivan, Victor, Thomas, Poland, & Milne, 2016). Thus, by using both quantitative and qualitative methods, a more detailed picture of SI, loneliness and PA in rurally-living older adults is presented in this thesis (Phoenix & Grant, 2009).

3.4 Interdisciplinary approach

Interdisciplinary research is defined as “any study or group of studies undertaken by scholars from two or more distinct scientific disciplines. The research is based upon a conceptual model that links or integrates theoretical frameworks from those disciplines, uses study design and methodology that is not limited to any one field, and requires the use of perspectives and skills of the involved disciplines throughout multiple phases of the research process” (Aboelela et al., 2007, p. 341). An interdisciplinary perspective is appropriate for addressing the research aim of this thesis because, in practice, factors

relevant to health and wellbeing in older age do not occur in disciplinary specific areas, but are interconnected (Riva, Marsan, & Grassi, 2014). For instance, psycho-sociological issues such as relationships are connected to physical health, i.e. mortality (Holt-Lunstad et al., 2015) and the engagement in PA is closely related to motivating and supportive social relationships (Franco et al., 2015). Therefore, the gathering of knowledge that can inform suitable and effective interventions aiming to support continued health and wellbeing in older age requires an interdisciplinary perspective, as it is a complex area of interest (Life-Long Health & Wellbeing, 2010; Rimer & Abrams, 2012; Rossini & Marra, 2014). This view resounds with that held by the UK Council for Lifelong Health and Wellbeing Programme which encourages a pluralistic approach to research about health and wellbeing in older age, rather than remaining in individual research silos (Life-long Health & Wellbeing, 2010).

Interdisciplinary research is well-suited to being applied to health-related and sociological research questions. In a systematic review of definitions of interdisciplinary methods, the field of health care or health sciences was found to be that in which most research using interdisciplinary methods was published (38.1% of research identified), followed closely by the social sciences (33.3%) (Aboelela et al., 2007). More specifically, interdisciplinary research has been recognised to be crucial in the advancement of scientific inquiry about increasing population levels of PA, as different disciplines share a stake in promoting health and quality of life for the population as a whole (King, Bauman, & Abrams, 2002).

In this thesis it is recognised that observing PA behaviour alone, without a complementary exploration of the social experiences of older adults, will only give a partial view, and may miss important information regarding long-term health and wellbeing. Thus, concepts and methods relating to the Psychology discipline in the Sports and Exercise Sciences, the study of human behaviour in sport and exercise settings (British Association of Sport and Exercise Sciences, 2017), as well as Social Psychology, the study of the manner in which the personality, attitudes, motivations, and behaviour of the individual influence and are influenced by social groups (Merriam-Webster, 2017), are combined in this thesis. The use of two or more disciplines in order

to contribute to the body of knowledge or solve a real-world problem in PA is a recognised branch of the Sports and Exercise sciences (British Association of Sport and Exercise Sciences, 2017). Through using perspectives from the Social Psychology and of Sports and Exercise Sciences to explore the SI, loneliness and PA in rurally-living older people in the UK, this thesis takes a more holistic view of factors which are important for older adults' health and wellbeing, than would be possible when using just one of these disciplines (Aboelela et al., 2007).

3.5 Theoretical perspectives

A biopsychosocial perspective of PA was used in this thesis, recognising that PA behaviour has both physical and psycho-social outcomes (Meisner, Dogra, Logan, Baker, & Weir, 2010). Within this perspective, the adapted socioecological model was adopted, a framework which recognises that past and current personal, social and environmental factors influence PA behaviour (Bauman et al., 2012). This socioecological model is well suited for the use of multiple theories of behaviour within it (Sallis et al., 2006). Therefore, two theories were employed regarding the field of SI and loneliness which fit within the personal domain of the socioecological model (i.e. the cognitive theory of loneliness (Perlman & Peplau, 1981)) and within the social domain of the socioecological model (i.e. the deficit theory of loneliness (Weiss, 1973)) (**Figure 3-1**).

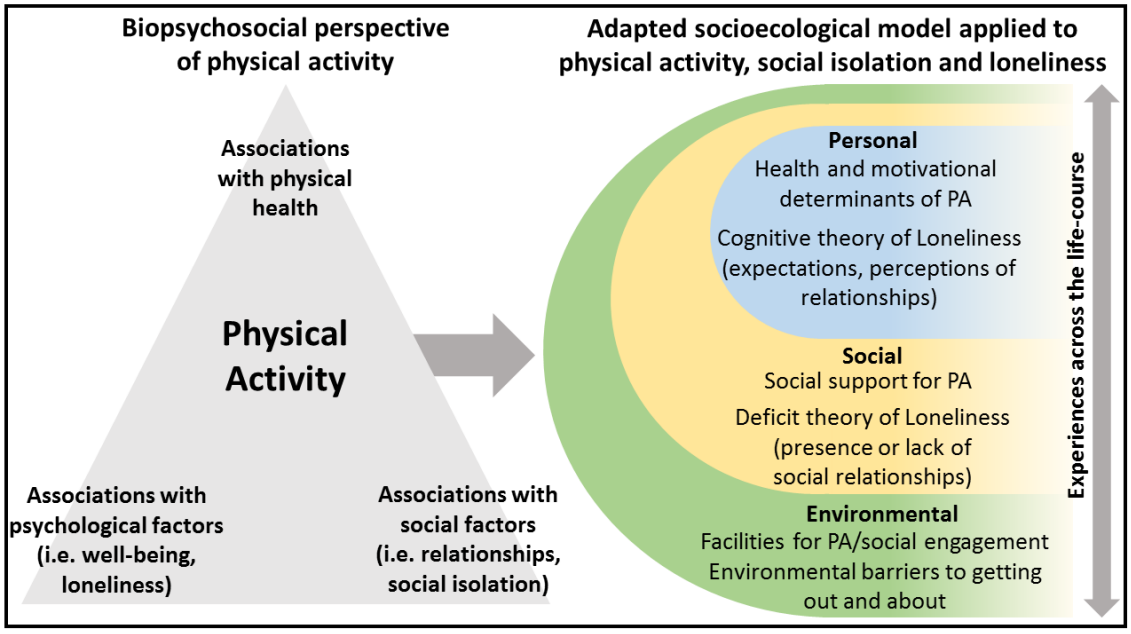

Figure 3-1. Conceptual diagram of theoretical perspective, framework and theories

The following sections provide an overview of the theoretical perspective and framework of PA and theories of loneliness used in this thesis. The broader biopsychosocial perspective is elaborated first, after which the adapted socioecological framework, which sits within in this perspective, is explained, followed by the theories of loneliness which position well within the adapted socioecological framework.

3.5.1 Biopsychosocial perspective of physical activity

A biopsychosocial perspective of PA is taken in this thesis, whereby the benefits of PA are not only seen to be physical, such as increased fitness and functionality, but also constitute positive psychological and social outcomes, such as well-being and social engagement with life (Liffiton, Horton, Baker, & Weir, 2012; Meisner et al., 2010). This perspective is based upon Rowe and Kahn's (1987; 1998) model of successful ageing which consists of three equally important and interconnected domains: (1) low probability of disease and disease-related disability; (2) high cognitive and physical functioning; and (3) active social engagement with life. There is evidence which shows that higher levels of PA are independently associated with each of the three domains of Rowe and Kahn's (1987; 1998) model of successful ageing. In a cross-sectional analysis of 12,042 adults aged 60 and over living in Canada, the inactive and moderately active respondents were more likely to have a chronic condition, to report a functional limitation and to feel socially disengaged with life compared with the most active older adults, even when controlling for age, sex and household income (Meisner et al., 2010). These authors discussed that, while the pathways between higher PA and better physical and cognitive functioning and a lower probability of disease are well supported in the literature, the pathways between social engagement with life and PA are still little understood and seem to be bi-directional and complex. In a later review Liffiton et al. (2012) also called for more research to tease out the relationship between PA and social engagement with life, and for health-related interventions to look at PA as having interdisciplinary benefits, not just the increase of physical fitness.

A biopsychosocial view of PA has been discussed by several authors in the PA literature. In a conceptual paper Gabriel, Morrow, and Woolsey (2012) concluded that there is a

need to reconceptualise PA in older age as a complex and multi-dimensional behaviour. Similarly, after a systematic review of literature using PA questionnaires in older populations, Eckert and Lange (2015) recommend the need to broaden the energy-based perspective of PA which focuses only on the time and physical intensity of activities, to one which also includes the utility and social nature of everyday activities that contribute to light PA and the avoidance of sedentary behaviour in older adults. Eckert and Lange (2015) also recommended that self-reported PA constructs need to measure specific types of PA which contribute to light and moderate-intensity PA for older people, which are likely to be none-sport/leisure activities. After reviewing the various ways in which the ageing (in)active body has been researched, Phoenix and Grant (2009) also called for a more expansive view of ageing and PA including the psychological, social and physical consequences of PA. The biopsychosocial perspective of PA taken in this thesis is therefore an important expansion of the field of PA research in older age.

3.5.2 The adapted socioecological model

The adapted socioecological model is a theoretical framework which recognises that intrapersonal (biological, psychological), interpersonal/cultural, organizational, physical environment (built, natural), and policy (laws, rules, regulations, codes) factors, experiences along one's life-course can affect PA behaviour (Bauman et al., 2012). It is founded on the socioecological model, designed to describe the determinants of all health-related behaviour (Sallis et al., 2006). It is argued that factors within the broad domains of the socioecological model influence human behaviour both directly and through interactions between the different domains (Giles-Corti, Timperio, Bull, & Pikora, 2005). The adaptation by Bauman et al. (2012) of this framework is its focus on PA behaviour and inclusion of the perspective that personal, social and environmental factors from across the life-course influence current PA behaviour. The socioecological framework has often been applied to the study of PA in older age, both in studies using quantitative or qualitative designs. For example, Carlson et al. (2012) explored the interactions among individual, interpersonal, and environmental correlates of two different types of walking (for transport and for leisure) by older adults in America. Using

qualitative methods, a comparison study between rurally-living and urban-living older adults in the UK, structured the barriers and facilitators to making trips outside the home in personal (such as lack of interest or health-related motivation), social (such as chance meetings with community members, and family support) and environmental domains (such as weather and distance to destinations) (de Koning, Stathi, & Fox, 2015). The rurally-living older adults relied more on community-level contact, while the urban older adults relied more on locally living family.

A critique of some studies applying the socioecological model to PA behaviour has been the use of generic PA variables such as total step count or minutes of MVPA (Giles-Corti et al., 2005). These authors suggest that specific PA behaviours should be studied (e.g. walking for transportation), rather than overall measures of PA. Giles-Corti et al. (2005) argue that the determinants and consequences of different types of PA, such as gardening or gym-based exercise, are unique, and that their determinants should be studied separately. This approach is therefore used in Chapter 4 **(Section 4.2.5, p. 94)**, where specific types of self-reported PA are evaluated as predictors of SI or loneliness, and in Chapter 5 **(Section 5.2.3, p. 121),** where specific reasons for leaving the house are observed and their association with SI or loneliness explored. Giles-Corti et al. (2005) also stress the importance of specifying the context in which PA behaviour is performed. This consideration guides this thesis' focus on rural areas in the UK, given that SI, loneliness and PA may be experienced differently by older people in a rural versus an urban context (Davis et al., 2011a; Shankar, McMunn, Banks, & Steptoe, 2011), and differently in rural places in the UK versus rural places in the US or Australia, for which data are available (Boehm et al., 2013; Moore et al., 2016).

3.5.3 Theories of loneliness

Within social psychology there are multiple theories of the aetiology and dimensions of loneliness and SI, reviews of which can be found elsewhere (Cacioppo & Cacioppo, 2014; de Jong Gierveld & Tesch-Römer, 2012; Heinrich & Gullone, 2006). The overall research question for this thesis is based on the hypothesis, stated within Hawkley & Cacioppo's (2010) loneliness model, that loneliness leads to self-imposed SI, which leads to low

levels of PA. This hypothesis is based upon the cognitive theory of loneliness (described below) which was selected for this thesis. A second theory, the deficit theory of loneliness (described below), was selected due to the empirical evidence supporting the joint applicability of the cognitive and deficit theories in explaining the presence of loneliness (Dykstra & Fokkema, 2007). Another reason for selecting these two theories, the cognitive and deficit theories of loneliness, was their conceptual fit within the adapted socioecological framework's personal and social domains, respectively. These theories are the most common perspectives used in recent research (Ong, Uchino, & Wethington, 2016). Even so, the selection of these theories will have influenced the analytical choices made throughout this thesis, and different outcomes may have been gained if other theories of loneliness and social interaction had been adopted.

The cognitive theory of loneliness

The premise of the cognitive theory of loneliness is that it is the discrepancy (mismatch) between desired and perceived social contact which leads to feelings of loneliness (Peplau & Perlman, 1982). This perspective proposes that faults in personal cognitive and psychological processes are drivers of loneliness, not the actual presence or absence of social relationships (Hawkley & Cacioppo, 2010). Irrational or distorted thinking is thought to lead to a perceived lack of social contacts while, in reality, this may not be the case (Hawkley & Cacioppo, 2010). A survey of 2,223 adults aged between 30 and 76 years about divorce in the Netherlands found evidence of the validity of the cognitive theory in this sample (Dykstra & Fokkema, 2007). In regression models, the stronger someone's rating of importance attached to having a partner, the higher their loneliness. Conversely, loneliness was far less prevalent among people without a partner who preferred not to have a partner or who had no more than a slight preference to have a partner. Thus, it was the perception of a deficit, not the actual deficit of the partner which affected loneliness. Regardless of having a partner, loneliness was more prevalent when the desired situation of having a partner was not met, and less prevalent among people whose actual situation largely coincided with their ideal situation (Dykstra & Fokkema, 2007). The cognitive theory of loneliness fits within the personal

domain of the adapted socioecological model due to its focus on cognition and personal perceptions that lead to feelings of loneliness.

Hawkley and Cacioppo (2010) have further developed the cognitive theory of loneliness into a proposed loneliness model. They theorise that the physiological response to loneliness is similar to that when feeling unsafe and that this primes the individual to be hyper-receptive to social threats, leading him/her to negatively interpret social exchanges, regardless of whether the social exchanges are indeed negative or unpleasant (Cacioppo, Hawkley, & Berntson, 2003). The loneliness model advocates that this forms a negative loop which drives lonely individuals to distance themselves from otherwise potential social partners, leading them to be socially isolated and consequently to lower levels of PA due to getting out and about less frequently (Hawkley & Cacioppo, 2010; Hawkley, Thisted, & Cacioppo, 2009). A longitudinal study of 229 adults aged 50 to 68 at baseline found that loneliness predicted diminished odds of self-reported PA two years later while the reverse association, low PA predicting loneliness two years later, was not significant (Hawkley et al., 2009). However, as is discussed in the literature review, there are important limitations to the research linking loneliness to lower levels of PA in older people **(Section 2.4.3, p. 68)**. Due to these limitations the hypothesis that loneliness is associated with low levels of PA is further explored and tested in this thesis.

The deficit theory of loneliness

The deficit theory of loneliness is based on the social needs approach which proposes that loneliness is caused by the absence of relationships which fulfil one's social needs for attachment, social integration, nurturance, reassurance of worth, reliance, alliance, and guidance (Weiss, 1973). The deficit theory conceptualises loneliness as two-dimensional based upon what kind of relationships are lacking: a lack of contact with friends and wider society equates to social loneliness and a lack of an intimate relationship which could provide emotional support equates to emotional loneliness (de Jong Gierveld, Van Tilburg, & Dykstra, 2006; Weiss, 1973). The assumption is made that different types of relationships serve different, more or less unique functions and that

these types of relationships are not, or are only barely, interchangeable (Weiss, 1973). Therefore, one kind of loneliness cannot be reduced by an increase in social contact of a different kind, e.g. emotional loneliness cannot be reduced by increasing contact with friends or the community (Weiss, 1973). The survey of 2,223 adults aged between 30 and 76 years about divorce in the Netherlands also found evidence of the validity of the deficit theory of loneliness (Dykstra & Fokkema, 2007). In regression models, social loneliness was not associated with the absence of a partner, while it was associated with having a smaller network size, and listing fewer people who could give support. Emotional loneliness, however, was strongly associated with the absence of a partner, and unrelated to the size of the support network (Dykstra & Fokkema, 2007). This theory fits within the social domain of the adapted socioecological model due to its focus on the absence of social relationships that lead to feelings of loneliness.

3.6 Summary

In summary, the work in this thesis is guided by Critical Realism which, although recognising that an impartial truth exists, necessitates a critical view of any researcher's interpretations of the data and inevitable bias in the process of creating scientific knowledge (McEvoy & Richards, 2003). This thesis integrates a range of theoretical perspectives and methods from Social Psychology and Sports Psychology to produce an exploratory, interdisciplinary and mixed-methods body of work. These methodological choices are made to support the aim of generating holistic and complex exploratory outcomes which may inform interventions to support the maintenance of health and wellbeing in rurally-living older people in the UK.

Chapter 4. A secondary quantitative analysis of predictors of loneliness and different social isolation types in rurally-living older adults in the UK

4.1 Introduction

4.1.1 Background

There is a need to identify predictors of loneliness independently from social isolation (SI), and *vice versa*, for effective public health policies and programmes. However, there is limited up-to-date research focused on loneliness and SI in older people in English rural places. The most thorough evidence available about SI and loneliness in a rural older sample comes from a longitudinal study in rural North Wales (1979-1999) which provided insights into the trajectories and predictors of SI and loneliness into very old age (85 to 102 years) (Wenger & Burholt, 2004). While this study contributed invaluable knowledge, its findings are now in need of updating in the current demographic, economic and cultural climate. One more recent UK-based study found that poor health has a significant indirect effect on loneliness through social resources and social participation in 6,613 adults aged 50 and older living in rural parts of Wales (Burholt & Scharf, 2013). Just one study to date has compared SI between rural and urban areas in England (Jivraj et al., 2012). This study of nationally representative ELSA data gives important insight into the potential urban-rural differences, and gender difference within rural populations, but did not explore rural-urban differences in loneliness and the findings relate mostly to younger older adults, as adults aged 52 and above were recruited. As different cultures, societies, and time-dependent political contexts influence the experience of loneliness (Yang & Victor, 2011), there is a need to investigate predictors of both SI and loneliness in recent UK-based data.

Despite a growing awareness that SI and loneliness are conceptually distinct (Cacioppo, Grippo, London, Goossens, & Cacioppo, 2015; Wenger & Burholt, 2004), this is not yet reflected in policy and practice. National UK policy documents consistently use loneliness and SI interchangeably, or 'loneliness and social isolation' as one construct (House of Lords, 2013). This is also true for many local policy documents in the UK (Devon County Council, 2012; Norfolk County Council, 2013; Wiltshire Council, 2014). Public interventions targeting SI may not benefit the individuals at risk/suffering from loneliness in situations where social relationships are available but are negatively evaluated by the individual due to maladaptive social cognition (Cacioppo & Cacioppo, 2014). For an explanation of the cognitive theory of loneliness, see Chapter 3 **(Section 3.5.3, p. 80)**.

A systematic review found that only interventions addressing maladaptive social cognition were successful at lowering loneliness, whereas interventions focussing on social contact were able to widen individuals' social networks, but not lower loneliness (Masi, Chen, Hawkley, & Cacioppo, 2011). Similarly, the group interventions effective at reducing loneliness identified in a systematic review of 30 health promotion interventions had an educational focus or provided targeted support activities for participants at risk, for example for widowed individuals (Cattan et al., 2005). Thus, it may be that it was not just the bringing together of peers in a group setting which reduced loneliness, but that the interventions stimulated a cognitive shift to better handle their particular social context. Identifying independent predictors of loneliness and SI may aid practitioners to recognise individuals at risk of specifically loneliness or SI and thus to tailor interventions appropriately (Burholt & Dobbs, 2012; Schnittger, Wherton, Prendergast, & Lawlor, 2012). Furthermore, failure to distinguish between these concepts may lead to miss-classification of those in need or not in need of social intervention.

Another distinction which has not often been investigated in the SI research is the difference between different types of SI depending on the source of contact. The definition of SI is less than weekly contact with friends, family and neighbours (Victor et al., 2003). However, different sources of social relationships (e.g. family or friends) were

seen to offer different levels of support for older Europeans (Wenger, 1997). Thus, isolation from different sources of social contact may also differ in their predictors and in their consequences on older adult health and wellbeing. Research using an American sample of adults aged 65 and above identified five social network types: 'friend' (large number of friends and frequent attendance at organized group meetings), 'congregant', (frequent attendance at religious services, but having the lowest rate of attendance at other organized group meetings), 'family' (relatively high number of children and relative dearth of other kinds of social ties) and 'diverse' (a combination of all contact types and having the greatest sociability) centred networks (Litwin & Shiovitz-Ezra, 2011). Is this same study it was found that different levels of support and personal satisfaction were associated with being in different networks. For effective policies and programmes, it is necessary to know in which ways specific types of social contact (with family, with friends and with neighbours) are beneficial, and what may predict being isolated from these different sources of social contact.

A few studies have explored how self-reported PA behaviour may be associated with loneliness and SI in older age (Hawkley et al., 2009; Netz et al., 2013; Shankar et al., 2011). A systematic review of 37 studies observing self-reported PA and loneliness across samples of children, adolescents adults and older adults reported that half of 24 cross-sectional studies found a direct negative relationship between self-reported PA and loneliness, while one in three longitudinal studies found a direct negative effect of self-reported PA on loneliness (Pels & Kleinert, 2016). Thus, there is contradicting evidence regarding this association. A nationally-representative cross-sectional study of 8,688 English adults aged 50 and over found that both loneliness and SI were independently related with greater risk of reporting less leisure or occupational activity (Shankar et al., 2011).

No studies have specifically focussed on rurally-living older populations, and the self-reported measures of overall time spent in leisure and occupational PA used by Shankar et al. (2011) may not have been able to observe a link between specific types of PA which may be common in rural areas (such as gardening or walking through the countryside). Through focussing on leisure, occupational or exercise-specific PA, these studies

reviewed by Pels and Kleinert (2016) may also not have observed an association between the PA generated from getting out and about for any reason, be it social, work-related, for a hobby or for shopping (Davis et al., 2011b). There is therefore a paucity of understanding how rural-specific PA behaviour could be associated with SI or loneliness in older adults.

4.1.2 Aim, research question and objectives

Study aim

The aim of this study was to provide evidence of predictors of loneliness, and two types of SI for older adults in a rural context which could help researchers and public health practitioners identify the situations in which these different concepts may arise, aiding further research and the development of preventative programmes in a rural context.

Research question

Do various socio-demographic, health and PA behavioural factors independently and differently predict the prevalence of loneliness, SI from one's family and SI from one's community in this rural sample of older people?

Study objectives

1. Document the prevalence of loneliness and SI from one's family and SI from one's community in an older, rurally-living population living in UK.
2. Explore a range of socio-demographic, health and PA behavioural predictors of loneliness, SI from one's family and SI from one's community in an older, rurally-living population living in UK.

4.2 Methods

4.2.1 Definitions of social isolation and loneliness

In this study SI is defined as less than weekly direct contact with family, friends and neighbours (Victor et al., 2003). From this widely used definition, two SI types are further specified: SI from family (less than weekly direct contact with family) and SI from the community (less than weekly direct contact with friends in the community). Loneliness is here defined as the subjective perception of SI (which may be present even in the absence of objective SI). Two widely used theories of the onset of loneliness will be used to discuss the findings of this study. The cognitive theory of loneliness states that loneliness is a negative subjective experience arising from a perceived lack of social contact frequency or quality, even when social contact is available (Perlman & Peplau, 1981). This cognitive perspective implies the role of maladaptive social cognition of the individual, not necessarily the lack of social contact in the onset of loneliness. The deficit theory of loneliness specifies that there are two types of loneliness each caused by a lack of particular social resources: emotional loneliness which follows the lack of intimate relationships, and social loneliness which follows the lack of wider social relationships (Weiss, 1973). For more information about these theories see Chapter 3 **(Section 3.5.3, p. 84, p. 85)**.

4.2.2 The GaPL dataset

The Grey and Pleasant Land (GaPL) study was designed to capture diversity in a representative sample of older adults living in rural areas in South West UK, where population ageing is more pronounced (Office for National Statistics, 2016b). This dataset was collected in 2009 and comprises quantitative survey responses from 920 adults aged 60 and over living across three rural communities in South Wales and three in South West England (Economic and Social Research Council, 2016b). The dataset includes responses on demographic, socio-economic, personal, behavioural, social, environmental and transport-related questionnaire items (Shergold & Parkhurst, 2012). In each country, three areas were selected according to their fit to pre-defined types of rurality: Type A (remote and deprived), Type B (less remote and deprived) and Type C

(less remote and less deprived). These rurality types were constructed by taking into account: the 2005 Office for National Statistics urban/rural definition of settlements (Office for National Statistics, 2013); social, cultural, political and economic differences; lifestyle differences (e.g. retirement retreats or dynamic commuter areas); the proximity to cities or large towns, nature of work (e.g. agriculture reliant), and the presence of older people using Census data (Hennessy, Means, & Burholt, 2014). Type A areas adhered to the Department for Environment, Food and Rural Affairs' Rural 80 classification, and both Type B and Type C areas adhered to the Rural 50 classifications (Office for National Statistics, 2013). For an in-depth account of the characteristics of each rural type see (Burholt, 2012). Using Census data, every resident aged 60 and over in the selected areas was posted information about the study and given the choice to opt out. All residents who did not opt out were visited by researchers and, if consenting, asked to complete the survey in their native language (Curry & Fisher, 2013). The estimated response rate for households containing people age 60 and over was 68% (Hennessy et al., 2014).

The GaPL dataset was selected for this secondary analysis because it includes a wide range of demographic, health and PA behavioural variables in a relatively large (n=920) sample of rurally-living older adults. Particularly, it includes self-reported measures on the frequency of several specific PA types, some of which, such as frequency of gardening and walking in the countryside, may be especially relevant in a rural context. The GaPL dataset was therefore preferable for investigating rural-specific PA predictors of SI or loneliness over the English Longitudinal Study of Ageing (ELSA) dataset which includes self-reported frequency of total vigorous/moderate/mild exercise and of whether occupational activity is sedentary or physically active (English Longitudinal Study of Ageing, 2017). The GaPL sample, aged 60 and above and specifically sampled from three rural areas different in community size and connectivity, was also more relevant to the current study of rurally-living older adults, than the ELSA sample which includes middle-aged adults (50 and 60 years) as well as adults over this age, and did not specifically recruit rurally living participants.

4.2.3 Study design

The present secondary analysis of GaPL data was exploratory in nature, given the paucity of recent findings about predictors of loneliness and SI in rural settings (Burholt & Dobbs, 2012). Multivariate binary logistic regression models were constructed to explore the associations between an array of socio-demographic, health-related and PA behaviour variables and three dependent variables: loneliness, SI from family and SI from the community. The sample was analysed as a whole in order to test potential predictors of loneliness and SI types in a variety of rural settings, not testing between different rurality types in order to retain the strongest possible statistical inferences. Potential clustering by rural dwelling was controlled for in the models. Data from 884 respondents was used, excluding 38 cases with incomplete datasets (de Koning, Richards, & Stathi, 2016).

4.2.4 Dependent variables

Loneliness

A unidimensional variable ('lonely', 'not lonely') was created from the question *"I experience a general sense of loneliness"* with response options 'agree', 'disagree' or 'don't know'. As self-rating scales for loneliness tend to underestimate loneliness due to a propensity for lonely individuals to not want to admit their loneliness consciously or unconsciously (Perlman, 2004), the 'I don't know' response was interpreted as an indication of some level of loneliness, even if unconscious. Thus, consistent with coding approach used for De Jong Gierveld's loneliness measure (de Jong-Gierveld & Kamphuis, 1985), 'agree' and 'don't know' were combined. A single item loneliness measure has been used in large English (Victor et al., 2005b; Victor & Yang, 2012) and European studies (Fokkema et al., 2012; Sundström, Fransson, Malmberg, & Davey, 2009; Tilvis et al., 2012).

Types of social isolation

Variables ('isolated', 'not isolated') were constructed using the SI definition: *'having less than weekly direct contact with family and friends'* (Victor et al., 2003). This definition has been used in other large studies (Holwerda et al., 2012; Jivraj et al., 2012; Tilvis et al., 2012). SI from family was defined as *'having less than weekly direct contact with*

family' and constructed using the question *"How often do you see any of your children or other relatives?"* SI from the community was defined as *'having less than weekly direct contact with friends and neighbours'* and constructed using the questions *"If you have friends in this community how often do you have a chat or do something with one of your friends?"* and *"How often do you have a chat with or do something with your neighbours?"*

4.2.5 Explanatory variables

A range of socio-demographic and health and PA behaviour explanatory variables were chosen with respect to previous association with loneliness or SI in urban, mixed or rural populations. Predictors of loneliness include widowhood (Demakakos et al., 2006; Golden et al., 2009; Victor et al., 2005b; Victor et al., 2006; Victor & Yang, 2012; Wenger & Burholt, 2004), poor physical health (Drennan et al., 2008; Victor & Bowling, 2012; Wenger & Burholt, 2004), poor psychological health and low education level (Victor et al., 2005b; Victor & Yang, 2012), low wealth status (Demakakos et al., 2006); recent immigration (Wenger & Burholt, 2004), lower levels of community participation (Newall et al., 2009). Predictors of SI include being unmarried (Golden et al., 2009; Jivraj et al., 2012), *not* being widowed (Jivraj et al., 2012), low wealth/socioeconomic status (Jivraj et al., 2012; Wenger, 1995) and having a physical disability (Golden et al., 2009). The access to a car (Lee, Steinman, & Tan, 2011) and public transport (Shergold & Parkhurst, 2012) explanatory variables were included because they have been shown to be specifically important for the maintenance of social functioning in rural areas. The PA explanatory variables were chosen due to hypothesized relationships between low PA and either loneliness of SI in older adults from previous research (Hawkley et al., 2009; Netz et al., 2013; Shankar et al., 2011).

The explanatory variables were grouped thematically in order to perform a stepped regression analysis, and to exclude collinear variables within thematic groups. The themes included socio-demographic variables, health-related variables and PA variables.

Socio-demographic variables

Six socio-demographic variables were used: 'widowhood' and 'household car access' (both 'yes'/'no'), 'years of residence in the community' ('less than 5', '6-10', '11-20', '21-30' and 'more than 30 years'), 'educational attainment' ('no qualifications', 'primary', secondary', 'college level', 'tertiary'), 'perceived financial coping' ('living comfortably', 'doing all right' and 'experiencing some to many problems') and 'neighbourhood deprivation rating' (membership of national quintiles of the English 2007 Indices of Multiple Deprivation [IMD] and Welsh 2008 IMD scores). The English IMD scores include Census information on: income, employment, health and disability, education skills and training, barriers to housing and services, living environment and crime (Communities and Local Government, 2008). The Welsh IMD scores include Census information on income, housing, employment, access to services, health, environment, education and crime and fire (Statistics for Wales, 2008).

Health-related variables

Two health-related variables were used: perceived physical and mental health over the last four weeks. 'Perceived physical health' was constructed by combining two questions: *"How much did physical problems limit your usual physical activities?"* and *"How much energy did you have?"* Five response categories were constructed by taking the minimum response for both questions: 'not at all', 'very little', 'to some extent', 'quite a lot' and 'very limited' physical health. 'Perceived mental health' was constructed using responses to: "*How much did emotional problems limit your usual physical activities?*" merged into four response categories: 'not at all', 'slightly', moderately', 'quite a lot or very much'. The physical and mental health variables were only weakly correlated, and therefore not judged to be collinear (Spearman's rho= 0.229, $p<0.001$).

Physical activity variables

Seven PA variables were computed: specific types of rural PA were frequency of *'walking in the countryside'*, frequency of *'gardening'* (both 'never', 'at least once a month', 'at least once a week' and 'most days') and *'total outdoor active pursuits'* (sum of weekly engagement in nine physically active, outdoor pursuits, e.g. gardening, collecting,

walking in the countryside: ‘0’, ‘1’, ‘2’, ‘3’, ‘4 or more’). *'Community engagement’* (sum of weekly engagement in 12 types of community-based activities, e.g. residents’ association, school, voluntary and charity group: ‘0’, ‘1’, ‘2’, ‘3’, ‘4 or more’ types) was used as a proxy for PA generated through voluntary local pursuits. Other variables assessing PA gained functional activities were *‘use of public transport’* ('less than once a month', 'in last month', in last week'), *‘assisting others’* and *‘caring for pets’* (both 'yes'/'no').

Control variables

Older age (Demakakos et al., 2006; Drennan et al., 2008) as well as female gender (Victor & Yang, 2012) have been associated with loneliness, and older age (Golden et al., 2009; Jivraj et al., 2012; Wenger, 1995) and being male (Jivraj et al., 2012) associated with SI for adults over age 60. Age categories (’60-69’, ’70-79’, ’80-89’, ’90-99’) and gender were therefore included as control variables so as to discount any potential influence of age and gender on social network size and loneliness while looking at the modifiable explanatory variables. Country (England or Wales) was also controlled for because the area deprivation variable (IMD) was constructed using different parameters in England and Wales.

4.2.6 Statistical analysis

The Stata 12.0 statistics package was used for all analyses. Cases with missing responses for any of the dependent variables were excluded (n=38). To assess potential selection bias, the responses of excluded and included cases were compared using the appropriate parametric tests (T-tests for continuous and binary variables and one-way ANOVA for ordinal variables with three or more levels). The proportion of respondents in each category of socio-demographic and rurality variables are presented for the whole sample and stratified by gender. The overlap between the three dependent variables was explored descriptively by cross-tabulation.

Binary regression modelling, adjusted for clustering for the six geographical areas to obtain robust standard errors (Rabe-Hesketh & Skondral, 2012, p. 591), was used in all

analysis. The resultant odds ratios (OR) and associated 95% confidence intervals (CI) are reported, with statistical significance set at $p<0.05$. Separate regression models were constructed for each dependent variable to test their associations with explanatory variables. Collinearity, defined as Spearman's Rho greater than or equal to 0.3, was tested between all explanatory variables prior to modelling.

Each dependent variable underwent five modelling steps (Models a-e) and all models were adjusted for age, gender and country. Model A: The dependent variable was entered with each explanatory variable into different univariate models. Model B: The explanatory variables in each sub-category (e.g. socio-demographic variables) with significant associations to the dependent variable in Model A were force entered as a group into an adjusted multivariate model. Model C: Explanatory variables with persisting significant individual associations in Model B of each sub-category (Wald test p-value) were force entered simultaneously in a multivariate model. Model D: Where collinear explanatory variables were both brought forward, a different model was constructed with each and the collinear variable with the highest statistically significant effect size retained in subsequent models. Model E: Explanatory variables with persisting significant associations in Models C and D, were force-entered into a fully-adjusted model with either combined SI (SI from both family and the community) added to the loneliness model, or loneliness added to the SI sub-type models as another confounding variable. This was done to assure independent influences by the predictors, distinct from any potential overlap between loneliness and SI.

Missing responses of explanatory variables were coded as 999 ('missing') and retained in the logistic models to maximise the sample size. In each step, explanatory variables with ordered categories were entered as ordinal variables (to derive measures of effect size for each level). The missing values categories were tested against the reference category, but not included in the tables. Next, the logistic regression tests were repeated with the missing cases excluded, entering the explanatory variable as a continuous variable to test the overall trend of increasing category membership of these variables.

4.3 Results

4.3.1 Participant characteristics

The gender distribution was relatively equal (57.9% women), the mean age was 71.5 (SD 8.2, range 60 to 97 years) and respondents were evenly distributed between the three pre-defined rural area types **(Table 4-1)**. Excluded cases were more likely to live alone (included 30% versus excluded 47%, p=0.047) and in more deprived communities (p=0.011), and had better levels of perceived mental health (p=0.013) compared with included cases. All other variables did not differ significantly between included and excluded cases.

4.3.2 Prevalence of loneliness and isolation variables

In the analysed sample of rurally-living older adults, 13% (111/884) were classified as lonely, with 8% (70/884) responding with 'yes' and 5% (41/884) showed uncertainty ('don't know') to the direct loneliness question; 49% (437/884) were isolated from their family; 9% (80/884) were isolated from their community; and 5% (45/884) were isolated from both family and community **(Figure 4-1)**. While significantly more men were isolated from their family than women (54.1% versus 46.3%, p=0.024), no gender differences were observed for loneliness or SI from the community **(Figure 4-1)**. Significantly higher proportions of older respondents reported loneliness (p=0.018), and to a lesser extent SI from family (p=0.040), although no differences were observed in SI from the community **(Figure 4-1)**.

Only 1.4% (12/884) of respondents were lonely and isolated from both family and the community. Around a third of people who reported feeling lonely (36.0%, 40/111) were not isolated in any way. A large proportion of those isolated from their family (85.6%, 374/437) or isolated from the community (75.0%, 60/80) were not lonely. Few of those isolated from their family were also isolated from the community (13.2%, 45/341); while around half of those isolated from the community were also isolated from their family (56.3%, 45/80).

Table 4-1. Characteristics of the GaPL sample

	Whole sample (%) (n=884)	Men (%) (n= 357)	Women (%) (n=512)	Difference across[1]: Gender (p-value)	Age groups (p-value)
Female	57.9				ns.
Missing responses	1.7				
Age				ns.	
60-69	42.9	42.0	43.8		
70-79	35.9	38.7	33.8		
80-89	17.7	17.7	17.4		
90-99	2.7	1.4	3.7		
Missing responses	0.9	0.3	1.4		
Mean age (SD)	71.5 (8.1)	71.3 (7.7)	71.6 (8.5)		
Widowed	20.5	9.2	27.9	<0.001	<0.001
Missing responses	1.6	2.5	1.0		
Education				<0.001	ns.
No qualifications	21.8	20.5	22.5		
School	24.7	18.5	29.3		
College	19.6	21.0	18.4		
Tertiary	18.1	23.8	14.5		
Missing, unsure, other	15.8	16.3	15.4		
Duration of residence				ns.	<0.001
<5 years	19.8	20.7	19.5		
6-10 years	14.5	15.1	14.1		
11-20 years	18.6	21.0	17.0		
21-30 years	16.4	16.5	16.4		
>30 years or always	29.5	24.1	32.6		
Missing responses	1.2	2.5	0.4		
Access to a car in household					
Yes	82.0	86.6	79.1	ns.	<0.001
Missing responses	6.3	6.7	6.3		
IMD National Quintiles[2] (Q.)				ns.	0.047
1st Q.	16.5	18.2	15.4		
2nd Q.	18.9	18.2	19.5		
3rd Q.	17.3	19.1	15.6		
4th Q.	14.9	13.2	16.2		
5th Q.	19.2	16.8	20.9		
Missing responses	13.1	14.6	12.3		
Rural classification				ns.	ns.
i. Deprived	32.5	33.9	32.0		
ii. Deprived, accessible	32.6	34.7	30.3		
iii. Affluent, accessible	35.0	31.4	37.7		

[1] Independent samples t-test for continuous or bivariate variables, one-way ANOVA for ordered variables. [2] 1st quintile is least deprived.

4.3.3 Factors associated with loneliness

In preliminary univariate models all six socio-demographic variables, both physical and mental health variables, and one behavioural variable (community engagement) were significantly associated with reporting loneliness **(Table 4-2)**. However, in the final, fully adjusted Model **(Table 4-3)**, car access was dropped due to collinearity with widowhood. Widowhood was retained due to the well-established importance of widowhood as a predictor of loneliness **(Section 2.2.3, p. 44)**. Community engagement was also dropped as it suppressed the effect of perceived financial difficulties. In both cases the retained variable showed the strongest effect. Factors which independently increased the odds of loneliness were: being widowed (OR=2.03, 95% CI 1.56 to 2.64), perceived financial difficulties (OR=0.36, 95% CI 0.17 to 0.79 for highest category versus lowest), living in the 4th highest deprivation quintile versus lowest (OR=1.81, 95% CI 1.09 to 2.99), and feeling more limited by physical health (OR=1.12, 95% CI 1.04 to 1.50) or mental health (OR=2.33, 95% CI 1.23 to 4.38 for highest category versus lowest).

The only factor that *reduced* the odds of loneliness was a longer residence in the community (OR=0.80, 95% CI 0.68 to 0.94 for each 10-year increase, and OR=0.36, 95% CI 0.17 to 0.79 for being resident 30 years or over, compared with <5 years). When SI was added to the fully adjusted model, it significantly increased odds of loneliness (OR=2.59, 95% CI 1.09 to 6.14), and seemed to exert a very small moderating effect (increasing the strength of associations) between widowhood and loneliness, and between poorer mental health and loneliness. Further, it demonstrated a very small mediating effect (decreasing the strength of associations) between older age and loneliness. For the control variables in the fully adjusted model, each 10-year increase in age raised the odds of loneliness (OR=1.23, 95% CI 1.03 to 1.47), but gender and country were not associated with loneliness.

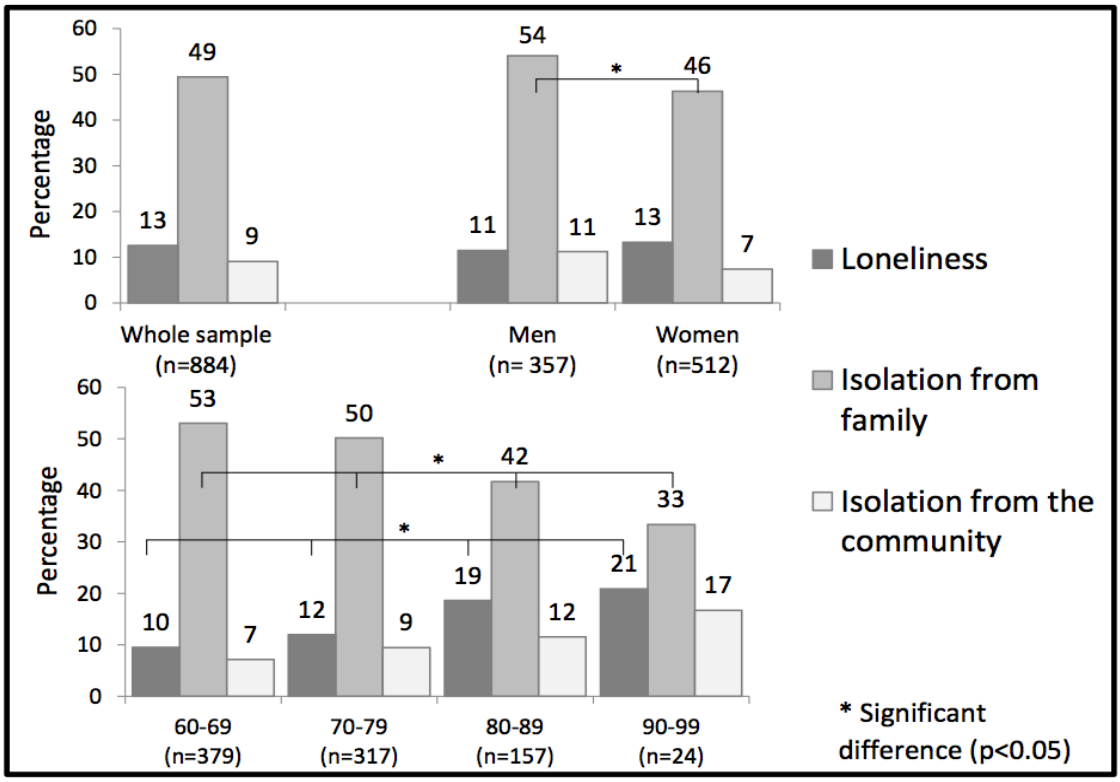

Figure 4-1. Prevalence of loneliness and two types of SI for the whole sample and across genders and age groups

4.3.4 Factors associated with isolation from one's family

In preliminary univariate models **(Table 4-2)** two socio-demographic variables (length of residence, perceived financial coping), and two PA behaviour variables (total weekly active pursuits, walking in the countryside) were significantly associated with being isolated from one's family. However, in the fully adjusted model **(Table 4-3)**, only the two socio-demographic variables remained significant. A longer residence in the community decreased the risk of being isolated from one's family (OR=0.71, 95% CI 0.63 to 0.80 for each 10-year increase, and OR=0.27, 95% CI 0.15 to 0.49 for being resident 30 years or over, vs <5 years). Counter-intuitively, perceiving financial difficulty also reduced the likelihood of being isolated from one's family (OR=0.67, 95% CI 0.53 to 0.84 for the highest compared with the lowest category). When adding loneliness to the final model, it did not predict SI from family, and did not change any of the associations between the predictors and SI from family. For the control variables in the fully adjusted model, being male increased odds of SI from family (OR=0.25, 95% CI 1.02 to 1.52) but age and country were not associated with SI from family.

Table 4-2. Univariate regression outcomes for demographic, personal, and physical activity variables predicting loneliness and two social isolation types

	Loneliness		Family SI		Community SI	
	OR	95% CI	OR	95% CI	OR	95% CI
Socio-demographic variables						
Widowed	1.87**	1.43, 2.44	0.54	0.28, 1.05	0.79	0.35, 1.81
Highest qualification						
None(ref)	1.00		1.00		1.00	
School	0.67	0.42, 1.08	0.90	0.59, 1.37	0.89	0.63, 1.27
College	0.57	0.28, 1.17	1.36	0.68, 2.69	0.90	0.58, 1.41
Tertiary	0.76	0.52, 1.13	1.73	0.88, 3.39	0.93	0.48, 1.82
Overall trend	0.86*	0.74, 1.00	1.24	0.96, 1.58	0.98	0.78, 1.23
Years of residence						
<5 years(ref)	1.00				1.00	
6-10 years	0.73	0.41, 1.30	1.28	0.73, 2.24	0.94	0.42, 2.09
11-20 years	0.91	0.50, 1.64	0.98	0.74, 1.29	0.57*	0.36, 0.91
21-30 years	0.50**	0.33, 0.76	0.73**	0.60, 0.89	0.75	0.49, 1.13
>30 years or always	0.39*	0.19, 0.82	0.26**	0.14, 0.50	0.39*	0.18, 0.84
Overall trend	0.80**	0.69, 0.93	0.71**	0.62, 0.81	0.81**	0.70, 0.95
Car access	0.62*	0.39, 0.99	1.35	0.87, 2.12	1.00	
Perceived financial coping					1.71	0.79, 3.72
Living comfortably(ref)	1.00		1.00			
Doing alright	1.44	0.87, 2.39	0.90	0.64, 1.27	1.00	
Perceived difficulty	1.68**	1.34, 2.10	0.70**	0.56, 0.87	0.80	0.44, 1.45
Overall trend	1.29**	1.15, 1.45	0.84**	0.75, 0.94	1.10	0.52, 2.33
National IMD Quintiles[1] (Q.)					1.04	0.69, 1.56
1st Q.(ref)	1.00		1.00		1.00	
2nd Q.	0.83	0.52, 1.33	0.93	0.56, 1.57	0.80	0.26, 2.51
3rd Q.	0.71	0.40, 1.27	0.93	0.68, 1.26	0.78	0.25, 2.44
4th Q.	1.59*	1.04, 2.44	1.30	0.75, 2.27	1.16	0.34, 4.00
5th Q.	0.76	0.51, 1.12	0.87	0.54, 1.38	0.72	0.28, 1.82
Overall trend	1.01	0.89, 1.13	0.99	0.91, 1.09	0.97	0.79, 1.19
Health-related variables						
Limited by physical health						
Not at all(ref)	1.00		1.00		1.00	
Very little	1.33	0.61, 2.92	1.07	0.78, 1.48	1.33	0.73, 2.42
To some extent	2.19**	1.38, 3.47	0.78	0.52, 1.16	1.21	0.43, 3.43
Quite a lot	2.16*	1.02, 4.58	1.03	0.81, 1.29	1.02	0.51, 2.05
Very limited	3.45**	1.35, 8.84	0.60	0.33, 1.08	2.29	0.99, 5.31
Overall trend	1.30**	1.16, 1.46	0.92	0.83, 1.01	1.09	0.89, 1.33
Limited by mental health						
Not at all(ref)	1.00		1.00		1.00	
Slightly	1.39	0.72, 2.65	0.81	0.58, 1.14	0.85	0.42, 1.70
Moderately	2.35*	1.00, 5.50	1.30	0.94, 1.80	1.19	0.71, 1.99
Quite a lot/very much	2.83**	1.65, 4.85	0.80	0.47, 1.35	1.06	0.55, 2.04
Overall trend	1.44**	1.22, 1.71	0.97	0.82, 1.15	1.02	0.82, 1.27

* p< 0.05, ** p< 0.01. [1] 1st Quintile is least deprived.

Table 4-2. Univariate regression outcomes for demographic, personal, and physical activity variables predicting loneliness and two social isolation types (Continued)

	Loneliness		Family SI		Community SI	
	OR	95% CI	OR	95% CI	OR	95% CI
PA behaviour variables						
Walking in the countryside						
Never (ref)	1.00		1.00		1.00	
At least once a month	1.64	0.89, 3.03	1.08	0.67, 1.73	0.59	0.23, 1.47
At least once a week	0.92	0.56, 1.53	1.17	0.71, 1.9	1.41	0.83, 2.39
Most days	1.35	0.62, 2.93	1.39**	1.09, 1.78	0.80	0.45, 1.42
Overall trend	1.07	0.83, 1.38	1.11*	1.01, 1.23	0.98	0.88, 1.09
Gardening						
Never (ref)	1.00		1.00		1.00	
At least once a month	0.57	0.13, 2.47	1.43	0.77, 2.65	1.55	0.72, 3.30
At least once a week	0.86	0.45, 1.62	1.12	0.87, 1.43	1.09	0.61, 1.93
Most days	0.86	0.52, 1.44	1.20	0.91, 1.59	0.99	0.61, 1.60
Overall trend	0.97	0.82, 1.15	1.05	0.94, 1.17	0.98	0.82, 1.16
Total weekly active pursuits						
None (ref)	1.00		1.00		1.00	
One	0.78	0.46, 1.33	1.22	0.69, 2.14	0.73	0.31, 1.72
Two	0.72	0.46, 1.13	0.96	0.58, 1.58	0.86	0.50, 1.48
Three	0.83	0.35, 1.96	1.18	0.62, 2.24	0.62	0.31, 1.21
Four +	0.81	0.28, 2.38	1.82*	1.01, 3.29	1.05	0.66, 1.68
Overall trend	0.97	0.75, 1.27	1.12	0.99, 1.27	1.01	0.92, 1.10
Community engagement						
None (ref)	1.00		1.00		1.00	
One activity	0.59	0.29, 1.19	0.96	0.64, 1.45	0.76**	0.67, 0.87
Two activities	0.44	0.19, 1.01	0.97	0.67, 1.40	0.30*	0.11, 0.83
Three activities	0.46*	0.25, 0.84	1.41	1.00, 2.01	0.15*	0.04, 0.65
Four+ activities	0.66**	0.50, 0.86	0.68	0.42, 1.11	1.00	1.00, 1.00
Overall trend	0.81**	0.70, 0.94	0.98	0.88, 1.10	0.54**	0.41, 0.71
Assisting others						
(ref = not assisting)	0.93	0.66, 1.30	0.98	0.77, 1.25	0.49*	0.27, 0.89
Caring for pets	0.78	0.42, 1.45	1.17	0.74, 1.83	1.06	0.63, 1.79
Public transport use						
< once a month (ref)	1.00		1.00		1.00	
In last month	1.34	0.94, 1.91	1.21	0.73, 2.01	0.91	0.46, 1.81
In last week	0.77	0.48, 1.24	0.83	0.54, 1.29	0.43	0.18, 1.00
Overall trend	0.94	0.79, 1.11	0.95	0.73, 1.23	0.70	0.46, 1.06

* p< 0.05, ** p< 0.01

4.3.5 Factors associated with isolation from the community

In preliminary univariate models **(Table 4-2)** only one socio-demographic variable (years of residence), and two of the PA behaviour variables (community engagement, assisting others) were significantly associated with being isolated from the community. In the fully-adjusted model **(Table 4-3)** only years of residence and community engagement remained significant. A longer residence in the community decreased the risk of being isolated from the community (OR=0.85, 95% CI 0.75 to 0.96 for each 10-year increase, and OR=0.48, 95% CI 0.25 to 0.95 49 for being resident 30 years or over, vs <5 years).

Each extra community engagement activity engaged in decreased the odds of SI from the community (OR=0.56, 95% CI 0.41 to 0.77), with three or more community engagement activities decreasing the odds by over 80% (OR=0.16, 95% CI 0.03 to 0.73, **Table 4-2**). When loneliness was added to the final model, it did not significantly predict SI from the community, but showed a very small mediating effect (reducing the associations) between community engagement and SI from the community, and a strong mediating effect between older age and SI from the community **(Table 4-3)**. For the control variables in the fully-adjusted model, being male increased odds of SI from the community (OR=1.46, 95% CI 1.07 to 1.99) but age and country were unrelated to SI from the community loneliness were not significant.

Table 4-3. Multivariate regression outcomes for predictors of loneliness and SI types

	Loneliness		Family SI		Community SI	
	OR	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
Socio-demographic variables						
Widowed	2.03**	1.56, 2.64				
Years of residence						
< 5 years (ref)	1.00		1.00		1.00	
11-20 years	0.61	0.30, 1.23	1.35	0.78, 2.31	1.06	0.44, 2.55
21-30 years	0.90	0.50, 1.64	0.97	0.72, 1.32	0.56*	0.33, 0.95
21-30 years	0.51*	0.28, 0.93	0.73**	0.61, 0.87	0.87	0.59, 1.29
>30 years or always	0.36*	0.17, 0.79	0.27**	0.15, 0.49	0.48*	0.25, 0.95
Overall trend	0.80**	0.68, 0.94	0.71**	0.63, 0.80	0.85*	0.75, 0.96
Perceived financial coping						
Living comfortably(ref)	1.00		1.00			
Doing alright	1.48	0.77, 2.84	0.92	0.62, 1.37		
Perceived difficulty	1.33*	1.01, 1.75	0.67**	0.53, 0.84		
Overall trend	1.15*	1.0, 1.32	0.83**	0.74, 0.93		

Table 4-3. Multivariate regression outcomes for predictors of loneliness and SI types (Continued)

	Loneliness		Family SI		Community SI	
	OR	95% CI	OR	OR	95% CI	OR
National IMD Quintiles[1] (Q.)						
1st Q. (ref)	1.00					
2nd Q.	0.88	0.57, 1.37				
3rd Q.	0.76	0.43, 1.32				
4th Q.	1.81*	1.09, 2.99				
5th Q.	0.81	0.48, 1.36				
Overall trend	1.03	0.91, 1.17				
Health-related variables						
Limited by physical health						
Not at all (ref)	1.00					
Very little	1.19	0.52, 2.72				
To some extent	1.78*	1.03, 3.07				
Quite a lot	1.74	0.75, 4.01				
Very limited	2.46	0.80, 7.60				
Overall trend	1.25*	1.04, 1.50				
Limited by mental health						
Not at all (ref)	1.00					
Slightly	1.37	0.68, 2.74				
Moderately	1.90	0.75, 4.81				
Quite a lot/very much	2.33**	1.23, 4.38				
Overall trend	1.33**	1.08, 1.64				
PA behaviour variables						
Community engagement						
None (ref)					1.00	
Two activities					0.88	0.67, 1.16
Two activities					0.33*	0.11, 0.98
Three activities					0.16*	0.03, 0.73
Four+ activities					1.00	1.00, 1.00
Overall trend					0.56**	0.41, 0.77
Control variables						
Age						
60 to 69 (ref)	1.00		1.00		1.00	
70 to 79	1.36	0.98, 1.90	0.94	0.76, 1.16	1.38	0.79, 2.43
80 to 89	1.73*	1.05, 2.85	0.75	0.48, 1.16	1.66	0.91, 3.04
90 to 99	1.33	0.54, 3.30	0.58	0.26, 1.30	2.53	0.82, 7.84
Overall trend	1.23*	1.03, 1.47	0.86	0.73, 1.02	1.31	0.99, 1.73
Gender (male)	0.95	0.64, 1.42	1.25*	1.02, 1.52	1.46*	1.07, 1.99
Country						
Wales (ref = England)	0.87	0.67, 1.15	1.12	0.79, 1.59	0.90	0.65, 1.24
Other social variables						
Socially Isolated	2.59*	1.09, 6.14				
Lonely			1.35	0.93, 1.96	2.33	0.89, 6.08
Constant	0.07**	0.02, 0.24	1.33	0.94, 1.88	0.13**	0.07, 0.24

* p<0.05 to ** p<0.01. [1] 1st Quintile is least deprived.

4.4 Discussion

4.4.1 Summary of the findings

This study explored the cross-sectional predictors of loneliness and two types of SI (from one's family and from one's community) in adults aged 60 and older living in rural areas of south-west UK. This is the first UK study to explore correlates of loneliness and SI types in a large, diverse rural sample since the late 1980s (Burholt & Dobbs, 2012; Stockdale, 2011). Loneliness and the two SI types had different, independent cross-sectional predictors, as supported by previous research (Havens et al., 2004; Wenger & Burholt, 2004). Being a newcomer in the community was the only predictor common to all three variables. Widowhood, older age and poor mental or physical health were only related to loneliness. Surprisingly few of the PA variables were related with SI types or loneliness, with only more frequent community engagement predicting lower incidence of SI from the community in the final regression model.

4.4.2 Contribution to literature

In the GaPL sample, 8% reported being lonely and 5% showed uncertainty ('don't know') to the loneliness question, which was interpreted as an underlying loneliness not expressed due to the social stigma associated with loneliness (Perlman, 2004). The proportion of definite cases of loneliness seems similar to the 9% who were 'severely' lonely in a nationally-representative sample of UK older adults, which included more urban than rurally-living participants (Victor & Bowling, 2012). However, it is not possible to accurately compare these questions due to their difference in wording and response categories. The level of SI (from both family and the community) was comparable to UK nationally-representative ELSA data at around 5% (Jivraj et al., 2012), although again, the constructs used to measure these were also worded differently, precluding accurate comparison. Gender was not associated with loneliness, supporting previous findings in UK older adults (Victor et al., 2006). Men were, however, more likely to experience both types of SI, supporting previous findings that older men in the ELSA dataset were almost twice as likely as women to become socially isolated over time (Jivraj et al., 2012). The trend of higher odds of loneliness with increasing age also

confirms previous evidence from longitudinal analysis of ELSA data (Shankar et al., 2013) and cross-sectional Irish data (Drennan et al., 2008). Given the over representation of adults aged 60 to 69 in the GaPL study, it may be that a large percentage of younger respondents were still working (Emmerson & Tetlow, 2006). This could play part in the age difference in feelings of loneliness, as retirement correlated positively with loneliness in several American datasets, despite this association not necessarily being of a cause and effect nature (Kerwin, 2004).

Widowhood is one of the most empirically supported predictors of loneliness in studies of older populations (Demakakos et al., 2006; Dykstra, Van Tilburg, & de Jong Gierveld, 2005; Victor et al., 2005b). The current findings and previous reports show that rurally-living individuals are not different in this regard (Wenger & Burholt, 2004; Wenger et al., 1996). The relation of widowhood only to loneliness, not types of SI, supports the deficit theory of loneliness' concept of 'emotional loneliness' which is initiated by a lack of intimate relationships, which cannot be replaced by other types of social contact (Weiss, 1973). For a full description of the deficit theory of loneliness see Chapter 3 **(Section 3.5.3, p. 85)**. A review of 39 qualitative studies of bereavement concluded that the relationships widow/ers have with close others cannot replace that which is lost (the spouse) (Naef, Ward, Mahrer-Imhof, & Grande, 2013). Thus, widowhood may be an important factor to help identify those at risk of loneliness, even if these individuals have access to family, friend or neighbourly social contact.

Physical and mental health has frequently been linked to the prevalence of loneliness across British, other European and American samples (Hawkley & Cacioppo, 2010). While the current study's cross-sectional association between perceived physical and mental health and loneliness cannot infer causality, longitudinal studies have found that loneliness is associated with the risk of being diagnosed with depression (Cacioppo et al., 2010), Alzheimer Disease (Boss, Kang, & Branson, 2015) and lower self-rated health (Hawkley et al., 2009). In a 20-year follow-up of older adults (85 to 102 at follow-up) in rural Wales, deteriorating health was related to the onset of loneliness, but not SI (Wenger & Burholt, 2004). Longitudinal analysis of Dutch, American and English samples have also reported that improvements in physical health and function were associated

with a reduced risk of being lonely (Dykstra et al., 2005; Luo, Hawkley, Waite, & Cacioppo, 2012; Victor & Bowling, 2012). Poor physical function and physical or mental health may be a way for health professionals to identify individuals at risk of loneliness. The promotion of healthy lifestyles and physical activity could also have a role in preventing the onset of loneliness through preserving better physical health and function.

This study's finding that perceived financial difficulties increased odds of loneliness confirm other cross-sectional observations of English (Demakakos et al., 2006) and other European older samples (Drennan et al., 2008; Fokkema et al., 2012; Losada et al., 2012). The lack of association between financial difficulties and SI from the community is similar to findings that wealth was not related to overall SI across waves one to five in ELSA (Jivraj et al., 2012) and in a cross-sectional analysis of older adults in rural Canada (Havens et al., 2004). The association between greater perceived financial difficulties and more contact with one's family has not been previously reported. It could be that rural-dwelling individuals with financial issues tend to get instrumental help from their family but that this type of support is not emotionally beneficial, as odds of loneliness are worse. Similar differences between types of social support were seen in a six-year study of 2,255 Dutch middle-aged and older participants, for whom emotional support, but not instrumental support, offered protective cognitive effects and loneliness relief (Ellwardt, Aartsen, Deeg, & Steverink, 2013).

Surprisingly, most PA variables, such as gardening, walking in the countryside, caring for pets and public transport use, were unrelated to loneliness or SI types. It was expected to find these associations due to previous cross-sectional findings of a relationship between more active leisure and occupational activity and lower odds of both SI and loneliness in 8,688 older adults in ELSA data (Shankar et al., 2011). The current self-reported PA variables may have been inaccurate proxies for PA, so these associations need further investigation using both objective PA measures and more accurate assessments of types of PA specific to older adults living in a rural context. The only two studies which have investigated how loneliness is associated with objectively-measured PA have used nationally-representative English (Harris et al., 2009) or Canadian older

samples (Newall et al., 2013). As these studies lack representation of rurally-living older adults, their findings may not be generalisable to a rural context and to perhaps rural-specific pursuits which add PA to older people's lives.

Nevertheless, engagement with more community activities was associated with lower likelihood of SI from the community. Altruistic behaviours, such as volunteering in the community, inextricably involve social contact and have been related to increased psychological well-being and reduced all-cause mortality (Barron et al., 2009; Cattan, Hogg, & Hardill, 2011). Due to the stepped-regression approach, community engagement was dropped from the model predicting loneliness as it statistically reduced the effect of financial coping. Financial coping was kept, however, as it had a stronger univariate association with loneliness than community engagement. However, more frequent engagement in community activities did predict lower odds of loneliness in models controlled for age and gender, so this association requires further investigation in a rural context. Canadian study findings showed that greater weekly social participation was associated with less loneliness in both a cross-sectional analysis of 1,243 older adults, and five-year longitudinal analysis of 688 older adults (all aged 72 or above) (Newall et al., 2009). Considering the deficit theory of loneliness, social contact with one's community could help to avoid feelings of social loneliness, a different dimension of loneliness that emotional loneliness, which is due to the lack of intimate relationships (Weiss, 1973).

Similar to the current findings, Wenger and Burholt (2004) found that for the 47 survivors of a 20-year study in rural Wales (aged between 85 and 102 years), the indigenous to the area were least likely to be lonely or socially isolated over time. Individuals who have lived longest in an area might have developed more meaningful friendships over time than newcomers. An earlier study of 240 older adults in rural North Wales found that long-term residents' social networks were made up of family and friends living locally, while newcomers' social networks comprised social contacts living further afield or contained very few contacts (Wenger, 1995). Newcomers in rural communities may be at risk of both SI and feelings of loneliness as the social networks between longstanding villagers may be strong and closed to new members. Length of

residence in a rural community may be an important index for practitioners to use to identify individuals who may benefit from some form of social intervention or assistance in relation to both loneliness and SI.

These current findings clearly reiterate the conceptual independence of loneliness and SI also reported in other studies (Cornwell & Waite, 2009; Havens et al., 2004). However, overall SI did independently predict loneliness and exert a small moderating influence on the effects of widowhood and poor mental health on loneliness. This supports Wenger and Burholt's (2004) conclusion from their 20-year rural follow-up study that, despite the conceptual independence of loneliness and SI, certain situations (widowhood and deteriorating health) predispose older individuals to both loneliness and SI, and that at these points in life individuals need increased support.

4.4.3 Practical implications

The findings of this study highlight the importance of ageing in place with regard to maintaining frequent social contact and avoiding loneliness. Our data and previous reports show that migrating to a new area at an older age may put both rural (Wenger & Burholt, 2004; Wenger et al., 1996) and urban-dwelling (Jivraj et al., 2012) individuals at risk of loneliness and/or SI. In a qualitative case study comparison between urban and rurally-living older English adults we found that the presence of supportive local social contacts was beneficial to staying actively engaged in their communities, regardless of setting (de Koning et al., 2015). However, rurally-living older adults may be particularly prone to relocating at an older age and so losing touch with their neighbourhood community, given longitudinal Welsh findings that rurally-living older adults are over 30% more likely to move (either to a rural or urban place) than those living in Major Conurbations (Wu, Prina, Barnes, Matthews, & Brayne, 2015). Ageing in place is already a central focus of UK policy as stated in the "Ready for ageing?" report by Age UK and the International Longevity Centre (Sinclair & Watson, 2014). However increased effort is necessary to facilitate rurally-living older adults to remain in their community, which in turn may help preserve their social network, prevent loneliness, and optimise long-term wellbeing and ultimately health. Practically, such facilitation may take the form of

greater provisions of public transport suitable for older adults, so that adults who have lost access to a car may remain independent (Shergold & Parkhurst, 2012), and the provision of assisted-living arrangements for those in need. Furthermore, public health interventions could also focus on ways of assisting newcomers to rural areas to forge strong and long-lasting connections with existing residents. Such ideas need to be tried and tested with community intervention studies.

4.4.4 Strengths and limitations

The GaPL dataset represents a large, diverse sample of people aged 60 and over living across six geographically and demographically different rural sites in the UK's most rapidly ageing region, the South West (Office for National Statistics, 2016b). Nevertheless, by design the six case studies approach does not provide a probability sample, so strong generalisations for ageing in rural areas cannot be made. The over-representation of adults aged 60 to 69 years likely means many respondents were still employed, and that the findings apply mostly to the retirement transition period, rather than to later adulthood. Furthermore, the cross-sectional nature of the data precludes any inference of causality. Our findings add important value to an under-researched field of ageing in rural areas, and will be able to inform further research using large and representative samples of rurally-living older adults in the UK, and ideally longitudinal or experimental study designs.

As with any secondary analysis, the current study was constrained by the available data. For example, the wording of the SI questions regarding contact with family (specifying face-to-face contact) was different from questions reporting contact with neighbours and friends in the community (not specifying face-to-face contact). This may have exaggerated the difference between SI from one's family and one's community members. Another limitation was the 'outdoor active pursuits' variable, which was a proxy for all leisure PA, and the 'community engagement' variable, which was a proxy for PA gained through local altruistic pursuits. These PA behaviour variables may not have been accurate or sensitive enough to replicate previous associations found between PA and SI or loneliness (Newall et al., 2013; Newall et al., 2009; Shankar et al.,

2011). Future investigations should use objective PA measurements because self-reported PA is limited by recall accuracy (Colbert et al., 2011). Self-reported measures using open categories to more precisely record the types of daily pursuits engaged in by older people in a rural context will also be informative in future studies. Lastly, as IMD is calculated differently across England and Wales, the findings of this study in relation to how area deprivation (IMD) co-varies with loneliness or SI need to be treated with caution.

4.4.5 Conclusions

The findings of this study strongly support the conceptual difference between loneliness, SI from the community, and SI from one's family, and highlight a range of independent predictors for these variables in rurally-living older adults. Researchers and practitioners are urged to use the appropriate measure of loneliness or SI types depending on the focus of their programme or research. Widowhood, declining mental or physical health and financial difficulties were related independently to loneliness, regardless of SI, and so may be used to identify older people at-risk of loneliness in rural communities. A longer duration of residence seems an important aspect that strongly and independently lowered odds of loneliness and both types of SI, warranting focussed public strategies to facilitate ageing in place and successful social integration of newcomers in rural areas.

Frequent community engagement predicted a lower likelihood of SI from the community, but no other PA measures were associated with loneliness or SI types. Moving forward, there is need for studies using objective PA measurements as well as open-ended methods to observe the specific types of PA occurring in rurally-living older populations. Such studies could more robustly investigate whether and how levels and types of PA may be related to loneliness and SI types, and contribute to the knowledge regarding the possible joint targeting of loneliness or SI through PA interventions in a rural context.

Chapter 5. A quantitative analysis of associations between physical activity, social isolation types and loneliness in rurally-living older people

5.1 Introduction

5.1.1 Background

Engaging in low levels of physical activity (PA), experiencing social isolation (SI) and feeling lonely have all been consistently linked with poorer physical health in older age and a risk of earlier mortality (Elovainio et al., 2017; Holt-Lunstad et al., 2015; Hupin et al., 2015). Chodzko-Zajko et al. (2009) reviewed experimental evidence concluding that regular exercise or PA in older age can halt the development and progression of chronic diseases. A meta-analysis of 70 longitudinal studies of 3,407,134 participants (mean age 66 years) followed for a mean of seven years, found that SI independently increased the risk of mortality by 29% and loneliness increased the risk by 26% (Holt-Lunstad et al., 2015). In a loneliness model proposed by Hawkley and Cacioppo (2010), it has been theorised that a low level of PA may be one of the mechanisms through which loneliness and SI have long-term negative effects upon health. An association between SI or loneliness and low levels of PA, which forms the basis for this theory, is supported by a growing body of literature using self-reported PA (Hawkley et al., 2009; Pels & Kleinert, 2016; Shankar et al., 2011). However, to date there are no studies using objectively-measured PA that confirm an association between loneliness or SI and lower levels of PA in a sample aged 65 and above.

Based upon the cognitive theory of loneliness, Hawkley and Cacioppo (2010) have suggested a loneliness model in which they explain association between loneliness and lower levels of PA. They argue that chronically lonely individuals are hypervigilant to perceiving situations as socially threatening, even in cases where there is no social threat

(Hawkley & Cacioppo, 2010). This cognitive bias, it is argued, sets in motion a self-fulling prophecy, whereby lonely individuals withdraw from potential social situations, thus further isolating themselves. It is also argued that lonely individuals have a diminished capacity for self-regulation of effortful behaviours, which diminishes their engagement in health-related behaviours such as PA. The hypothesis that loneliness is associated with low levels of PA is tested in this chapter, because it is still a young theory and the evidence supporting it is based on subjective PA measurements.

In support of the loneliness model, a longitudinal study found that loneliness was associated with a 58% increased chance of making a transition from being physically active to inactive, measured through self-report, over a two-year timeframe in 229 Americans aged 50 to 68 (Hawkley et al., 2009). This appeared to be a causal relationship, as baseline self-reported PA level did not predict changes in loneliness in subsequent years. Another longitudinal study of 228 older people (aged 77 to 96 years) also found a longitudinal association between loneliness at baseline and reduced self-reported PA two years later (Newall et al., 2013). A systematic review of 24 cross-sectional studies and four longitudinal studies mean ages ranging between below 14 and above 65 years also concluded that most studies supported a relationship between loneliness and lower PA, in either direction of causality (Pels & Kleinert, 2016). Nevertheless, only two studies in this review used objective measures of PA, neither of which supported an association between loneliness and low levels of PA.

Given the established link between higher levels of PA and better health, Hawkley and Cacioppo (2010) further reason that one of the mechanisms through which loneliness may harm physical health is through a reduction in levels of PA by lonely individuals. This theory has received tentative support from a prospective study of 6,789 individuals, aged 21 years or older in 1965, for whom the chances of all-cause mortality in 1999 were significantly higher if they reported feeling often lonely compared with never lonely at baseline, and that adding self-reported PA to the regression model attenuated this relationship (Patterson & Veenstra, 2010). However, this population included all-age adults, not specifically adults aged 65 and above. Lower expectations and a more positive evaluation of one's social support have been associated with advancing age,

despite infrequent or declining levels of actual social support (Schnittker, 2007). Therefore, a study linking loneliness with levels of PA in an older age sample may find a different outcome from one including younger adults who may evaluate social contact differently.

It is clear that loneliness and SI are distinct concepts with different predictors as found in Chapter 4 **(Sections 4.3.3, 4.3.4, and 4.3.5, p. 100-104)** and other literature (Wenger & Burholt, 2004) and that SI and loneliness have independent associations with long-term health and mortality (Elovainio et al., 2017; Holt-Lunstad et al., 2015). Nevertheless, there is also reason to hypothesise that SI may lead to long-term health deteriorations (independently from loneliness) due to decreased levels of PA. Davis et al. (2011b) found that each trip outdoors by older people using active or public transport was associated with 11 additional minutes of MVPA, even when controlling for common confounding variables. The purposes for such trips were often social in nature or would involve incidental social contact with others, such as socialising, shopping or work (Davis et al., 2011a). Thus, older adults with few social reasons to get out and about may take fewer trips outdoors and therefore engage in less lifestyle-related PA. This may, in turn, lead to the longitudinal association between SI and earlier mortality seen in prospective cohort studies (Elovainio et al., 2017; Holt-Lunstad et al., 2015). This is supported by an analysis of 8,688 adults aged 52 and above from wave two in the English Longitudinal Study of Ageing (ELSA) study which found that SI increased the risk of being inactive in self-reported leisure or occupational PA (Shankar et al., 2011). Such a pathway is likely to be independent from any cognitive tendencies to feel lonely or not, given that loneliness and SI are not closely related (Cornwell & Waite, 2009).

A major limitation of the studies supporting a relationship between loneliness or SI and lower levels of PA is their use of self-reported PA measures. In the review by Pels and Kleinert (2016), only two of the 36 studies used objective measures of PA. These two studies found loneliness to be unrelated to step counts in cross-sectional data from 238 adults aged 65 and above in the UK (Harris et al., 2009) and unrelated to accelerometer counts two years later in 228 adults aged 77 and above in Canada (Newall et al., 2013). Newall et al. (2013) discussed that this result was contrary to their expectations and

called for more studies using objective measures of PA to corroborate it. Indeed, using accelerometers to measure PA is superior in accuracy to self-reported PA in questionnaires, the latter of which is susceptible to socially desirable answers and unintentional recall difficulties or misinterpretations (Colbert et al., 2011).

Another limitation of the supportive evidence for a link between loneliness and lower levels of levels of PA is the analysis of samples including many respondents under age 65 in North America (Hawkley et al., 2009; Patterson & Veenstra, 2010). These findings may not be transferrable to adults over age 65, and even less to for those over age 85, for whom evaluations of social support differ from younger adults (Schnittker, 2007). American-based evidence may also not translate to a UK rural-context, where geographical differences may influence loneliness, SI and levels of PA compared with urban-living adults in the UK (Burholt & Scharf, 2013). The only study that has measured PA objectively in a rurally-living older sample in the UK is that by McMurdo et al. (2012). However, these authors did not analyse the rural data separately from the urban and suburban data. Most of the published evidence on older age SI and loneliness in rural areas of the UK is derived from a study undertaken several decades ago in rural North Wales (Wenger & Burholt, 2004) which may no longer reflect the current societal context, or Irish rural samples which may differ on an economical and societal level from English rural populations (Burholt & Scharf, 2013).

The secondary analysis of GaPL data in Chapter 4 **(Section 4.4.1, p. 106)** provided new information on the prevalence of SI and loneliness in Welsh and English rurally-living older people, and found no relationship between loneliness, or two types of SI, and self-reported PA variables. However, this analysis was limited by the lack of objective measures of PA, the use of a binary loneliness measure (yes/no), which could not measure the frequency of loneliness and therefore may not have captured individuals feeling lonely only some of the time. The GaPL dataset was also limited by the use of merged questions for SI from friends and from community members, which may have been related differently to levels of PA.

In exploring the association between loneliness or SI and levels of PA, there is also value in examining whether certain everyday pursuits which lead to the accumulation of PA are also associated with a lower likelihood of SI or loneliness. According to a bio-psychosocial perspective of behaviour certain active pursuits may provide benefits on both a physical level and a social or psychological level (Eckert & Lange, 2015). For a full description of the biopsychosocial perspective, see Chapter 3 **(Section 3.5.1, p. 81)**. PA measurement, whether self-reported or objective, has often focussed on structured activities which clearly contribute to PA such as leisure-time PA or active transport (Eckert & Lange, 2015). More recent thinking in the field of active ageing has included the benefits engaging in light-intensity physical activity (LPA) as well as engaging in moderate-to-vigorous intensity physical activity (MVPA) (Sparling et al., 2015). This means that everyday pursuits derived from daily tasks and social interactions which give older people a reason to leave their homes may make important contributions to overall levels of PA, as has been confirmed in adults aged 70 and over living in an urban UK context (Davis et al., 2011a).

5.1.2 Aim, research questions and objectives

Study aim

The aim of this study was to generate new exploratory knowledge about SI types, loneliness, and levels and sources of PA, and the association between these variables, in a rural setting, in order to aid the development of future rural-focussed interventions, programmes or policies.

Research questions

What is the prevalence SI, loneliness and levels and types of PA? Are SI or loneliness associated with objectively-measured levels of PA in a rural setting, as proposed by the loneliness model (Hawkley & Cacioppo, 2010)?

Study objectives

1. To describe the prevalence of different types of SI (from friends, from family and from neighbours), and of different measures of loneliness (the direct measure

and UCLA score), and to describe the levels and types of PA engaged in by the SHARP respondents.

2. To explore whether higher levels of objectively-measured overall PA types are negatively associated with the occurrence of SI types (from friends, from family and from neighbours) and loneliness (two measurement types), based upon the loneliness model (Hawkley & Cacioppo, 2010).
3. To explore whether some specific reasons for trips out of the house relate to both higher levels of PA and to a reduced likelihood of either SI (from friends, from family and from neighbours) or loneliness (direct or UCLA score).

5.2 Research methods

5.2.1 Study design

The Staying Healthy and Active in Rural Places (SHARP) study design and data collection methods were based on the cross-sectional observational study, Older People and Active Living (OPAL) (Fox et al., 2011), which was also adopted for research in Scottish older communities (McMurdo et al., 2012). Consistent with the OPAL study, a mixed methodology was employed, comprising a quantitative cross-sectional observational study (presented in this chapter) and sequential qualitative interviews (presented in Chapter 6). The OPAL study documented PA levels in community-dwelling adults aged 70 and above and presented cross-sectional associations of determinants of activity with objectively-measured PA levels in an urban-living population in south-west England (Fox et al., 2011).

The study by McMurdo et al. (2012), which was based on the OPAL study, documented similar findings for a mix of urban and rurally-living older people in Scotland, presenting a combined picture of the urban and rurally-living populations. However, they did not present an analysis of rural older people specifically, or present PA characteristics in as much detail as was done for the OPAL study (Davis et al., 2011a; Davis et al., 2011b). Living in rural areas in Scotland may also be very different from living in rural areas in England, with greater distances between neighbouring towns, villages or facilities (Philip, Gilbert, Mauthner, & Phimister, 2003). The current study therefore applies the

same protocol and methods to a sample of older people living exclusively in rural areas in the South West of England.

The intention in the current study was to yield comparable rural-based data to that collected by Fox et al. (2011) and McMurdo et al. (2012). Sharing common variables provides this dataset with a unique opportunity to compare and merge rural data with the McMurdo study which has been discussed and agreed between the research teams leading these studies. While it was initially planned to merge SHARP data with McMurdo's dataset in this thesis, this proved to be difficult due to a time delay in obtaining NHS ethics approval and complicated logistics of data sharing. It was therefore decided to explore the SHARP dataset on its own for the current thesis, while keeping open the possibility of merging of these compatible datasets in future studies.

5.2.2 Participant recruitment

Geographical area

The SHARP study was conducted in the county of Wiltshire, in the South West of England. The majority of Wiltshire is rural according to the Office for National Statistics' definition (Office for National Statistics, 2013). Its dwelling types comprise rural towns and fringe villages, in which 21.7% of the population are aged 65 and over, and rural villages and dispersed dwellings, in which 23.4% are aged 65 and over, in the mid-2014 Census data (Office for National Statistics, 2015). This proportion of older residents is high compared with that in an average urban dwelling in England and Wales (18.6%) in mid-2014 (Office for National Statistics, 2015).

General practice selection

Recruitment was aided by general practitioner (GP) patient lists. Over 98% of the UK population is registered with a GP (Hippisley-Cox & Vinogradova, 2009). Thus, sampling through general practice lists can aid obtaining a sample representative of the general population of older adults. The SHARP study was adopted by the National Institute for Health Research (NIHR) funded-West of England Clinical Research Network (WoE CRN),

UKCRN ID: 16433, which supported participant sampling and recruitment via GP patient lists.

Three rural Lower Super Output Areas (LSOAs) in Wiltshire were selected due to their level of rurality, deprivation scores and the availability of a research active general practice. Super output areas (SOA) are levels within a geographic hierarchy designed to improve the reporting of small-area statistics. A lower layer of a SOA (a LSOA) has a minimum population of 1000 and are of consistent size across England and Wales and are not subjected to regular boundary changes (Office for National Statistics, 2016a). LSOAs classified as a 'rural village or isolated dwelling' by the 2011 Rural-Urban Classifications were first identified (Office for National Statistics, 2013). These were matched to the 2010 Index for Multiple Deprivation (IMD) national overall scores and sub-domain scores available from the Census of 2010 (Department for Communities and Local Government, 2011). Using these IMD scores, the most deprived LSOAs in rural Wiltshire were identified, totalling 18 LSOAs. When compared to all LSOA across the UK, the selected 18 rural LSOAs in Wiltshire were within the 60% national percentile of multiple deprivation, a higher score indicating greater multiple deprivation. Eight of the 18 LSOAs were covered by the NIHR WoE CRN and could be considered for recruitment. The WoE CRN identified three research active general practices who might be willing to support the SHARP study which were contacted via email by the PhD candidate and asked to support participant recruitment.

Participant sampling

Research Nurses generated patient lists according to the following criteria:

- **Inclusion criteria:** individuals aged 65 or over, living independently in the community (i.e. not a care home) and resident in a specified post code area.
- **Exclusion criteria:** individuals with a diagnosis of Dementia or Alzheimer's disease (due to the inability to give informed consent and accurately complete questionnaires and activity diaries), or judged by a GP to be at risk of emotional distress when answering questions about loneliness (e.g. due to a recent bereavement).

Lists of potential participants were screened by the GP who applied the study criteria. Individuals deemed eligible were each sent an invitation pack by a practice administrator. Invitation packs included a GP covering letter, an invitation to participate in the SHARP study, a participant information sheet and a reply card with pre-paid envelope to express an interest in the study. Individuals who returned the reply slip were contacted with a telephone call or email and two dates were arranged for data collection visits.

Sample size considerations

With the view of combining the SHARP data with that collected for 150 rurally-living respondents by McMurdo et al. (2012), it was calculated that 75 additional SHARP participant were necessary, as a total sample of n=225 participants would be sufficiently powered to observe a one point change in the direct three-level loneliness question, significant at $p<0.05$. Assuming a 21% response rate from the initial invitations, as observed in the OPAL study (Fox et al., 2011), 450 invitations were sent across three general practices (150 invitations from each practice). However, as the collaboration with McMurdo et al. (2012) was delayed beyond the timeframe of this thesis, the recruitment target was revised to satisfy the required number of participants for the analysis for objective 3. This analysis involved three independent variables (light PA, moderate-to-vigorous PA and total PA). Therefore, in order to test the individual prediction strength of each of these upon the dependent variables (SI types and loneliness) the equation for necessary participants was $n \geq 104+m$ (where m is the number of independent variables) (Tabachnick & Fidell, 2007). Thus, the revised recruitment target was a minimum of n=107, with a view to over-recruit if the response-rate was higher than predicted.

5.2.3 Data collection

Consistent with the OPAL (Fox et al., 2011) and McMurdo et al. (2012) studies, data collection methods included waist-mounted accelerometers, seven-day activity diaries, participant questionnaires and an objective assessment of physical functioning. The data

were collected by the PhD candidate at participants' homes with the exception of one participant who preferred to meet at their GP surgery and two participants who preferred to come to the University of Bath. Participants were visited on two occasions, seven to ten days apart. During the first visit written consent was obtained, the physical function assessment administered, the first part of the questionnaire completed and an explanation given of how to wear the accelerometer and how to complete the activity diary for the next seven consecutive days. During the second visit the accelerometer and activity diaries were collected and participants completed the second half of the participant-reported questionnaire. The questionnaire was divided into two parts and administered over two visits to reduce participant burden. (For consent forms see **Appendix B: p. 251**).

Physical function

To measure physical function objectively, the Short Physical Function Battery (SPPB) was administered (Guralnik et al., 1994). This is a valid and reliable test of older people's leg strength, balance and walking speed of older people. It has a high inter-rater reliability and test-retest reliability (Studenski et al., 2003), and has been shown to predict mobility disability (inability to walk 400m) (Vasunilashorn et al., 2009) and of length of time older people remain in hospital when admitted for a serious health problem (Volpato et al., 2008). As physical function strongly predicts levels of PA (Shah et al., 2012) it was included as a control variable in models testing any associations between SI or loneliness and PA. The researcher led each participant through three progressive balance tests (scored out of three), a four-meter timed walk (scored out of four) and a sit-to-stand test (scored out of four). A stop watch was used to time all aspects of the assessment, an available chair in the participant's home (straight backed and without arm support) and a rope measured out to be four meters long. The SPPB scores were summed to form a scale variable of 0 to 12, following the method used by Guralnik et al. (1994).

Questionnaires

The questionnaire was interviewer-administered and included items on socio-demographic factors from established questionnaires (Economic and Social Research

Council, 2016b; Fox et al., 2011; McMurdo et al., 2012), the three item UCLA loneliness measure (Hughes et al., 2004), a direct, one-item loneliness question (Yang & Victor, 2011), social contact frequency questions from the Social Capital Module (Harper & Kelly, 2003) and health-related quality of life (SF-12v2) (Cheak-Zamora, Wyrwich, & McBride, 2009). The remaining questionnaire items were not analysed in this chapter, and are therefore not described here. The questionnaires were checked for interpretability in public and participant involvement (PPI) work **(see Section 0, p. 129)**. The questionnaire-derived variables analysed in this chapter are socio-demographic characteristics, physical and mental health-related quality of life, three types of SI and two measures of loneliness.

Demographic variables. Demographic variables used as descriptors or control variables included age, gender, ethnicity, education (middle school, some secondary school, completed secondary school, some college or vocational training, or completed tertiary education), household income (under £5,000, £5-10,000, £10-20,000, £20-30,000 or more than £30,000 per annum), perceived financial difficulties (living comfortably, doing alright, just about getting by, finding it quite difficult, or finding it very difficult), retirement status (retired, working part-time/casual hours, or working full-time), home ownership (own house/free stay, or rent), and residence duration (0 to 9 years, 10 to 19 years, 20 to 29 years, 30 to 39 years, 40 to 49 years).

Health-related quality of life. Perceived physical and mental health, as measured by the 12 item SF12v2 health-related quality of life scale (Cheak-Zamora et al., 2009), were selected as control variables in models predicting PA, SI or loneliness, as self-reported physical and mental health variables have been strongly associated with SI, loneliness and PA in older samples (Cacioppo, Hughes, Waite, Hawkley, & Thisted, 2006; Steinmo, Hagger-Johnson, & Shahab, 2014; Vallance, Eurich, Lavallee, & Johnson, 2012; Victor & Bowling, 2012; Wenger & Burholt, 2004). The summary scores of physical and mental health (physical component score and mental component score) of the SF-12v2 scale were generated by the SF12v2 trademarked software, as continuous scales (OPTUM, 2017). The summary scores have been shown to predict the original SF36 summary scores using data from general population surveys from nine European countries (Ware

& Gandek, 1998), and have shown to have acceptable reproducibility in psychometric performance in a range of populations (Ware, Kosinski, & Keller, 1996). The SF12v2 was also shown to be a reliable and valid measure of health status in independently living older adults (Resnick & Nahm, 2001).

Types of social isolation. The SI variables were constructed using three questions about social contact frequency from a Social Capital Module questionnaire (SCM: Harper & Kelly, 2003): *'How often do you meet up with relatives who are not living with you?'*, *'How often do you meet up with friends?*' and *'How often do you speak to neighbours face-to-face?'* The response categories were 1 (on most days), 2 (once or twice a week), 3 (once or twice a month) and 4 (less often than once a month). The SCM was used as it had also been used by McMurdo et al. (2012). Binary variables for SI were used which conform to the established SI definition of 'less than weekly direct contact with family, friends or neighbours' (Victor et al., 2003). However, this was deconstructed to attain three types of SI: from family, from friends and from neighbours. Thus each of the variables for social contact frequency was made into a binary variable with *not isolated* coded for the responses 'on most days' or 'once or twice a week', and *socially isolated* for responses 'once or twice a month' or 'less often than once a month'.

Loneliness. A single-item direct measure of loneliness (Yang & Victor, 2011) and the 3-item UCLA indirect measure of loneliness (Hughes et al., 2004) were used as dependent variables. As the analysis was exploratory, both methods of measurement were selected, given that each has strengths and weakness. The direct single-item measure *"How often do you feel lonely?"* includes the response categories of 1 (hardly ever), 2 (some of the time) and 3 (often). It was coded into a binary variable with responses 2 and 3 named as 'lonely' and response 1 as 'not lonely', to a clear and meaningful interpretation of logistic regression modelling. This direct single-item measure of loneliness has been used extensively in research with older adults (Fokkema et al., 2012; Losada et al., 2012; Luo & Waite, 2014; Tilvis et al., 2012; Yang & Victor, 2011). As it asks directly about one's perception of loneliness, it is unlikely to be misinterpreted. However, it may be prone to social desirability effects; by using the term 'loneliness',

some individuals may not answer truthfully if they do not want to openly admit to feelings of loneliness (Shiovitz-Ezra & Ayalon, 2012).

The 3-item UCLA loneliness scale poses three indirect questions about loneliness: *"How often do you feel that you lack companionship?"*, *"How often do you feel left out?"* and *"How often do you feel isolated from others?"* with response categories of 1 (hardly ever), 2 (some of the time) and 3 (often), the answers to which are summed into a score between 3 and 9 (Hughes et al., 2004). This was scored into a binary measure with a score of 4 or above named as 'lonely', as this indicates a response of 'some of the time' or 'often' to at least one question, and with a score of 3 named as 'not lonely', as this indicates a response of 'none of the time' to all three questions. Again, this was done to allow more interpretable outcomes from logistic regression models, rather than predicting a 1 point increase in a scale of 3 to 9. The original 20-item UCLA scale has been widely used (Cacioppo et al., 2010; Hawkley et al., 2009; Steptoe, Owen, Kunz-Ebrecht, & Brydon, 2004) and its 3-item derivative showed to have good psychometric properties (Hughes et al., 2004). As this construct does not overtly use the term 'loneliness' it may better avoid social desirability effects. The advantages and disadvantages of the direct one-item loneliness question and the UCLA loneliness measure are reviewed in Chapter 2 **(Section 2.2.1, p. 31)**.

Accelerometer-measured physical activity

PA was measured through a waist-mounted Actigraph (GT3X) accelerometer worn by participants for seven consecutive days during waking hours. Research on older populations has reported that objective PA measures are superior in accuracy to self-reported measures (McMurdo et al., 2012; Sun et al., 2013). Participants were asked to wear the accelerometer during waking hours but to take it off during the day if it was likely to become wet (e.g. during bathing or swimming). Participants noted down the times they put on and took off the accelerometers in the seven-day diary. This protocol of accelerometer data collection has been used in other studies using accelerometry with older adults (Davis et al., 2011b; Harris et al., 2009; Jefferis et al., 2014; McMurdo

et al., 2012). A discussion of merit of different modes of PA measurement can be found in Chapter 2 **(Section 2.3.1, p. 53)**.

Accelerometer data were extracted using the Actilife v6.11.2 software and interpreted using the Freedson et al. (1998) adult cut-off values. Accelerometer data was considered valid if five or more days had recorded data for at least ten hours. Three PA variables were computed from the established categories derived by the Actilife software: light PA (LPA), moderate-to-vigorous PA (MVPA) and total PA (TPA). For each of these variables the daily mean values were computed by dividing the weekly total amount by the number of days for which there were valid accelerometer readings, following the procedures applied in the OPAL study (Davis et al., 2011b).

Light physical activity. LPA was explored because low intensity PA may confer health benefits for older adults who undertake very low levels of PA (Bann et al., 2015; Buman et al., 2010; Sparling et al., 2015). This variable was computed by adding the minutes classified by the Actilife software as light activity (100 to 759 counts/minute) and as lifestyle activity (760 to 1051 counts/minute) (Freedson et al., 1998). LPA has been previously defined as an intensity of $\leq$3 Metabolic Equivalents (METs) (Ainsworth et al., 2000). The LPA variable was coded into ordinal categories: '0 to 120 minutes, '120 to 150 minutes', '150 to 180 minutes', '180 to 210 minutes' and '>210 minutes'. A category width of 30 minutes of LPA was selected because an analysis of repeated accelerometer measurements over six months of 862 adults over age 65 found that, in statistical models, substituting 30 minutes of sedentary time with LPA (using two measures: low-LPA and high-LPA) related to a 0.34 and 0.30 standard deviation increase in physical health, respectively (Buman et al., 2010). The base category of 120 minutes (2 hours) of LPA was selected by looking at the data distribution of 30-minute categories, starting at zero minutes, and selecting a starting value containing at least 20 participants.

Moderate-to-vigorous physical activity. MVPA was explored because of the well-established link between higher levels of MVPA and better physical health and function in older age (Chodzko-Zajko et al., 2009; Fox et al., 2014; Gebel et al., 2015; Marques et al., 2014). This variable was computed by adding the minutes classified by the Actilife

software as moderate activity (1952 to 5724 counts/minute), vigorous and very vigorous (5725 counts/minute and above) (Freedson et al., 1998). Moderate PA has been defined as an intensity of 3-6 METs and vigorous and very vigorous PA as >6 METs (Ainsworth et al., 2000). MVPA was coded into ordinal categories: '0 to 10 minutes', '10 to 20 minutes', '20 to 30 minutes', '40 to 50 minutes', and '> 50 minutes'. The category width of 10 minutes of MVPA was selected as 10-minute bouts of MVPA are widely used in health recommendations (Department of Health, 2011). Although guidelines suggest that MVPA should be accumulated in 10-minute bouts (Department of Health, 2011), it has been argued and empirically demonstrated by Fox et al. (2011; 2014) that for adults aged 65 or over, any minutes of MVPA are beneficial even if they are accumulated in shorter bouts than ten minutes. Thus, any minutes of MVPA of were counted, regardless of bout length.

Total physical activity. TPA was explored because this has been associated with both long-term physical function (Shah et al., 2012) and cognitive health (Buchman et al., 2012) in longitudinal studies of older adults. TPA gives a measure of the amount of PA older people engage in, regardless of its intensity. Previous accounts of TPA have been analysed by using pedometers or number of trips outdoors for older adults, and these authors found a strong association between higher TPA and better physical function measured with the SPPB (Davis et al., 2011b). A high TPA may also mean that older people spend less time being sedentary, a behaviour also strongly associated with worse health in older age (Dogra & Stathokostas, 2012). The TPA variable was computed by adding the minutes of light (100 to 759 counts/minute), lifestyle (760 to 1051 counts/minute), moderate (1952 to 5724 counts/minute) and vigorous and very vigorous (5725 counts/minute and above) PA (Freedson et al., 1998). The TPA variable was coded into ordinal categories: '0 to 120 minutes', '120 to 150 minutes', '150 to 180 minutes', '180 to 210 minutes' and '>210 minutes'. These categories were chosen for the same reason as which guided the selection of categories for the LPA variable.

Seven-day prospective activity diaries

Participants completed a seven-day activity diary between the first and second home visit, the same days on which they wore Actigraph accelerometers. The diary design was based on the OPAL study (Davis et al., 2011a; Fox et al., 2011). Participants recorded all trips out of the house, including into their garden, garage or onto their driveway, and provided the time, reason and transport option used for each trip. This diary was a valid measure of PA in the OPAL study as the total number of trips on each day correlated significantly with number of steps ($R=0.367$ to 0.505, $p<0.001$), and with accelerometer-measured moderate-to-vigorous PA on each day ($R=0.366$ to 0.472, $p<0.001$) (Davis et al., 2011a). The OPAL-version of the diary was modified slightly for the rural context. One difference was the use of open responses for the type of activities, rather than closed ones, as less is known about the nature of daily activities in a rural setting. Another difference was the inclusion of trips into the garden or driveway, rather than just trips away from the house and garden, because of evidence that gardening represents a significant source of light and moderate intensity PA for older adults (Park, Lee, Son, & Shoemaker, 2012). For the activity diary layout see **Appendix C (p. 249).**

The open responses outlining the reasons for trips were coded into the OPAL framework of reasons for trips using a qualitative thematic coding process and the *NVivo 10* software. Slight modification of the framework was required for some reasons for trips which did not fit within the existing framework. A total of 16 categories of reasons for trips were derived from the diary data. Ten categories were equivalent to the OPAL study (shopping, visits or social events, entertainment-related trips, personal trips or household errands, accompanying others, sports or exercise, health-related trips, day trips, hobby-related trips and religion-related trips). Six new categories were added which were either more specific or were additional categories relating to a rural context (walking for leisure or exercise, dog walking, volunteering, paid work, gardening, do-it-yourself tasks in the garden or driveway). For a list of the lower-level and higher-level codes of activity types see **Appendix D (p. 256)**.

5.2.4 Public and participant involvement

Public and participant involvement (PPI) was used during the planning phase of the SHARP study to increase the interpretability, acceptability and validity of the data collection methods. The questionnaire and seven-day activity diary were completed by n=10 advisors aged 65 or older (four men and six women) attending a day-time social group in one of the villages included in study participant sampling. Advisors provided feedback about any difficulties in interpreting the meaning of items in the questionnaires. In response, minor changes such as word additions were made to the new measures developed from a rural case study (de Koning et al., 2015) and the urban-focused measures taken from the OPAL study (Fox et al., 2011). The widely-used measures of SI and loneliness used for the analysis in this chapter did not require alterations. All advisors found the seven-day activity diary easily interpretable and an acceptable task to be asked to do for seven consecutive days. When discussing the overall data collection process, the advisors suggested that study participants would find it rewarding to receive feedback on their PA levels and on basic study findings after taking part. Thus, a summary of the sample characteristics and individualised PA feedback was created for each study participant. For an anonymised example of an individualised participant summary see **Appendix E (p. 259)**.

5.2.5 Ethical considerations

Physical or psychological risks were not anticipated for participants involved in this study. The research protocol had been carried out in two prior studies with older adults without complaints or complications (Fox et al., 2011; McMurdo et al., 2012). There was potential, however, for a time-burden when filling out the activity diaries for seven days. To minimise this the activity diary was pre-structured so that participants only needed to fill the blanks and tick relevant boxes. From the public engagement work, it was clear that the time requirement was acceptable. The SHARP study was approved by the London-Central NHS Research Ethics Committee (reference number: 14/LO/0456) and the Bath NHS Research & Development committee (Reference: 2014/008) **(Appendix A: p. 249)**.

5.2.6 Data analysis

The analyses were performed with the *Stata 13.1* software package. The level of statistical significance was set at $p<0.05$ level throughout the analyses described below.

Validation of activity diaries

To test the concordance between diary responses and accelerometer data, hourly Actigraph records were manually matched with each trip reported on the first day of the activity diaries for the first 50 participants. As this was a time-intensive process, hourly accounts on these 50 days (amounting to 757 valid hours) were deemed sufficient to establish diary validity. Any hour in which the participant had noted being out of the house for any reason was marked as 1 in a new binary variable, and all other hours as 0. A binary variable was constructed for each hour time period (out of house/in house) and this was then compared with the hourly LPA, MVPA, or TPA Actigraph data using Spearman correlation tests.

Analysis for objective 1

Descriptive statistics were used to summarise the: (i) characteristics of the study population (e.g. socio-demographic and socio-economic variables); (ii) three types of SI (from family, from friends and from neighbours); (iii) two measures of loneliness (direct question, and indirect score from the UCLA loneliness scale); (iv) three objectively measured PA variables (LPA, MVPA and TPA); and (v) the 16 variables of reasons for trips gained from the activity diaries. Due to the non-parametric nature of the data, the Mann-Whitney U test was used to test for differences between genders, and the Kruskal-Wallis rank sum test examined differences across age groups (in five-year age categories).

Analysis for objective 2

Logistic regression models were constructed to explore whether objectively-measured LPA, MVPA or TPA are associated with the three SI types or with the two loneliness measures. As this included multiple testing of fifteen relationships and, based upon previous research, a hypothesis of an association could be made, the Bonferroni

correction was applied to the significance cut-off value. This is an adjustment to the acceptable level of statistical significance to show the presence of a relationship when considering the increased likelihood of a type two error (finding a false positive due to chance) (Bender & Lange, 2001). Thus, given an original acceptable $p<0.05$ to find a relationship, the adjusted p-value for this analysis was $0.05/15=0.003$.

The dependent variables (three SI types and the two loneliness measures) were entered as binary variables into separate logistic regression models. Three univariate models were created for each dependent variable, including one of the three PA types as the independent variable (LPA, MVPA or TPA) entered in categorical form. Control variables were added simultaneously into each model. Control variables included factors which have been associated with SI and loneliness in the literature concerning older adults: gender, age (continuous), widowhood (binary) and duration of residence (years, continuous), objectively-measured physical function (continuous), SF12 mental health component (continuous), SF12 physical health component (continuous). For each regression model an LR-contribution test was applied to assess whether the addition of the independent variable (LPA, MVPA or TPA) significantly increased the model's ability to predict the dependent variable (SI type or loneliness) in comparison to the model which only included the control variables as predictors.

Analysis for objective 3

For the third objective, more exploratory regression modelling was undertaken to examine whether any of the 16 reasons for trips variables were associated with both PA and SI or loneliness. As this analysis involves multiple testing, again an approach to protect against type two error (finding a false positive due to chance) would be to apply a correction so that the level at which differences are deemed to attain statistical significance is more conservative (i.e. lower) than the 0.05 level. However, the application of corrections for multiple testing is not a universal requirement. In a methodological overview by Bender and Lange (2001), it is argued that while corrections for multiple testing are essential for experimental studies seeking to inferentially and definitively test differences between groups, this approach is too conservative for

exploratory analyses. By definition, an exploratory analysis is hypothesis generating rather than testing, seeking to identify potentially important new relationships between variables. In this context, Bender and Lange (2001) argue that setting statistical significance at $p<0.05$ is the preferred approach, as long as the researcher is careful not to over-interpret the exploratory findings. For the third objective there were no relationships from the previous literature that were being replicated, but instead new sources of potential activities relating to both life-style PA and the avoidance of SI or loneliness were being explored. It was therefore deemed unnecessary to apply a statistical correction, as long as the exploratory nature of the findings was stressed in the discussion.

There were seven dependant variables explored in separate regression analyses. Three dependant variables (LPA, MVPA and TPA) were entered as continuous variables in Ordinary-Least-Square regression models, because seeing associations with each minute increase in PA would be meaningful. Five dependent variables (the direct loneliness measure, UCLA measured loneliness, and SI from family, from friends or from neighbours) were entered as binary variables in Logistic regression models because there are established binary definitions of these concepts, and there is evidence that the middle range of these measures suffers more from personal interpretation and therefore lack of validity and reliability (Shiovitz-Ezra & Ayalon, 2012). There were 16 independent continuous variables for each model (total weekly frequency of each reason for trips) obtained through the seven-day activity diaries.

Control variables included factors related to the dependent variables (PA, SI or loneliness) in the older adult literature. For models predicting levels of PA (LPA, MVPA or TPA), control variables included: gender, age (continuous), objectively-measured physical function (continuous), SF12 mental health component (continuous), SF12 physical health component (continuous) and access to a car in the household (binary) (Crombie et al., 2004; Fox et al., 2011; Steinmo et al., 2014; Vallance et al., 2012). For the models predicting the presence of SI (from family, from friends, from neighbours) or loneliness (the direct measure and the UCLA measure) control variables included gender, age (continuous), widowhood (binary) and duration of residence (years,

continuous), objectively-measured physical function (continuous), SF12 mental health component (continuous), SF12 physical health component (continuous) (Cacioppo et al., 2006; Victor & Bowling, 2012; Victor et al., 2006; Wenger & Burholt, 2004).

Fully-adjusted multivariate regression models were built for each dependent variable (three PA types, two loneliness measures, and three types of SI), using three steps**:**

1. **Independent variable selection:** Non-parametric Spearman correlation tests were applied to identify reasons for trips which were correlated with either one of the PA variables (LPA, MVPA or TPA) or with the loneliness or SI variables. Only the reasons for trips which were correlated significantly ($p<0.05$) with the dependent variable (PA, SI types, or two loneliness variables) were retained in subsequent regression models. This step was undertaken to minimise the number of regression models tested and therefore to reduce the chance of type two error.
2. **Model A (univariate)**: For each dependent variable (three PA types, two loneliness measured and three SI types), univariate models were created for each type of trip (independent variable) that was significantly correlated in the previous step. All control variables were simultaneously included in the univariate models. Ordinary-least square regression models were used for the continuous PA variables, and logistic regression models for the binary loneliness and SI variables. This step was performed to assess whether associations between reasons for trips and the dependent variables (PA, loneliness or SI) persisted when accounting for the variations in control variables, and to exclude any reasons for trips from the multivariate model if the relationship did not persist.
3. **Model B (multivariate):** The reasons for trips (independent variables) that remained significant in Model A were checked for collinearity using a non-parametric correlation test (defining collinearity as $r>0.7$). None were collinear using this definition. The reasons for trips which remained significant in Model A ($p<0.05$) were added into a multivariate model, along with all the control variables. This step was performed to assess whether reasons for trips were independently associated with the dependent variables (PA types, loneliness measures or SI types) when adjusting for the variations in the other reported reasons for trips.

5.3 Findings

5.3.1 Sample characteristics

A quarter (25.1%) of the invited participants were recruited into the study (n=113/450). Almost all recruited individuals were retained for both quantitative data collection visits (112/113). Time burden was the reason for the one participant drop-out. The sample of n=112 older adults lived across 23 rural villages or hamlets in the county Wiltshire in the South West of England. The mean age was 72.8 (SD 6.6) years and the sample contained almost equal proportions of males and females **(Table 5-1),** although there was no representation of ethnic diversity. Almost three quarters had a high physical function (70.5%), the most common education achievement was tertiary (40.2%) and over a third of the sample lived in high-earning households (35.7%). Women ($p<0.05$) and older respondents ($p<0.0001$) reported significantly lower incomes. Despite the generally high incomes, 15.2% were renting their home. Almost a quarter (23.3%) of respondents were still in paid work, with the majority of these working part-time (18.8%). About a fifth (22.3%) of the sample were relatively new to the area, living there nine years or fewer, while about a quarter (26.8%) of the sample had lived in their local area for 30 years or longer.

Table 5-1. Demographic characteristics of the quantitative SHARP sample

	Frequency (%)	Gender difference (p-values)	Age difference (p-values)
Age categories (Mean 72.8, SD 6.6)		0.78	NA
65 to 69 years	50 (44.6)		
70 to 74 years	23 (20.5)		
75 to 79 years	19 (17.0)		
80 to 84 years	14 (12.5)		
85+ years	6 (5.4)		
Sex (female)	58 (51.8)	NA	0.96
Physical function (SPPB)		0.47	<0.001[1]
Low (1-6)	7 (6.2)		
Mid (7-9)	26 (23.2)		
High (10-12)	79 (70.5)		

[1]Older age groups have significantly lower physical function; [2] More women and older participants were single or widowed; [3] More women and older participants reported lower household incomes.

Table 5-1. Demographic characteristics of the quantitative SHARP sample (continued)

	Frequency (%)	Gender difference (p-values)	Age difference (p-values)
White/Caucasian	112 (100.0)	NA	NA
Marital status		0.001[2]	0.03[2]
Married/in relationship	82 (73.2)		
Widowed (living alone)	21 (18.8)		
Single/separated (living alone)	9 (8.0)		
Education achieved		0.07	0.10
Middle school	2 (1.8)		
Some secondary school	3 (2.7)		
Completed secondary school	27 (24.1)		
Some college/vocational training	35 (31.3)		
Completed Tertiary education	45 (40.2)		
Household income		0.03[3]	<0.001[3]
More than £30,000	40 (35.7)		
£20-30,000	27 (24.1)		
£10-20,000	30 (26.8)		
£5-10,000	9 (8.0)		
Under £5,000	3 (2.7)		
Don't know	1 (0.9)		
Missing response	2 (1.8)		
Retirement status		0.51	0.98
Retired	86 (76.8)		
Working part time/casual hours	21 (18.8)		
Working full time	5 (4.5)		
House ownership		0.11	0.60
Own/buying/free stay	95 (84.8)		
Rent	17 (15.2)		
Residence duration (Mean 22.2, SD 12.4)		0.35	0.31
0 to 9 years	25 (22.3)		
10 to 19 years	26 (23.2)		
20 to 29 years	31 (27.7)		
30 to 39 years	21 (18.8)		
40 to 59 years	9 (8.0)		

[1]Older age groups have significantly lower physical function; [2] More women and older participants were single or widowed; [3] More women and older participants reported lower household incomes.

5.3.2 Descriptive statistics

Prevalence of social isolation types and loneliness

The full sample of n=112 (51.8% female, mean age 73, SD 7 years) provided responses to the SI and loneliness questionnaire items. Over two thirds (69.6%) of respondents were isolated from their family, 34.8% were isolated from friends, and 16.1% were isolated from neighbours, while only 7.1% of the sample were isolated from all three groups at once (family, friends and neighbours) **(Table 5-2)**. There were no significant gender or age differences observed for any of the SI variables. There was very little overlap between the types of SI **(Figure 5-1)**.

Table 5-2. Self-reported frequency of direct social contact

	Family (Freq. [%])	Friends (Freq. [%])	Neighbours (Freq. [%])	Family, Friends or Neighbours (Freq. [%])
Contact Frequency				
Daily	7 (6.3)	13 (11.6)	44 (39.3)	54 (48.2)
Weekly	27 (24.1)	60 (53.6)	50 (44.6)	50 (44.6)
Monthly	35 (31.3)	29 (25.9)	12 (10.7)	7 (6.3)
<Monthly	42 (37.5)	9 (8.0)	5 (4.5)	1 (0.9)
Never	1 (0.9)	1 (0.9)	1 (0.9)	0 (0.0)
'Socially isolated'[1]	**78 (69.6)**	**39 (34.8)**	**18 (16.1)**	**8 (7.1)**

[1] Social isolation defined as less than weekly direct contact (Victor et al., 2003).

Almost a quarter of respondents (24.1%) reported any loneliness assessed using the direct loneliness question; 19.6% were lonely 'some of the time' and 4.5% 'often' lonely **(Table 5-3)**. Using the UCLA score, 39.3% reported any loneliness (a response of 'some of the time' to at least one of the three indirect loneliness questions: a score of ≥4) **(Table 5-3)**. The one-item direct loneliness question measured only a small proportion of participants (2.7%) as lonely who did not report loneliness with the UCLA construct, while the UCLA score measured a high proportion (17.9%) of people as lonely who did not report loneliness with the single direct loneliness question. There were no significant gender or age differences in the frequency of feeling lonely measured through either loneliness measurement method**.** The two measurement types did, however, have a large area of overlap for individuals showing any loneliness **(Figure 5-1)**.

Table 5-3. Self-reported frequency of feeling lonely

	Single direct question (Freq. [%])	UCLA score (Freq. [%])
Loneliness frequency		
Hardly ever / UCLA 3	85 (75.9)	68 (60.7)
Some of the time / UCLA 4 to 6	22 (19.6)	37 (33.0)
Often / UCLA 7-9	5 (4.5)	7 (6.3)
Any loneliness[1]	**27 (24.1)**	**44 (39.3)**

[1] Any loneliness defined as either reporting being lonely 'some of the time' or 'often' for the one item question, or a UCLA score of 4 or greater.

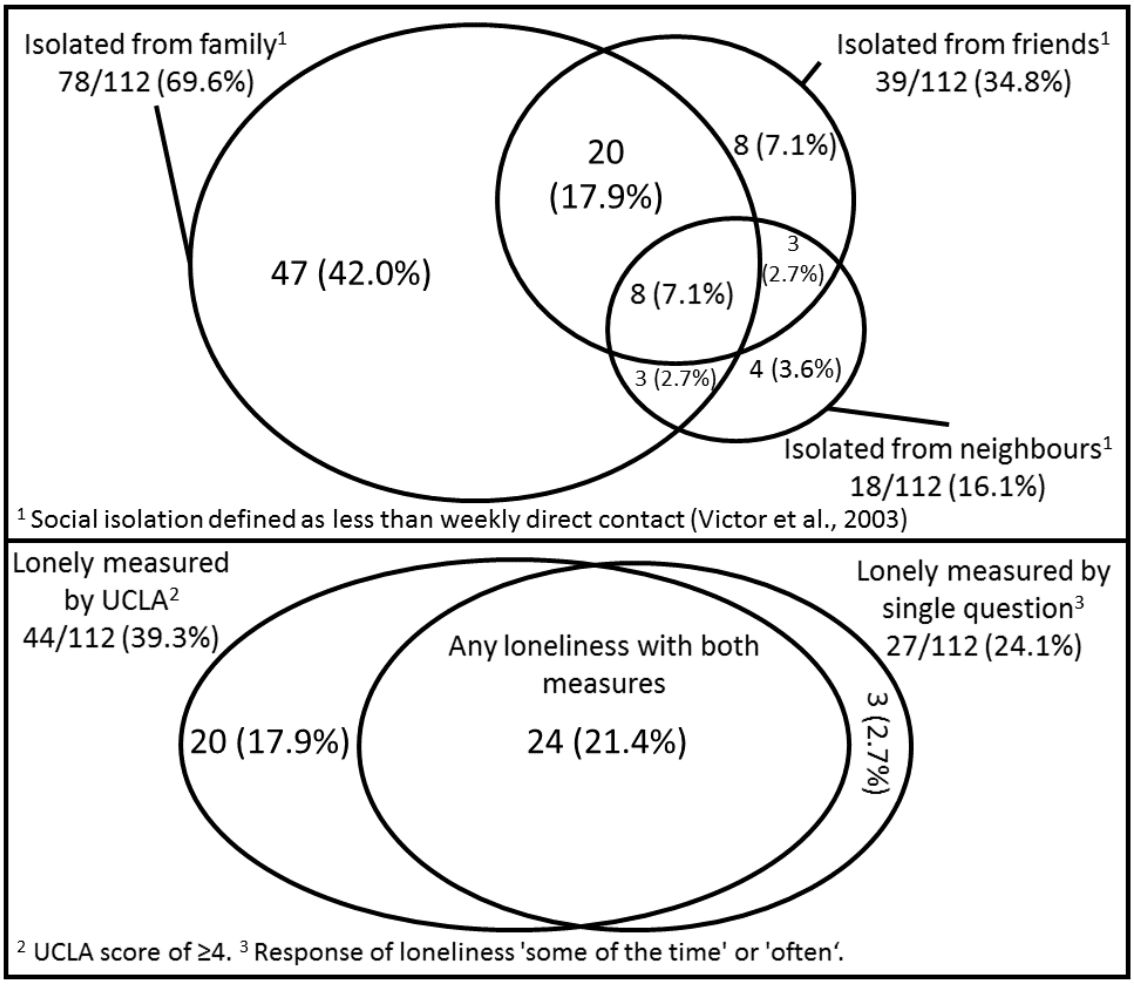

Figure 5-1. Venn diagrams of the overlap between types of SI, and between loneliness measures

Objectively-measured levels of physical activity

Valid accelerometer data was attained from n=106/112 participants. This sub-sample was equally split for gender (51% female), and the mean age was 73 years (SD 7 years) with ages ranging between 65 and 95 years. Participants engaged in a daily mean of 3.0 hours (SD 1.1) of LPA, 32.3 minutes (SD 25.6) of MVPA, and 3.5 hours (SD 1.3) of TPA. Women spent significantly more time in LPA than men ($p<0.01$), but did not differ from men in the duration of time spent in MVPA and TPA**.** Younger participants spent significantly more time in LPA ($p<0.05$), MVPA ($p<0.0001$) and TPA ($p<0.001$) than older age groups **(Table 5-4)**.

Table 5-4. Mean time/day spent in differing intensities of physical activity

	Whole sample (Freq. [%])	Men (Freq. [%])	Women (Freq. [%])	Gender diff. (p-value)	Age diff. (p-value)
LPA					
<=120 min.	18 (16.5)	13 (24.1)	5 (9.1)	<0.01[1]	<0.01[2]
120 to 150 min.	33 (30.3)	16 (29.6)	17 (30.9)		
150 to 180 min.	19 (17.4)	13 (24.1)	6 (10.9)		
180 to 210 min.	24 (22.0)	10 (18.5)	14 (25.5)		
> 210 min.	15 (13.8)	2 (3.7)	13 (23.6)		
Mean (SD) hrs.	3.0 (1.1)	2.7 (1.0)	3.3 (1.1)	<0.01[1]	<0.05[2]
MVPA					
<=10 min.	22 (20.2)	14 (25.9)	8 (14.6)	0.91	<0.001[3]
10 to 20 min.	24 (22.0)	8 (14.8)	16 (29.1)		
20 to 30 min.	11 (10.1)	8 (14.8)	3 (5.5)		
30 to 40 min.	14 (12.8)	5 (9.3)	9 (16.4)		
40 to 50 min.	14 (12.8)	4 (7.4)	10 (18.2)		
> 50 min.	24 (22.0)	15 (27.8)	0 (16.4)		
Mean (SD) min.	32.3 (25.6)	32.0 (26.7)	32.6 (24.7)	0.74	<0.0001[3]
TPA					
<=120 min.	14 (12.8)	9 (16.7)	5 (9.1)	0.08	<0.001[4]
120 to 150 min.	12 (11.0)	7 (13.0)	5 (9.1)		
150 to 180 min.	7 (6.4)	3 (5.6)	4 (7.3)		
180 to 210 min.	20 (18.4)	8 (14.8)	12 (21.8)		
210 to 240 min.	24 (22.0)	17 (31.5)	7 (12.7)		
240 to 270 min.	11 (10.1)	4 (7.4)	7 (12.7)		
> 270 min.	21 (19.3)	6 (11.1)	15 (27.3)		
Mean (SD) hrs.	3.5 (1.3)	3.2 (1.2)	3.8 (1.4)	0.05	<0.001[4]

[1] Women spent longer in LPA than men; Younger participants spent longer in LPA[2], MVPA[3], and TPA[4] than older participants.

Reasons for trips measured by activity diaries

Valid activity diary data was attained from n=109/112 participants. This sub-sample was equally split for gender (51% female), the mean age was 73 years (SD 6 years) and ages ranged from 65 to 95 years. The diary reports of being out of the house were seen to be a valid indicator of PA level, as they correlated significantly with minutes of LPA ($r=0.43$, $p<0.0001$), MVPA ($r=0.41$, $p<0.0001$) and with TPA ($r=0.49$, $p<0.0001$). Line graphs of the binary measure of trips outdoors and the LPA and MVPA from three randomly chosen consecutive participants, show that spikes of both LPA and MVPA activity tended to occur when individuals indicated being out on a trip **(Figure 5-2)**.

Shopping errands were the most common and most frequent reasons for making trips outdoors, and thereby of incidental PA out of the home, with almost all participants made a shopping trip at least once a week **(Figure 5-3)**. Visiting/social events and gardening were the next most common pursuits, both engaged in by over 60% of the sample, although only once or twice a week by most. All other pursuits were performed by 50% or fewer of the participants. While just under 30% of the sample walked a dog in the measured week, most of these did so four or more times per week.

There were no statistical differences between men and women in their weekly frequency of engaging in the specific activities. Gardening, around-house pursuits and sports or exercise frequency differed across age groups ($p<0.01$). Both gardening and around-house pursuits were done more frequently by the youngest (65 to 69 years) and the oldest participants (80 years or above) than by the participants in the middle age-categories (70 to79 years), while sports or exercise was done more frequently by the younger participants (65 to 69 years).

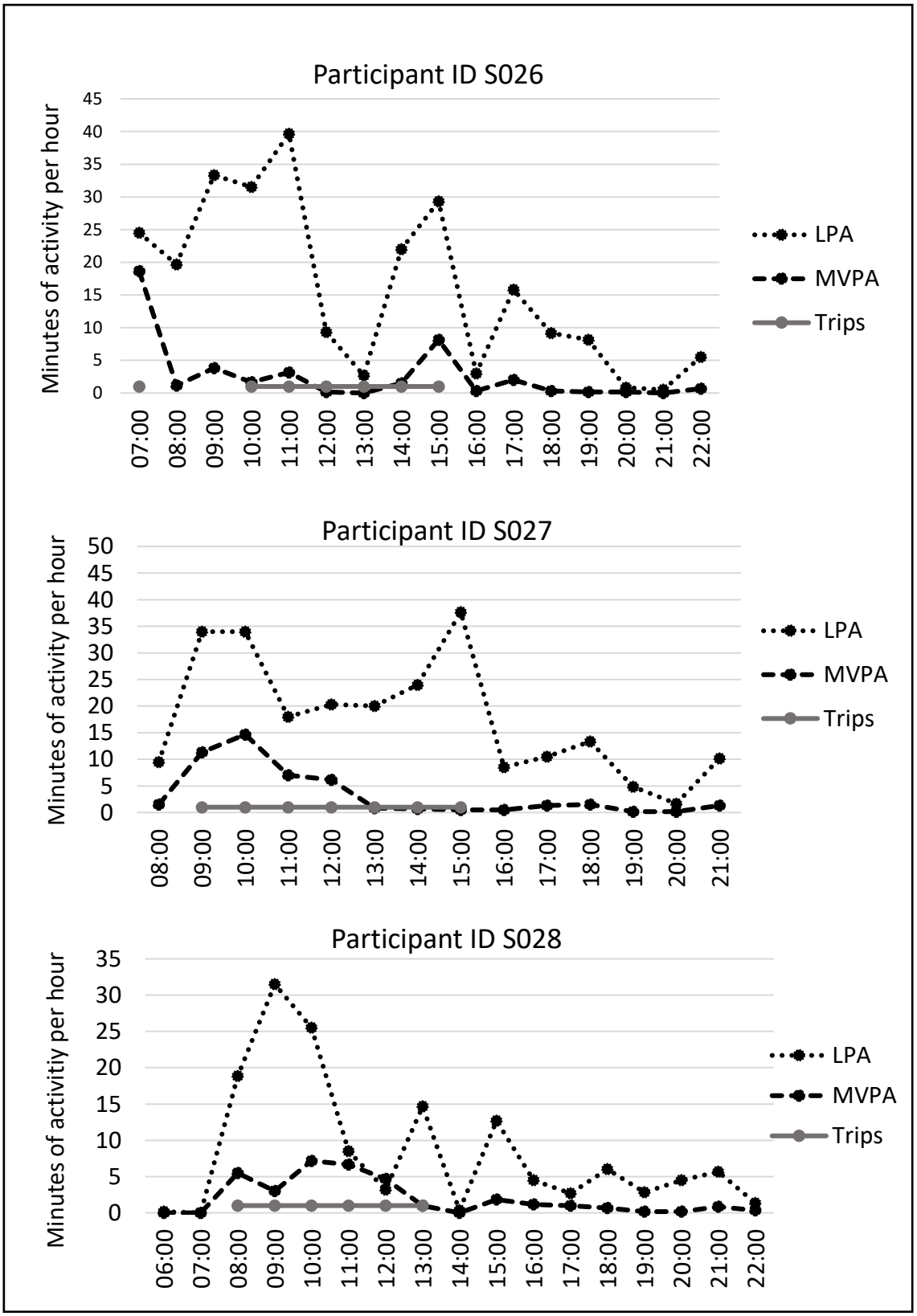

Figure 5-2. Concordance between reports of trips in diaries and minutes of Actigraph-measured physical activity levels for three participants (ID S026, S027 and S028)

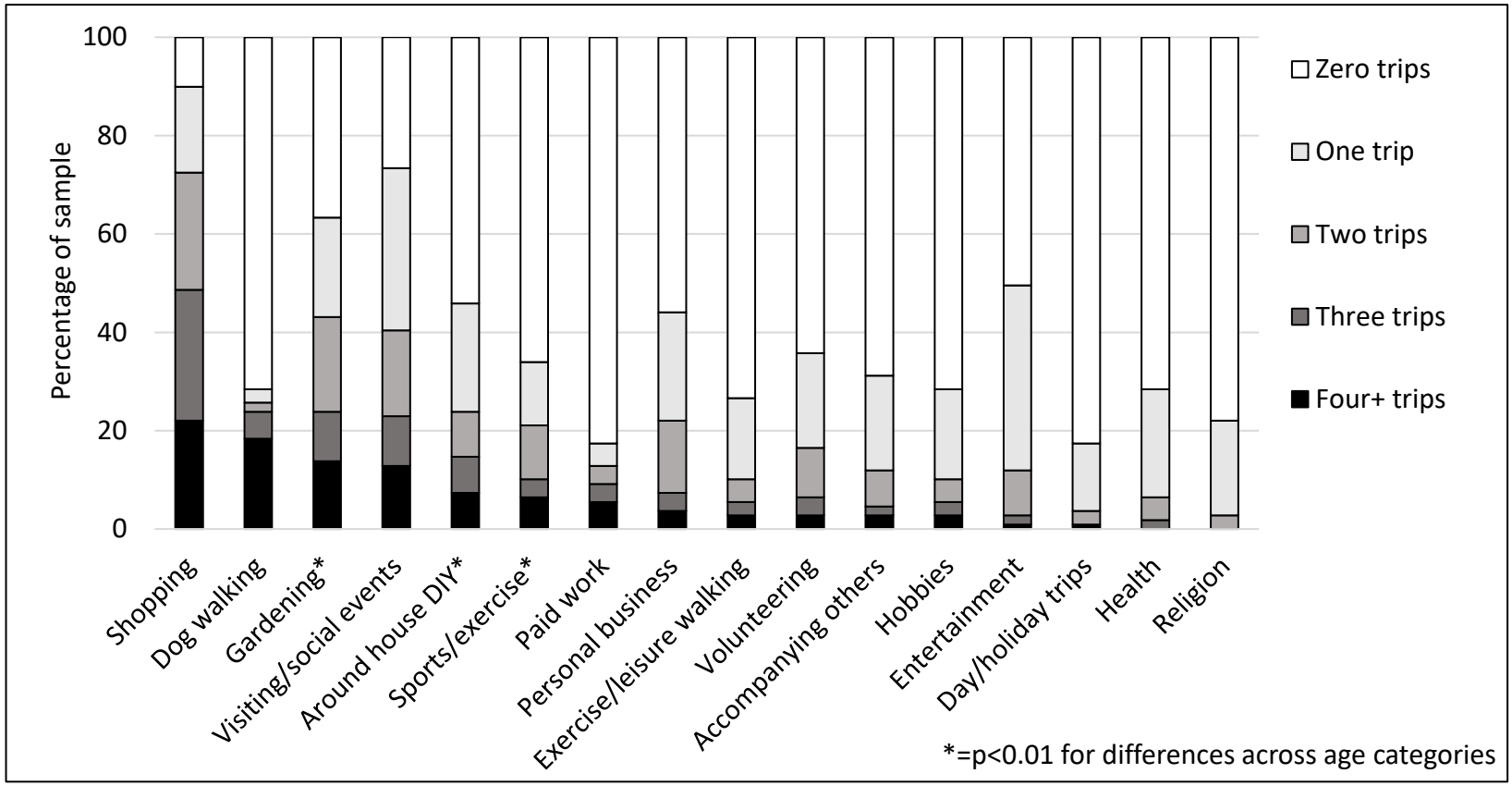

Figure 5-3. Frequency of weekly trips for different reasons measured using the seven-day activity diary

5.3.3 Associations between levels of physical activity and the likelihood of social isolation types or loneliness

Physical activity and social isolation types

Both the LPA and TPA variables, but not the MVPA variable, made significant contributions to the regression models predicting SI from family (LPA: LR chi^2=6.85, p<0.01; MVPA: LR chi^2=1.64, p=0.20; TPA: LR $chi^{2=}$7.38, p<0.01). However, in regression models adjusted for control variables none of the categories of LPA and TPA significantly decreased the odds of SI from family in reference to the base (≤120 minutes) to satisfy the significance value of p<0.003 **(Table 5-5)**. LPA, MVPA and TPA did not make significant contributions to regression models predicting SI from friends (LPA: LR chi^2=0.25, p=0.62; MVPA: LR chi^2=0.03, p=0.87; TPA: LR chi^2=0.00, p=0.99) or to models predicting SI from neighbours (LPA: LR chi^2=0.75, p=0.39; MVPA: LR chi^2=3.60, p=0.06; TPA: LR chi^2=2.86, p=0.09).

Physical activity and loneliness

LPA, MVPA and TPA did not make significant contributions to regression models predicting the direct loneliness variable (LPA: LR chi^2=0.14, p=0.71; MVPA: LR chi^2=1.52, p=0.22; TPA: LR chi^2=0.03, p=0.87) or the UCLA loneliness variable (LPA: LR chi^2=0.16, p=0.69; MVPA: LR chi^2=0.17, p=0.68; TPA: LR chi^2=0.44, p=0.51). There were also no significant associations between these two loneliness variables and each category of LPA, MVPA or TPA in reference to the baseline **(Table ix-3, Appendix F: p. 264)**.

Table 5-5. Multivariate regression outcomes for LPA, MVPA and TPA predicting SI from family, SI from friends and SI from neighbours

	SI from family		SI from friends		SI from neighbours	
	OR	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
LPA (ref: ≤ 120 min)						
120 to 150 min	0.46	0.08, 2.50	6.91*	1.05, 45.42	0.42	0.07, 2.42
150 to 180 min	0.32	0.05, 2.31	5.00	0.68, 36.79	0.63	0.09, 4.38
180 to 210 min	0.23	0.04, 1.38	4.32	0.61, 30.70	0.89	0.15, 5.18
> 210 min	0.09*	0.01, 0.69	4.92	0.57, 42.24	0.16	0.01, 2.08
Control variables						
Widowed	0.20*	0.05, 0.83	0.26	0.04, 1.55	1.42	0.26, 7.74
Older age (years)	0.96	0.87, 1.05	1.06	0.96, 1.17	0.88*	0.78, 1.00
Household income	1.54	0.90, 2.63	1.68	0.95, 2.95	0.99	0.52, 1.86
Residence years	0.98	0.94, 1.01	0.96	0.92, 1.00	1.01	0.96, 1.05
Physical function	0.99	0.65, 1.53	0.80	0.55, 1.17	0.73	0.47, 1.14
SF-12 PCS[1]	1.00	0.97, 1.03	0.97	0.94, 1.00	1.01	0.98, 1.05
SF-12 MCS[2]	0.98	0.94, 1.02	1.04	1.00, 1.10	1.00	0.95, 1.04
MVPA (ref: ≤ 10 min)						
10 to 20 min	0.14	0.02, 1.07	6.28	0.82, 48.32	0.89	0.08, 10.09
20 to 30 min	0.31	0.03, 3.85	5.18	0.51, 52.90	3.99	0.35, 45.53
30 to 40 min	0.21	0.02, 1.88	4.08	0.45, 36.62	1.00	
40 to 50 min	0.10*	0.01, 0.93	1.32	0.11, 15.50	0.35	0.03, 4.36
> 50 min	0.15	0.02, 1.35	3.40	0.40, 29.16	0.31	0.03, 3.65
Control variables						
Widowed	0.35	0.09, 1.30	0.32	0.06, 1.72	1.46	0.26, 8.31
Older age (years)	0.95	0.86, 1.06	1.01	0.91, 1.12	0.85*	0.73, 0.99
Household income	1.66	0.99, 2.80	1.36	0.81, 2.29	0.94	0.48, 1.84
Residence years	0.99	0.95, 1.03	0.96	0.92, 1.00	1.00	0.95, 1.04
Physical function	1.22	0.75, 1.99	0.68	0.43, 1.07	0.70	0.41, 1.20
SF-12 PCS	1.00	0.97, 1.03	0.98	0.95, 1.01	1.02	0.98, 1.06
SF-12 MCS	0.98	0.94, 1.02	1.05*	1.00, 1.10	1.00	0.95, 1.05
TPA (ref: ≤ 120 min)						
120 to 150 min	0.92	0.06, 13.29	12.92*	1.03, 162.17	0.53	0.05, 6.16
150 to 180 min	0.28	0.02, 3.70	258.64**	7.77, 9.E+03	0.87	0.04, 19.14
180 to 210 min	0.12	0.01, 1.11	23.66*	1.72, 324.59	0.85	0.09, 7.57
210 to 240 min	0.14	0.01, 1.55	9.08	0.61, 134.49	0.41	0.04, 3.98
240 to 270 min	0.21	0.02, 2.88	19.46*	1.14, 333.52	0.22	0.01, 4.05
> 270 min	0.05*	0.00, 0.66	9.20	0.60, 140.70	0.14	0.01, 1.89
Control variables						
Widowed	0.16*	0.03, 0.75	0.17	0.02, 1.26	1.42	0.25, 8.13
Older age (years)	0.94	0.84, 1.04	1.02	0.92, 1.14	0.85*	0.74, 0.98
Household income	1.46	0.84, 2.52	2.00*	1.07, 3.75	0.94	0.49, 1.81
Residence years	0.98	0.94, 1.02	0.95*	0.91, 1.00	1.00	0.96, 1.05
Physical function	1.00	0.64, 1.56	0.64	0.41, 1.02	0.70	0.44, 1.11
SF-12 PCS	1.01	0.98, 1.04	0.96*	0.93, 1.00	1.02	0.98, 1.06
SF-12 MCS	0.97	0.93, 1.02	1.06*	1.00, 1.12	0.99	0.95, 1.04

*0.05, **0.01. [1] Physical component score, [2] Mental Component Score.

5.3.4 Associations between reasons for trips and levels of physical activity, social isolation types or loneliness

Trips for volunteering

Trips for volunteering were associated with MVPA and TPA, but not with LPA, in the univariate models. When added into the multivariate models these associations remained significant for predicting more minutes of MVPA (B=41.84, p<0.01, 95% CI 17.57 to 66.12) and TPA (B=96.68, p<0.05, 95% CI 17.86 to 175.50) **(Table 5-6)**. Trips for volunteering also significantly decreased the likelihood of being isolated from neighbours in the univariate controlled model (OR=0.23, p<0.05, 95% CI 0.06 to 0.91) which was not developed into a multivariate model due to the lack of associations with other pursuits **(Table 5-7)**. Trips for volunteering were not correlated with the two loneliness measures nor with isolation from friends or from family, and therefore these associations were not explored in regression models. For correlation statistics see **Table ix-3 (Appendix F: p. 264).**

Trips to accompany others

Trips to accompanying others were associated with LPA and TPA in the univariate models, but when added into the multivariate models the association only persisted for predicting more minutes of LPA (B=88.47, p<0.05, 95% CI 16.68 to 160.26) **(Table 5-6)**. As trips to accompany others were not correlated with MVPA this association was not explored in a regression model. Trips to accompany others also significantly decreased the likelihood of SI from family (B=0.39, p<0.01, 95% CI 0.22 to 0.68) which was not developed into a multivariate model due to the lack of associations with other pursuits **(Table 5-7)**. Trips to accompany others were not correlated with the two loneliness measures nor with isolation from friends or from neighbours, and therefore these associations were not explored in regression models.

Table 5-6. Correlation, univariate and multivariate regression outcomes for reasons for trips as predictors of LPA, MVPA and TPA

		Model A (univariate)		Model B (multivariate)	
	R[1]	B	95% CI	B	95% CI
LPA					
Volunteering	0.242*	63.78	-7.36, 134.91	(Not carried forward)	
Accompany	0.217*	89.77*	13.81, 165.73	88.47*	16.68, 160.26
Gardening	0.362***	66.62**	28.94, 104.30	66.16**	29.40, 102.93
Control variables					
Female				207.22**	64.42, 350.01
Older age[2]				-8.86	-21.44, 3.72
Car access				103.82	-245.77, 453.42
PF[3]				65.96*	10.32, 121.59
SF-12 PCS[4]				3.65	-0.54, 7.85
SF-12 MCS[5]				-13.59***	-19.75, -7.43
MVPA					
Volunteering	0.305**	40.87**	14.97, 66.76	41.84**	17.57, 66.12
Sports/ex.[6]	0.401***	37.16**	16.48, 57.83	37.86***	18.23, 57.50
Ex. walking	0.337***	24.38	-0.57, 49.33	(Not carried forward)	
Control variables					
Female				8.48	-43.46, 60.41
Older age				-10.42***	-15.08, -5.76
Car access				-49.97	-175.49, 75.55
PF				-10.33	-30.55, 9.89
SF-12 PCS				3.11***	1.59, 4.62
SF-12 MCS				-1.59	-3.85, 0.67
TPA					
Volunteering	0.286**	104.64*	21.69, 187.60	96.68*	17.86, 175.50
Accompany	0.212*	94.20*	3.72, 184.68	75.28	-9.83, 160.40
Gardening	0.341***	75.69**	30.85, 120.52	76.70**	33.71, 119.70
Control variables					
Female				232.02**	64.20, 399.84
Older age				-20.50**	-35.24, -5.75
Car access				41.29	-367.93, 450.52
PF				56.63	-8.44, 121.71
SF-12 PCS				6.73**	1.83, 11.64
SF-12 MCS				-14.92***	-22.13, -7.72

* p<0.05, ** p<0.01, *** p<0.001; [1] Spearman's Rho; [2] Age increases of one year; [3] Physical Function; [4] Physical Component Score; [5] Mental Component Score.

[6] Exercise. Note: Model A and B include all control variables.

Trips for gardening

Trips for gardening were associated with LPA and TPA in the univariate controlled models and, when carried forward into the multivariate models, remained significant for predicting more minutes of LPA (B=66.16, p<0.01, 95% CI 29.40 to 102.93) and TPA (B=76.70, p<0.01, 95% CI 33.71 to 119.70) **(Table 5-6)**. As trips for gardening were not correlated with MVPA this association was not explored in a regression model. Trips for gardening were also not correlated with the two loneliness measures, or with any of the SI types, so these were also not explored in regression analyses.

Trips for sports or exercise

Trips for sports or exercise were associated with more minutes of MVPA in the univariate controlled model and this association remained significant in the multivariate model (B=37.86, p<0.001, 95% CI 18.23 to 57.50) **(Table 5-6)**. Trips for sports or exercise were not correlated with LPA or TPA, so these relationships were not explored in regression models. More frequent trips for sports or exercise also predicted a lower likelihood of SI from friends, in both the univariate and multivariate controlled models (B=0.56, p<0.01, 95% CI 0.33 to 0.97) **(Table 5-7)**. Trips for sports or exercise were not correlated to either of the loneliness variables or to SI from family or from neighbours, so these associations were not explored in regression models.

Trips for exercise walking

Although a significant correlation existed between trips for exercise-motivated walking and MVPA, this association was not significantly associated with MVPA in the univariate model, and therefore not carried forward to the multivariate model **(Table 5-6)**. Trips for exercise-motivated walking were not correlated with LPA or TPA or with loneliness, SI from family, from friends or from neighbours, so these relationships were not explored with regression models.

Table 5-7. Correlation, univariate and multivariate regression results for reasons for trips as predictors of different types of SI

		Model A (univariate)		Model B (multivariate)	
	R[1]	OR	95% CI	OR	95% CI
SI from friends					
Sports/exercise	-0.260**	0.55*	0.34, 0.92	0.56*	0.33, 0.97
Hobbies	-0.341***	0.45*	0.22, 0.91	0.50	0.24, 1.05
Religion	-0.194*	0.25*	0.07, 0.90	0.29	0.08, 1.09
Control variables					
Female				0.98	0.38, 2.54
Older age[2]				0.96	0.88, 1.05
Widowed				0.36	0.08, 1.73
Residence yrs.				0.98	0.94, 1.02
Physical function				0.90	0.61, 1.34
SF-12 PCS[3]				0.98	0.95, 1.01
SF-12 MCS[4]				1.04	1.00, 1.09
SI from neighbours					
Volunteering	-0.287**	0.23*	0.06, 0.91		
Control variables					
Female		1.26	0.39, 4.03		
Older age		0.90	0.81, 1.00		
Widowed		1.34	0.29, 6.09		
Residence yrs.		0.98	0.94, 1.03		
Physical function		0.72	0.47, 1.10		
SF-12 PCS		1.01	0.98, 1.05		
SF-12 MCS		0.99	0.95, 1.03		
SI from family					
Accompanying	-0.279**	0.39**	0.22, 0.68		
Control variables					
Female		0.47	0.16, 1.36		
Older age		0.95	0.87, 1.04		
Widowed		0.22*	0.06, 0.85		
Residence yrs.		0.97	0.94, 1.01		
Physical function		0.86	0.57, 1.29		
SF-12 PCS		1.01	0.98, 1.04		
SF-12 MCS		0.98	0.94, 1.02		

*p<0.05, **p<0.01, ***p<0.001; [1] Spearman's Rho; [2] Age increases of one year; [3] Physical Component Score; [4] Mental Component Score. Note: model A and B include all control variables.

Summary of exploratory associations

The reasons for trips which were associated with both more minutes of an objectively-measured PA variable and lower odds of one of the three types of SI in the multivariate regression models were: 1) volunteering; 2) accompanying others; and 3) sports or exercise **(Figure 5-4)**. None of the reasons for trips were associated with a lower likelihood of loneliness.

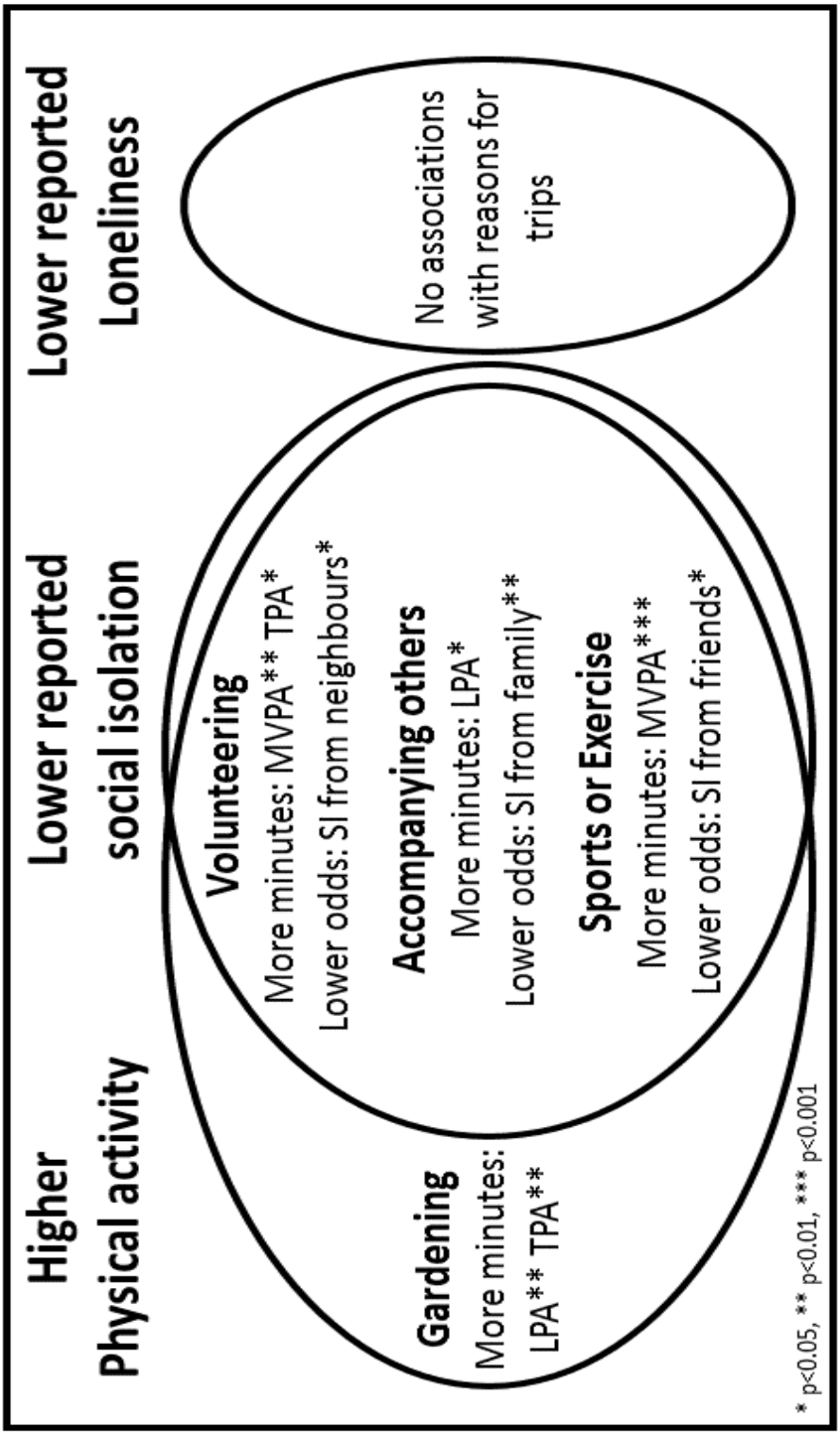

Figure 5-4. Associations between reasons for trips and higher levels of LPA, MVPA or TPA, and a lower likelihood of SI types and loneliness from multivariate regression models

5.4 Discussion

5.4.1 Summary of the findings

This study has generated updated prevalence statistics of objectively-measured PA, SI types and loneliness in a rurally-living sample aged 65 and above, and found a higher than expected PA level in women, and preliminary indications of a lower prevalence of loneliness in rurally-living older adults when compared with nationally-representative UK data. Secondly, this study explored the associations previously found between self-reported PA and loneliness (Hawkley et al., 2009; Pels & Kleinert, 2016) and SI (Shankar et al., 2011) in an older, rurally-living population. Surprisingly, no evidence was found for these associations when using objective measurements of overall LPA, MVPA and TPA. This study also explored whether specific reasons for trips out of the house could be associated with both higher PA levels and with a lower likelihood of SI types or loneliness. Trips for volunteering, accompanying others, sports or exercise and gardening were each associated with a higher weekly PA level (LPA, MVPA or TPA), the first three of which were also associated with a lower likelihood of a SI type (from neighbours, family, and from friends, respectively). Given the limited current evidence on PA levels, SI and loneliness in rurally-living older populations in the UK, this study adds important new insights into the behavioural and social characteristics of this population. However, these findings cannot be interpreted as decisive given their exploratory nature, cross-sectional design, small sample size and confinement to the south-west of England. Replication studies with larger, more geographically diverse samples and using longitudinal or interventional study designs are necessary as well as qualitative explorations aimed at explaining the current findings.

5.4.2 Contribution to literature

Prevalence of SI and loneliness in rurally-living older adults

A comparison between the SHARP SI prevalence with other UK-based studies is difficult to make, given the heterogeneity in SI measurement techniques **(Chapter 2, Section 2.2.1, p. 31)**. However, it seems that overall SI may not be very different from national population levels. An analysis of waves one through five of ELSA data found that SI

(termed detachment from social networks) remained relatively stable around 5% for men and women combined, with it being lower for women (2 to 3%) and higher for men (6 to 7%) (Jivraj et al., 2012). Overall SI in the SHARP sample stood at 7.1% (6.9% of women, 7.4% men). Using the same ELSA data, Jivraj et al. (2016) found that 33.5% of English middle-aged and older adults see their family once a week, 58.5% see their children once a week and 57.8% see their friends once a week. In the rural SHARP sample these frequencies were not dissimilar, although frequency of seeing family and children was captured in one variable, and seems slightly lower in the rural SHARP sample, at 30.4% seeing family on a daily or weekly basis, than in the national ELSA sample. However the SHARP data, including adults aged 65 and above, cannot be directly compared with ELSA data as it includes adults aged 52 and above (Jivraj et al., 2012).

The SHARP analysis gives a preliminary indication that loneliness may be experienced by a smaller proportion of older people living in rural communities in the south west of England than nationally across England. In the SHARP sample 4.5% reported feeling 'often' lonely and 19.6% reported feeling lonely 'some of the time'. Studies with similar age older adults living in the UK found these to be 9% and 30%, respectively, at the baseline of the Omnibus Survey of 999 nationally-representative older adults (Victor & Bowling, 2012), 7.4% and 18.4%, respectively, in the UK sample of 2,393 older adults in the European Social Survey (Victor & Yang, 2012), and 7.7% and 38.3%, respectively, in 1,255 randomly sampled older adults in the Barnsley metropolitan area (Dahlberg & McKee, 2014). Nevertheless, an analysis of data from older adults across rural and urban geographies in Ireland found no significant difference between the loneliness scores in urban and rural areas, as measured by the 3-item UCLA scale (Burholt & Scharf, 2013). However, the Irish culture, socio-demographic characteristics and rural service provisions are likely different from those in the south west of England. A higher income has been shown to correlate with lower rates of loneliness in 7,780 older adults in wave two from ELSA (Demakakos et al., 2006) and a higher education level has previously predicted lower rates loneliness in European older samples (Fokkema et al., 2012; Savikko, Routasalo, Tilvis, Strandberg, & Pitkälä, 2005). Therefore, it may be that the lower rate of loneliness in the SHARP sample relative to national English samples is due to the high education and income levels in the SHARP sample. Finally, the minimal

overlap found between self-rated loneliness and SI confirms and strengthens the GaPL findings that these are separate concepts and should not be used interchangeably (de Koning et al., 2016).

Levels of physical activity in rurally-living older adults

Women in the SHARP sample reported higher levels of LPA than men. This is consistent with findings from OPAL showing that men engaged in more sedentary time than women in 240 city-dwelling older adults (Davis et al., 2011b). However, SHARP data shows a different MVPA trend between genders compared with data from urban populations. In SHARP, women achieved similar levels of MVPA as men while a study of 2,450 adults between age 70 to 93 across 25 UK towns (Jefferis et al., 2014) and the OPAL study (Davis et al., 2011b) found that older men spent significantly more time in MVPA than women. The OPAL study reported 22.6 ± 18.3 and 14.3 ± 18.3 minutes spent in MVPA by men and women, respectively (Davis et al., 2011b), while this was 32.0 ± 26.7 and 32.6 ± 24.7 minutes for men and women, respectively, in SHARP. Notwithstanding this, this comparison must be viewed with caution, due to important differences in the samples contributing to the analysis. For example, the mean age in OPAL sample was older than that in SHARP and the latter appeared more affluent. Although at least one other study has collected objective PA data form rurally-living older people (McMurdo et al., 2012), this publication did not present the MVPA levels of the rurally-living sub-sample or compare MVPA between its urban and rural participants. To further explore whether rurally-living women do achieve more MVPA than their urban peers, the OPAL, McMurdo and SHARP data could be analysed together, statistically controlling for variables such as age, education and wealth.

Reasons for trips associated with higher levels of physical activity

The SHARP findings provide new insights into the reasons for trips out of house, and therefore modes of accumulating LPA, MVPA and TPA, engaged in by rurally-living older adults. Shopping, gardening and social visits/events were the reasons for trips engaged in by the most people. Previously, such findings were only known for older people in urban environments in the UK (Davis et al., 2011a). The high frequency of shopping

errands and social events found in the SHARP data is consistent with the urban-based OPAL findings (Davis et al., 2011a). Knowing the naturally-occurring pursuits in a rural context can inform interventions aimed at helping rurally-living older adults increase or maintain their levels of PA. For instance, the findings show that gardening was engaged in by 65 out of 109 participants (63%) while sports or exercise was only engaged in by 37 out of 109 participants (34%). Park, Lee, and Son (2011); Park et al. (2012); Park, Shoemaker, and Haub (2008); Park, Shoemaker, and Haub (2009) have demonstrated that gardening tasks provide a range of low to moderate-intensity PA for older adults. Thus, in a rural context a public health campaign to facilitate gardening-related PA may be an effective strategy for engaging older people.

Lack of association between physical activity and loneliness

The finding that objectively-measured PA was not associated with a lower odds of loneliness is consistent with the lack of associations between several self-reported direct and proxy PA variables and loneliness in Chapter 4 **(Section 4.3.3, p. 100)** as well as findings from previous studies using objective PA measures in nationally-representative older populations (Harris et al., 2009; Newall et al., 2013). However, the finding is inconsistent with the theoretical extension of the loneliness model presented by Hawkley and Cacioppo (2010). The loneliness model reasons that lonely individuals may withdraw themselves from company and as a result attain less PA by engaging in less out of house activity. The current finding contradicts longitudinal findings of 229 older adults which found a predictive association between loneliness and low self-reported levels of PA three years later (Hawkley et al., 2009), as well as cross-sectional data linking loneliness with lower self-rated PA in 1,663 older adults in Israel (Netz et al., 2013) and the general conclusion of the systematic review of 36 studies assessing the association between loneliness and PA by Pels and Kleinert (2016).

A key difference between the SHARP data and previous studies is the use of objective PA measures in the former and the use of self-reported PA measures in the latter (all but two studies in the review by Pels and Klenert [2016] used self-reported PA). As Hawkley et al. (2009) found that poor self-regulation of emotion and diminished hedonic

regulation mediated the association between loneliness and lower self-reported PA in older adults, it could be that lonely individuals are more likely to under-report their PA levels due to this reduced emotional and hedonic regulation (i.e. feeling more negative about themselves). Loneliness has also been causally linked to depression in longitudinal studies (Cacioppo et al., 2010; Jaremka et al., 2014). Thus, depressive traits may also be attributable to lonely individuals having a more negative view of their PA level than non-lonely individuals, perhaps independently from their actual, objective level of PA. This would be consistent with findings from 228 Canadian adults, aged 77 to 96, showing that perceived PA, but not accelerometer-measured PA, predicted loneliness over two years (Newall et al., 2013).

The lack of association between loneliness and objectively measured PA makes one question the plausibility that loneliness leads to poorer long-term physical health through the mechanism of reduced overall PA as proposed by Hawkley and Cacioppo (2010). However, this pathway may hold when considering self-reported PA. A pooled analysis of 661,137 men and women from six population-based cohort studies found a clear dose-response relationship between higher self-reported MVPA and lower odds of mortality over a median follow-up of 14.2 years (Arem et al., 2015). Similar to how better self-reported health predicts delayed mortality (Verropoulou, 2014), it may also be that a more positive view of one's PA level, independent from objective PA level, could be related to delayed mortality. Nevertheless, the largest prospective study to date, following 466,901 participants between age 40 and 69 over six years, looking at associations between loneliness, SI and mortality only reported smoking and alcohol use, not self-reported moderate or vigorous PA, to be associated with loneliness (as well as SI) (Elovainio et al., 2017). Thus, significant controversy remains in the literature regarding the mechanistic role of lower PA between loneliness and deteriorations in long-term health.

Associations between physical activity and types of social isolation

The findings that objectively-measured LPA, MVPA and TPA were not associated with SI types (from friends, from neighbours or from family) substantiates similar findings in

Chapter 4 using the GaPL dataset, although this used self-reported PA **(Sections 4.3.4, p. 101 and 4.3.5, p. 104)**. However, it is inconsistent with the findings from an analysis of nationally-representative ELSA data which found that higher levels of self-reported PA lowered the likelihood of SI in adults aged 52 and above (Shankar et al., 2011). The association found by Shankar et al. (2011) with self-reported PA may have been due to their inclusion of 'participation in social activities' in the SI measure, which could be an inherently active type of social contact. In contrast the SHARP study used a measure only concerning contact frequency, and thus this could be social contact at home or during any other non-active pursuits. Again, another reason for the disparity in findings may be the use of self-rated leisure-time PA by Shankar et al. (2011) and accelerometry in the SHARP data. Accelerometer-measured PA includes all incidental PA, accrued in isolation or with others, whereas self-reported leisure-time PA will include, for the large part, participation in activities which include social contact (Colbert et al., 2011).

Nevertheless, some reasons for trips were associated with both more weekly LPA or TPA and a lower likelihood of a SI type: volunteering was associated with both MVPA and lower odds of SI from neighbours; accompanying others was associated with both LPA and lower odds of SI from family; and sports or exercise was associated with both MVPA and lower odds of SI from friends. It could be that overall objective LPA, MVPA or TPA were not directly associated with SI types because these include all minutes of LPA, MVPA and TPA accrued in daily life, including those generated in solitary tasks like walking by oneself, exercising at home, gardening or household tasks. Volunteering, accompanying others and sports or exercise, on the other hand, often include social contact and may therefore contribute to the avoidance of SI. Volunteering interventions have shown some benefits for social contact frequency (Stathi et al., 2015) and increases in PA measured objectively through daily steps in older adults living in urban settings (Varma et al., 2016). Interventions based on structured PA programmes for older adults have found subjective social benefits as a result of the exercise engagement (Martin & Woods, 2012; Stathi, McKenna, & Fox, 2010). Thus, the use of exercise and volunteering-based interventions, as already widely done in the literature (Jenkinson et al., 2013; Moore et al., 2016), may be fruitful avenues for improving both PA level as well as

frequency of social contact with neighbours and with friends for older people in rural settings.

5.4.3 Strengths and limitations

The key strength of this study was the use of the accelerometer-derived PA data and the in-depth analysis of open responses in prospective seven-day activity diaries. Objective measures of PA are superior to self-reported PA questionnaires as the latter is affected by overestimations, recall difficulties and socially-desirable answers (Colbert et al., 2011; Strath et al., 2013). The SHARP data therefore improved upon the GaPL findings, in which PA was estimated through retrospective ratings of frequency of specific types of PA or exercise from questionnaire data. However, a limitation of the particular accelerometers used was their inability to be worn in water, and so any water-based exercise was not recorded. Newer accelerometer models which are able to be worn in water are recommended for future studies. The seven-day activity diaries which collected information on activity types and frequencies prospectively, is likely to have given more accurate information than the retrospective activity questionnaire items available in the GaPL dataset and in other cross-sectional studies, due to a much shorter recall time-frame (Kamiya, Whelan, Timonen, & Kenny, 2010; Kouvonen et al., 2011). The analysis of how specific pursuits were associated with both PA and with SI types or loneliness over the same time frame was novel, as neither the OPAL study (Davis et al., 2011a) nor that by McMurdo et al. (2012) performed such an analysis. However, as only one week was recorded in the diaries and with the accelerometers, these may have observed an unrepresentative week, for instance during a holiday or a period of illness.

The questionnaire items selected for the SHARP study improved upon some of the items included in the GaPL questionnaire. The SHARP questionnaire used a direct loneliness variable with three levels of responses (‘most of the time’, ‘some of the time’ and ‘almost never’) instead of the one item ‘yes/no’ loneliness question used in the GaPL study. The difference in loneliness rate between the SHARP sample (24.1%, **Table 5-3, p. 137**) and the GAPL sample (13%, **Figure 4-1, p. 101**) may be explained by this difference in loneliness measure. The response categories ‘yes’ and ’no’ used in GaPL

could have led individuals who felt lonely only 'some of the time' to answer 'no'. The SHARP study also employed SI variables that were more detailed than those used in the GaPL questionnaire, with SI from neighbours and friends measured separately, instead of merged into one measure. Implications of the limitations in GaPL data have been discussed in more detail in Chapter 4 **(Section 4.4.4, p. 111)**.

Using GP patient lists to select and invite participants increased the chances of recruiting a representative sample due to the ability to randomly select participants from an almost complete list of the older population in the sampling area. This led to the inclusion of participants across 23 different rural villages and an equal representation of men and women. Rural villages tend to be diverse in their social and geographical characteristics (Manthorpe et al., 2008; Manthorpe et al., 2004) therefore including such a large number of villages allowed the sample to be more representative of a wide range of rural village types. A limitation of using GP practices as recruitment agents was the inability to know the mean age and sex profile of the 450 people sent an invitation due to the requirement for patient confidentiality. It was therefore not known how representative the recruited participants were of all who had been invited.

The SHARP study was limited due to the constrained time-frame and resources of a PhD study. The key limitations are its cross-sectional design, limited sample size of n=112 and limited geographical and socio-demographical diversity of the sample. Taken together, the SHARP results are mostly exploratory, rather than hypothesis confirming. The cross-sectional nature of the dataset precludes the ability to make assumptions about causality in any relationships seen. The limited sample size may have allowed certain outliers to exert a strong influence on the regression outcomes assessing the relationship between PA and SI types or loneliness (Tabachnick & Fidell, 2007). The sample, all living in one county in South West England, showing no ethnic diversity and being generally quite affluent and highly educated also limits the generalisability to rural areas in other counties of the UK where socio-demographic characteristics are different (Office for National Statistics, 2016d). The relatively high household income and education may also be evidence of selection bias of individuals with higher PA levels (Dollman, Hull, Lewis, Carroll, & Zarnowiecki, 2016) and lower SI (Jivraj et al., 2012) and

loneliness levels (Demakakos et al., 2006) than in less wealthy or educated samples. The data were also collected between August and December 2014. While the advantage of this is that it may have captured a mean over two extremes of seasonal variation, both PA and SI or loneliness values may have differed if the data had been collected only over the summer months (Tucker & Gilliland, 2007; Victor et al., 2015).

There are also statistical limitations to heed when interpreting the current results. The analysis for objective 3 regressed reasons for trips (independent variable) onto LPA, MVPA and TPA and onto SI types or loneliness (dependent variables). However, the significantly correlated reasons for trips (independent variables) included in these models were selected from a large group of potential independent variables (16 different reasons for trips). Thus, given a 1/20 chance that variables were related due to chance alone, when using a significance cut-off value of $p<0.05$, there is a high likelihood that one of the correlated reasons for trips with PA, SI types or loneliness is a false positive result (type two error) that appeared through chance alone (Tabachnick & Fidell, 2007). Nevertheless, as previously argued **(Section 0, p. 130)**, this approach is acceptable when considering the exploratory nature of objective 3, as long as the results interpreted with caution (Bender & Lange, 2001). Another limitation for the analyses for both objective 2 and 3 was that all theoretically selected control variables were forced into the model at once. As a result, control variables may have been included which did not statistically add to the model fit, causing the models to be over fitted and reducing the explanatory power of each independent variable (Tabachnick & Fidell, 2007). Nevertheless, the control variables were selected based upon previously published associations with either PA, SI or loneliness, so the adjustment for these was deemed necessary.

5.4.4 Research recommendations

Given the current findings it may be possible that SI and/or loneliness could be experienced by both older adults with high PA levels and with low PA levels, when PA is measured objectively. Nevertheless, the stated association between loneliness and lower PA in the loneliness model (Hawkley & Cacioppo, 2010) may be present for PA

gained through specific pursuits, such as sports or exercise or volunteering. Thus, further research could examine whether an intervention to address cognitive-trait loneliness leads to more engagement in specific active pursuits. However, instead of relying on self-reported measures of leisure pursuits, such studies could use a combination of objective PA measurement and activity diaries, to both quantify the PA gained and describe the activities contributing to the gained PA.

The current quantitative methods could only investigate the mean association between PA and SI types or loneliness over the whole sample. However, it may be that strong outliers of this association in either direction caused the very wide confidence intervals seen in the regression outcomes (Tabachnick & Fidell, 2007). There remains considerable scope for qualitative research to investigate the presence of differing combinations of PA and SI or loneliness. Here, qualitative methods could observe and analyse specific circumstances of each individual, and compare between contrasting participants (Holloway & Biley, 2011). This will therefore be pursued in the next chapter of this thesis. From a public health perspective, it could be valuable to know more about the situations in which PA and social contact and social wellbeing (a lack of loneliness) could be maintained simultaneously, but also how social contact and social wellbeing could be maintained when age-related difficulties have reduced the ability to be physically active.

There is also scope to combine urban data from the OPAL study (Davis et al., 2011b), urban and rural data from the McMurdo et al. (2012) study and rural data from the SHARP study. This would permit a replication of the analysis testing for associations between objectively-measured PA and loneliness or SI types in a larger sample of older adults, with a more diverse socio-demographic profile. Within this merged dataset it would also be insightful to compare urban and rurally-living older people in their levels of objectively-measured PA and types of pursuits that contribute to objectively-measured PA in each setting. This could help inform decisions about whether urban-based PA promotion strategies could be directly transferred to a rural setting or whether rural context-specific active ageing interventions are needed (de Koning et al., 2015). While the OPAL study has been extended to include a four-year follow-up (Fox et al.,

2014), the McMurdo et al. (2012) and the SHARP datasets are cross-sectional. A follow-up of the participants in these latter studies would allow a longitudinal assessment of the relationship between objectively-measured PA and loneliness or SI in rural settings. If this relationship exists, such data would also allow assessment of the causal direction over time, or whether the relationship is reciprocal, all of which have been suggested based on analyses using self-reported PA (Pels & Kleinert, 2016).

Given the identification of three activity types which may relate to both more PA and more social contact of a specific type (volunteering, accompanying others, and sport or exercise) there is scope for rurally-based interventions to investigate whether increasing such pursuits would lead to greater PA and more frequent social contact over time. While volunteering, and sport or exercise interventions are already numerous in nationally-representative, urban and rurally-living older populations (Jenkinson et al., 2013; McMahon & Fleury, 2012; Moore et al., 2016), the evaluation of long-term effect on SI or loneliness have only been investigated in urban settings (Pels & Kleinert, 2016). Evaluating this relationship in rurally-tailored interventions using the above mentioned pursuits would make a valuable addition to the literature, given the rapidly increasing older population in rural areas of the UK (Office for National Statistics, 2015). It would also be useful to investigate potential mediators of such an association (Pels & Kleinert, 2016). For instance, PA participation may reduce loneliness through increased social support (McAuley et al., 2000; Taliaferro, Rienzo, Miller, Pigg, & Dodd, 2010), through an improvement in physical function or physical health (Victor & Bowling, 2012), through improvements in cognitive appraisal of social contact and better emotional regulation (Hawkley et al., 2009) or increases in happiness (Newall et al., 2013).

5.4.5 Conclusions

While this exploratory study cannot provide decisive outcomes, it provides new perspectives on types of SI, loneliness and levels of PA in the under-researched population on rurally-living older people in the UK (Burholt & Dobbs, 2012). The findings give a preliminary indication that there may be more equality in male and female levels of MVPA for older people in a rural versus an urban context (Davis et al., 2011b; Jefferis

et al., 2014) and that loneliness may be less prevalent, or at least equally prevalent, in rurally-living older people compared with nationally-representative data in the UK (Victor & Bowling, 2012; Victor & Yang, 2012). The findings provide contrasting evidence to the theorised association between loneliness and lower PA included in the loneliness model (Hawkley & Cacioppo, 2010) and also contrast the association found between SI and lower PA in the ELSA data (Shankar et al., 2011), both of which used self-reported PA measures. These findings build on the lack of these association found in Chapter 4 when using self-reported, proxy PA variables (analysis of GaPL dataset) and call for a qualitative analysis to investigate the possibility of wide diversity in SI and/or loneliness in both highly active and inactive, rurally-living older people. The findings also suggest that volunteering, accompanying others, sports or exercise, or gardening may provide a useful starting point for rurally-tailored PA interventions for older adults.

Chapter 6. A qualitative analysis of the diversity in experiences of social isolation and loneliness across physically active and inactive rurally-living older people

6.1 Introduction

6.1.1 Background

Associations between loneliness or social isolation (SI) and lower levels of physical activity (PA) have been reported in large-scale quantitative studies with middle-aged or older adults using self-reported measures of PA (Hawkley et al., 2009; Luo & Waite, 2014; Netz et al., 2013; Shankar et al., 2011; Theeke, 2009). The quantitative analysis presented in Chapter 5, however, did not find a significant relationship between objectively-measured PA and levels of loneliness or types of SI in rurally-living older adults, replicating findings from other studies which have used objective PA measures in adults aged 65 and above (Harris et al., 2009; Newall et al., 2013). While the quantitative SHARP study was limited by sample size, these null findings provide evidence of a more complex picture regarding the mediating role of PA between loneliness or SI and poor health in older age as proposed in the loneliness model (Hawkley & Cacioppo, 2010).

The analysis in this chapter will more thoroughly explore the relationships between objectively-measured PA levels and experiences of SI and loneliness using qualitative methods. As before in this thesis, SI is defined as "less than weekly direct contact with family, friends and neighbours" (Victor et al., 2003, p. 2) and loneliness is defined as "the unpleasant experience that occurs when a persons' network of social relations is deficient in some important way, either quantitatively or qualitatively" (Perlman & Peplau, 1981, p. 31). Both the cognitive theory of loneliness, which views loneliness as arising from maladaptive social cognition, that can occur even in situations when social

relationships are present (Perlman & Peplau, 1981), and the deficit theory, which states that loneliness arises from a lack of intimate relationships (emotional loneliness) or a lack of wider social relationships (social loneliness) (Weiss, 1973) are used to further explore the loneliness model's hypothesis about SI, loneliness and levels of PA. For a full explanation of these theories see Chapter 3 **(Section 3.5.3, p. 84, p. 85)**.

The null findings in Chapter 5 may indicate the presence of a high level of diversity in loneliness and SI in both active and inactive older people in rural places. Such diversity can be better observed using qualitative methods, as these are able to more deeply explore diverse and contrasting individual participant cases. The wider qualitative literature provides many accounts of the diverse experiences of loneliness and/or SI in older age (Cela & Fokkema, 2017; Cloutier-Fisher, Kobayashi, & Smith, 2011; Dahlberg, 2007; Davies, Crowe, & Whitehead, 2016; Graneheim & Lundman, 2010; Hauge & Kirkevold, 2012; Kharicha et al., 2017; McHugh Power, Hannigan, Carney, & Lawlor, 2017; Sullivan, Victor, Thomas, Poland, & Milne, 2016; Tiilikainen & Seppanen, 2017; Yetter, 2010). There is also a wealth of qualitative research supporting the importance of social correlates of PA for older adults (valuing interactions with others, encouragement from others), as found in a systematic qualitative synthesis of 132 qualitative studies observing the motivators of exercise and PA by a mixture of community-dwelling and assisted-living adults aged between 60 and 89 years (Franco et al., 2015). However, the diversity in experiences of loneliness and SI within contrasting levels of PA attainment in older age has not yet been studied qualitatively.

Perlman and Peplau (1981) defined loneliness as an unpleasant experience created by a mismatch between desired and actual level of social contact. Qualitative studies have highlighted a range of experiences of loneliness but have not always separated loneliness, as defined by Perlman and Peplau (1981), from SI. A content analysis of qualitative interviews with 30 adults aged between 85 to 103 years who lived alone described that there were both negative (e.g. feeling abandoned) and positive experiences of loneliness (e.g. feeling free and having new opportunities) (Graneheim & Lundman, 2010). This study, however, selected participants based on living alone, not on feeling lonely. Thus, the observed positive experiences of being alone may have been

situations in which participants were socially isolated, but not lonely, as also reported by Wenger and Burholt (2004) in their qualitative study of 47 rurally-living Welsh adults between 85 and 103 years. Qualitative interviews with 12 Danish adults aged between 70 and 79 years also highlighted experiences of loneliness ranging from severe loneliness to one which people felt able to manage and which was at times empowering (Hauge & Kirkevold, 2012). A phenomenological study of 26 mixed-age participants (between 12 and 82 years) described four constituents of the meaning of loneliness: loneliness without others; loneliness with others; loneliness as a strange, wrong, ugly, or even shameful thing; and loneliness as a restful and creative thing (Dahlberg, 2007). This last theme, 'loneliness as a restful and creative thing' seems to describe a state in which a person is socially isolated but values this isolation and does not feel lonely, at least in the way defined by Perlman and Peplau (1981). Dahlberg (2007) noted that such individuals tended to value the companionship of nature or animals over other people. More recently interviews with 37 lonely people aged 67 to 87 years observed the complexity, dynamic and highly personal nature of loneliness, as well as the difficulties of openly discussing it due to a perceived societal stigmatisation of lonely older people (Sullivan et al., 2016).

Experiences of SI have also shown to vary and to depend on from whom people are isolated, and on experiences across the life-course. An analysis of 28 qualitative interviews with adults aged 65 and over, all classified as at risk of SI through scoring low on a the Lubben social network measure, reported that experiences across the life-course were linked with the size of social support networks in older age, and with the meaning older people attributed to having kin and non-kin ties in a small social network (Cloutier-Fisher et al., 2011). This analysis also found that having a small network of peripheral social ties such as from a church, club or community organisation can be protective against SI or loneliness in older age, thus showing the importance of the type of social contact rather than quantity of contact. Cloutier-Fisher et al. (2011) were critical of the use of the quantitative measure of SI (the frequency of any social contact), and recommended using a more detailed construct which recognises the subjective dimensions of this phenomenon, such as the level of support and intimacy attained through social contacts, as they found that these can be present in very small social

networks. While SI has often been linked with deteriorations in health in longitudinal quantitative research (Holt-Lunstad et al., 2015), positive experiences of SI have been noted in qualitative research. Living alone, which some researchers define as SI, was observed to make a positive contribution to the lives of 14 older men, aged 60 to 92 (Yetter, 2010). This phenomenological study found that these men experienced living alone as providing them with opportunities for self-growth and the freedom for self-determination.

Numerous qualitative studies are available reporting the importance of social interaction for being physically active in older age. Franco et al.'s (2015) thematic synthesis of 132 qualitative studies involving 5,987 mostly community-dwelling participants (including some participants living in care facilities) between age 60 and 89 from 24 countries reported that social influences were one of the six major themes relating to adherence to exercise and structured PA. Valuing social interaction with peers during physical activities was a theme present in 64% of the studies and social support to enable exercise or structured PA was present in 62% of the studies. Social support included verbal encouragement and practical help (e.g. transportation). Some participants reported involvement in exercise or physical activities to be difficult due to the lack of encouragement or overprotectiveness from others. While this synthesis was very thorough, one of its limitations was that most studies observed the motivators of exercise and structured PA. The review did not analyse studies looking at PA gained from everyday tasks and specific exercise pursuits separately, while PA gained from everyday tasks and PA gained through exercise-specific pursuits are different concepts and may be differently connected with social factors (Eckert & Lange, 2015).

Despite the substantial body of literature linking social support and positive social experiences to levels of PA in older age (Franco et al., 2015), there seem to be no studies which have explored the diversity in experiences of SI or loneliness in both active and inactive older adults. The systematic review of 37 studies by Pels and Kleinert (2016) only identified one qualitative study which included aspects of loneliness and PA. This study however, identified loneliness as a thematic barrier to PA in patients with schizophrenia, aged between 22 and 63 (Rastad, Martin, & Åsenlöf, 2014). Thus, directly

relevant qualitative observations linking loneliness and SI to low levels of PA, as theorised in the loneliness model (Hawkley & Cacioppo, 2010) seems to be lacking for the population aged 65 and over.

When applying the cognitive theory of loneliness (Perlman & Peplau, 1981) as well as the deficit theory of loneliness (Weiss, 1973), it seems possible that both highly active and inactive individuals can experience or avoid loneliness. The cognitive theory states that it is the mismatch between one's expectations and the reality of social contact which leads to feelings of loneliness (Perlman & Peplau, 1981). From this perspective, a physically inactive individual with limited social contact but who does not expect or desire more contact might not feel lonely, while a physically active individual who has frequent social contact but expects more contact or contact of a different quality, might experience loneliness. The deficit theory of loneliness states that different types of relationships serve unique and irreplaceable purposes (e.g. a spouse relationship cannot be replaced by a relationship with a friend) and that the deficit of either an intimate or social relationship will lead to loneliness (Weiss, 1973). From this perspective it would also be possible to be highly physically active in activities with friends, while feeling lonely due to a missing intimate relationship, and also possible to be house-bound and inactive but to have close intimate relationship(s) at home and therefore not to feel lonely.

Socio-demographic and health-related correlates of SI and loneliness have been studied extensively, but have been reported for general older populations, not those with either very low or high levels of PA. For a review of predictors of SI and loneliness see Chapter 2 **(Section 2.2.3, p. 44)**. The current study bridges the two research areas of SI and loneliness and PA in older age, which is novel in the qualitative literature. The findings may provide an insight into why the expected associations between loneliness or SI and low levels of PA, as expected according to the loneliness model (Hawkley & Cacioppo, 2010), were not observed in Chapter 5 **(Section 5.3.3, p. 142)**. The analysis will also contribute a deeper understanding of different situations in which individuals may age successfully, when considering both a sufficient level of PA and the avoidance of SI and loneliness as criteria of successful ageing (Rowe & Kahn, 1998).

6.1.2 Aim, research question and objectives

Study aim

The aim of this study was to provide a deeper understanding of the diversity of experiences of PA, SI and loneliness in the rurally-living older SHARP sample in order to explore why low levels of PA were not associated with SI and loneliness in Chapter 5 **(Section 5.3.3, p. 142)**.

Research question

How, and in what circumstances, are SI and loneliness experienced by highly physically active and inactive older adults in a rural setting?

Study objectives

1. Identify diversity in SI and loneliness experiences in rurally-living older adults with high and low moderate-to-vigorous physical activity (MVPA); and
2. Explore the personal, social and environmental factors experienced earlier in the life-course and at present associated with the diversity in experiences of SI or loneliness in rurally-living older adults with high and low MVPA.

6.2 Methods

6.2.1 Study design

The study design was an exploratory, sequential mixed-methods approach, with a greater weight given to the qualitative data (Doyle, Brady, & Byrne, 2009). For a discussion about of the choice of sequential mixed-methods throughout this thesis see Chapter 3 **(Section 3.3, p. 75)**. Previously collected quantitative PA, demographic and physical function data were used to guide participant sampling and to assist in data analysis. These data facilitated the selection of two comparable groups of older people with highly contrasting levels of MVPA, made possible the triangulation of data regarding SI, loneliness and PA and enhanced the trustworthiness of the findings (Creswell, Gutmann, & Hanson, 2003).

6.2.2 Research framework

This study was guided by the adapted socioecological model of PA behaviour over the life-course (Bauman et al., 2012), an extension of the socioecological model of health-behaviour (Lawton & Nahemow, 1973; Sallis et al., 2006). The socioecological model of health-behaviour recognises that intrapersonal (biological, psychological), interpersonal/cultural, organizational, physical environment (built, natural), and policy (laws, rules, regulations, codes) factors influence human health-related behaviour both directly and through interactions between these levels of influence (Giles-Corti, Timperio, Bull, & Pikora, 2005; Sallis et al., 2006). Bauman et al. (2012) adapted the socioecological model to more specifically apply to PA behaviour, and to incorporate the influence of experiences over the life-course, using findings from an extensive systematic review of literature reporting correlates of any type of PA or exercise by children, adolescents and adults (>18 years) published between 1999 and 2012 **(Figure 6-1)**.

This adapted model recognises that personal, social, environmental and policy conditions earlier in life, and experiences gained from behaviours earlier in life, play a part in shaping current PA behaviour. Life-course focussed qualitative research supports the relevance of past experiences in influencing the current PA behaviour of older adults (Kenter et al., 2015). Bauman et al.'s (2012) adapted socioecological model will be applied in the current study to explore current and past personal, social and environmental factors associated with diverse experiences of SI and/or loneliness in older rurally-living adults with high or low levels of MVPA.

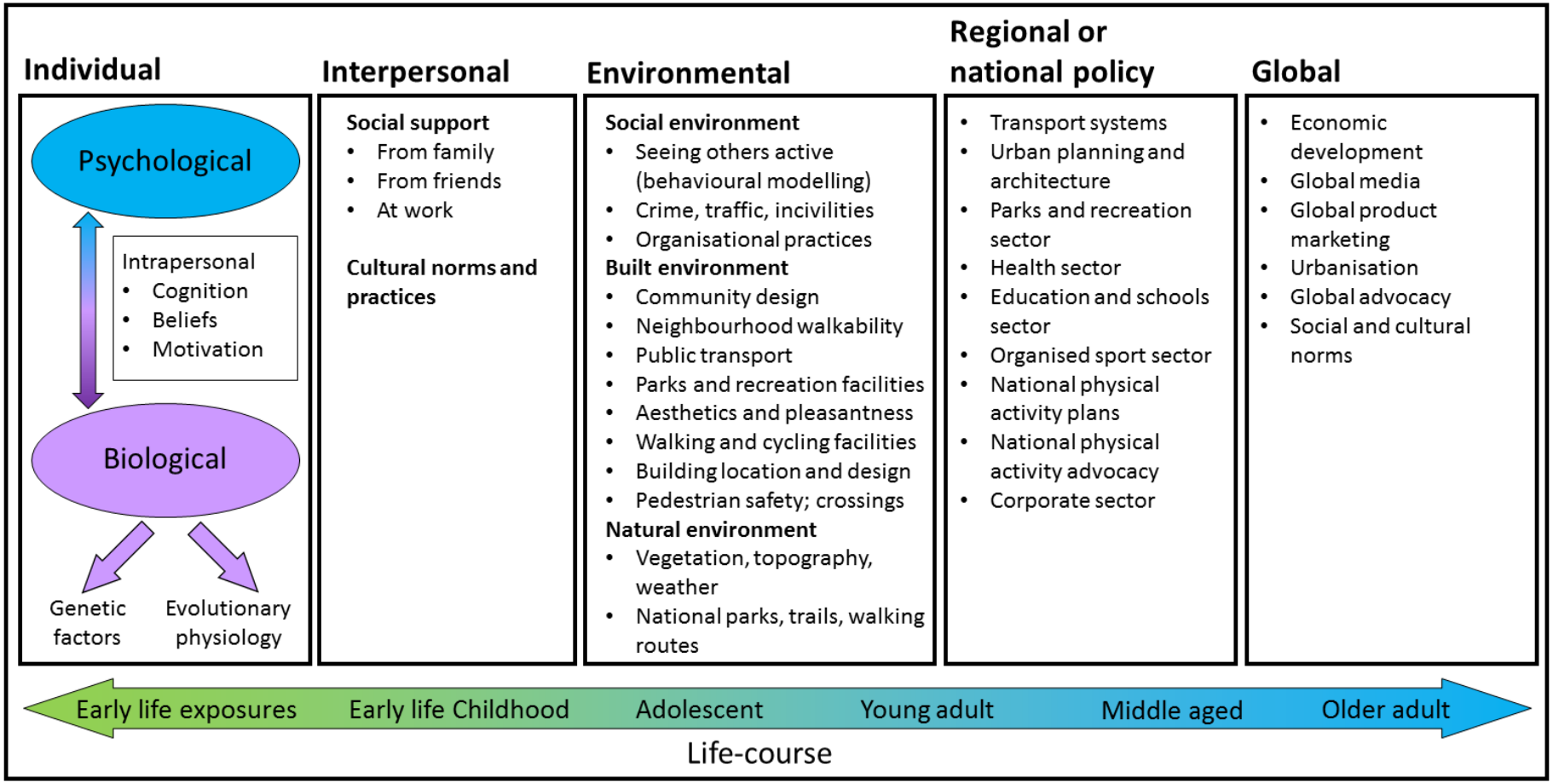

Figure 6-1. The adapted socioecological model of PA correlates across the life-course (Bauman et al., 2012)

The socioecological model of health-behaviour allows the incorporation of theories of human behaviour relating to the personal, social or environmental domains and is argued to present a more useful framework for health-behaviour promotion than focussing on any one of the socioecological levels alone (Sallis et al., 2006). As Bauman et al.'s (2012) adapted socioecological model builds on the original model, the same is true regarding the value of using theories on multiple domains. The current study therefore employed aspects of both the cognitive (Perlman & Peplau, 1981) and the deficit theories of loneliness (Weiss, 1973) to guide the identification of loneliness from the qualitative data. The cognitive theory functions in the personal (psychological) domain, while the deficit theory functions in the interpersonal (social support) domain. For a full explanation of these theories see Chapter 3 **(Section 3.5.3, p. 84, p. 85)**.

Both the cognitive and deficit theories of loneliness have been widely supported in the empirical literature with younger and older adults (Burholt & Scharf, 2013; Cacioppo & Cacioppo, 2014; Dykstra & Fokkema, 2007). The current exploratory study therefore uses both perspectives to identify experiences of loneliness in the qualitative data. It was anticipated that this would elucidate a wider range of loneliness experiences, given the knowledge that loneliness is a highly complex and individual experience (Hauge & Kirkevold, 2012; Sullivan et al., 2016). The hypothesis that loneliness and SI lead to low levels of PA is based upon the cognitive theory of loneliness (Hawkley & Cacioppo, 2010). Thus, if this association exists in the data, cognitive loneliness traits will be seen in the low active group, while they will not be seen in the highly active group.

6.2.3 Participant selection

On completion of the data collection visits for SHARP part 1, participants were asked whether they would like to be considered for the qualitative follow-up study (100% of participants agreed). Informed consent was given for participation in qualitative interviews at the start of the quantitative SHARP study. Using the quantitative SHARP data from Chapter 5, participants were purposefully selected in order to attain two highly different groups in terms of moderate-to-vigorous physical activity (MVPA) levels but comparable on other factors such as gender, age and physical function measured by

the Short Physical Performance Battery (SPPB) (Guralnik et al., 1994). MVPA was measured with accelerometers over seven days and represents a mean daily sum of the total minutes of moderate, vigorous and very vigorous activity, as quantified by adult count cut-off points (Freedson et al., 1998). MVPA was chosen as the indicator for PA level because the attainment of at least 30 minutes of MVPA per day has been shown to have a preventative and therapeutic effect on physical and mental health in older age (Chodzko-Zajko et al., 2009).

The complete SHARP sample (n=112) was divided into quintiles of mean daily minutes of MVPA. Ten participants from the lowest MVPA quintile (0.6 to 8.5 minutes/day) and 10 from the highest MVPA quintile (53.3 to 113.1 minutes/day) were identified with the objective of having equal distributions of sex, age and physical function scores in both groups. Adequate matching of ages and physical function scores was not possible using only the lowest and highest MVPA quintiles. Thus, two extra participants were selected from the second from lowest MVPA quintile (8.6 to 18.9 minutes/day) and the second from highest MVPA quintile (39.1 to 52.5 minutes/day) in order to match overall age and physical function ranges in the low and high-MVPA groups. The final sample contained 24 participants **(Table 6-1)**. All the participants, invited via a phone call, agreed to take part.

6.2.4 Data collection

Twenty-four semi-structured qualitative interviews (45 to 90 minutes) were conducted by the PhD candidate in the participants' own homes and were audio-recorded. These took place between three and four months after the quantitative SHARP data collection, a time-lag which was due to the need to first process and analyse the quantitative data and create individualised feedback for each participant **(Appendix E: p. 259)**. Before commencing, each participant signed a consent form **(Appendix B: p. 251)**. An interview guide was used comprising two sections. Section one focussed on earlier life-course periods, questions were asked about the types of physical and social pursuits engaged in, any personal, social or environmental factors which may have facilitated, or got in the way of, such pursuits, and the effect these activities had on the participant's wellbeing.

Section two asked similar questions to section one but, instead, focussed on the current time in life. In second two, the researcher first recounted the activities noted by the participant in the seven-day activity diary collected during SHARP 1 as a starting point for the participant to talk about their current weekly activities. For examples of summarised seven-day diaries see **Appendix G (p. 265)**. Throughout the interviews, open-ended questions were asked in order to gain un-prompted qualitative information. As a technique to elicit more detail on the topics discussed, participants' accounts were paraphrased by the researcher, which often prompted participants to add additional details. As the interviews were semi-structured the researcher sometimes probed further, asking additional questions in response to new emergent topics. For the full interview guide see **Appendix H (p. 267).**

Field notes were taken during the data collection process and raw thematic observations were discussed regularly with the primary PhD supervisor. After the 24 interviews had been conducted, the raw thematic observations were again discussed with the supervisor and, given the lack of novel themes seen in the last interviews, it was jointly decided that sufficient data saturation had been reached and that further participant selection was not necessary (Morse, Barrett, Mayan, Olson, & Spiers, 2002).

6.2.5 Public and participant involvement

Public and participant involvement (PPI) was conducted to help focus and adjust the interview guide. PPI is also known as Public Engagement and is defined as "The myriad ways in which the activity and benefits of higher education and research can be shared with the public. Engagement is by definition a two-way process, involving interaction and listening, with the goal of generating mutual benefit." (National Co-ordinating Centre for Public Engagement, 2017). It is recognised that this interaction with the public can happen for three reasons: 1) to transmit knowledge; 2) to receive knowledge; 3) to collaborate with others (University of Bath, 2017).

The current study conducted PPI to satisfy the second reason, to receive knowledge regarding how appropriate and relevant the items on the interview guide were. The

interview guide was piloted on the first three participants, and then reviewed to reflect on whether the questions were easy to understand and whether other topics needed to be added. It was observed that participants did not always reflect on the impact of their environment or available bus services on their level of physical and social activities. Thus, two further probing questions were added to the interview guide if participants had not spontaneously reflected on these aspects. In the first version of the interview guide the last question asked participants to reflect on any physical or social activities they had stopped doing in the last 20 years. After the piloting, this recall period was changed to be 10 years as this was more realistic for participants to remember and could potentially generate more useful information about recent changes in personal, social and environmental factors.

6.2.6 Ethical considerations

The participants were drawn from the quantitative SHARP sample, recruited through the help of NHS GP practices, which was approved by the London-Central NHS Research Ethics Committee (reference number: 14/LO/0456) and the Bath NHS Research & Development committee (Reference: 2014/008) **(Appendix A: p. 249)**. All participants had read and signed a consent form prior to engaging in the first part of the SHARP study in which the possibility of a qualitative follow-up had been outlined **(Appendix B: p. 251)**.

With regard to the data collection, in the unlikely event that participants experienced significant distress during the interview, the researcher had planned to stop the interview and provide emotional support to the participants. The interview guide was written with consideration to how participants would feel emotionally about being asked the questions. Therefore, it was structured to focus mainly on physical and social activity, any associated socioecological factors and the consequences on participants' wellbeing, but the researcher did not pose any direct questions about loneliness. However, if loneliness, or indications of dissatisfaction with the level of social contact, were mentioned by a participant then the researcher followed this topic with further appropriate and considered questions. During the interviews every effort was made to not use ageist ideologies or language such as assuming a decreased level of PA, social

interaction or wellbeing in older age, or using derogative words such as 'elderly'. The researcher maintained a respectful, friendly and interested manner towards the interviewee at all times.

6.2.7 Data analysis

Interview audio-recordings were transcribed verbatim by the PhD candidate and uploaded onto the *Nvivo 10.2.1* software. Participants were given pseudonyms and other people and places were anonymised. Directed Content Analysis was used to interpret the data. This is a systematic method of qualitative analysis which uses both deductive and inductive reasoning (Hsieh & Shannon, 2005). The analysis starts deductively, using a pre-defined theoretical framework (the adapted socioecological model) and looks for certain themes in the data which fit within this framework. This is a way of testing the validity of existing theoretical models (Elo & Kyngäs, 2008; Hsieh & Shannon, 2005). The analysis then becomes more inductive by searching for themes emerging from the data which do not fit the pre-defined framework or add new perspectives on elements within the framework, to develop the framework. (For an annotated transcript see **Appendix I: p. 269**). Data coding and interpretation was conducted in three stages: 1) Deductive and inductive coding of interview data into themes nested within the adapted socioecological model; 2) Identification of MVPA, SI and loneliness profiles using the social and personal domains of the adapted socioecological model; and 3) Exploration of personal, social and environmental factors associated with the MVPA, SI and loneliness profiles.

1. Coding of themes into the adapted socioecological model

After reading each interview transcript the PhD candidate deductively coded the content into raw codes under the socioecological and life-course categories of the coding framework: personal, social and environmental influences over active and social behaviour, distinguishing between influences from a previous life-stage and current influences. Next, the raw codes were re-considered and inductively grouped into lower-level thematic categories such as ‘personal PA enablers’, ‘contributors to wellbeing’ or ‘contributors to low well-being’. Within these categories, further thematic categories

were created such as within the 'personal PA enablers' there were the categories 'good health', 'social motivation', 'confidence', 'strategy', 'character', 'life-long histories and habits' and 'beliefs and view points' (**Figure 6-2**).

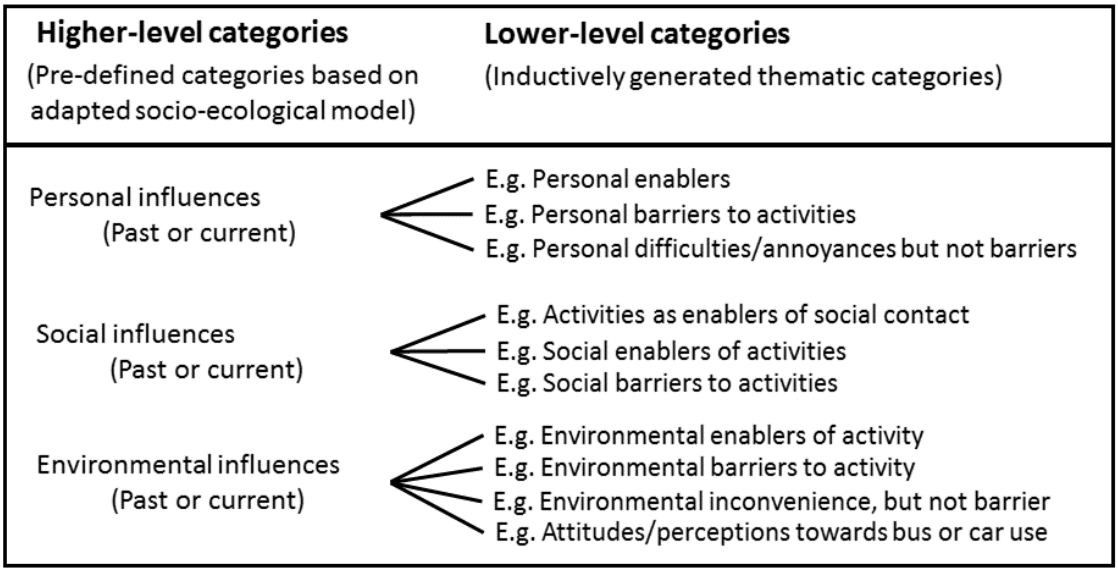

Figure 6-2. Coding tree representation for Directed Content Analysis

2. Classification of MVPA, SI and loneliness profiles

Both quantitative and qualitative data were used to classify participants into MVPA, SI and loneliness profiles. The interpretation of qualitative data as indications of SI or loneliness was double-checked by another experienced qualitative researcher, the primary PhD supervisor, to minimise any interpretation bias shown by the PhD candidate.

First, participants were classified into MVPA, SI and loneliness profiles depending on the questionnaire and accelerometer data collected during SHARP phase 1. Given the low prevalence of total SI (less than weekly contact with friends, family and neighbours) in the full SHARP sample (8/112, 7.1%, **Table 5-2, p. 136**), the SI threshold was lowered to having less than weekly contact with at least two of the three sources of social contact (e.g. less than weekly contact with friends and neighbours, or with family and friends, or with family and neighbours), as the stricter definition may define only very few, if any, of the 24 participants as socially isolated in this study. This was also done in order to distinguish between individuals who had a wide and varied network of contacts and those who relied on one source, for example, only family contact.

Next, the personal and social codes derived from the qualitative interviews were re-read and interpreted for evidence supporting or contradicting the classifications of loneliness or SI. Statements of infrequent social contact with family, friends or neighbours were sought as evidence for SI (e.g. *"I hardly ever see…"; "I only see XXX about twice a year"*). Because the social stigma of loneliness has been argued to stop individuals openly characterising themselves as lonely (Shiovitz-Ezra & Ayalon, 2012; Victor et al., 2005a), the evidence for experiences of loneliness was sought from statements based on the deficit and cognitive theories of loneliness, which did not necessarily include using the word 'lonely'.

Statements were sought which referred to the lack of intimate or social relationships, indicating 'emotional' or 'social' loneliness, respectively (the deficit theory, Weiss, 1973):

- Missing an intimate relationship (e.g. *"I miss a really close relationship…"; "I don't feel close to anyone…")*
- Missing social relationships with friends, neighbours or family (e.g. *"I miss seeing my old friends/neighbours…"*)

Statements were sought which referred to the dissatisfaction with current social relationships, indicating loneliness due to a mismatch of expected and perceived social contact (the cognitive theory, Perlman & Peplau, 1981):

- Dissatisfaction with amount of social contact with friends, neighbours or family (e.g. *"I don't have enough contact with my family/friends/neighbours…"*)
- Relationships with friends, neighbours or family not meeting the standard that participants expected at their current time in life (e.g. *"In my retirement I expected to have more contact with my friends…"*)
- Emotional disturbances due to the lack of social relationships with friends, neighbours or family such as depression (e.g. *"I get very sad about not seeing my family…"*).

Qualitative data on SI and loneliness were given more weight than questionnaire responses, due to the ability of qualitative enquiry to gain person- and context-specific information (Camfield, Crivello, & Woodhead, 2009; Holloway & Biley, 2011). The questionnaires might not have captured loneliness if individuals were not open to admitting to the social stigma surrounding this topic, either consciously or unconsciously (Shiovitz-Ezra & Ayalon, 2012). The questionnaires had also been administered three to six months prior to the interviews, so participants' SI or loneliness status could have changed between questionnaire and interview administration. Thus, any qualitative indications of SI or loneliness conflicting with the questionnaire data were used to re-classify individuals in different SI and loneliness profiles.

3. Interpretation of socioecological factors relating to profiles

The previously-coded themes on personal, social and environmental factors associated with physical and social behaviours, both at present and from previous life-stages were re-read, and summarised for each individual. The individual summaries were compared across all participants in each MVPA, SI and loneliness profile, and the common themes extracted and presented in the findings with selected associated quotations.

6.2.8 Qualitative rigour

The findings were informed by the underlying Critical Realism philosophical grounding, and the academic, professional and personal experiences of the PhD candidate (McEvoy & Richards, 2003). For a full description of Critical Realism see Chapter 3 **(Section 3.2, p. 73)**. To create qualitative rigour, recognised strategies were applied within the data collection and data analysis stages to encourage researcher reflexivity and to produce rich findings which take into account multiple possible interpretations. The pursuit of reliability, however, is inconsistent with the philosophical grounding and aims of qualitative research and is an inappropriate means of attaining qualitative rigour (Morse, 2015; Smith & McGannon, 2017).

Different experiences, theoretical understandings and power relations between participants and researchers, and between research colleagues, mean that member-

checking or inter-rater reliability checking are not valid means of validating interpretations against an independent truth (Smith & McGannon, 2017). The pursuit of agreement between researchers may also over-simplify or trivialise the interpretations and outcomes and thereby limit the richness and creativity of the qualitative enquiry (Morse, 2015). Qualitative data is also never collected twice and natural circumstances are not repeatable, making the pursuit of reliability nonsensical (Morse, 2015). Thus, the interpretive nature of the findings was embraced and a standpoint taken to discard the necessity for reliability, as done by many qualitative researchers (Braun & Clarke, 2013; Levitt, Motulsky, Wertz, Morrow, & Ponterotto, 2017; Smith & McGannon, 2017). Nevertheless, three recognised strategies for increasing rigour of qualitative research were used: Researcher responsiveness during the data collection, triangulation of data sources, and discussion with 'critical friends' (Miles, Huberman, & Saldana, 2014; Morse et al., 2002; Smith & McGannon, 2017).

Researcher responsiveness

One method of achieving qualitative rigour is by being responsive to emerging themes during data collection (Morse et al., 2002). The first responsive step taken was the piloting of the interview guide, followed by editing the guide to make questions more interpretable and relevant to older rurally-living adults, as mentioned earlier in this chapter **(Section 6.2.5, p. 171)**. A fieldwork diary was also kept to note down any emerging themes from individual interviews, as mentioned earlier **(Section 6.2.4, p. 170)**. These themes were then pursued in subsequent interviews to assess the sense of the researcher's interpretations, as well as to build on the emerging themes with subsequent participants' accounts. Another responsive technique was the paraphrasing of participants' accounts during the interviews in order to confirm with participants that the researcher's interpretations were correct.

Triangulation of data sources

Triangulation is a technique of supporting research findings by showing that at least three independent sources of data agree with respect to a finding (Miles et al., 2014). The current findings rely, primarily, on qualitative interviews but these were supported

by questionnaire data, seven-day diary data, and accelerometer data. Questionnaire and interview data both provided independent information on the levels of SI and loneliness, and seven-day diaries provided information on the frequency of social pursuits during the measured week in SHARP phase 1. These sources each contributed to the classification of participants as socially isolated or lonely. Regarding the classification of PA level, the objective accelerometer data was used primarily, but interview data about how PA levels may have changed since accelerometer measurements were also considered. As noted by Miles et al. (2014), when data sources used in triangulation corroborate, this gives an assurance of trustworthiness. However, data sources will at times conflict or directly contradict each other. When this happens, it gives the researcher cause to reflect on the integrity of the data sources used and become aware of important data limitations (Miles et al., 2014). This was seen in the current data and addressed in the limitations section of the discussion.

Discussion with 'critical friends'

A researcher's experiences, theoretical beliefs, experiences and opinions will inevitably affect the interpretation of qualitative data, despite the best intentions to minimise such biases (Guba & Lincoln, 2005). Even though the pursuit of inter-rater reliability is inappropriate in a qualitative enquiry (as discussed above), the discussion of interpretations of qualitative data with a 'critical friend' is beneficial for allowing a process of critical dialogue which encourages reflexivity and challenges a researcher's construction of knowledge (Cowan & Taylor, 2016). Thus, in the analysis of this chapter the primary supervisor, an experienced qualitative researcher, reviewed the quotations which led to the classification of SI or loneliness states as well as to the socioecological factors associated with MVPA, SI and loneliness profiles, as mentioned earlier in this chapter **(Section 6.2.7, p. 173)**. The PhD candidate's interpretations of this data were then critically discussed with the primary PhD supervisor, the result of which was the re-thinking, broadening or narrowing of some concepts. Both the primary and secondary supervisors also provided thorough comments on the data presentation in this chapter to minimise the chance of over-emphasis or misrepresentation of the content in the quotations.

6.3 Findings

6.3.1 Participant characteristics

All 24 participants approached agreed to take part in an interview. Participants were equally split for gender (12 women; 12 men) and represented a wide age range (66 to 83 years of age) and MVPA range (2 to 113 minutes/day) **(Table 6-1)**. The low MVPA group had a higher mean age (75.3 versus 70.8 years) and lower mean physical function score (8.7 versus 10.3 out of 12) than the high MVPA group. Education level was lower, widowhood more prevalent, and income lower in the low MVPA group versus the high MVPA group. Six participants (25%) were classified from interview data as experiencing loneliness: emotional loneliness (two participants, high MVPA) or social loneliness (four participants, low MVPA). Questionnaire responses also indicated loneliness for the two highly active participants showing emotional loneliness in the interviews, but questionnaire responses conflicted with the social loneliness seen in the interviews with the four inactive participants **(Table 6-1)**.

6.3.2 Profiles of physical activity, social isolation and loneliness

Seven profiles of PA, SI and loneliness were identified: A to G **(Table 6-2)**. The majority of participants in both the high MVPA (8/12) and low MVPA groups (7/12) were not socially isolated and did not experience loneliness. Based on interview data, only a small number of participants were socially isolated (2/12 in the high MVPA group; 2/12 in the low MVPA group). A small number of participants reported experiences of loneliness in the interviews (2/12 in the high MVPA group; 4/12 in the low MVPA group), the majority of whom were not socially isolated (5/6). Most profiles were characterised by different personal and social characteristics, while environmental circumstances differed only between high and low MVPA **(Figure 6-3)**.

Table 6-1. Participant characteristics in the low-MVPA and high-MVPA groups

Group	Pseudonym (sex)	Age	MVPA[1]	PF[2]	Social trips/wk[3]	Questionnaire SI types[4]	Questionnaire Loneliness[4]	Interview SI/Loneliness	Education[4]	Marital status[4]	Income[4]
High MVPA	Phil (M)	66	89	12	5	Not SI	Hardly ever	Not SI or Lo	Voc.	Mar.	20-30,000
	Mark (M)	66	87	11	3	SI family	Hardly ever	Not SI or Lo	Voc.	Mar.	>30,000
	Rose[5] (F)	68	84	9	1	SI All	Hardly ever	SI/*not Lo*	Ter.	Div.	10-20,000
	Bill (M)	68	81	10	3	SI family	Hardly ever	Not SI or Lo	Ter.	Mar.	>30,000
	Barbara (F)	**68**	**66**	**10**	**7**	**SI family**	**Often**	**Not SI/*but Lo***	**Sec.**	**Mar.**	**>30,000**
	Ashley (F)	69	83	11	6	SI family	Sometimes	Not SI or Lo	Sec.	Mar.	>30,000
	Margery (F)	**70**	**113**	**11**	**10**	**SI family**	**Sometimes**	**Not SI/*but Lo***	**Sec.**	**Div.**	**20-30,000**
	Vanessa (F)	71	65	11	6	Not SI	Hardly ever	Not SI or Lo	Ter.	Mar.	20-30,000
	Reese (M)	72	71	10	1	SI family	Hardly ever	Not SI or Lo	Voc.	Mar.	>30,000
	Robert (M)	74	58	9	3	SI fam. & friends	Hardly ever	SI/*not Lo*	Ter.	Div.	20-30,000
	Warren (M)	77	39	10	6	SI family	Hardly ever	Not SI or Lo	Ter.	Mar.	20-30,000
	Isla (F)	81	40	10	Missing	SI friends	Hardly ever	Not SI or Lo	Voc.	Wid.	<5,000
Low MVPA	**Nathan (M)**	**67**	**13**	**12**	**3**	**SI family**	**Hardly ever**	**Not SI/*but Lo***	**Ter.**	**Mar.**	**>30,000**
	Christina (F)	**67**	**11**	**10**	**1**	**SI family**	**Hardly ever**	**SI & Lo**	**Ter.**	**Mar.**	**20-30,000**
	Daniel (M)	68	3	7	2	SI fam. & friends	Hardly ever	SI/*not Lo*	Ter.	Mar.	>30,000
	Sandra (F)	**71**	**6**	**11**	**1**	**SI fam. & friends**	**Hardly ever**	**SI & Lo**	**Ter.**	**Mar.**	**>30,000**
	Barry (M)	**72**	**3**	**6**	**3**	**SI friends**	**Hardly ever**	**Not SI/*but Lo***	**Voc.**	**Mar.**	**10-20,000**
	Janice (F)	73	4	6	3	SI family	Hardly ever	Not SI or Lo	Sec.	Wid.	10-20,000
	Eve (F)	77	4	8	4	SI family	Hardly ever	Not SI or Lo	Voc.	Div.	5-10,000
	Ray (M)	77	3	11	2	SI family	Often	Not SI or Lo	Sec.	Mar.	Missing
	Joan[6] (F)	80	7	6	1	SI friends & neigh.	Hardly ever	Not SI or Lo	Sec.	Wid.	<5,000
	Mary (F)	81	2	9	4	SI family	Hardly ever	Not SI or Lo	Voc.	Wid.	10-20,000
	Mike (M)	83	4	9	6	Not SI	Hardly ever	Not SI or Lo	Sec.	Mar.	20-30,000
	Ian (M)	87	4	9	5	SI family	Hardly ever	Not SI or Lo	Sec.	Mar.	20-30,000

[1] Mean min./day MVPA from accelerometer data; [2] Physical function score out of 12; [3] From seven-day diaries; [4] From questionnaires, [5] Six days and [6] Five valid days of valid accelerometer measurement. Bold: Loneliness observed in interview data. Voc.=vocational, Ter.=tertiary, Sec.=secondary education, Mar.=married, Div.=divorced, Wid.=widowed.

Table 6-2. Seven profiles of MVPA, social isolation and loneliness

	High MVPA	Low MVPA
Not socially isolated	**A: Not socially isolated/ not lonely (8/12)** Phil (66) Mark (66) Bill (68) Ashley (69)[1] Vanessa (71) Reese (72) Warren (77) Isla (81)	**B: Not socially isolated/ not lonely (7/12)** Janice (73) Eve (77)[4] Mary (81)[4] Mike (83) Ian (87) Ray (77)[1] Joan (80)[2]
Socially isolated	**C: Socially isolated/ not lonely (2/12)** Rose (68) Robert (74)	**D: Socially isolated/ not lonely (1/12)** Daniel (68)
Lonely	**E: Emotional loneliness/ not socially isolated (2/12)** Barbara (68) Margery (70)	**F: Social loneliness/ not socially isolated (2/12)** Nathan (67)[3] Barry (72)[3] **G: Social loneliness/ socially isolated (2/12)** Christina (67)[3] Sandra (71)[3]

Note: Superscript numbers indicate disagreement between questionnaire responses and qualitative evidence: [1] No qualitative evidence of loneliness; [2] Qualitative evidence for frequent contact; [3] Qualitative evidence of social loneliness; [4] Qualitative evidence of increased PA.

Profile A: High MVPA, not socially isolated, not lonely

Eight of the 12 participants with high MVPA had frequent social contact and provided no qualitative evidence of loneliness **(Table 6-2)**. The majority of these participants engaged in physically active leisure pursuits as well as other creative interests or volunteering which involved social contact with friends and community members:

> *"I try and do something every day. You know, Monday I do Aqua fit… the other day, the friends that I have actually met at Aqua, we went to [a nearby town]."; "And I help down at the, you know, the [social] club in the village." (Ashley, age 69, 83 min. of MVPA/day)*
>
> *"Yea, yea, it's a crowd of us go away, well we did that trip to Portugal, it was a crowd of guys, we go away for 4 days down in [a county near the coast] every year as well, playing golf down there." (Phil, age 66, 89 min. of MVPA/day)*
>
> *"I did take on more voluntary activities down here, which um, I still do which, I took on the school, I am now Chair of the Governors, and I work at [a National Trust gardens site]". (Bill, age 68, 81 min. of MVPA/day).*

Two of these participants engaged mostly in social and active pursuits with their families, or received support from younger family members to continue a productive and active lifestyle:

> *"We have family get-togethers all the time… we all meet up we go for a walk, the family"; "We're going down to Croyd Bay at Easter. And then I shall take my Kayak down there, because the children will be down there, the grandchildren now. We've rented, like we do, we've rented a big house down there so the whole family can go down." (Reese, age 72, 71 min. of MVPA/day)*
>
> *"I don't like driving so, my daughter, she's also a registered [riding] instructor like me, and you have to do all these things [continuing professional development], so we always work it that we go together and she drives. Which is lovely."; "She's just the best, the oldest one who actually works for me two days a week. So she's quite good really, an arrangement, because she's keeping an eye on me." (Isla, age 81, 40 min. of MVPA/day).*

While there was no qualitative evidence of loneliness for these eight participants, one woman (Ashley, age 69) had provided a conflicting questionnaire response four months earlier indicating that she sometimes felt lonely **(Table 6-1)**.

Profile B: Low MVPA, not socially isolated, not lonely

Seven of the 12 participants with low MVPA had frequent social contact and provided no evidence of loneliness **(Table 6-2)**. The majority of these participants engaged in hobby, voluntary or religious activities which enabled them to have frequent contact with locally living friends (although not always in the same neighbourhood):

> *"I've also got my two art groups that I go to"; "there's another thing in [my previous village] that I go to once a month and that's an oldies lunch club… there's usually about 8 of us and we go to the [pub] on a Thursday."; "I also go to a bible study class, um, a prayer meeting [laughs], I'm still doing those." (Eve, age 77, 4 min. MVPA/day)*
>
> *"We still go to that [local social] club." (Ian, age 87, 4 min. MVPA/day)*
>
> *"I'm on the [nearby village] Village Hall committee. So I help at the St. George's day lunches and Harvest festival" (Janice, age 73, 4 min. MVPA/day)*

Many also had frequent contact with their families through social visits from, or going to visit, children or grandchildren, or through practical support received from younger family members:

> ***"****We do go out, you know, see our family." (Mike, age 83, 4 min. MVPA/day); "And one of the sons comes up and does the weekends and makes sure everything is alright up here." (Mike's wife)*
>
> *"I see my daughter more on a regular basis, yea we do, because I had my son, my daughter-in-law and her parents here the other Sunday… I mean now and again I have them all over and I go to my daughter's you know. Um, and then she comes and pops in and comes to me." (Joan, age 80, 7 min. MVPA/day)*
>
> *"Our daughter still lives with us, thank goodness... It is wonderful, it is. Um, and we cope with the modern society with the fact that she is a computer person. So she can sort us out with all sorts of things that actually we would not be able to do for*

ourselves." (Ray's wife); "When we want anything, tell [our daughter]." (Ray, age 77, 3 min. MVPA/day)

While there was no qualitative evidence of loneliness, one participant (Ray) gave a conflicting questionnaire response four months prior, indicating loneliness. One participant (Joan) also seemed socially isolated from the questionnaire data, but interview data showed her to have frequent contact with both friends and family **(Table 6-1)**.

Profile C: High MVPA, socially isolated, not lonely

Two of the 12 participants with high MVPA had infrequent social contact with friends and community members (socially isolated). However, they did not desire more contact and did not report feelings of loneliness **(Table 6-2)**. These participants did not engage with their local social communities:

"Lots of things go on here [in the village], and I read about them, but I don't take part."; "I haven't got any, I've got a friend across the village, but I never walk over and see her." (Rose, age 68, 84 min. MVPA/day)

"It seems to be the church, the school and the army, you know. They seem to be the main social groups here. And I'm not, you know, I don't go to that church, and I haven't got any children who go here, and… temperamentally I'm not the least bit interested with army attitudes [laughs]". (Robert, age 74, 58 min. MVPA/day)

They did, however, have infrequent contact with their family:

"Yes, [my son] sings over the last few years… so whenever they put on a concert I think 'yeah!' I get to come you see… Well perhaps 3 or 4 times a year?" (Rose)

"There's the regular contact with my sister in Norwich, and um my son, that may or may not be meeting with [him], if he's down. Because he has been down to Bath on occasions, so we've had meals together." (Robert)

They also had contact with individuals through their productive or active engagements, although these were not their friends:

> *"There's a lovely sense of comradery because I know the other stall holders [at flower shows]"; "No, no, [I don't keep in touch with them], they're business, um, well not colleagues, but they're other people with businesses like I have." (Rose)*

> *"I sometimes hire horses on the other side of Bournemouth and go out there… the weekend I went, there was an actual retired Steeple Chase Jockey who was there and we both got on very well [laughs]." (Robert)*

Profile D: Low MVPA, socially isolated, not lonely

One of the 12 participants with low MVPA had infrequent contact with his local community and friends (socially isolated) but he did not show a desire for more social contact and did not report feelings of loneliness **(Table 6-2)**. He engaged in social pursuits with a long-standing club and the local community, but only a few times per year, and his prime social contact was with his wife, whom he accompanied for practical pursuits such as shopping:

> *"The [cricket] organisation is changing and it looks as if there'll be less activities, but we did have a get together at Christmas and we'll probably have get together later on [in the year]." (Daniel, age 68, 3 min. MVPA/day)*

> *"I'm a member of the [village] bonfire committee… we meet in the pub and have a drink or something like that… That's about 4 times a year." (Daniel)*

> *"Basically, um… to help [my wife] or keep her company [while shopping]" (Daniel)*

Profile E: High MVPA, not socially isolated, but emotional loneliness

Two of the 12 participants with high MVPA experienced emotional loneliness due to the lack of an intimate relationship which they desired, despite having frequent contact with friends and community members **(Table 6-2)**. These women engaged in active leisure and volunteering which provided frequent social contact with community members and friends:

> *"Oh yes I do those [aerobics classes] every week."; "We've got three [voluntary] cleaning teams… we always go Thursday mornings and clean the church." (Barbara, age 68, 66 min. MVPA/day)*

> *"I still do all the dog walking, the gardening, swimming"; "I do four mornings a week nearly, I try to do in the charity shop." (Margery, age 70, 113 min. MVPA/day)*

These women, however, missed close contact with certain family members (grandchildren or a spouse), contributing to feeling emotionally low:

> *"Probably one of the biggest things is I've got two sons and my youngest son has fallen out with the rest of the family. And um, that's where my two grandchildren are, so I never see them… So I feel um, um… yea, I feel I've missed out… it is quite um, I get quite distressed… quite depressed about it at times." (Barbara)*

> *"I was more active when I was at 40s to 50s because, and then my partner walked out on me and broke my heart and life went down-hill"; [Interviewer: "Any significant changes since your working life?"] "Depression… And it's still there." (Margery)*

Profile F: Low MVPA, not socially isolated, but social loneliness

Two of the 12 participants with low MVPA were not socially isolated but seemed to experience social loneliness, although this contrasted with their questionnaire responses **(Table 6-2)**. They had regular contact with their local community (only through committee activities, not social visits) and with family:

> *"[The Probus club] meets once a month and we get a lecture for an hour and we have a meal afterwards, so I'm still chairman or president of that."; "Sunday we drove to see my mother at her brother and her sister's"; "In the summer months,*

the children and the grandchildren come back from Qatar." (Nathan, age 67, 13 min. MVPA/day)

"There're certain members of the committee, the carnival committee, who are very, very nice"; "[My wife's] son and daughter in-law, the reason we're down here… they come here every Saturday for bacon rolls… Yea, you know, it's a weekly thing." (Barry, age 72, 3 min. MVPA/day)

However, they did not seem to 'fit' into or get along with their local communities:

"The relationship between ourselves and other people in the village it's more than nodding acquaintance, but they're not people that um, um, you know, if we moved away, we would probably send Christmas cards to or anything... our values can be very different to theirs. Um… our lifestyle has been very different to theirs." (Nathan)

"It's difficult to break into the village community. I find that people in Wiltshire are very close-knit. On the committee, and there's a couple of nice people, the chairman, one of the committee members, he drives the old people's bus and this sort of thing, they're nice. Um, but apart from that it's a difficult community to break into." (Barry)

These men missed the close contact they had had with colleagues in the past or with friends in their previous neighbourhood communities, contact which they had not managed to replace in their current rural locations:

"When you're in a [army] regiment, you've got a little family there and that's your social. And changing to civilian life, it, it's very, very different. Um, I mean, we don't throw many dinner parties now because, you know, people don't really do it. Actually most of our friends, aren't um, that local, to do it." (Nathan)

"We've been here three years, as I say we came from Suffolk, and where we were reasonably happy but we didn't think we were going to miss Suffolk as much as we do. Here you know, nobody would realise if you'd drop dead you know." (Barry)

Profile G: Low MVPA, socially isolated, and social loneliness

Two of the 12 participants with low MVPA were socially isolated from community members and friends, and experienced social loneliness, although this contrasted with their questionnaire responses **(Table 6-2)**. These women lacked the free time to have contact with friends or family, due to caring or work responsibilities:

> *"On a weekly basis I do very little out of the house… um because I can't leave mum." (Christina, age 67, 11 min. MVPA/day)*

> *"Yea, this is the trouble, in fact it was a really busy week with the [house] lettings, so we were in and out the whole time… And the working was painting more than anything."; "I mean we haven't had a holiday for, last one I had was 1980. Cos at the moment we haven't been going out much because we're always doing one of the flats. It's been a bit of a bugbear. (Sandra, age 71, 6 min. MVPA/day)*

They desired a higher level of social contact than was currently possible, given their responsibilities. Sandra missed her previous community friends, and Christina missed the social activities which she had to stop due to the caring responsibility she had for her mother:

> *"They [previous community members] were such a jolly lot. It was good. I miss them very much. A couple have died, but I think the others are still there. But we haven't seen them recently." (Sandra)*

> *"I personally would have continued going to the flower club because I love flowers and I enjoy the socialising with the people… There are a lot of things that, yes, a lot of things that I miss out on. Because I just physically can't do it, there isn't time." (Christina)*

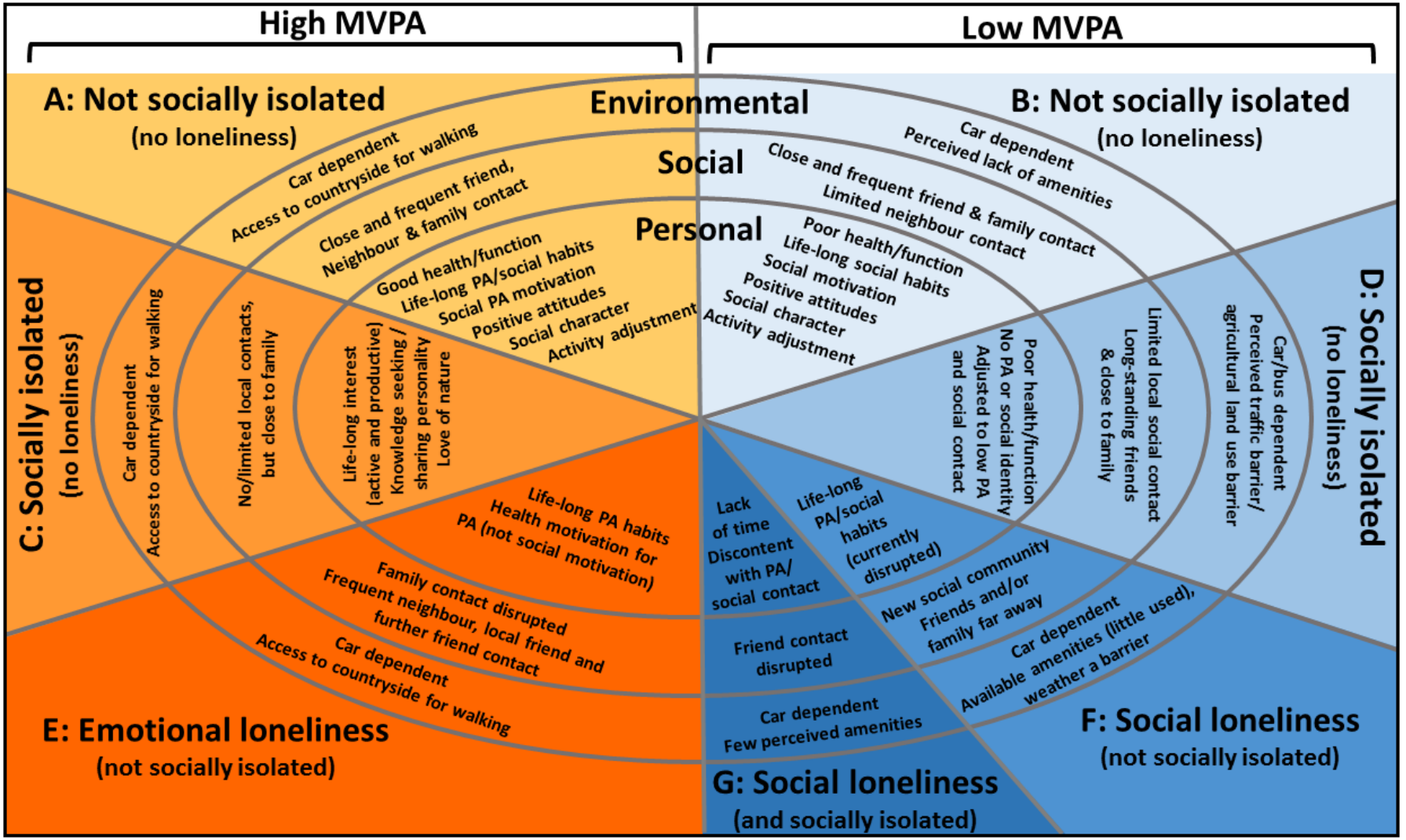

Figure 6-3. Socioecological characteristics observed in different MVPA, social isolation and loneliness profiles

6.3.3 Socioecological characteristics relating to different profiles of physical activity, social isolation and loneliness

Shared personal, social and environmental characteristics for participants within each profile of MVPA, SI and loneliness are presented in **Figure 6-3**. The personal domain contains both characteristics relating to the present time (e.g. health) and previous life-stages (e.g. life-long habits of PA). Very active and inactive participants are displayed on the left and right sides of the figure, respectively.

High MVPA group

Personal domain

Most adults in the high MVPA group (regardless of SI or loneliness) had a PA history and established PA habits which aided them to continue engaging in active pursuits in older age. However, the extent to which past active pursuits had been socially-orientated differed. Those who were not socially isolated and not lonely **(Profile A, p. 182)** had a history of engaging in both social and active pursuits such as team sports and social committees, while the socially isolated but physically active participants **(Profile C, p. 184)** had life-long interests based on productive pursuits such as gardening and coaching athletics. The physically active individuals suffering from emotional loneliness **(Profile E, p. 186)** had a history of engaging in solitary exercise pursuits such as swimming, or group exercise classes in which no close friends were made:

> *"Yes I mean I've played tennis, ever since I was at school, so… sport and music actually, is the two things they excelled in, and I think that's probably had a fair, um, influence on my life" (Vanessa, Profile A, age 71, 65 min. MVPA/day)*

> *"I started coaching [athletics]… I started that and um yes, so [age] 55, 56, I'm 74, yea, so it's continuing"; "I have always been a member of athletics clubs. Right from the age of 14 or something." (Robert, Profile C, age 74, 58 min. MVPA/day)*

> *"I've always been active dog walking and swimming"; "Even if I don't feel like it I do it" (Margery, Profile E, age 70, 113 min. MVPA/day)*

The motives for active pursuits also differed. Those who were not socially isolated or lonely **(Profile A, p. 182)** were motivated by social contact to engage in PA, exercise or sports activities, while those who were socially isolated **(Profile C, p. 184)** were mainly motivated by knowledge seeking and sharing, and those experiencing emotional loneliness **(Profile E, p. 186)** were mainly motivated by health-reasons and enjoyment of being active.

> *"Very much the social side, it's very strong. Um, I wouldn't go out and play golf on my own for example. You see one or two guys doing that but um, it's… the fun of going." (Phil, Profile A, age 66, 89 min. MVPA/day)*
>
> *"When I go on my London [seed merchant] shows, you know, you have to be quite knowledgeable because people ask you quite searching questions. I quite like questions that I don't know the answer to because I can go home and look them up"; "I think what I really want to do is, the teacher in me, I want to teach them how to grow properly. (Rose, Profile C, age 68, 84 min. MVPA/day)*
>
> *"I'm actually very aware of keeping very physically fit because if you're not very physically fit you're very restricted in what you can do." (Barbara, Profile E, age 68, 66 min. MVPA/day)*

Social domain

The sources of social contact differed across the high MVPA group. A lack of contact with family was only experienced by participants who experienced emotional loneliness (Profile E). Their discontent with social contact seemed to relate to a past family disruption, leading them to feel sad or depressed at present, even though they had frequent contact with neighbours and local and further friends (see quotations by Barbara and Margery, **p. 186**).

Those who were socially isolated but not lonely (Profile C), did have close, although infrequent, contact with their families, and this perhaps, in part, protected them from feeling lonely (see quotations by Rose and Robert on **p. 184**). Participants who were not socially isolated or lonely (Profile A) tended to have a wide range of social contact with neighbours, friends and family (see quotations by Ashley, Phil and Bill on **p. 182**).

Environmental domain

There was very little diversity in perceptions of the environment across the high MVPA group. Most participants perceived themselves to have good or adequate access to walking paths and picturesque countryside surrounding them, although all participants used a private car to get to social and active pursuits out of their own village, due to the long distances to places or due to heavy traffic. All but one participant felt reliant on this form of transport.

> *"I think if somebody hadn't got access to a car, it's quite difficult." (Warren, Profile A, age 77, 39 min. MVPA/day)*

> *"You do need a car to be able to go out and do anything really." (Barbara, Profile E, age 68, 66 min. MVPA/day)*

Low MVPA group

Personal domain

The inactive participants who were not lonely or socially isolated **(Profile B, p. 183)** and one participant who was not lonely despite being socially isolated **(Profile D, p. 185)** differed in their level of past engagement in social activities and sense of social identity. In Profile B (not lonely, not socially isolated) participants had a history of high levels of social engagement and viewed themselves as having a social identity. This led to them continuing to seek social engagement in their current older age, despite age-related health and functional difficulties. Those who had physical limitations managed to continue their socialising by adapting their pursuits in order to maintain the social aspects while reducing the physical demand of the activities:

> *"I go to skittles but I don't play it now... We go to [nearby village] which is over that way, and it's a damn good evening because it's a double alley, therefore you've got at least 45 people there. It's like a little party really. Cos I know most of them, so you can have a chat with anybody you know, you know, it's a good job." (Mike, Profile B, age 83, 4 min. MVPA/day)*

In contrast, the one participant who was socially isolated but not lonely (Profile D), saw himself as never having been, the 'type' to engage in physically demanding pursuits and,

while he had engaged in social pursuits, this had only been initiated by a social pressure, not an intrinsic desire for social contact. He, therefore, seemed to be content with, or at least to have adjusted to, his current low level of social and PA in older age.

> *"I'm not really a physical type, I mean I've never particularly found physical exercise to be that rewarding, I mean, run for a bus that's ok, but running round and round a block to keep fit, never been my thing."; "First of all I was inveigled [meaning: persuaded] into taking part in that [cricket club] and then I decided it was quite, quite, yea not too bad, not too good but not too bad of a game and um I quite enjoyed it." (Daniel, Profile D, age 68, 3 min. MVPA/day)*

In contrast, participants who reported social loneliness **(Profile F, p. 186; Profile G, p. 188)** had a life-long history of active and social pursuits but, due to a variety of circumstances (having moved away from their previous living or work-related community, or having a lack of time due to family caring duties or ongoing employment) these pursuits were disrupted in their older age which led to discontent in the level of social contact:

> *"I keep wanting to establish some sort of daily schedule, some sort of daily routine. I haven't managed that yet. Being retired nearly eight years I still haven't managed that yet… Too busy! There's always something else… errand or a job to do." (Nathan, Profile F, age 67, 13 min. MVPA/day)*

> *"When I was 60 [my mother] had a massive stroke and um I've been looking after her full time since then. …I personally would have continued going to the flower club because I love flowers and I enjoy the socialising with the people… There are a lot of things that, yes, a lot of things that I miss out on. Because I just physically can't do it, there isn't time." (Christina, Profile G, age 67, 11 min. MVPA/day)*

Despite current physical limitations, individuals who were not lonely (Profiles B and D) showed high levels of satisfaction when looking back over their life's achievements:

> *"We've had a very good life actually. I'm not complaining about any of it, we've been very, very fortunate… I'm happy with it." (Mary, Profile B, age 81, 2 min. MVPA/day)*

Lonely participants (Profiles F and G), in contrast, showed a discontent with their current life, some wishing their retirement had happened differently and some wishing to be able to establish different activity patterns:

> *"Of course he and I, had thought when we retired, that um we'd go to the pub and go and see the countryside and drive around the countryside and go and see places we haven't been to before. And that, we've failed miserably on all of that." (Christina, Profile G, age 67, 11 min. MVPA/day)*

Social domain

Across the low MVPA group there seemed to be limited contact with the local neighbourhood community. However, differences could be seen in the level of contact with friends and family. Participants who were not socially isolated or lonely **(Profile B, p. 183)** had frequent and close contact with friends and family.

> *"We've got quite a big circle of friends, and we entertain and we go to other people's for tea… every week we try and do something with friends." (Ian, Profile B, age 87, 4 min. MVPA/day)*

The one participant who was socially isolated but not lonely (Profile D) had infrequent contact with long-standing friends:

> *"We have a few get-togethers now and then [with friends from previous Cricket steward team]… We used to have an annual visit somewhere." (David, Profile D, age 68, 3 min. MVPA/day)*

However, those feeling socially lonely **(Profile F p. 186; Profile G, p. 188)** lived far away from their friends and family and saw them infrequently due to the distance or lack of time (due to work or caring responsibilities).

> *"[Friends in our previous village] were such a jolly lot. It was good. I miss them very much."; "At the moment we haven't been going out much because we're always doing one of the flats [work]. It's been a bit of a bugbear… I want to go and visit friends again. Because we've been so cut off from people recently, with the lifestyle that we've had. I would like to go and see friends again." (Sandra, Profile G, age 71, 6 min. MVPA/day)*

Environmental domain

A common theme across the low MVPA group was the perceived inadequacy of the environment, be it the available facilities, a lack of pavement, agricultural land use or bad weather, for engaging in more PA. As most participants with low MVPA lived in similar rural villages to the highly active participants, this perception of environmental difficulties may be shaped by their physical limitations, lack of an active identity, or lack of social motivation due to being far from family and friends.

> *"The traffic has increased, what? A 100% since I first came." (Ray's wife); "Increased a lot… We've got bicycles in the shed but we never use them because it's too dangerous." (Ray, Profile D, age 77, 3 min. MVPA/day)*
>
> *"The road is terrible. We haven't got a path until we get just past that mucky farm, and that's all muddy"; "I only just walk her [pet dog] in the field, but I haven't, sometimes I don't do it, depends on how windy and one thing and another it is." (Joan, Profile B, age 80, 7 min. MVPA/day)*
>
> *"The other thing round here is that the farmers have ploughed up a lot of the footpaths… You can walk round the edge of the field, under sufferance, if you don't mind walking through some nettles and brambles and this sort of thing… there's no way I'm going to walk along a field of vegetables." (Barry, age 72, Profile F: 3 min. MVPA/day)*
>
> *"If we get six days of heavy rain… I'll stick my nose out of the door and say no." (Nathan, Profile F, age 67, 13 min. MVPA/day)*

As with the high MVPA group, all inactive participants depended on transport, either private or, for one participant, the bus to engage in their daily pursuits.

> *"If we didn't have the car and we'd have to rely on buses, we'd be restricted… if they take away my licence we shall be in trouble." (Ian, Profile B, age 87, 4 min. MVPA/day)*
>
> *"If they stopped the busses then that'd be it… I suppose I'd have to move." (Joan, Profile B, age 80, 7 min. MVPA/day)*

6.4 Discussion

6.4.1 Summary of findings

This analysis aimed to explore the diversity in experiences of SI and loneliness in both highly active and inactive rurally-living older adults. The qualitative analysis found that there is, indeed, wide diversity in SI and loneliness, regardless of whether older adults engaged in high or low levels of MVPA. Older adults who attain a high level of MVPA can experience SI without loneliness if they have life-long interests in solitary, productive pursuits and knowledge seeking personalities and are satisfied with infrequent family contact **(Profile C, p. 184)**. However, older adults with high levels of MVPA can also experience emotional loneliness when family relationships are disrupted, despite regular contact with friends and neighbours **(Profile E, p. 186)**. Inactive older adults can be socially isolated due to poor health and function, but not lonely due to being satisfied with irregular contact with friends and having supportive and close contact with a spouse **(Profile D, p. 185)**. However, inactive older adults can also experience social loneliness after relocating to a new neighbourhood, or lacking the time to continue social activities due to occupational or caring responsibilities **(Profile F, p. 186; Profile G, p. 188)**. This diversity and complexity provides insight into why the quantitative analysis in Chapter 5 found no association between objectively-measured PA and reported loneliness or SI types **(Section 5.3.3, p. 142)**.

Regardless of their level of PA, the interviewed participants tended to continue the pursuits (active, social or both) in which they had engaged previously in life, making adjustments to activities to become less physically demanding if age-related barriers to physical exertion were present. Only when the expected and desired level of social contact was disrupted (due to a family relationship disruption, lack of time due to work or caring responsibilities, physical distance from friends, or lack of integration into local community), did participants experience feelings of either emotional loneliness (when intimate partner or family contact was disrupted) or social loneliness (when contact with friends and previous neighbours was disrupted).

6.4.2 Contribution to literature

These findings add new evidence to a body of qualitative studies which, although they have explored older people's experiences of, and precursors to, loneliness and SI in diverse older populations, have not investigated the experiences of loneliness or SI in contrasting groups of PA level (Barg et al., 2006; Graneheim & Lundman, 2010; Lou & Ng, 2012; Machielse, 2015; McHugh Power et al., 2017; Sullivan et al., 2016). The current study adds a new perspective in counter-argument to the associations found between loneliness and low PA (Hawkley et al., 2009) and between SI and low PA in older adults (Shankar et al., 2011) in quantitative studies using self-reported levels of PA. The findings do agree with existing qualitative literature regarding the precursors of loneliness, such as a lack of intimate relationships (Brittain et al., 2017; Dahlberg & McKee, 2014; Dykstra & Fokkema, 2007; Tiilikainen & Seppanen, 2017) and informal caring roles (Vasileiou et al., 2017) as well as often-cited PA correlates for older adults such as good health/function, a history of PA, social motivation, and access to transport (Franco et al., 2015; Koeneman, Verheijden, Chinapaw, & Hopman-Rock, 2011).

These findings highlight the important dimension of inter-personal variability when evaluating quantitative findings of an association between loneliness and/or SI and low PA (Hawkley et al., 2009; Pels & Kleinert, 2016; Shankar et al., 2011). While these studies found statistically significant quantitative relationships, the current findings show that experiences of loneliness with or without SI are diverse and complex. These previous studies, while employing large sample sizes, also used subjective reports of leisure or occupational PA. Their findings, therefore, might only indicate that people who are lonely or socially isolated *perceive* themselves to engage in less leisure and occupational PA. However, the current findings show that it is possible to be socially isolated or to feel lonely irrespective of levels of PA, when PA is measured objectively. When measured objectively, total PA includes minutes of PA gained through any everyday activity, not just leisure or occupational PA. The current findings of diversity in these experiences, regardless of levels of PA, provide insight into the lack of association between objectively-measured PA and SI or loneliness in Chapter 5 **(Section 5.3.3, p. 142)**.

Newall et al. (2013) also found that loneliness was cross-sectionally associated with self-reported PA but not with objectively-measured PA in 228 adults aged 65 and above in Canada. While a phenomenological qualitative study of nine rurally-living older adults receiving befriending services identified 'loneliness as a consequence of inactivity' as a key theme, the authors also cited several examples of sedentary or bedridden individuals who reported their ability to avoid loneliness by remaining mentally busy (e.g. with cross-word puzzles) (McHugh Power et al., 2017). Thus, the current findings call for the need to further develop/modify the loneliness model's proposed causal pathway between loneliness, lower PA and worse physical health (Hawkley & Cacioppo, 2010) to integrate the possibility that older people can be both lonely and physically active, or not lonely and inactive.

The diversity in SI and loneliness experienced by both highly active and inactive older people highlights the need to avoid stereotypes of older age, as these could limit therapeutic interventions and perpetuate harmful societal views about ageing. Stereotypes of healthy, active older people may not include the possibility that highly active individuals could feel lonely, while, *vice versa*, stereotypes of inactive older people may assume physical inactivity to coincide naturally with loneliness and SI. Given the current results, such assumptions would be wrong, and may lead to missed opportunities to assist physically active yet lonely individuals, who could be wrongly assumed to not suffer loneliness. Assistance may take the form of interventions to re-engage them with disrupted intimate relationships or to shift their expectations of such relationships through cognitive behavioural therapy (Masi et al., 2011). In reverse, the stereotype that inactivity and loneliness always coincide may lead to perpetuating harmful ageist attitudes regarding age-related physical changes, inactivity and the onset of loneliness (Dykstra, 2009). Encouraging negative ageing attitudes in older adults can have harmful effects on older individuals' self-evaluation and behaviour, and may even lead to feelings of loneliness (Coudin & Alexopoulos, 2010; Pikhartova et al., 2016).

These findings support and add to the cognitive theory of loneliness (Perlman & Peplau, 1981). This theory's reasoning that loneliness is present only when there is a mismatch between the level of desired personal relationships and the actual relationships was

supported by the finding that some individuals (Profiles C and D) could be isolated from certain relationships but not feel lonely because they did not have expectations of more social contact. The relevance of the cognitive theory within the adapted socioecological model is a new extension of both the theory and model. Experiences of social and active pursuits from earlier in life influenced the cognitive expectation of social contact in older age, and that common activity barriers such as lack of free time and caring responsibilities can disrupt the realisation of these expectations in older age, thus leading to loneliness. A further development of the use of the cognitive theory is its ability to explain why some older people are content with a low or high level of PA: if the expected PA level is realised (which is influenced by previous life experiences), then older people are more likely to be content with it, even if this is a low level of PA.

The hypothesis that lonely individuals tend to withdraw from social interactions and thereby become less physically active (the loneliness model: Hawkley & Cacioppo, 2010) was not supported by the qualitative findings in this chapter. The observation of two lonely participants (Profile E) who were highly physically active and had frequent local and further social interactions, contradicts Hawkley and Cacioppo's (2010) proposed link between loneliness, social withdrawal and lower PA. For these participants, the deficit theory of loneliness (Weiss, 1973) came closer to explaining their feelings of loneliness. This theory explains the presence of loneliness as derived from a lack of intimate or wider social relationships and that different relationships serve unique purposes which cannot be replaced by other types of relationships (e.g. the relationship with a spouse cannot be replaced by that with a friend) (Weiss, 1973). The clear absence of a close family relationship in the highly active group (Profile E) and the absence of frequent contact with friends in the inactive group (Profiles F and G) shows that the absence of specific types of relationships themselves can also lead to loneliness. Therefore, as also found by Dykstra and Fokkema (2007), the presence of loneliness can be explained by both the characteristics of people's network of relationships (the deficit theory of loneliness) and their relationship preferences (the cognitive theory of loneliness).

The finding of the independence of PA, SI and loneliness support the notion that biomedical and psycho-social dimensions of the multi-dimensional concept of successful

ageing, can be experienced independently and therefore should be considered in their own right (Bowling, 2007). Rowe and Kahn (1997) initially proposed that the avoidance of disease and disability was the foundation of successful ageing, after which came cognitive and physical function and engagement with life. However, the current findings show that even in cases where the ageing body has physical limitations, satisfaction with life may be preserved through adjusting one's activities to still meet one's expectations of social relationships and engagements. Thus, as previous critiques of Row and Kahn's (1997) model of successful ageing have argued, successful ageing is not limited to fit and able-bodied older adults, when also considering the psycho-social dimension (Masoro, 2001).

The current study has explored SI and loneliness using the adapted socioecological framework for the first time, and so adds knowledge regarding the wider applicability of this framework to social behaviours and social experiences. The socioecological model, although mostly used for PA behaviour in older age, was developed to describe the determinants of any health-related behaviours or states (Sallis et al., 2006). Its current extension to the context leading to SI or loneliness is therefore consistent with its original design given that SI and loneliness are both recognised as health-limiting states (Holt-Lunstad et al., 2015). Both the cognitive and deficit theories of loneliness fitted well within the personal (preference and expectations of contact) and social domains (presence of intimate or social relationships) of the adapted socioecological model. The use of this model also allowed the observation of a theoretical extension of the cognitive theory: the influence of social pursuits from earlier in the life-course on one's expectations of social relationships in later life which, in turn, seems to influence the likelihood of feeling lonely if social contact is disrupted due to certain barriers (poor health, distance from friends, lack of time). The cognitive theory of loneliness was also extended to explain why some older adults were satisfied with reduced levels of PA in older age, as they either had expectations of low PA levels, or they had adjusted their expectations of PA levels and adapted activities to be less physically demanding.

6.4.3 Strengths and limitations

This study provides important and novel findings which challenge perspectives of inactive and active older adults and their risk for SI or loneliness. However, these findings are exploratory in nature and in need of further verification. As discussed in Chapter 5 **(Section 5.4.3, p. 155)**, the geographical confinement to one southern county in England limits the socio-demographic diversity of the sample and thereby the transferability of these findings to other rural locations in the UK. Nevertheless, there was evidence of a wide range in socio-economic status of the purposefully selected sample for this qualitative study **(Table 6-1, p. 180)**.

A particular strength was the strategic matching of older people in two groups of objectively measured PA, regarding gender, age and functional ability score. While not creating identically matched groups, this process did create a socio-demographically comparable group of older people with very distinctly different PA levels. Nevertheless, selecting the top quintile and bottom quintile of objectively-measured MVPA limited the analysis in gaining an insight into the diversity of the experiences of older adults with a middle-range MVPA level. The findings therefore might not be particularly relevant to moderately active older people who may attain their PA more from everyday tasks and less from dedicated sports or exercise activities. The strength of this approach, however, is that it compared and contrasted the experiences of very diverse groups regarding PA. This study therefore improves upon other qualitative studies of PA by rurally-living older adults which have used subjective ratings of PA level (de Koning et al., 2015).

There was a three-to-six month gap between the accelerometer measurements taken during the quantitative phase of SHARP and the qualitative interviews which might have resulted in some changes in PA level by the time of the interview. For instance, one participant (Mary) had gained access to a car and had started attending a weekly Zumba Gold class (a dance exercise class for older adults) at the time of the interview. Thus, her previous accelerometer measures of 4 minutes per day of MVPA may have increased at the time of the interview. Another factor which may have influenced PA level between accelerometer measurement and the time of interview was the season and weather.

Some participants (e.g. Ian, a keen gardener) had worn the accelerometer in December but were interviewed in April, when they may have improved their PA due to the spring weather. This was compensated for by reviewing the participant's seven-day diary (obtained during the same week as the accelerometer data) in the interview and asking if and how any activities had changed since the diary was completed.

Loneliness and SI were assessed from the interview content, allowing the time and situationally accurate social state to be observed. It is known that loneliness is a dynamic feeling, with variations across seasons (Victor et al., 2015). It was also anticipated that SI could be highly variable over three-to-six months due to potential changes in friend, neighbour and family networks. Therefore, the questionnaire responses to SI and loneliness items were only used as rough indicators, but overridden if interview data proved otherwise. While the interviews provided in-depth information about social activities, experiences and wellbeing, direct questions about loneliness were not asked due to ethical concerns about focussing on this topic. As a result, the interviews may not have captured all instances of loneliness. That said, using both the cognitive theory and deficit theory of loneliness to interpret the qualitative text did allow the identification of experiences of loneliness, even when the word 'loneliness' was not mentioned by the researcher or participant. The contrasting loneliness classifications between the questionnaire responses and the interviews regarding 'social loneliness' (loneliness due to the absence of wider social relationships), particularly, could indicate the limited ability of a single-item question about loneliness to capture experiences of Weiss' (1973) construct of social loneliness in older people.

6.4.4 Research recommendations

Future qualitative work should employ a larger, more ethnically and geographically diverse sample to further develop the notion of different PA, SI and loneliness profiles. Similar mixed methods to those used in the current study would be helpful in measuring PA and defining the state of SI or loneliness. Although, a worthwhile addition would be the measurement of both the social and emotional loneliness concepts from the deficit theory (Weiss, 1973) and using quantitative and qualitative methods within a closer time

frame. For instance, participants could be asked to wear accelerometers the week preceding the interview, and to complete a short questionnaire containing validated items on loneliness and SI on the same day as the interview. As loneliness has been directly discussed in a research setting in another study (Sullivan et al., 2016), future studies are also encouraged to directly engage in the topic of loneliness in an interview setting, provided the researcher has appropriate communication skills and the ability to provide sufficient support in case of participant distress. Given the strong emergence of the influence of earlier life experiences on present-day expectations and social/active engagement, the use of a life-course perspective in a further qualitative enquiry is also recommended. It is argued by Stowe and Cooney (2014) that the multi-dimensional influences across the life-course are important contributors to how people age successfully.

The current observational cross-sectional design cannot determine what might happen if socially isolated or lonely older adults were to increase their PA level. The body of research on PA or exercise interventions in older adults is formidable, as demonstrated by the presence of several reviews (Baxter et al., 2016; McMahon & Fleury, 2012) with interventions studies more recently examining whether pre-frail or frail older people also stand to benefit from PA or exercise interventions (Giné-Garriga, Roqué-Fíguls, Coll-Planas, Sitjà-Rabert, & Salvà, 2014). While the systematic review by Pels and Kleinert (2016) found five PA intervention studies in samples aged 65 and above, which included loneliness as an outcome measure, four of which showed a favourable effect of the PA intervention on loneliness, these studies all used self-reported PA measures. This is a weakness shared with observational data showing an association between loneliness or SI and low PA in older age (Hawkley et al., 2009; Shankar et al., 2011). Even so, the comparison of those receiving a PA intervention with control groups in these studies provides a good level of confidence that PA intervention in older age may also benefit social relationships and social wellbeing. Future PA or exercise interventions with older adults would benefit from using objective PA measurements and including SI and loneliness as outcome measures in order to evaluate, definitely, how these aspects change with increased PA, relative to a control group.

6.4.5 Conclusion

There was a wide diversity in experiences of SI and both social and emotional loneliness in highly active participants (three profiles) and inactive participants (four profiles). These findings provide an insight into why there was no quantitative association between low objectively-measured PA and reported SI types or loneliness in the study presented in Chapter 5. The findings support the salience of both the cognitive theory (Perlman & Peplau, 1981) and deficit theory (Weiss, 1973) of loneliness, and show that these theories fit well within an adapted socioecological model that recognises how experiences in previous life-stages influence current expectations and behaviour (Bauman et al., 2012). The results challenge the idea that low levels of PA in older age are generally accompanied by SI and/or loneliness. It is possible for highly active older people to be socially isolated (but not lonely) if their interests lie in solitary pursuits, and possible for them to experience emotional loneliness (but not SI) when important intimate relationships are disrupted. It is also possible for inactive older people to adapt their activities sufficiently to meet their own expectations of social contact while becoming less physically demanding and, in so doing, to avoid becoming socially isolated and/or lonely. The complexity of any associations between PA, SI and loneliness, and how these may interact to influence older adult health and wellbeing need to be investigated further in studies using mixed-methods designs and socio-demographically and geographically diverse rural populations.

Chapter 7. General Discussion

7.1 Summary of the findings

The overarching aim of this thesis was to investigate the associations between social isolation (SI) and loneliness and the levels and types of physical activity (PA) in rurally-living older adults in the UK. Three research questions were asked and answered using quantitative methods in Chapters 4 and 5. A fourth research question was asked in response to the quantitative findings and answered using qualitative methods in Chapter 6.

7.1.1 Research question one

What are the prevalence and predictors of loneliness and different types of SI in rurally-living older adults?

This question was asked due to the lack of recent scientific knowledge about rural-specific prevalence of these factors, and the conflicting views of whether ageing in rural areas brings a higher or lower likelihood of SI or loneliness in older age. Secondary analysis of the GaPL dataset of 884 adults aged 60 and above (Chapter 4) showed that 8% of respondents said 'yes' to feeling lonely, 9% were isolated from the community and 49% were isolated from family members, although only 5% were isolated from both family and the community **(Figure 4-1, p. 101)**. The quantitative SHARP study of 112 adults aged 65 and above (Chapter 5) showed that 5% reported being often lonely and 20% reported being lonely some of the time **(Table 5-3, p. 137)**, while 16% were isolated from neighbours, 35% isolated from friends and 70% isolated from family, although only 7% were isolated from all three sources of social contact **(Table 5-2, p. 136)**. The multivariate regression analysis of the GaPL data also found that loneliness, SI from family and SI from the community have different independent health and socio-demographic predictors **(Table 4-3, p. 104)**. Worse self-reported health only predicted loneliness, while financial difficulties related in opposing directions to loneliness

(increased likelihood) and SI from family (decreased likelihood). However, living in a rural area for a shorter period of time predicted a higher likelihood of all three social variables, in controlled regression models.

7.1.2 Research question two

What are the levels of objectively-measured PA and what types of everyday pursuits contribute to PA in rurally-living older adults?

This question was asked due to the lack of objective PA data for rurally-living older adults, the conflicting views regarding whether rural areas facilitate or hinder opportunities for PA in older age, and the lack of knowledge regarding which types of PA may be most suitable and effective to promote in rural areas. The quantitative SHARP study (Chapter 5) collected objective PA data, as well as detailed seven-day diary data, from a randomly recruited sample of 112 rurally-living adults aged 65 and above. The findings revealed a mean level of 32.3 minutes/day (SD 25.6) moderate-to-vigorous PA (MVPA), although the range was wide with 20% attaining 10 minutes or less and 22% attaining more than 50 minutes of MVPA per day **(Table 5-4, p. 138)**. The MVPA levels did not differ between men and women, but they were significantly lower with each five-year increase in age. Findings also showed that trips for volunteering, sports or exercise, accompanying others and gardening were associated with more minutes of light PA (LPA), MVPA and/or total PA (TPA) **(Table 5-6, p. 145)**.

7.1.3 Research question three

Are SI and loneliness associated with levels of objectively-measured PA or with everyday pursuits which contribute to gaining PA in rurally-living older adults?

This question was asked because previous studies assessing these associations have used only self-reported PA and have not been relevant to adults aged 65 and over. Based on Hawkley and Cacioppo's (2010) loneliness model and other published studies (Shankar et al., 2011; Hawkley et al., 2009), it was hypothesised that SI and loneliness would be associated with lower levels of PA. This hypothesis was not supported by the

quantitative SHARP regression analysis (Chapter 5), which found no significant relationships between three types of SI or loneliness and low levels of LPA, MVPA or TPA **(Table 5-5, p. 143)**. However, specific PA types such as trips for volunteering, sports or exercise, and accompanying others were associated with a lower likelihood of SI from neighbours, SI from friends or SI from family, respectively **(Table 5-7, p. 147)**.

7.1.4 Research question four

How, and in what circumstances, are SI and loneliness experienced by highly physically active and inactive older adults in a rural setting?

This question was asked in the follow-up qualitative study (Chapter 6) to further explore why no association was found between SI, loneliness and objectively-measured PA in the quantitative SHARP study (Chapter 5). A thematic qualitative analysis of interviews with 12 highly active and 12 inactive older adults was conducted to address this question. The findings showed that highly active older adults could feel emotionally lonely if family relationships were disrupted **(Profile E, p. 186, p. 191)**, and that highly active older adults could be socially isolated (but not lonely) if they pursued a life-long solitary, but active pursuit **(Profile C, p. 184, p. 190)**. Inactive older adults could be neither lonely nor isolated if they continued and adapted life-long pursuits making them less physically demanding to retain existing social contacts **(Profile B, p. 183, p. 192)**. However, older adults could be inactive and feel socially lonely if they had not integrated into their local community after moving there, and so did not engage with their local community in social or active engagements **(Profile F, p. 186, p. 194)**, or if they had caring or work responsibilities which hindered their engagement in social and active pursuits **(Profile G, p. 188, p. 194)**.

7.2 Contribution to the literature

The findings of this thesis, based on studies using perspectives and methods from the Sports and Exercise Sciences and Social Psychology, contribute to a variety of disciplines due to the holistic focus on health and wellbeing in older age. The findings regarding the levels and types of PA and the avoidance of loneliness and SI by older people in rural

contexts of the UK, detailed in the following sections, can be used to help inform intervention research in the fields of Public Health and active ageing promotion. The exploration of how, and in what circumstances, loneliness and SI may be associated with low levels of PA in older age, detailed in the following sections, can contribute to further development of theoretical perspectives in the Social and Health Psychology fields.

7.2.1 Social isolation and loneliness in a rural context

The findings in this thesis showed that SI and loneliness may not be felt any more frequently by rurally-living older adults in the UK, when compared with their urban counterparts **(Section 5.4.2, p. 149)**. A societal view exists that older people living in rural areas may be more likely to experience loneliness and SI due to the lower population density, less 'hustle and bustle' of a city and fewer accessible amenities (Age UK, 2013; Wenger, 2001). However, it is important to note that frequent loneliness and SI from all social contact measured (family, friends and neighbours) were not common experiences in the rurally-living older samples analysed in this thesis. In the GaPL sample 5% said 'yes' to feeling lonely **(Section 4.3.2, p. 98)**, and in the SHARP sample 5% reported feeling 'often lonely' **(Table 5-3, p. 137)**, which is lower than the 9% reporting feeling 'often lonely' in the baseline data from the Omnibus Survey of 999 older adults across the UK (Victor & Bowling, 2012) and broadly comparable with the 7% reported in the UK sub-sample of the European Social Survey, containing data from 2,393 older adults (Victor & Yang, 2012). SI was also low in the SHARP sample, with 7% seeing family, friends and neighbours on a less-than-weekly basis **(Table 5-2, p. 136)**. This is also broadly comparable with the SI prevalence of 5% in wave five of the nationally-representative ELSA dataset of adults aged 52 and above in England (Jivraj et al., 2012).

These exploratory findings, while preliminary and in need of replication, cast doubt over the view that older adults are at increased risk of loneliness and SI when living in rural environments (Age UK, 2013; Wenger, 2001). However, the SHARP sample had a high mean education and income level **(Table 5-1, p. 134)**, which may be indicative of south-west regions of England. This may have influenced levels of loneliness and SI, making the data un-representative of rural areas outside the south-west. Nationally-

representative data from rural areas across the UK is needed in order to compare SI and loneliness prevalence with urban-based or ELSA data.

Nonetheless, when considering individuals who have recently migrated to rural places, there does seem to be an increased risk of SI and loneliness. The GaPL study found that living in one's neighbourhood for more than 30 years, compared with fewer than five years, predicted a reduced likelihood of loneliness (OR=0.36, 95% CI 0.17 to 0.70), a reduced likelihood of SI from family (OR=0.27, 95% CI 0.15 to 0.49) and a reduced likelihood of SI from the community (OR=0.48, 95% CI 0.25 to 0.95) **(Table 4-3, p. 104)**. The lack of a supportive family network in rural places was also noted by Stockdale and MacLeod (2013) in their study of adults aged 50 to 64 years who had migrated to three rural areas in the UK. They argued that this lack of family network might lead to difficulties in care provision when the migrants aged in-situ.

In the qualitative SHARP study (Chapter 6), some inactive participants reported that they had not been able to fully integrate into their local neighbourhood community after retiring to the countryside and that they missed their previous social networks, which was interpreted as social loneliness **(Profile F, p. 186)**. A cross-sectional study of 1,995 individuals living across 20 rural Canadian communities similarly found that the number of years lived in the community predicted both the psychological sense of community and the participants' involvement in neighbouring (Wilkinson, 2008). In the quantitative SHARP study (Chapter 5), the frequency of trips for volunteering was associated with both a higher level of MVPA **(Table 5-6, p. 145)** and with more contact with neighbours **(Table 5-7, p. 147)**. Therefore, if a lack of local integration by recently migrated older adults leads to less local voluntary engagement, it may also lead to lower levels of MVPA which could otherwise be gained from volunteering. Thus, the fears voiced by some, that relocating to rural areas in later life may not be as idyllic as it is thought, may be correct in situations where individuals do not integrate well into their new communities (Age UK, 2013).

7.2.2 Physical activity in a rural context

The findings of Chapters 5 and 6 provide a new insight into the levels of PA engaged in by rurally-living older people in the UK, suggesting that women aged 65 and over in rural places may have higher levels of PA than their urban-living counterparts. In the quantitative SHARP study, men and women did not differ in their level of mean daily MVPA **(Table 5-4, p. 138)**. This contrasts with findings from an urban context in the UK in which objectively-measured MVPA was significantly lower for older women than for men (Davis et al., 2011b). The qualitative SHARP study (Chapter 6) also provided evidence of engagement in sports, active leisure and productive pursuits by both men and women in the active group **(Profile A, p. 182; Profile C, p. 184; Profile E, p. 186)**. In the quantitative SHARP study men engaged in a mean of 32 minutes/day (SD 26.7) and women in a mean of 33 minutes/day (SD 24.7) of MVPA **(Table 5-4, p. 138)**. This meets the UK government's PA guidelines of 150 minutes of MVPA per week (Department of Health, 2011). However, as seen in the standard deviations, the range was wide, showing that there is a high polarity in very active and inactive rurally-living older adults. Indeed, 25.9% of men and 14.6% of women engaged in less than 10 minutes/day of MVPA, while 26.7% of men and 24.7% of women engaged in more than 50 minutes/day of MVPA. Clearly other factors, besides living in a rural area, influenced the engagement in MVPA in the sample. This was further supported by the findings of the qualitative SHARP study. Respondents living in the same village differed greatly in their motivations and preferences for active and social pursuits, both of which were largely influenced by their past engagement in active and social pursuits **(p. 190, p. 192)**.

Martin et al. (2005) found that older people living in rural areas in US reported being less physically active than their urban counterparts. This may not be the case in rural areas of the UK, at least not for 47.6% of the SHARP sample who engaged in 30 minutes/day of MVPA or more. The difference in rural geography (i.e. walkability and distances from neighbouring towns or cities), climate and culture between the US and the UK, may lead to very different ageing experiences in rural areas across the UK, the US and other nations. Rind and Jones (2011) reasoned that there may be more opportunities to perform recreation in green spaces in rural areas than in urban areas in

the UK. This difference was thought to explain their finding of higher self-reported recreational PA levels in rural versus urban-living adults in a nationally-representative sample of 360,323 people aged 16 and older, of which 20% were aged 65 or above (Rind & Jones, 2011). Nevertheless, one rural community may differ greatly from another in its availability of green space, amenities and community spirit (Manthorpe et al., 2004), which may have implications on the opportunities for PA for the older residents. Directly comparable objective PA data of older adults of the same age range and socio-demographic backgrounds living in different sizes of rural and urban places are necessary to better understand the implications of rurality/urbanisation on older adult PA levels.

Pursuits which are familiar and naturally occurring in older people's daily lives may be a suitable and effective way to promote PA in the rurally-living older population of the UK. The quantitative SHARP study identified that more frequently leaving the house for volunteering, accompanying others, sports or exercise, or gardening were associated with gaining more LPA (via accompanying others and gardening), MVPA (via volunteering and sports or exercise) and more TPA (via volunteering) **(Table 5-6, p. 145)**. The qualitative SHARP analysis also supported this notion through finding that most pursuits in which older adults engaged in later life were habitual activities continued and adapted from earlier in life **(p. 190)**. While findings from Chapters 5 and 6 are cross-sectional and cannot infer causality, they do provide a picture of types of everyday pursuits in which participants in this study frequently engaged.

Making more trips out of the house, especially if on foot, has been related to higher levels of MVPA in an English sample of 214 adults over aged 70 and over (Davis et al., 2011b). There is therefore scope to promote the types of pursuits which were most frequently reported in the quantitative SHARP study in future rural-based interventions (e.g. gardening, visiting/social events, volunteering) **(Figure 5-3)**. The facilitation of activities which may not initially be perceived as exercise (such as volunteering), but do add significant amounts of daily LPA, MVPA or TPA and thereby help older people to avoid sedentary behaviour, could be an important strategy for promoting active ageing (Sparling et al., 2015; Varma et al., 2016).

7.2.3 Social isolation, loneliness and physical activity

All three studies in this thesis provided evidence against the hypothesis that loneliness and SI are associated with lower levels of PA (Hawkley & Cacioppo, 2010). While the GaPL study did not find associations between PA and the incidence of loneliness or two SI types, this lack of association may have been due to the limitations of the self-reported and proxy measures of PA used, and of the constructs used to measure loneliness and SI. For a full discussion see **Section 4.4.4 (p. 111)**. To address these limitations, the quantitative SHARP study explored these associations using objectively-measured PA, prospective activity diaries and more precise and recognised measures of loneliness and different types of SI **(Section 5.1.2, p. 117)**. This study also did not find direct cross-sectional associations between LPA, MVPA or TPA and loneliness or SI types, although it cannot provide definitive evidence on this matter, as the study may have been under-powered to find such associations. To further develop and understand the findings from Chapter 5, qualitative interviews were conducted to explore the experiences of SI and loneliness in both highly active (n=12) and inactive older adults (n=12) from the SHARP sample **(Section 6.1.2, p. 166)**. Findings from this study also support the lack of association between SI or loneliness and low PA, given that in both highly active and inactive older adults there was evidence of SI or loneliness, as well as a lack of SI or loneliness (with some of the most physically active showing evidence of loneliness).

The findings in this thesis replicate those from the two available studies observing a lack of association between loneliness and objectively-measured PA, cross-sectionally in an English sample of 238 adults aged 65 years and older (Harris et al., 2009) and longitudinally in a Canadian sample of 228 adults aged 77 years and older (Newall et al., 2013). In both these studies, however, the lack of this association has not been discussed in detail, although it presents contradicting evidence to the hypothesis that loneliness and SI are associated with low levels of PA (Hawkley & Cacioppo, 2010). More recently, Elovainio et al. (2017) conducted a prospective study of 644,901 men and women aged between 40 and 69 at baseline, with a mean follow-up of 6.5 years. While the authors reported an association between two of the three health behaviours measured (alcohol

consumption and smoking) and loneliness and SI, they did not report the association between the third measured health behaviour (self-reported moderate or vigorous PA) and loneliness or SI. It is unknown whether the lack of reporting means that there was no association was found between these variables, or whether this analysis was not conducted.

In contrast, the longitudinal association found between loneliness and lower self-reported PA in a study of 229 adults aged 50 to 68 years (Hawkley et al., 2009) and the cross-sectional association found between loneliness, SI and low self-reported PA in the 8,688 adults aged 52 and above from wave two of the ELSA dataset (Shankar et al., 2011) have been widely discussed and referenced. These studies, as well as other cross-sectional and longitudinal studies using self-reported PA, seem to have solidified the hypothesis that loneliness and SI are accompanied by low PA (Pels & Kleinert, 2016). There have not, however, been any studies using objectively-measured PA in a sample of adults aged 65 and above that have confirmed this association. For instance, the summary table of 37 cross-sectional, longitudinal and intervention studies in a recent systematic review shows that this association has only been found in studies using subjective PA measurements in samples of children, adolescents or adults including those younger than 65 years (Pels & Kleinert, 2016). While the studies in this thesis cannot definitively disprove that loneliness and SI lead to low PA, or *vice versa*, due to the statistical limitations of the data and cross-sectional study designs, they bring to the fore the need to question these associations and the need to further explore the reasons why highly active older individuals may experience loneliness and/or SI and what protects some inactive older individuals from experiencing loneliness and/or SI. As discussed in Chapter 5 **(Section 5.4.2, p. 152)**, it may be that loneliness, being a subjective experience, is associated with subjective ratings of PA, but not with objective PA, which does not closely relate to subjective ratings of PA (Colbert et al., 2011).

A direct implication of a potential lack of association between low levels of objective PA, SI and loneliness is that behavioural interventions to increase PA levels in older adults may do nothing to reduce SI or feelings of loneliness in rurally-living older people, unless they include intervention components designed to help increase participants' social

connections and help participants to meet/change their own expectations of social contact (Masi et al., 2011). Fortunately, recent PA interventions for older adults are embracing a multi-component approach which includes theory-based social and educational components intended to increase social integration and social cohesion within the intervention groups (REACT, 2017). Given the support found in Chapter 6 for both the deficit theory (Weiss, 1973) and the cognitive theory of loneliness (Perlman & Peplau, 1981), as well as the influence of the life-course on social expectations in later life, future PA interventions could consider these theories when designing their social and psychological components. It might be necessary to measure both the social and emotional dimensions of loneliness in any PA programme intending to also alleviate loneliness in order to capture its effectiveness. For instance, making new local friendships in a community-based intervention may help relieve social loneliness, but may not relieve emotional loneliness generated from a lack of/loss of an intimate relationship (such as with a spouse or other close family member) (Weiss, 1973).

Nevertheless, group interventions targeting PA, SI and loneliness might not help to reduce loneliness for some individuals as the reasons for their reported loneliness vary widely (Sullivan et al., 2016). Given that loneliness has been related to many personal circumstantial triggers including widowhood (Dykstra et al., 2005; Victor et al., 2005b; Wenger & Burholt, 2004; Wenger et al., 1996), poor physical health (Newall et al., 2009; Victor & Bowling, 2012; Wenger & Burholt, 2004) and recent migration to an area of residence (Wenger & Burholt, 2004), an individually-tailored approach might be needed to alleviate loneliness, rather than a group intervention approach (Sullivan et al., 2016).

7.2.4 Contribution to theory

All three studies support the need to deconstruct the dimensions of both SI and loneliness. Not only are loneliness and SI theoretically and empirically distinct as found in the GaPL study **(Section 4.4.1, p. 106)** and other literature (Havens et al., 2004; Wenger & Burholt, 2004), but so too are the different types of SI depending on from whom one is isolated: from family, from friends or from neighbours, as found in the GaPL study **(Section 4.4.1, p. 106)** and the quantitative SHARP study **(Section 5.4.1, p.**

149). Thus, researchers and practitioners aiming to identify who may be experiencing different types of SI, or wishing to evaluate how effective a particular strategy or intervention is in increasing social contact, may need to measure the type of social contact more specifically than the general definition of SI that summarises the frequency of social contact with all three of these sources.

Most large studies concerning SI have not specified from whom individuals are socially isolated (Holt-Lunstad et al., 2015; Jivraj et al., 2012; Shankar et al., 2013; Shankar et al., 2011; Tilvis et al., 2012). It may be beneficial to return to the use of social network types which describe the predominant source of social contact and include a measure of quality of social contact, such as those documented by Wenger (1991) and by Litwin (1998). Identifying older people's social networks, and where these are deficient, may facilitate the design of targeted social interventions. The use of social networks as an outcome measure in PA interventions, rather than the simple SI measure, would also provide a more detailed picture of any changes in the sources and quality of social contact.

The qualitative SHARP findings support the integration of the deficit theory and cognitive theory of loneliness (de Jong Gierveld & Tesch-Römer, 2012; Dykstra & Fokkema, 2007) and their application within the life-course perspective of the adapted socioecological model **(Section 6.4.1, p. 196)**. The two dimensions of loneliness defined by the deficit theory; emotional and social loneliness (Weiss, 1973) were seen in both highly active and inactive older participants. Loneliness was also related with meeting, or not meeting, expectations of social contact developed over the life-course, supporting the cognitive theory of loneliness (Perlman & Peplau, 1981) and highlighting the benefits of integrating this theory with a life-course perspective of the adapted socioecological model (Bauman et al., 2012).

Interventions which aim to alleviate loneliness might need to be tailored towards targeting specific dimensions of loneliness. For instance, for an active older individual who has frequent social contact with a wide social network, but who feels emotional loneliness due to a missing spouse (as seen in **Profile E, p. 186**), it may be helpful to

address inter-personal relationship skills, expectations and evaluations. Indeed, a meta-analysis of 50 intervention studies found that interventions which addressed maladaptive social cognition were most effective at reducing loneliness (Masi et al., 2011). While for individuals who miss contact with their wider social network (as seen in **Profile F, p. 186**), interventions to facilitate neighbourhood and friend social networks may be helpful. Even though the meta-analysis by Masi et al. (2011) found that interventions designed to increase social contact did not reduce loneliness, this finding may be limited by the use of a unidimensional concept of loneliness, rather than separately measuring emotional and social loneliness, in most of the included studies. It would be interesting to evaluate interventions designed to increase friend or community engagement for individuals specifically demonstrating social, not emotional, loneliness.

7.3 Strengths and limitations

7.3.1 Study samples and methods

The studies in this thesis include the quantitative analysis of the large GaPL dataset of 844 adults aged 60 and above living in rural areas of South Wales and South West England **(Chapter 4, p. 87)**, the quantitative analysis of the SHARP dataset of 112 adults aged 65 and above living in rural areas of Wiltshire in England **(Chapter 5, p. 113**) and a qualitative analysis of 24 purposefully selected older adults between 66 and 83 years of age from the SHARP study **(Chapter 6, p. 161)**. Each of these studies has key strengths and limitations. Most importantly, all three studies were observational and cross-sectional, and therefore are able to show associations between variables but cannot claim causality.

Some strengths of the GaPL study (Chapter 4) were its large sample size of 844 older adults and the recruitment of participants living across six different geographical areas, equally representing South West England and South Wales. The large sample size provided the statistical power for confident inferences of associations between predictor variables and the SI or loneliness variables. The representation of both smaller, more isolated and larger, better connected rural areas, and areas with a low or high average socio-economic status in England and Wales allowed the findings to be broadly

representative across rural areas in the South West of the UK. However, it has been strongly argued that rural places differ greatly from each other on social and environmental characteristics (Manthorpe et al., 2008; Manthorpe et al., 2004). Therefore, the grouped analysis of six varied rural communities in the GaPL study may not be wholly applicable to individual rural villages or hamlets, for which individual case studies would be necessary. Unfortunately, the selection of variables for the GaPL study was limited to self-reported PA and SI and loneliness measures which are not comparable to other literature, factors which were out of the researcher's control, due to the secondary nature of the analysis. For more discussion see Chapter 4 **(Section 4.4.4, p. 111)**.

The quantitative SHARP dataset addressed some of the GaPL study's limitations by using objectively-measured PA and more detailed measures of SI and loneliness frequently used in other studies. However, it was limited in terms of sample size with 112 participants included in the analysis. This modest sample size introduced the possibility that outcomes may have occurred due to chance or due to influential outliers. Thus, it is important to remember that the nature of this work is exploratory, not confirmatory (Bender & Lange, 2001). Replication studies using larger and more diverse samples are therefore needed. It was not possible to stratify the analysis by gender, as this would have further reduced the sample size, and thereby the statistical power. Given the significance of gender as a control variable in the regression models predicting mean daily PA through reasons for trips in the quantitative SHARP analysis **(Table 5-6, p. 145)**, gender-stratification may have provided evidence of gender-specific associations between reasons for trips outdoors and PA. The emergence and popularity of gender-specific programmes such as the Men in Sheds initiative in which men engage in woodwork activities (Milligan et al., 2013) gives some indication of potential value in gender-specific approach to PA and social interventions for older adults.

Both the quantitative GaPL and SHARP datasets contained a high percentage of adults in the younger age range. In the GaPL sample, 42.9% were between 60 and 69 years of age and 20.4% aged 80 and above **(Table 4-1, p. 99)**. In the SHARP sample 44.6% were aged between 65 and 69 and 17.9% aged 80 and above **(Table 5-1, p. 134)**. The analyses

conducted are therefore mostly applicable to this group of younger older adults, and may not give an accurate picture of active and social pursuits engaged in, or their predictors, by adults aged 80 and above in rural areas. The only other comparable dataset with objectively-measured PA measures of older adults in the UK had no adults below age 70, with an average age of 77.5 years for men and 78.6 years for women (Fox et al., 2011). Consequently, Fox et al.'s (2011) findings are not directly comparable with the SHARP findings. Due to the large percentage of adults aged below 70 years, only a small percentage of respondents had a low score on the objectively-measured physical function test (the SPPB measure), with only 6.2% scoring 6/12 or lower in the SHARP sample **(Table 5-1, p. 134)**. It is likely that the GaPL sample, with a similar percentage of adults below age 70, also included few respondents with advanced functional limitations. This may have occurred due to a selection bias of higher-functioning participants, who may be more willing to take part in research, and it likely reduces the generalisability of the GaPL and quantitative SHARP findings to rurally-living older adults with advanced functional limitations. Nevertheless, the intention of these studies was not to specifically recruit the oldest-old (aged 80 and above) or functionally limited, but to conduct a population study of rurally-living adults aged 65 and above. Future studies could focus on recruiting adults aged 80 years and above or functionally limited adults living in rural places to further explore how the findings in this thesis relate to this population.

The qualitative analysis in Chapter 6 was able to overcome some of the limitations of the quantitative SHARP study in Chapter 5; one of the advantages of a mixed-methods design (Doyle et al., 2009). The qualitative SHARP study purposefully selected participants who were very active or very inactive and balanced PA groups regarding age, gender and physical function, using previously collected objectively-measured PA data, questionnaire responses and physical function data from the quantitative SHARP study. This purposeful selection created a balanced sample including younger (66-70 years) as well as older ages (71-83 years) in both high and low PA groups and allowed a high level of certainty that participants being compared did differ in their levels of PA **(Table 6-1, p. 180)**. The use of a qualitative methodology allowed the in-depth analysis of interview data from each participant, including some participants aged 80 and above

living with functional limitations. However, the three-to-four month gap between the quantitative data collection and the qualitative interviews may have allowed PA and physical function to change between these two time points. For a more detailed discussion see Chapter 6 **(Section 6.4.3**, **p. 201)**.

In both the quantitative **(Table 5-1, p. 134)** and qualitative SHARP samples **(Table 6-1, p. 180)**, the mean education and household income levels were high. This may have deflated the prevalence of SI and loneliness, given their association with income and education (Demakakos et al., 2006; Jivraj et al., 2012). The levels and types of PA and social pursuits may also have been influenced by high levels of education and income (Fox et al., 2011; Smith et al., 2015). For example, they may have been a greater engagement in pursuits which cost money, such as playing golf and dining out, than would have been seen in a less affluent sample of rurally-living older people, who may engage in more low-cost sedentary activities, such as watching TV (Smith et al., 2015). For a more detailed discussion see Chapter 6 **(Section 5.4.3, p. 155).**

7.3.2 Methodological approach

The sequential mixed-methods approach of this thesis is one of its key strengths. Two quantitative studies were first conducted and a qualitative follow-up study was subsequently conducted. An advantage was that the qualitative study could provide a more in-depth investigation of the personal, social and environmental circumstances at present and earlier in the life-course of each interviewed participant and, therefore, help to better understand and explain the quantitative findings of the first two studies (Doyle et al., 2009). There were also some instances of true mixing of methods within an analysis. First, in the quantitative SHARP study, the qualitative process of categorising the open-ended activity diary responses allowed the activity categories to be grounded in the data rather than being based on existing activity categories used in other literature, and therefore to be closely representative of the rural context **(Section 5.2.3, p. 128)**. As measures of frequent pursuits by older people are generally developed with urban-living older adults, this approach created a novel documentation of out-of-house pursuits commonly engaged in by older adults in a rural context. Secondly, the use of

quantitative data from the first SHARP study in the qualitative SHARP study **(Section 6.2.3, p. 169)** allowed the identification and recruitment of specific PA groups, aided the classification of loneliness or SI in the analysis, and enriched the presentation of findings through quantification of objective PA levels.

The studies in this thesis were built on previous research findings and integrated the perspectives of older people in several ways. First of all, the overall thesis research question was inspired by the findings from previous qualitative work comparing the personal, social and environmental influences on getting out and about for rurally-living and urban-living older adults carried out by the PhD candidate (de Koning et al., 2015). Next, the quantitative and qualitative SHARP studies (Chapters 5 and 6) were planned using reflections on both quantitative and qualitative findings from the OPAL study of urban-living older people which also explored barriers and facilitators to getting out and about (Davis et al., 2011a; Davis et al., 2011b; Fox et al., 2011; Stathi et al., 2012). As described previously, Public and Patient Involvement (PPI) was also sought to verify the interpretability and acceptability of the data collection methods for the quantitative **(Section 0, p. 129)** and qualitative SHARP studies **(Section 6.2.5, p. 171)**. PPI takes several forms, including the transmission of information to the research participant group (University of Bath, 2017). Considerable time was dedicated to this through producing individually tailored feedback reports for each of the 112 participants of the quantitative SHARP study. For an example feedback report see **Appendix E (p. 259)**. Future work focussed on developing actionable strategies to support the maintenance of health and wellbeing of older adults in rural areas of the UK, would benefit from creating PPI discussion groups with rurally-living older people to co-design suitable intervention strategies and to develop the research methods used to evaluate them (Blair & Minkler, 2009; Ottmann, Laragy, Allen, & Feldman, 2011).

7.3.3 Theoretical approaches

The overall aim of this thesis was to investigate the associations between SI, loneliness and levels and types of PA in rurally-living older adults in the UK. This aim was chosen in response to the hypothesis that loneliness is associated with self-imposed SI and thereby associated with reduced levels of PA (Hawkley & Cacioppo, 2010). While this hypothesis is based upon the cognitive theory of loneliness, the studies in this thesis integrated two theories of loneliness (cognitive theory and the deficit theory of loneliness) within the adapted socioecological model of PA determinants which recognises the influence of time and experiences during the life-course (Bauman et al., 2012) **(Figure 3-1, p. 80)**. Using such a meta-theoretical model enabled a multi-faceted observation of the multi-dimensional concept of loneliness (de Jong Gierveld & Tesch-Römer, 2012; Dykstra & Fokkema, 2007; Sullivan et al., 2016). It was the first instance in which the adapted socioecological model (developed for PA determinants) was also applied to loneliness and SI (Bauman et al., 2012). The application of this comprehensive framework to both PA and social behaviours allowed the categorisation of different levels of influence (personal, social, environmental) on the complex topics of loneliness and SI in the qualitative SHARP analysis of Chapter 6.

Although it was outside the scope of this study, the methodology did not allow the observation of how higher level environmental and societal factors influence loneliness or SI, as only the participants' perceptions of these were recorded. As argued by de Jong Gierveld and Tesch-Römer (2012), societal norms, the state of social welfare and demographic population distributions interact with personal and inter-personal factors in influencing the onset of loneliness. Thus, further research using the adapted socioecological model to frame antecedents to loneliness would benefit from incorporating higher-level variables regarding the wider societal, environmental and political context of rural communities in the UK.

7.4 Directions for further research

7.4.1 Longitudinal studies of rural populations

Longitudinal studies, using large and geographically diverse samples and interdisciplinary methods will enable a better understanding of the changes in objectively-measured PA behavioural patterns and social wellbeing as people age in rural communities. The one longitudinal study of rural ageing undertaken in the UK concerned rural areas in north Wales and collected data between 1979 and 1999 (Wenger & Burholt, 2004). This study provided valuable insights into the changes in loneliness and SI over time, but is limited to its cultural setting and time period. Longitudinal studies are needed in which data are collected from small rural areas across all counties in the UK, akin to the ELSA dataset (English Longitudinal Study of Ageing, 2011), and which collect data on a variety of behavioural, social and health-related topics. It may be possible to undertake new analyses using the rurally-living respondents from ELSA, as there are 7,820 rurally-living participants in wave five (2010-11) (Jivraj et al., 2012, p. 90). However, the currently available ELSA data has not measured PA objectively, as evidenced by the most recent publications using this dataset (Garfield, Llewellyn, & Kumari, 2016; Rogers et al., 2017; Smith, Dainty, & MacGregor, 2017). Thus, the addition of objective PA measurement would be worthwhile in future data collection waves.

As healthy ageing is multidisciplinary by nature, any future large studies need to incorporate a multidisciplinary approach to research design. For instance, methods could include the use of objective PA measurements, questionnaire-derived and interview-derived measures of social networks, SI types and the social or emotional loneliness concepts from the deficit theory of loneliness (Weiss, 1973). Additional methods could also include physiological measurements such as biomarkers of health and disease as is done in the ELSA dataset (Hackett, Hamer, Endrighi, Brydon, & Steptoe, 2012; Hamer et al., 2012) and geographical mapping tools as done by Rind and Jones (2011). Such studies would provide stronger evidence of how PA and the maintenance of social connections contribute to prolonged health, wellbeing and independence into older age. The broadening of multidisciplinary methods and greater sampling of rurally-

living older adults in future waves of ELSA would allow rural and urban settings to be accurately compared. This would also facilitate the evaluation of long-term effects of policy changes (such as social care, housing, retirement and public transport policies) on the ageing experiences in rural areas.

7.4.2 Rural intervention studies

There is scope for high-quality evaluations of rural community-led programmes or initiatives, and randomised controlled trials (RCTs) of community-based programmes for older adults in rural UK settings. The only published PA intervention targeting rural areas in the UK was focussed on a wide age-range (adults aged 18 and above), not specifically on older adults (Solomon et al., 2013). While having many commendable research processes, such as the random recruitment of 10,412 participants across 128 different villages and the creation of PA interventions tailored to each village through public engagement activity, this trial does not provide insights into how to support rurally-living people over age 65 to remain active or socially connected. Its focus on promoting opportunities for sports and exercise, rather than life-style related PA (such as gardening, volunteering or socialising), may be one of the reasons for the minimal uptake of the PA opportunities provided by the intervention (Solomon et al., 2014).

Moore et al. (2016) advised that future PA intervention studies for older people should use tailored and socially-facilitated approaches to increase low to moderate-intensity PA and use objective PA measurements. Interventions aiming to increase PA through social activity have been evaluated for older adults living in urban areas in the UK, such as the pilot Active, Connected and Engaged communities (ACE) intervention, which used one-to-one peer volunteers to accompany less-active older people to local activity destinations (Withall et al., 2016). There is still a need for a larger-scale RCT to evaluate this approach. Such an approach would be worth tailoring to, and evaluating in, rural settings in the UK. Based on the findings of this thesis, an important addition to the evaluation of any PA intervention would be the measurement of impact on specific types of social contact (family, friends or neighbours) and the impact on social or emotional loneliness.

Trips for volunteering were associated with both a higher level of MVPA as well as more frequent social contact with neighbours in Chapter 5 **(Figure 5-4, p. 148),** making volunteering a possible target behaviour for rurally-tailored interventions. However, there was a wide range of volunteering types, ranging from attending committee meetings to helping maintain village green spaces and conducting the village car speed watch **(Appendix D: p. 256)**. It is therefore difficult to know what kind of volunteering would be most effective at increasing PA and/or social in an intervention. The effects of different volunteering types on PA and local social networks need to be investigated using experimental designs. There is scope to conduct Participatory Action Research (PAR) projects in collaboration with rurally-living residents to find appropriate and effective ways to facilitate the different types of volunteering (Burholt, Nash, Naylor, & Windle, 2010). Once a PAR approach has identified worthwhile intervention approaches, RCTs employing intervention mapping approaches to the expected health outcomes are necessary to provide definitive evidence of their effectiveness in increasing PA, social contact and other health-related outcomes (Jenkinson et al., 2013). In a time of governmental cuts in public spending (UK government, 2016), there is a need for robust, definitive evidence which can convince regional councils to fund such community initiatives or, at least, to halt the withdrawal of funding from rural services and programmes with proven effectiveness in supporting the maintenance of PA and social connections by older adults.

Evaluations of community-based interventions using gardening as a means of increasing PA and social contact for rurally-living older adults may be worthwhile. The quantitative SHARP study found that gardening was a regular pursuit for many older participants and that it was associated with more LPA and TPA, and therefore the avoidance of sedentary behaviour **(Table 5-6, p. 145)**. Limited intervention evidence is available for gardening activity relating to rural areas in the UK. One of the few available UK-based studies is a pilot intervention trial focussed on community conservation in a British sample of 42 adults, of whom nine were aged 65 and above (Christie, Miller, & Dewhurst, 2015). They found that one hour of conservation gardening elicited a mean heart rate response that indicated moderate-intensity PA, and that the older participants worked significantly

harder than the younger participants, relative to their maximum heart rate (Christie et al., 2015).

Most research on gardening for older people, however, has been conducted in Asian cultures (Park, Lee, Son, Lee, & Kim, 2016; Park et al., 2011; Park et al., 2012; Park et al., 2008; Park et al., 2009) or Australia (Scott, Masser, & Pachana, 2014). An RCT of a three-month gardening intervention at two Korean senior centres including 50 older women found that self-reported PA increased in the intervention group but not in the control group (Park et al., 2016). However, this trial used self-reported PA measures and observed only two senior centres which were randomised at the group level, introducing group-level confounding variables.

There is scope for RCTs focussed on gardening activities for older people in community-based spaces such as allotments which collect objectively-measured PA data and detailed information about social contact levels and perceptions. The aim of such interventions could be to elicit both increased PA as well as 'shoulder-to-shoulder' social contact, as seen in the Men in Sheds programme in which older men engage in activities such as woodwork together (Milligan et al., 2013). Gardening interventions align with the concept of green gyms, which involves voluntary work in a variety of nature conservation roles (Birch, 2005). After interviewing three volunteers, Birch (2005) reported that green gym volunteers felt that they had increased their fitness, improved mental wellbeing and gained social contact through their involvement. There is a need, however, for more rigorous evaluations of the effectiveness of models of gardening/green gym interventions in increasing PA and alleviating/avoiding SI or loneliness for older adults living in rural areas of the UK.

7.5 Conclusions

The three studies reported in this thesis have added to the limited UK-based literature on PA, SI and loneliness in rurally-living older adults in the following ways:

- The quantitative GaPL and SHARP studies showed that the prevalence of SI and loneliness appears comparable with published data on urban-living older adults. The GaPL study found that living in a rural area for a shorter time (i.e. more recent migration) is an independent predictor of SI from the community, SI from family and loneliness.

- The quantitative SHARP study found that trips for volunteering, accompanying others, sports or exercise, and gardening were associated with engaging in more LPA, MVPA and/or TPA. This study did not find an association between loneliness or types of SI, and lower overall levels of LPA, MVPA or TPA, contrasting with the loneliness model's hypothesis about this association (Hawkley & Cacioppo, 2010; Pels & Kleinert, 2016; Shankar et al., 2011). Nevertheless, specific PA types such as more frequently making trips for volunteering, sports or exercise, or accompanying others did associate with a lower likelihood of SI from the community, SI from friends and SI from family, respectively.

- The qualitative SHARP study found that very active older adults may feel emotionally lonely if their family relationships are disrupted, and may be socially isolated (but not lonely) if they engage in a life-long active, but solitary pursuits. Some older adults were inactive due to health issues, but avoided loneliness and SI if they continued life-long social pursuits, but made adaptations to reduce their physical demand. However, other older adults were inactive and felt socially lonely due to their inability to continue former social and physical activities, as a result of caring or work responsibilities, or not socially integrating into their new rural community. These findings support recent arguments of the complex, individual and multi-dimensional nature of loneliness (de Jong Gierveld & Tesch-Römer, 2012; Sullivan et al., 2016).

To conclude, future studies should aim to develop theory-led interventions (integrating the cognitive and deficit theories of loneliness into an adapted socioecological model which recognises life-course influences) to alleviate loneliness in both highly active and inactive older people in rural settings. Interventions could also focus on evaluating rurally-tailored means of increasing PA (i.e. volunteering, gardening, sports or exercise) which may also strengthen local social networks, especially for older people who have recently migrated to their rural localities.

viii. References

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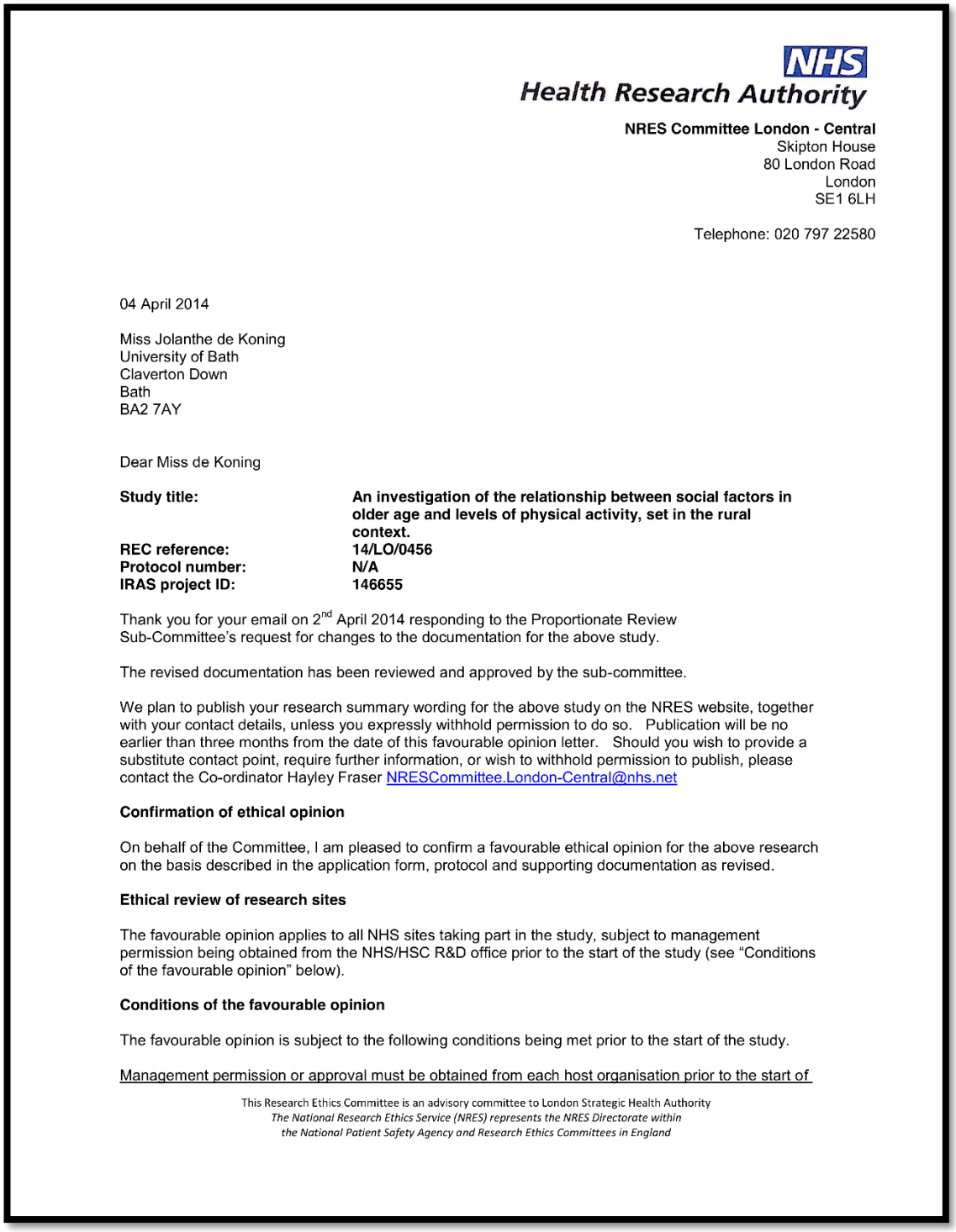
ix. Appendices

Appendix A: NHS ethics and R&D approval



NHS
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Telephone: 020 797 22580

04 April 2014

Miss Jolanthe de Koning
University of Bath
Claverton Down
Bath
BA2 7AY

Dear Miss de Koning

Study title:	**An investigation of the relationship between social factors in older age and levels of physical activity, set in the rural context.**
REC reference:	**14/LO/0456**
Protocol number:	**N/A**
IRAS project ID:	**146655**

Thank you for your email on 2nd April 2014 responding to the Proportionate Review Sub-Committee's request for changes to the documentation for the above study.

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

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

Confirmation of ethical opinion

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

Ethical review of research sites

The favourable opinion applies to all NHS sites taking part in the study, subject to management permission being obtained from the NHS/HSC R&D office prior to the start of the study (see "Conditions of the favourable opinion" below).

Conditions of the favourable opinion

The favourable opinion is subject to the following conditions being met prior to the start of the study.

Management permission or approval must be obtained from each host organisation prior to the start of

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

BATH RESEARCH & DEVELOPMENT
NHS BANES SWINDON WILTSHIRE

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Miss Jolanthe de Koning
University of Bath
Claverton Down
Bath
BA2 7AY

10 April 2014

Dear Jolanthe,

Re: 2014/008 An investigation if the relationship between social factors in older age and levels of physical activity, set in the rural context.
IRAS ID: 146655

On behalf of NHS Wiltshire CCG we are pleased to inform you that governance checks have now been successfully completed by Bath R&D. Please accept this letter as assurance that the project meets the appropriate research governance standards for GP surgeries within the CCG to act as Participant Identification Centres (PICs).

Please note that PICs are not permitted to take informed consent or undertake any other protocol procedures.

Participant identification must be undertaken in accordance with the Data Protection Act 1998, the Research Governance Framework and ICH GCP.

If you need any further support or information, please do not hesitate to contact me at the above address, quoting our reference number.

Yours sincerely

Irene Blair
Research Governance Facilitator

cc: NHS Wiltshire CCG

Appendix B: SHARP study consent forms

Phase 1 consent form

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Staying Healthy and Active in Rural Places (SHARP)

A research project to observe the everyday lifestyles of senior rural residents

Participant Consent Form: Phase 1

Please look at each of the statements and decide whether or not you agree. Circle **Yes** if you agree and **No** if you do not agree.

EXAMPLE: I understand the information provided for me.	Yes		No
I have read and understood the contents of the Participant Information Sheet.	Yes		No
I have had the opportunity to ask questions about the study and have received satisfactory answers to my questions and any additional details I requested.	Yes		No
I agree to take part in answering the questionnaire.	Yes		No
I understand that the information collected about me will be stored on a computer and that it will be made anonymous. Only researchers on the SHARP study will have access to this data.	Yes		No
I understand that taking part is voluntary and that I can change my mind, withdraw from any part of the study, at any time without giving any reason and without penalty.	Yes		No
I understand that something I say might be used in a written report but my name will not be used.	Yes		No
I understand that the information I provide may be used in future research projects in an anonymised form.	Yes		No

Name of participant	Date	Participant's signature
Name of person taking consent	Date	Signature

Please turn over….

1

Summary of participant information sheet

What is this study about?
Project SHARP is a study which aims to observe the everyday lifestyles of adults over age 65 who live in rural areas. We will ask questions about a range of aspects of your life with specific emphasis on your social relationships and your participation in social activities. We will give you a waistband with a small box to wear for a week which will measure your physical activity, and ask you to keep a brief diary of your everyday activities for one week.

Who is conducting this study?
The researchers who will be conducting this study are Jolanthe de Koning (PhD student and lead researcher) and Dr. Afroditi Stathi. Jolanthe can be contacted on 01225 384323 or J.de.Koning@bath.ac.uk and Dr. Stathi on 01225 383027 or A.Stathi@bath.ac.uk.

Who is organising the study?
The study is being organised by the Department for Health at the University of Bath, BA2 7AY. It part of a PhD study which is being paid for by the Economic Social Research Council (ESRC). SHARP will run from May to August 2014.

Who approved this study?
The Central-London NHS research ethics committee gave a favourable ethical opinion of the research (reference no: 14/LO/0456).

Confidentiality and data protection
Your involvement in the research, anything you say and all the information you give us is confidential. Information will be anonymised (your name removed) and securely stored. After 6 years all data associated with the SHARP project will be destroyed. If you consent to taking part, the researchers will comply with all formal, ethical duties and obligations, including the Data Protection Act 1998.

We greatly appreciate your help,

With warm thanks from: The Project SHARP research team, Department of Health, University of Bath, BA2 7AY

Phase 2 consent form

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Staying Healthy and Active in Rural Places (SHARP)

A research project to observe the everyday lifestyles of senior rural residents

Participant Consent Form: Phase 2

Please look at each of the statements and decide whether or not you agree.
Circle **Yes** if you agree and **No** if you do not agree.

EXAMPLE: I understand the information provided for me.	Yes		No
I have read and understood the contents of the Participant Information Sheet.	Yes		No
I have had the opportunity to ask questions about the study and have received satisfactory answers to my questions and any additional details I requested.	Yes		No
I agree to the audio-taping of any interview that I take part in.	Yes		No
I understand that the information collected about me will be stored on a computer and that it will be made anonymous. Only researchers on the SHARP study will have access to this data.	Yes		No
I understand that taking part is voluntary and that I can change my mind, withdraw from any part of the study, at any time without giving any reason and without penalty.	Yes		No
I understand that something I say might be used in a written report but my name will not be used.	Yes		No
I understand that the information I provide may be used in future research projects in an anonymised form.	Yes		No

Name of participant	Date	Participant's signature
Name of person taking consent	Date	Signature

Please turn over….

1

Summary of participant information sheet

What is this study about?

SHARP (Staying Healthy and Active in Rural Places) is a research project which aims to observe the everyday lives of adults over age 65 who live in rural areas. This is the second part of the study, in which we are especially interested in participants' lifetime experiences, and how these may have shaped current patterns of social and physical activity.

Who is conducting this study?

The researchers who will be conducting this study are Jolanthe de Koning (PhD student and lead researcher) and Dr. Afroditi Stathi. Jolanthe can be contacted on 01225 384323 or J.de.Koning@bath.ac.uk and Dr. Stathi on 01225 383027 or A.Stathi@bath.ac.uk.

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Confidentiality and data protection

Your involvement in the research, anything you say and all the information you give us is confidential. Information will be anonymised (your name removed) and securely stored. After 6 years all data associated with the SHARP project will be destroyed. If you consent to taking part, the researchers will comply with all formal, ethical duties and obligations, including the Data Protection Act 1998.

We greatly appreciate your help,

With warm thanks from: The Project SHARP research team, Department of Health, University of Bath, BA2 7AY

Appendix C: Seven-day activity diary

Example day .....Thursday..... Date *(write the date here as dd/mm/yy)* ….6th..... / ….June..... / …2014.....

A: Wearing the Actigraph

Q1. At the start of the day, I put on the Actigraph at... — **Time:** ...8:15.... AM (morning) or ..... PM (evening)

Q2. At the end of the day, I took off the Actigraph at... — **Time:** ..... AM (morning) or .....9:45... PM (evening)

Q3. Did you remove the Actigraph between these times? *(tick ✓ box)*

No ❑ *If "no", skip Q4, and continue to the following page*
Yes ☒ *If "yes", complete Q4*

Q4. If you removed the Actigraph, please indicate the times you removed it and put it back on and the reasons why below.

	Time: I removed it at...	Time: I put it back on at...	Reason: I removed it because...
1st removal	…11:00..AM ❑ (morning) .....PM ❑ (evening)	.....AM ❑ .. 12:30..PM ❑	.....I went swimming.....
2nd removal	.....AM ❑ .....PM ❑	.....AM ❑ .....PM ❑	.....
3rd removal	.....AM ❑ .....PM ❑	.....AM ❑ .....PM ❑	.....

Possible reasons for removing the Actigraph are: bath / shower / washing / swimming / discomfort




B: Log of daily trips

Q1. Have you made any trips today? ***(Into the garden or further)***

No ❑ *If "no", you have completed today's trip log.*
Yes ☒ *If "yes" continue to question 2.*

Q2. For each trip, please indicate the times at which you went out, the reasons why you did so and your main transport below. *(Of course, there's no need to mention transport for garden work)*

	Time: I went out at...	Time: I returned at...	Reason: I went out to...	Transport: I...
Trip 1	…9:00...AM ☒ .....PM ❑	…9:30...AM ☒ .....PM ❑	*The village shop, to collect the paper*	☒ Drove myself ❑ Was driven in a car ❑ Took the bus / ❑ train ❑ Walked ❑ Cycled ❑ Drove my scooter ❑ Other.....
Trip 2	..10:30..AM ☒ .....PM ❑	.....AM ❑ …1:00...PM ☒	*I went swimming at the leisure centre*	❑ Drove myself ❑ Was driven in a car ☒ Took the bus / ❑ train ❑ Walked ❑ Cycled ❑ Drove my scooter ❑ Other.....
Trip 3	.....AM ❑ …5:00...PM ☒	.....AM ❑ ...6:00...PM ☒	*I went into my garden to do some weeding*	❑ Drove myself ❑ Was driven in a car ❑ Took the bus / ❑ train ❑ Walked ❑ Cycled ❑ Drove my scooter ❑ Other.....
Trip 4	.....AM ❑ .....PM ❑	.....AM ❑ .....PM ❑	.....	❑ Drove myself ❑ Was driven in a car ❑ Took the bus / ❑ train ❑ Walked ❑ Cycled ❑ Drove my scooter ❑ Other.....
Trip 5	.....AM ❑ .....PM ❑	.....AM ❑ .....PM ❑	.....	❑ Drove myself ❑ Was driven in a car ❑ Took the bus / ❑ train ❑ Walked ❑ Cycled ❑ Drove my scooter ❑ Other.....

Appendix D: Activity diary categories

Table ix-1. Lower and higher-level categories of activity types derived from the 7-day diary entries

No.	Higher-level activity categories (Used in OPAL: Fox et al., 2011)	Lower-level activity categories observed inductively from 7-day activity diaries (Fitted under the higher-level categories used in OPAL, or in new ones if necessary)
1	Shopping	1. [32] General shopping [general - mostly food shopping at larger stores] 2. [33] Local shopping [to local or village shop for the daily paper or other] 3. [38] DIY shopping
2	Visits / social events [Includes meeting people in a non-home setting]	1. [2] Visiting young family [visit to children and or grandchildren's home or out] 2. [3] Visiting siblings [visit siblings (or in law), their home or out] 3. [4] Visiting parents [parent visit or help or visiting parents grave] 4. [5] Visiting spouse [visit spouse in caring facility] 5. [6] Group social [parties or social events, village activities, social groups] 6. [8] Coffee, tea-related social meetings [coffee or tea and cakes out with friends] 7. [9] Funerals [acquaintances' funerals] 8. [10] Social visits [to friends' homes] 9. [11] Shopping-related social meetings [meet friends for or during shopping] 10. [12] Neighbourly social [practical or chance neighbourly interaction]
3	Entertainment	1. [7] Food-related social [lunch or dinner with friends] 2. [54] Musical or theatrical entertainment [bands, concerts, theatre shows, cinema, street parade] 3. [56] Spectating sport 4. [58] Eating or drinking out
4	Personal / household errands	1. [34] Post-related errands 2. [35] Car-related errands 3. [36] Bank or accountant errands 4. [37] Library errands 5. [39] Recycling errands [to the waste tip or recycling services] 6. [40] Pet errands [pet shopping or to vets] 7. [55] Beauty or grooming treatment

5	Walking for leisure or exercise	1. [18] Walking for exercise
6	Dog walking	2. [41] Dog walking
7	Volunteering	1. [13] Committee meetings 2. [16] Volunteering in community [community-benefitting volunteering or help (village shop, maintaining public property and green spaces, running clubs, events or Speed Watch)] 3. [17] Volunteering outside community [formal charity work outside community]
8	Paid work	1. [59] Farm work 2. [60] Manual work from home, non-farming 3. [61] Office work from home 4. [62] Work needing travel
9	Escort	1. [1] Caring for grandchildren [child-minding in grandchildren's home or escorting children between destinations] 2. [14] Inter-personal help [inter-personal practical help or caring - not including caring for grandchildren] 3. [15] Transport help [giving others car lifts, excluding grandchildren]
10	Sports / exercise	1. [19] Structured exercise [gym, studio or pool-based exercise or movement; group or individual] *(pool-based exercise included in frequency variable, but not in objective PA variables)* 2. [20] Bike ride [for exercise reasons] 3. [21] Outdoor running [for exercise reasons] 4. [22] Golf 5. [23] Tennis 6. [49] Social physical games [bowling, bowls or skittles]
11	Health	1. [44] Hospital or GP appointments 2. [45] Non-GP medical appointments [Dentist, Podiatrist, Chiropodist, Physiotherapy or Homeopath appointments or Chemist]
12	Day trip	1. [53] Nature and heritage outings [nature, countryside house, museum or city-focussed outings] 2. [57] Holidays
13	Hobby	1. [42] Horse care tasks 2. [47] Musical hobby [in a band or choir] 3. [48] Social games [bingo or bridge in local social centres]

		4. [50] Hobby in nature [birdwatching, picking blackberries, fly-fishing, shooting] 5. [51] Interest group activities [book club, gardening club, gliding club [NADFAS society, pub quizzes, continuing education clubs] 6. [52] Artistic hobby [sketching, painting, pottery or sewing]
14	Religion	1. [46] Church-related activities
15	Gardening	1. [24] Allotment work [away from home] 2. [25] Gardening [Garden maintenance work (in garden or greenhouse)] [While in OPAL they did not include gardening in one's own garden in this category, I think we need to here as having just the 'allotment work' will not generate enough responses. Many people gardened at home, but few people had an allotment.]
	Additional categories (not in Davis et al., 2011)	
16	Activities around the house (non-gardening)	1. [26] Non-garden work in garden [cleaning things, emptying kitchen waste, hanging laundry, feeding fish, chicken birds and bees] 2. [27] Working with wood [moving and working with fire wood] 3. [28] DIY [work in shed, garage, workshop and front drive] 4. [29] Car maintenance work 5. [30] Front drive tasks [loading and unloading from car, emptying dustbins]

Appendix E: Individualised SHARP feedback

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S · H · A · R · P

Staying Healthy and Active in Rural Places

Participant no: S001

Dear XXX,

Thank you for taking part in the SHARP study. This report comprises a brief overview of the answers given by all participants living across 23 villages and hamlets in Wiltshire who we surveyed and some personalised feedback about the week you wore the activity-measuring belt.

Of 113 individuals who responded:

51%	are women	49%	are men
45%	are aged between 65 to 69		
37%	are aged between 70 to 79		
18%	are aged between 80 to 95		

74%	live with others (e.g. spouse, children)
26%	live alone

Duration of residence in the community:	
22%	have lived there for 0 to 9 years
23%	have lived there for 10 to 19 years
28%	have lived there for 20 to 29 years
27%	have lived there for 30 years or longer

Travel:	
52%	drive daily
37%	drive less often than daily
55%	are dependent on driving or a driver for getting out and about
16%	live 30 minutes walking from their children, or closer
69%	have children living in another town, city or country, out of walking distance
15%	live 30 minutes walking from other relatives or closer
80%	have other relatives living in another town, city or country, out of walking distance

Health and wellbeing:	
56%	are completely satisfied with life
65%	think life is worthwhile
25%	feel lonely or isolated
16%	are mildly or more anxious
5%	are mildly or more depressed

20%	see their health as excellent
73%	see their health as fair or good
7%	see their health as poor

The local area:	
95%	think it is easy and pleasant to walk around their local area
18%	think hills, the road structure or lack of pavements make it difficult to walk around
65%	are bothered by the speed of the traffic
59%	feel very safe going out alone in the day and after dark
16%	feel unsafe going out alone after dark
84%	think their neigbourhood is a very good place to live for them

Volunteering in your community:	
17%	volunteer on most days
43%	volunteer at least once or twice a week

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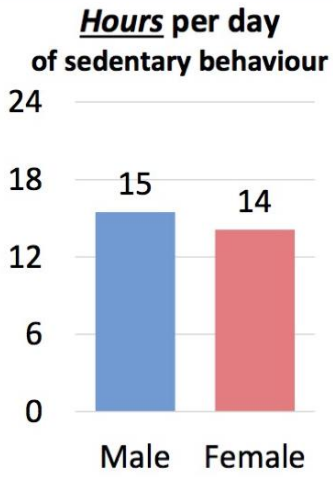
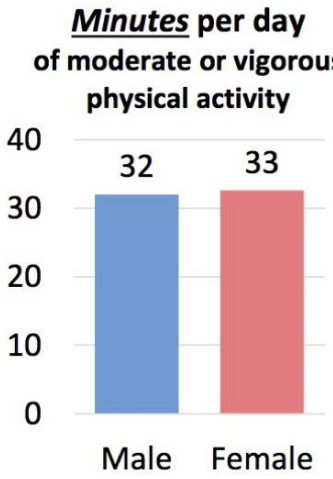
Physical Activity

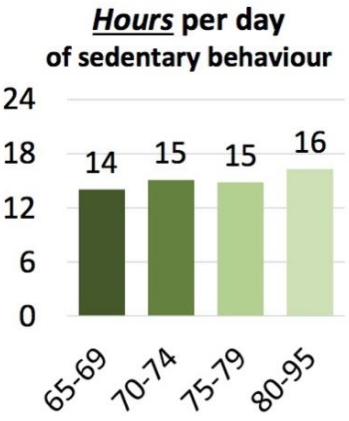
We were interested in the amount of physical activity you and your peers took throughout a normal week. We gathered the following information from the activity-measuring belts which the 113 participants wore for seven days.

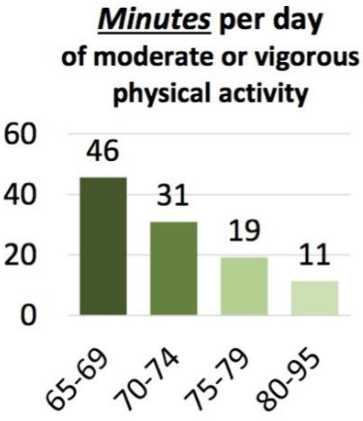
The following graphs show the average daily activity values for all the men and women in the group of participants.

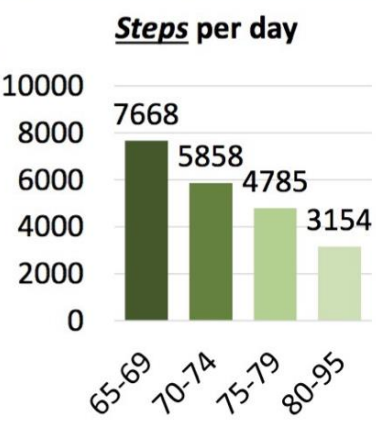




The following graphs show the average daily activity values for all the participants in different age groups.







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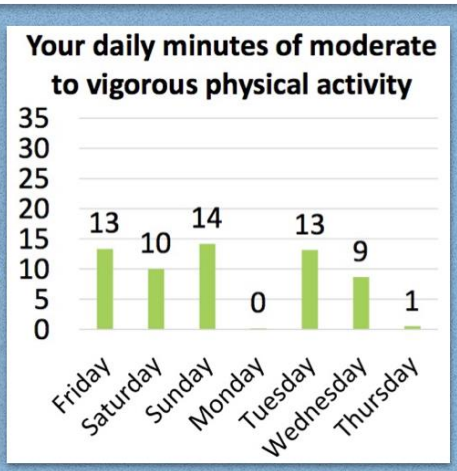
Your activity level

During the week of measurement…
You did **63 minutes** of moderate to vigorous physical activity (on average **9 minutes** per day).
You took on average **1,904 steps** per day.
You sat/lay down on average **17 hours** per day.

On your most active days…
You did **14 minutes** of moderate or vigorous physical activity (Sunday 10/08/2014)
You took **3,148 steps** (Friday 08/08/2014)



You could look at the following guidelines for physical activity to see if you currently meet the recommended levels.

Guidelines for physical activity

Older adults should aim to be active daily. Over a week, activity should add up to at least **150 minutes** (2 1⁄2 hours) of **moderate intensity activity** in bouts of 10 minutes or more – one way to approach this is to do **30 minutes** on at least 5 days a week.

It is healthy to aim for **7,000 steps** per day, but it is good to aim for **5,500 steps** if walking is difficult for you.

Examples of ***moderate*** intensity activities:
• Brisk walking
• Ballroom dancing
• Pushing a lawnmower

It is also important to minimise the amount of time spent being sedentary (sitting) for extended periods.

To minimise sedentary behaviour:
• Get up regularly to make a cup of tea / drink a glass of water
• When talking on the phone, stand up and walk around the living room
• Take regular walk breaks around the garden or street
• Reduce time spent watching TV

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Further analysis

We hope that this brief summary has been of interest.

There is still a lot of analysis to be done using all the information we gathered. We will have this completed and presented in Jolanthe de Koning's PhD thesis by December 2015.

The next step for the SHARP project

In February and March 2015 we will be conducting follow-up interviews with 20 individuals. These individuals have now been selected, based on where they live and their activities, and invited.

The interviews will explore how experiences during one's lifetime may influence one's preferences for, and ability to do, different types of physical activity.

Further interest

If you think the information in this report may serve as a resource to your local council, then please feel free to pass it on, or to recommend him/her to contact me (Jolanthe de Koning) directly.

You may also contact me if you, yourself, would like to receive a summary of the main findings in January of 2016.

Contact details

Jolanthe de Koning, PhD student

Email: J.de.Koning@bath.ac.uk
Telephone: 01225 384 133

Address: 1 West Building, 4.111,
University of Bath,
Claverton Down,
Bath, BA2 7AY.

Thank you, once again, from the SHARP study team!

Appendix F: Additional correlation statistics

Table ix-2. Spearman correlations between frequency of activity types and three measures of physical activity (in order of positive correlation with MVPA) which informed the analysis in Chapter 5.

Activity type (weekly frequency)	Light PA	MVPA[1]	Total PA
Sports/exercise	0.019	**0.401*** **	0.167
Leisure/exercise walking	0.039	**0.337*** **	0.129
Volunteering	**0.242***	**0.305****	**0.286****
Gardening	**0.362*** **	0.187	**0.341*** **
Dog walking	0.087	0.168	0.135
Paid work	0.058	0.128	0.056
Hobbies	0.136	0.112	0.129
Accompanying others	**0.217***	0.097	**0.212***
Personal business	0.074	0.041	0.062
Holiday/day trips	0.083	0.022	0.060
Religion	-0.045	-0.026	-0.051
Around house DIY[2]	0.089	-0.033	0.039
Shopping	-0.032	-0.069	-0.062
Health-related trips	0.019	-0.155	-0.014
Visiting	-0.113	**-0.192***	-0.152
Entertainment	**-0.224***	**-0.212***	**-0.253****

* p<0.05, ** p<0.01, *** p<0.001. [1] MVPA = moderate-to-vigorous physical activity. [2] DIY = do-it-yourself household tasks.

Table ix-3. Spearman correlations between social disconnectedness variables and frequency of specific activities (in order of highest correlation with social isolation from friends) which informed the analysis in Chapter 5.

Activity type (weekly frequency)	SI[1] from friends	SI from neighbours	SI from family	Loneliness
Hobbies	**-0.341*** **	-0.059	0.088	-0.008
Sports/exercise	**-0.260** **	-0.104	0.005	0.119
Religion	**-0.194***	-0.038	-0.182	0.126
Visiting	-0.137	-0.096	-0.151	-0.009
Volunteering	-0.112	**-0.287** **	0.045	-0.070
Gardening	-0.078	-0.110	-0.034	-0.049
Around house DIY	-0.038	-0.104	0.103	0.029
Shopping	-0.034	-0.150	-0.064	0.119
Entertainment	-0.029	-0.074	-0.041	-0.064
Dog walking	0.022	-0.017	0.044	-0.023
Holiday/day trips	0.028	0.162	-0.003	-0.090
Leisure/exercise walking	0.035	-0.047	0.084	0.133
Health-related trips	0.040	-0.037	-0.077	0.028
Accompanying others	0.045	-0.028	**-0.279** **	-0.081
Personal business	0.046	-0.017	-0.001	-0.087
Paid work	0.107	-0.134	0.008	-0.038

* p<0.05, ** p<0.01, *** p<0.001. [1] SI= social isolation, [2] DIY = do=it-yourself household tasks.

Appendix G: Summarised activity diaries

Example 1

Participant ID: S004

Pseudonym: Daniel

Interview date: 04.03.15

Active pursuits
Gardening

Errand pursuits
Village shop for the paper (x 3)
Village shop for the paper
Village shop for the paper
Village shop (x 3)
Village shop
Village shop
Prosthetist in Bournemouth (as he has a prothetic leg)
Shopping and library (probably Warminster)

Social / leisure pursuits
Visit a friend
To Worcester for cricket (I think to watch)

Example 2

Participant ID: S007

Pseudonym: Eve

Interview date: 18.03.15

Active pursuit out of house
Walk dog down lane
Drive down lane to walk dog
Walk dog in combination with other trip (x 3)

Active pursuit in garden
Gardening x 3
Feed birds and pick up apples (garden) x 5
Pick up apples in garden, put bin out
Hang out washing and feed birds

Errands

Post office
Go to post office/ walk dog / shop
Dr. appointment and shopping
Garden centre & walk dog

Social/ religious activities
Visit daughter
Visit grand daughter
Church sale / Walk dog / garage sale
Church

Example 3

Participant ID: S008

Pseudonym: Margery

Interview date: 05.03.15

Active pursuits
Dog walking (x 11)
Swimming (x 2)
Swim
Walk

Errand pursuits
Shopping

Helpful activities
Charity work (x 3)

Social activities
Visit/ walk (x 4)
Visiting
Visit / lunch
Barn Dance

Appendix H: Interview guide

TOPIC: SOCIAL AND PHYSICAL ACTIVITIES ACROSS THE LIFECOURSE AND AT PRESENT.

Thank you for agreeing to take part in this follow-up study. During this interview I will ask you to look back at the activities you have taken part in across your lifetime, about what led you to do these activities, and how they may have influenced you in later years. Then I will ask some questions about the types of social and physical activities that you do in your current everyday life, what leads you to do these, and how your past experiences may have influenced these.

Part 1. Activities over the life course

1. Thinking back across your lifetime, when were the times that you were particularly active, with regard to social activity or physical activity?

- Cue: Were there other times, in which you were also active, but differently active?

Interviewer: If the participant mentions several different times in his/her lifetime, ask each of the following for each specific time:

- a) What type of activities were you doing then?
- b) Who did you do these activities with?
- c) What motivated you to do these activities?
- d) Were there any obstacles you had to overcome? How did you overcome them?
- e) Were there obstacles you didn't overcome? Why couldn't you overcome them?
- f) Is there anything else you think is important to mention about this time in your life?

2. Have there been times in your lifetime when changes in your roles or your situation prompted you to decrease of increase your level of activity or the types of activities you engaged in?

- Cue: such as finding work, getting married, having children, moving away etc.

Interviewer: For each transition the participant mentions, ask each of the following questions:

- a) How did your activities change?
- b) What was or were the reasons that this transition influenced your activities?
- c) How did you find this transition?
- d) Were there any consequences to this change in activities? Physically? Socially? Emotionally?
- e) How do you think this transition has affected the activities you started, stopped or continued to do in later years?
- f) Is there anything else about this life transition which you think is important to mention?

Part 2. Relating current activities with the life course

Interviewer: Substitute each of the _____ with the 5 most frequent activities the participant noted down in the 7-day activity diary.

3. In the 7-day Activity Diary which you completed in the first study, you noted down that _____, _____, _____, _____ and _____ are activities which frequently take you out of the house in the week.

1. a) Would you say that this is accurate for you as you are now?

Interviewer, skip (b) – (c) if participant agrees that this is correct.

2. b) If not, could you tell me what other activities take you out of the house on a weekly basis?
3. c) How many times per week does this activity take you out of the house?
4. d) With whom do you do these activities?
5. e) How do you travel to and from these activities?

Interviewer: Ask the next set of questions for each frequent activity, starting with the most frequent.

4. Now, I'd like to ask you some questions about each activity which takes you out of you house during a normal week.

Let's start with _____ (*e.g. Going to Church).*

- a) What is your motivation for _____?
- b) Have any of your activities experiences in life previously played a role in how you currently _____? How so?
- b) Have any transitions you've had, in the past or more recently, had an effect on how you _____? How so?
- c) Looking back in time, as well as at your present situation, what are the combination of factors which lead you to _____?
- d) Are there any other things about _____ which you think are important to mention?

5. Are there any social or physical activities which you did until recently, say within the last 20 years, which you have stopped doing regularly?

- a) When did you stop?
- b) When did you start doing this activity?
- c) At this time, what motivated you start and continue this activity?
- d) What is the reason that you stopped taking part in this activity?

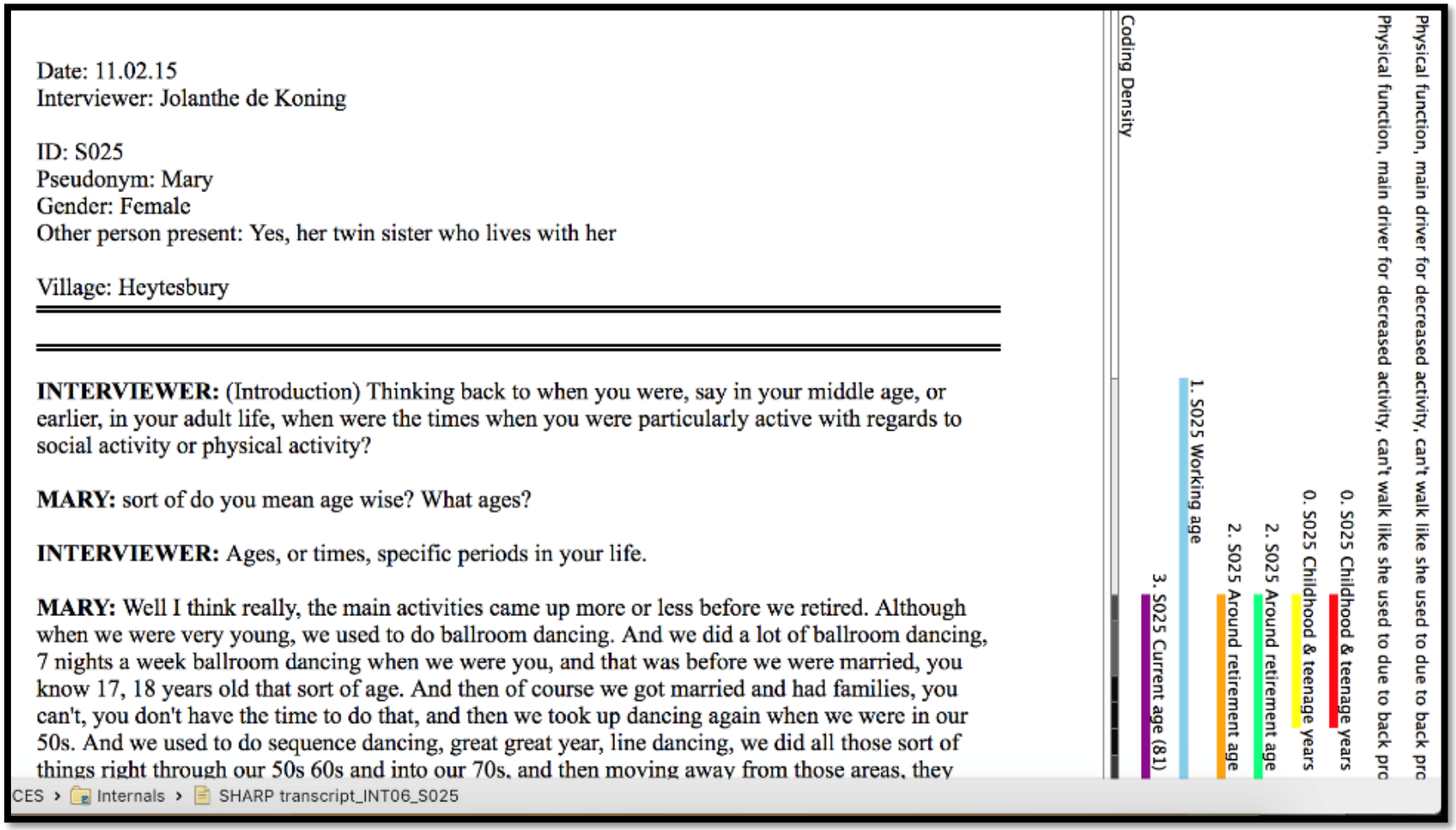
Cue 1: Was it a change in role or life situation which brought on this change?
Cue 2: How so?

- e) Is there anything else which you would like to mention about this activity, or about your life situation when you stopped doing it?

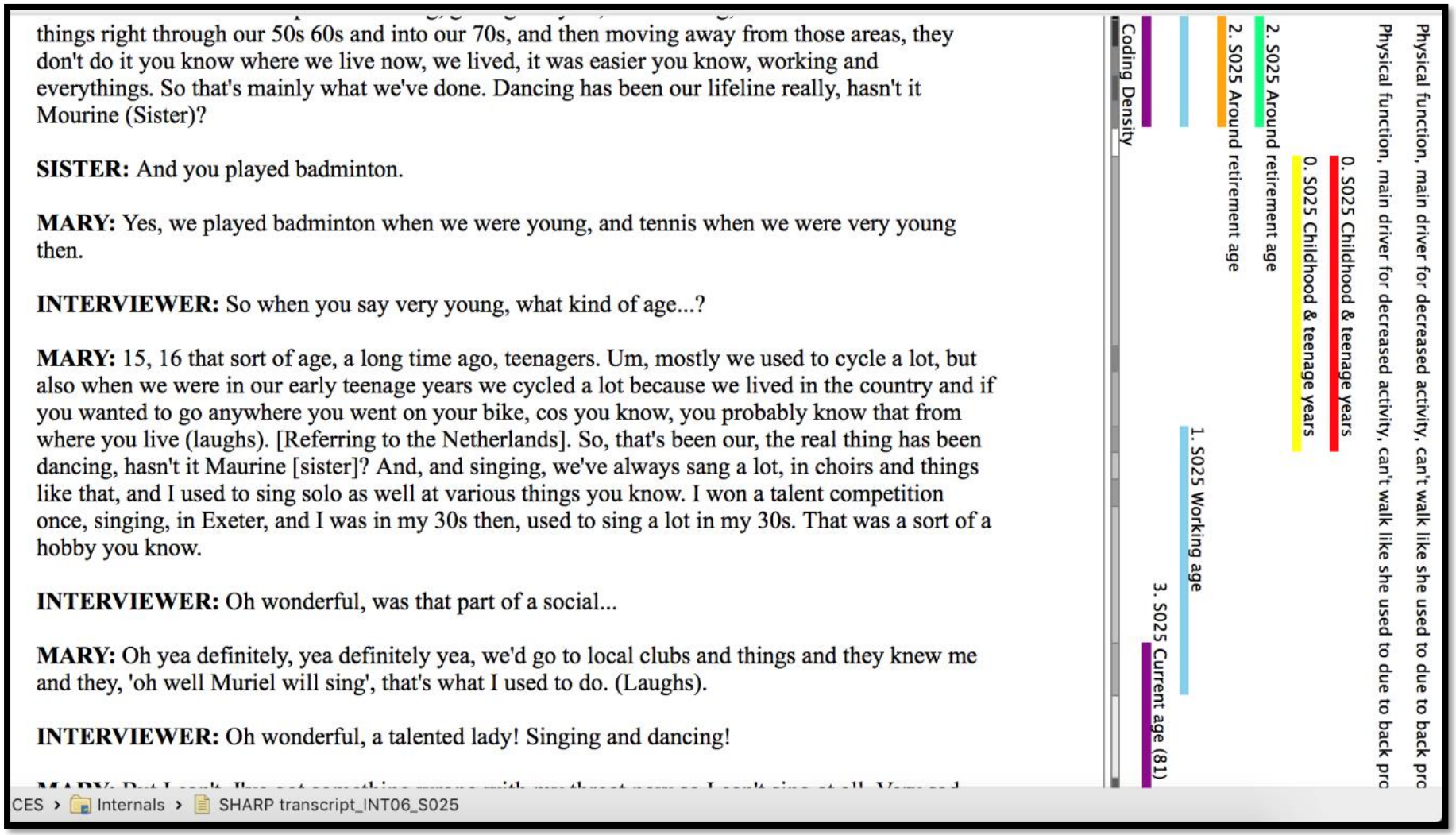
Appendix I: Annotated interview transcript

The interview transcripts were analysed electronically using the NVivo 10 software to add meaningful 'nodes' to sections of text, and with these Node trees of higher and lower-level themes were created. It was not possible to provide a traditional annotated transcript, as NVivo does not display 'nodes' in this manner. However, I have provided the screen shots of the first half of an interview transcript, which show the higher level nodes associated with sections of text on the right.

Screenshot 1



Screenshot 2



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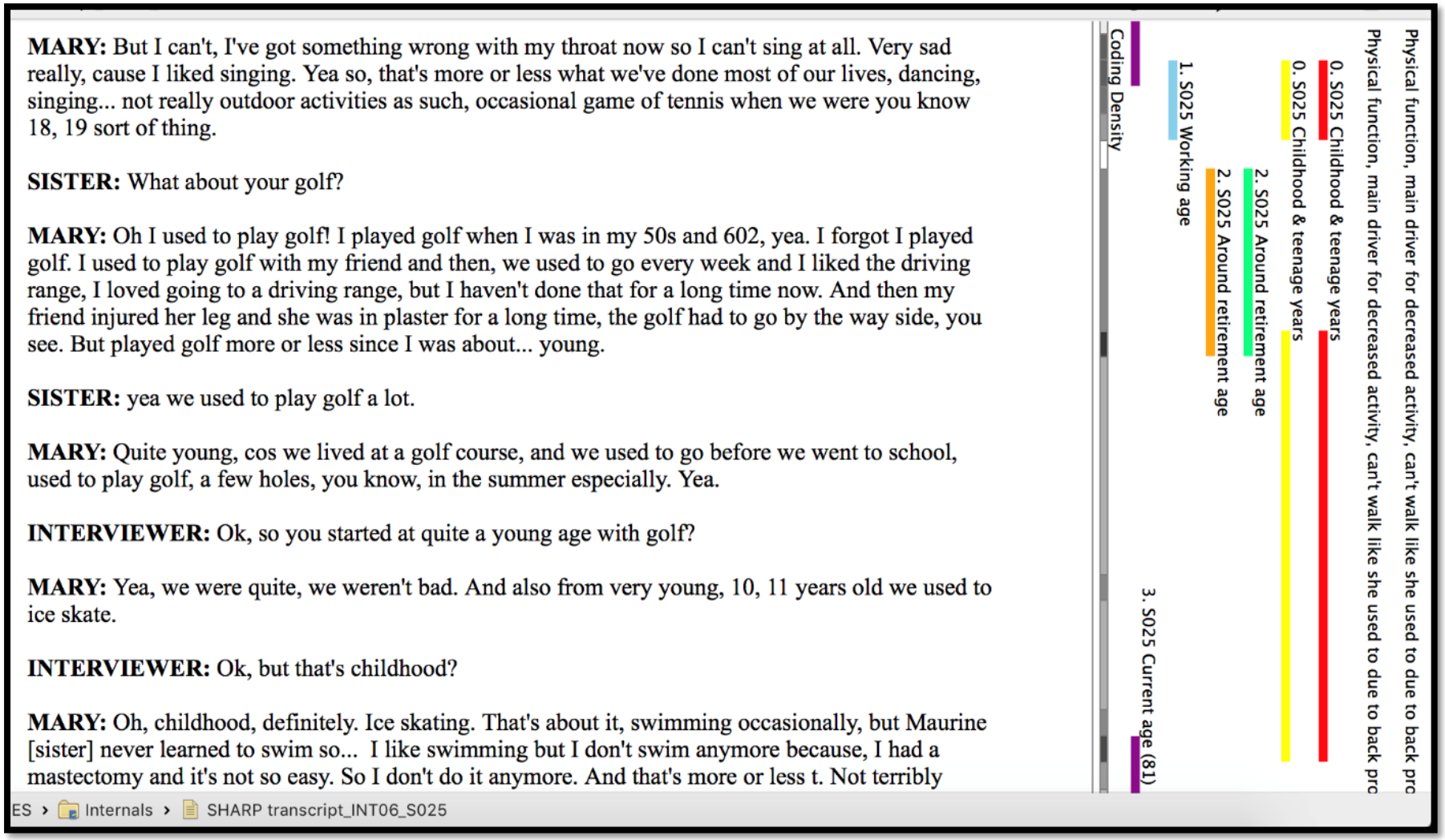
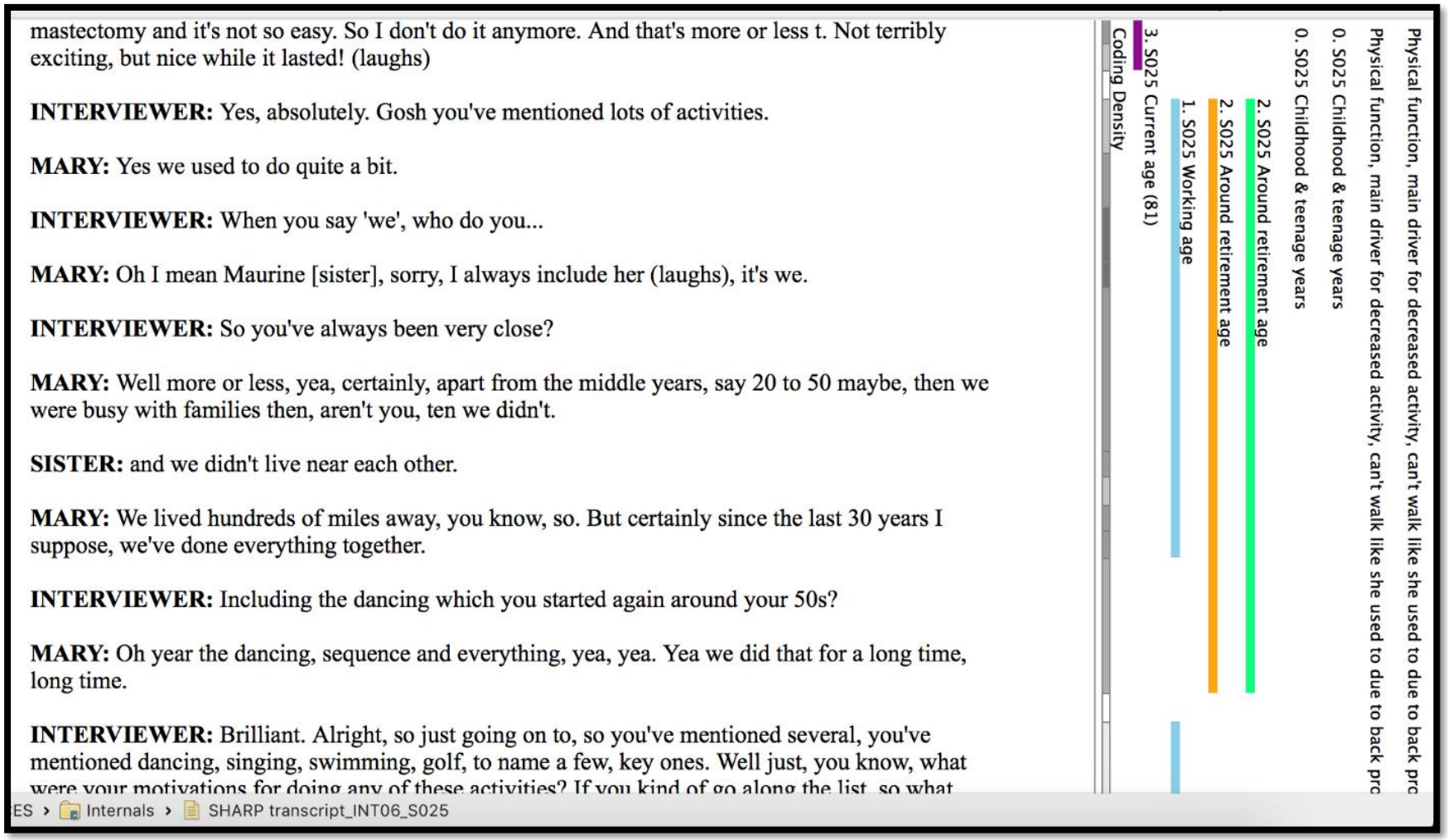
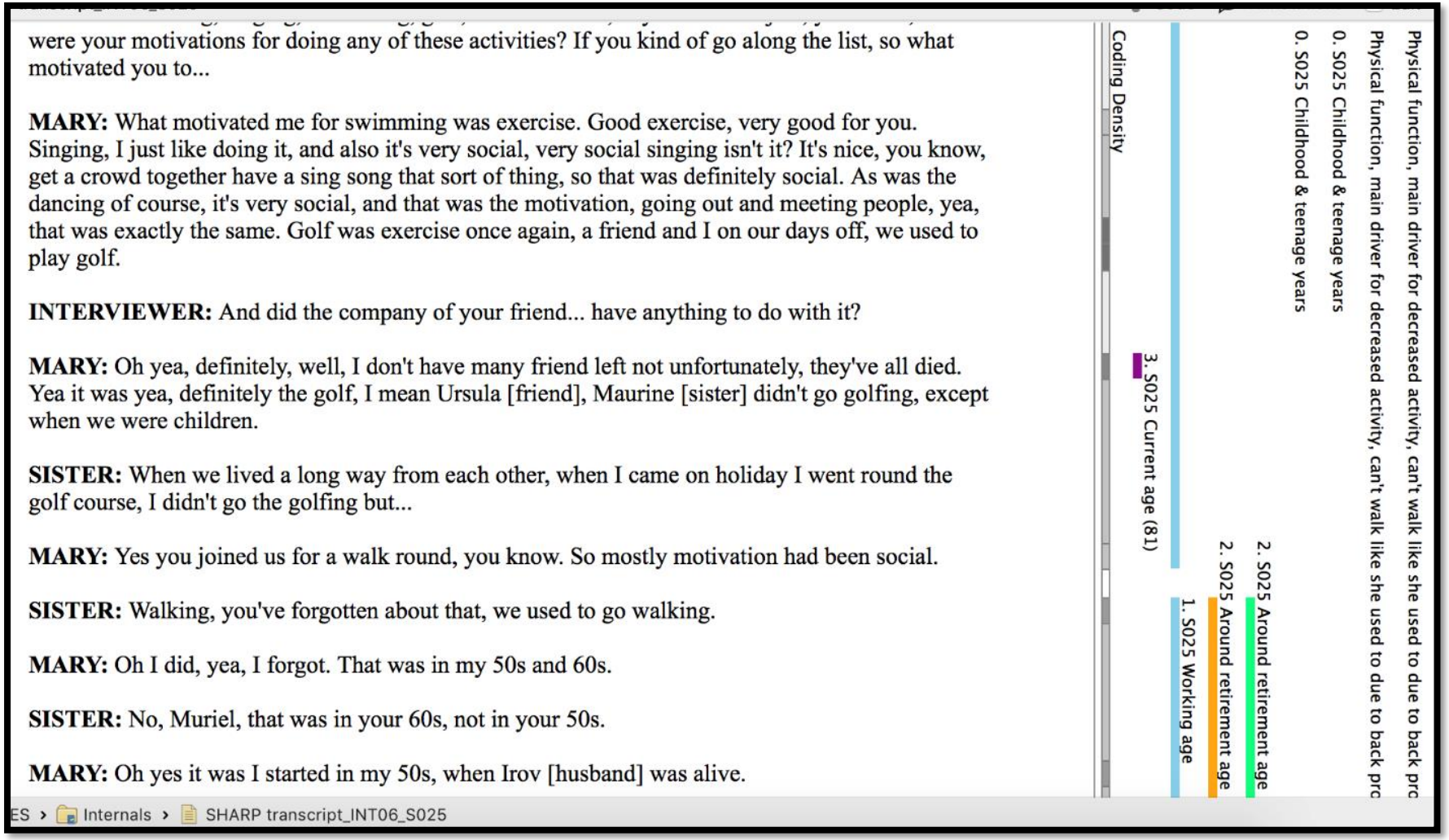


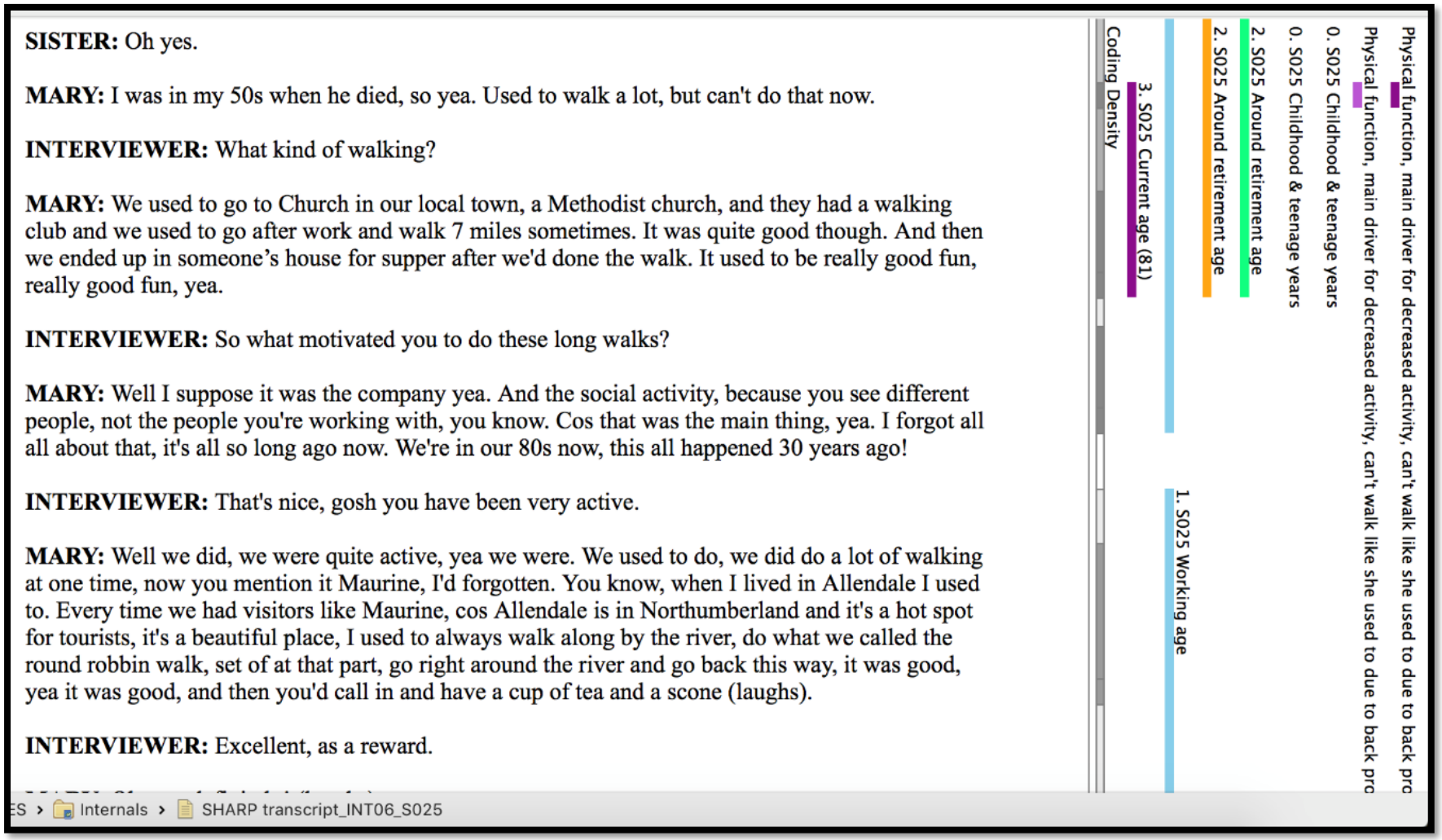
Screenshot 4



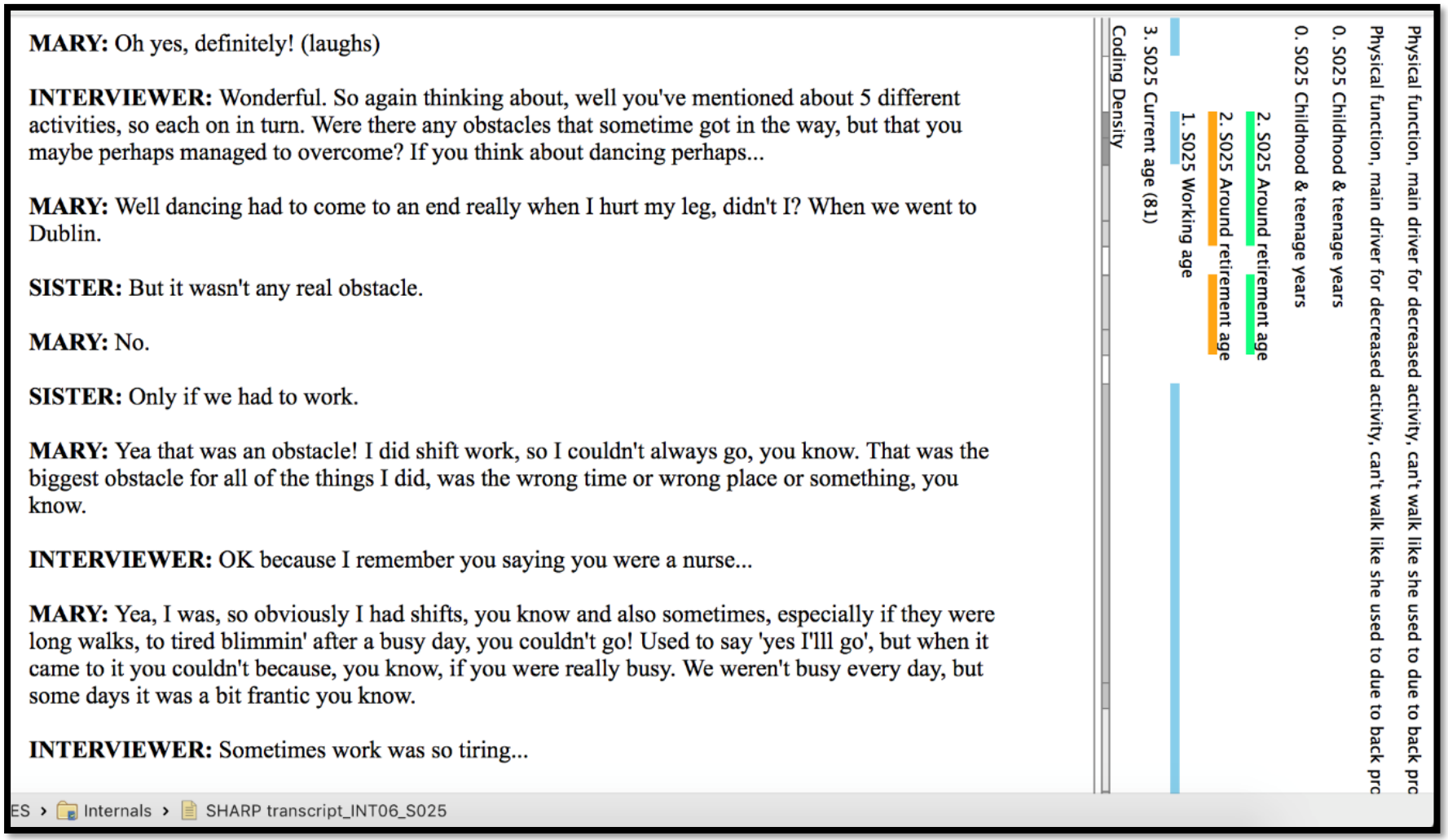
Screenshot 5



Screenshot 6



Screenshot 7



MARY: Oh yes, definitely! (laughs)

INTERVIEWER: Wonderful. So again thinking about, well you've mentioned about 5 different activities, so each on in turn. Were there any obstacles that sometime got in the way, but that you maybe perhaps managed to overcome? If you think about dancing perhaps...

MARY: Well dancing had to come to an end really when I hurt my leg, didn't I? When we went to Dublin.

SISTER: But it wasn't any real obstacle.

MARY: No.

SISTER: Only if we had to work.

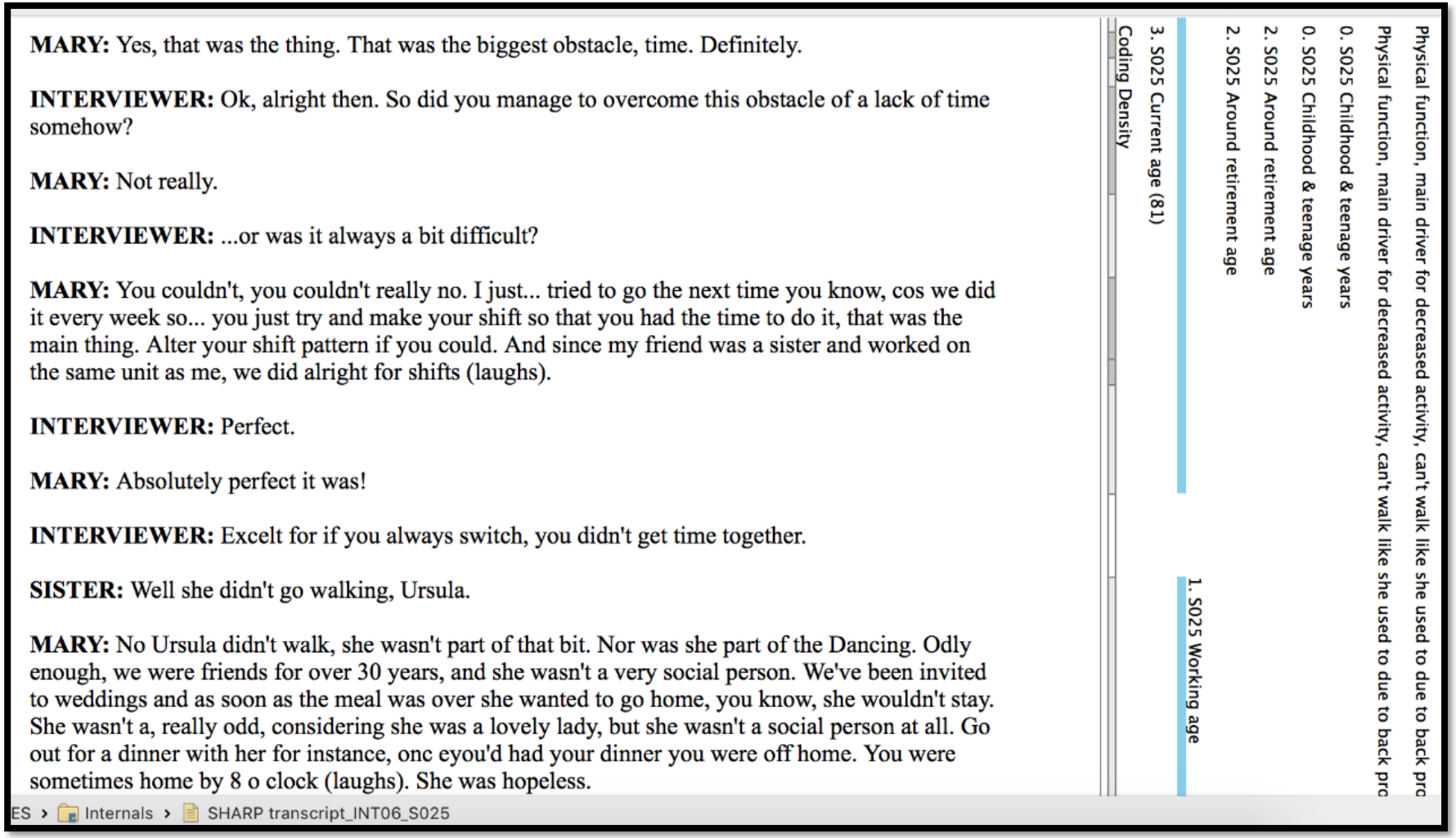
MARY: Yea that was an obstacle! I did shift work, so I couldn't always go, you know. That was the biggest obstacle for all of the things I did, was the wrong time or wrong place or something, you know.

INTERVIEWER: OK because I remember you saying you were a nurse...

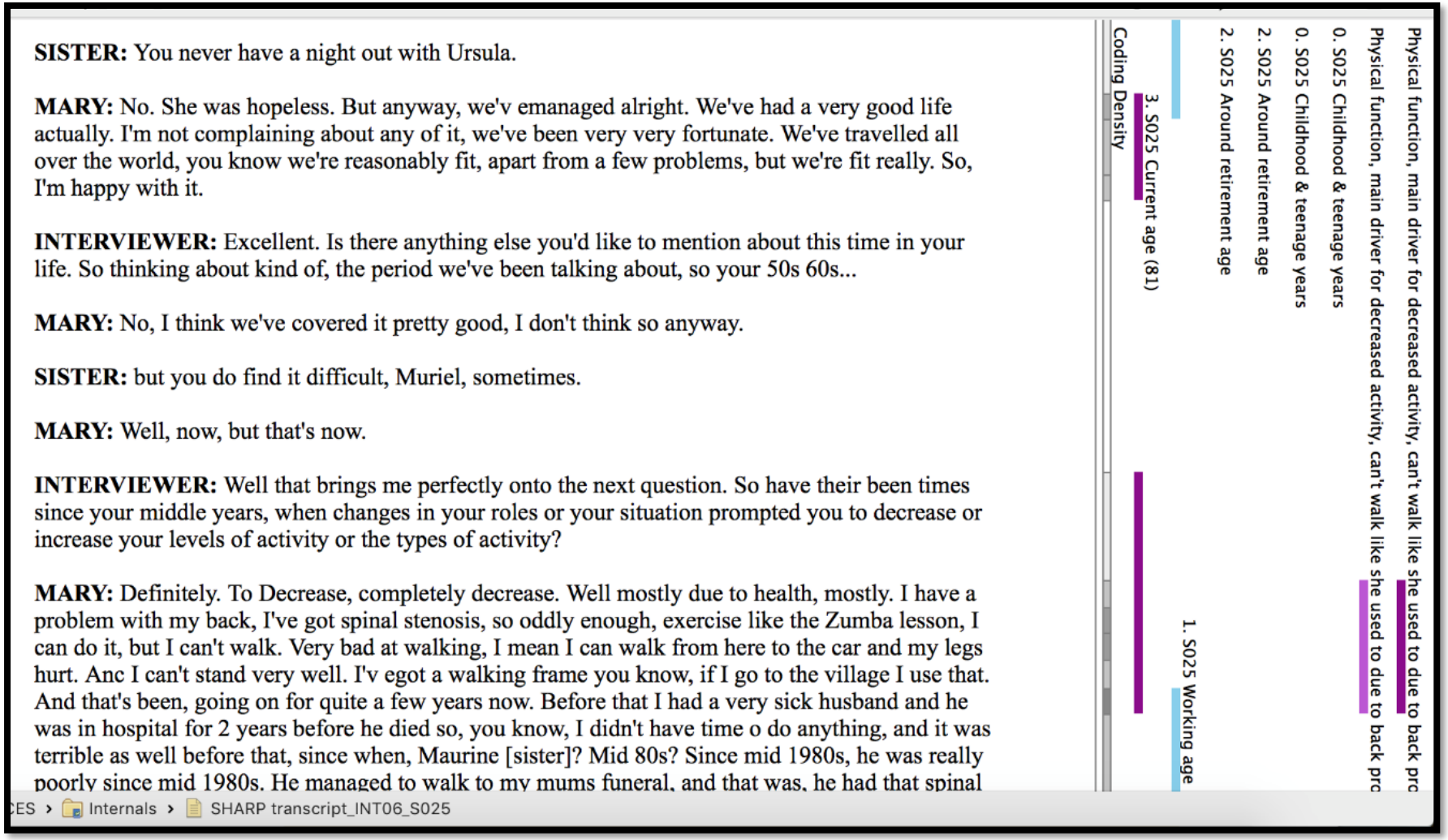
MARY: Yea, I was, so obviously I had shifts, you know and also sometimes, especially if they were long walks, to tired blimmin' after a busy day, you couldn't go! Used to say 'yes I'lll go', but when it came to it you couldn't because, you know, if you were really busy. We weren't busy every day, but some days it was a bit frantic you know.

INTERVIEWER: Sometimes work was so tiring...

Screenshot 8



Screenshot 9



Screenshot 10