UNIVERSITY OF BATH

University of Bath

Title: Predictors of loneliness and different types of social isolation of rural-living older adults in the UK.

Running head: Predictors of loneliness and isolation of rural older adults

Journal: Ageing and Society, Cambridge University Press (accepted for publication)

Author names and affiliations:

Miss Jolanthe Louise de Koning, MRes, BSc, PhD candidate, University of Bath (J.de.Koning@bath.ac.uk) (First author)

Dr Afroditi Stathi, PhD, MSc, BSc, University of Bath (A.Stathi@bath.ac.uk)

Dr Suzanne Richards, PhD, BSc, University of Exeter (S.H.Richards@exeter.ac.uk)

Corresponding author: Jolanthe de Koning

Telephone: 0044 (0) 7735 474 831

Email: J.de.Koning@bath.ac.uk

Postal address (office):

1 West building, University of Bath,

Claverton Down, Bath, BA2 7AY, UK.

Abstract

Loneliness and social isolation are recognised, conceptually-distinct threats to health and wellbeing in older age but limited evidence is available on their predictors in rural populations. This study performed logistical regression modelling to explore the predictors of loneliness, isolation from one's family and isolation from one's community in 884 British rural-living older adults (57.9% female, mean age 71.5 [SD 8.1] years) within the Grey and Pleasant Land dataset. While 13 per cent of participants reported feeling lonely, 49 per cent reported isolation from their family and 9 per cent reported isolation from their community. Minimal cross-over between groups was observed. Widowhood, financial difficulties, area deprivation and self-reported impairments in physical and mental health predicted loneliness. Greater financial difficulty gave lower odds of isolation from one's family, and higher levels of community engagement gave lower odds of isolation from the community. Ageing in place (longer residency) was the only common predictor for all three dependent variables. Initiatives aimed at tackling loneliness and social isolation in rural-living older people must recognise that the two concepts are distinct, affecting different population sub-groups with mostly different risk factor profiles. Future interventions and policies should clearly identify whether their target is loneliness or social isolation and tailor their interventions appropriately.

Introduction

A lack of social connectedness is a known risk factor for mortality, comparable in magnitude to other established risk factors including smoking and obesity (Holt-Lunstad et al., 2010; 2015). A lack of social connectedness has been operationalised as a subjective feeling of loneliness, or objective concept, of being socially isolated. Loneliness has been defined as a discrepancy between the perceived quantity and quality of one's social relationships and one's desire for them (Scarf and de Jong Gierveld, 2008). Social isolation has been defined as less than weekly contact with family, friends or neighbours (Victor et al., 2003). A meta-analysis of 70 longitudinal cohort studies found that loneliness and social isolation each independently increase mortality risk by almost 30 per cent in a large and age-diverse sample, though objective social deficits were more detrimental to adults under age 65 (Holt-Lunstad et al., 2015). It is widely recognised that loneliness and social isolation are related but conceptually and empirically distinct; one can be socially isolated but not feel lonely and vice versa (Cornwell and Waite, 2009; Havens et al., 2004; Wenger and Burholt, 2004).

Social disconnectedness is seen in both younger and older adults. The UK has a higher prevalence of loneliness in younger (less than 25 years) and older adults (over 65 years), with around 9 per cent in both groups reporting feeling severely lonely, but only 5% of those aged 25 to 44 years feeling severely lonely (Victor and Yang, 2012). A recent analysis of representative UK-based data from the Opinions and Lifestyle Survey presented the same pattern in loneliness prevalence across 5,159 individuals (Thomas, 2015). The prevalence of social isolation, about 5 percent, is similar across younger adults (Caspi et al., 2006) and middle-aged and older adults (Jivraj et al., 2012).

While preventing or alleviating loneliness and social isolation is important across the lifespan, population ageing has led to an increased focus on identifying effective ways to achieve this in older age (e.g. Dickens et al., 2011). Evidence suggests that, in older age, loneliness might have more severe health consequences than social isolation (Holwerda et al., 2012; Tilvis et al., 2011). Longitudinal studies of older populations show that loneliness increases the risk of all-cause mortality, while social isolation does not (Holwerda et al., 2012; Tilvis et al., 2011). Loneliness increases the risk of peripheral vascular disease mortality (Patterson and Veenstra, 2010), cognitive decline (Boss et al., 2015) and results in a greater number of physician visits (Newall et al., 2015), irrespective of social isolation. These health effects may occur through the mechanism of biological stress brought on by the psychological experience of loneliness (Steptoe et al., 2004). A meta-analysis of 91 prospective studies demonstrated that increased social contact frequency (the reverse of social isolation) had only a minimal effect on longevity (Shor and Roefs, 2015).

There is some controversy within the literature however, which may stem from inconsistent definitions of social isolation. Steptoe et al. (2013) found social isolation to be predictive of all-cause mortality, while loneliness was not. In this study social isolation included a measure of social participation, an active component which broadens the more common definition of social isolation as the quantity of social contact. Social participation has been analysed as a separate concept from social isolation and found to have had a different longitudinal influence on mortality in an older Finnish population (Tilvis et al., 2011).

Loneliness has been conceptualised in various different ways. The cognitive perspective of loneliness conceptualises loneliness as arising from maladaptive cognitive and psychological processes, resulting in the negative interpretation of social cues, even when

they are not (Cacioppo et al., 2003; Peplau and Perlman, 1982). Using this perspective, several dimensions of loneliness have been formed. De Jong Gierveld et al. (2006) conceptualised loneliness as two-dimensional: a lack of social contact ('social loneliness') and a lack of emotional support ('emotional loneliness'). Cacioppo et al. (2015) argued a further differentiation: a perceived lack of social contact from the closest others (e.g. spouse; 'intimate loneliness'), friends or other family ('relational loneliness'), and one's wider social network ('collective loneliness'). Despite this theoretical complexity, a unidimensional concept of loneliness as a subjective satisfaction with one's total level of social contact had also been applied in many large studies (Fokkema et al., 2012; Sundström et al., 2009; Tilvis et al., 2011; Victor and Yang, 2012; Victor et al., 2005), and is used in the current study.

Researchers have also identified various social network types: 'friend', 'congregant', 'family' and 'diverse' centred networks ('diverse' being a combination of all contact types) (Litwin and Shiovitz-Ezra, 2010). Different sources of social relationships (e.g. family or friends) have been seen to offer different levels of support for older Europeans (Wenger, 1997). Isolation from these different types of social networks may therefore also differ in their consequences on older adult health and wellbeing and in their predictors. In this paper we focus on isolation from one's family and from one's friends and neighbours, to explore if they are experienced by older people with different personal and social characteristics.

Despite a growing awareness that social isolation and loneliness are conceptually distinct (Cacioppo et al., 2015), this is not yet reflected in policy and practice. National UK policy documents consistently use loneliness and social isolation 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 (e.g. Devon County Council, 2013; Norfolk County Council, 2013; Wiltshire Council, 2013). Building on this, public interventions targeting social isolation may not benefit many individuals at risk/suffering from loneliness due to maladaptive social cognition (Cacioppo and Cacioppo, 2014). 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 et al., 2011). Similarly, the group interventions effective at reducing loneliness identified by Cattan et al. (2005) had an educational focus or provided targeted support activities for participants at risk, for example for widowed individuals. 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 social isolation may aid practitioners recognise individuals at risk and tailor interventions appropriately. In a longitudinal study, worsening loneliness eight years after baseline measurements was significantly related to being no longer married, and showed a trend of relation to deterioration in social activity, increasing chronic illness, no longer cohabiting and a decrease in number of confiding relationships for UK older adults (Victor and Bowling, 2012). Cross-sectional, UK data show older age loneliness to be related with lower socio-economic status, less contact with one's children (Demakakos et al., 2006), lack of transport and living in a rural area (Drennan et al., 2008). Increasing social isolation over time was predicted by being male, less wealthy and living in rural areas in the English Longitudinal Study of Ageing (ELSA) (Jivraj et al., 2012).

Despite research findings that older adults living in rural areas are more likely to experience loneliness (Drennan et al., 2008) and social isolation (Jivraj et al., 2012) than their urban counterparts, few studies have been devoted to understanding loneliness and social isolation in a rural population (Burholt and Dobbs, 2012). Rural areas, defined as settlements with a population below 10,000 (Department for Environment, Food and Rural Affairs [DEFRA], 2013), house a higher proportion of adults over the age of 65 (25.0%) than urban areas in the UK (15.3%), a gap expected to widen further in the near future (DEFRA, 2015). Rural areas are also characterised by less accessible public transport, public facility maintenance (i.e. roads and pavements), commercial outlets, and health and social care services, as well as greater income inequality and fewer households with children living at home (Age UK, 2013; Le Mesurier, 2003; Philip and Gilbert, 2007). These factors may put rural residents at risk of declining social opportunities and possibly loneliness and/or social isolation as they age.

While a few studies compared predictors of loneliness and social isolation in older, rural populations (Burholt and Wenger, 2004; Havens et al., 2004), these relate to Welsh and Canadian older adults, respectively, and their findings are now dated. As different cultures, societies, and time-dependent political contexts influence the experience of loneliness (Yang and Victor, 2012), there is a need to re-investigate predictors of both social isolation and loneliness in recent UK-based data. This study explores the differences in predictors of loneliness and two types of social isolation (from one's family and from one's community) in an older, rural-living population living in UK.

Methods

The Grey and Pleasant Land 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 (Brown et al., 2005). The data was collected in 2009 and comprised 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 Social Research Council [ESRC], 2015). The survey included items on demographic, socio-economic, personal, social, environmental and transport-related factors (Shergold and 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 DEFRA urban/rural definition of settlements (ONS, 2016); 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 and Burholt, 2014). Type A areas adhered to DEFRA's Rural 80 classification, and both Type B and Type C areas adhered to the Rural 50 classifications (ONS, 2016). 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 and Fisher, 2013). The estimated response rate for households containing people age 60 and over was 68% (Hennessy, Means and Burholt, 2014).

Study design

The present secondary analysis of GaPL data was exploratory in nature, given the scarcity of recent findings about predictors of loneliness and social isolation in rural settings (Burholt and Dobbs, 2012). Multivariate binary logistic regression models were constructed to explore the associations between an array of socio-demographic, socio-economic, health-related and behavioural variables and three dependent variables: loneliness, isolation from family and isolation from the community. The sample was analysed as a whole in order to test potential predictors of loneliness and social isolation in a variety of rural settings (not testing between different types) and to attain 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.

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 en Kamphuis, 1985), 'agree' and 'don't know' were combined. A single item loneliness measure has been used in large English (Victor and Yang, 2012; Victor et al., 2005) and European studies (Fokkema et al., 2012; Sundström et al., 2009; Tilvis et al., 2011).

Social isolation variables: Variables ('isolated', 'not isolated') were constructed using the social isolation definition: *'having less than weekly direct contact with family and friends'* (Victor et al., 2003). This definition has been used in other large studies (Jivraj et al., 2012; Holwerda et al., 2012; Tilvis et al., 2012). Isolation 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?"* Isolation 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?"*

Explanatory variables

Due to the exploratory nature of this analysis, a range of explanatory variables were chosen.Some variables were chosen because they have previously been found related to loneliness or social isolation in urban, mixed or rural populations, and it is important to see whether these predictors are also valid in a more contemporary rural context. Predictors of loneliness include widowhood (Demakakos et al., 2006; Golden et al., 2009; Victor, et al., 2005; 2006; Victor and Yang, 2012; Wenger and Burholt, 2004), poor physical health (Drennan et al., 2008; Victor and Bowling, 2012; Wenger and Burholt, 2004), poor psychological health (Victor, et al., 2005), low education level (Victor, et al., 2005; Victor and Yang, 2012), low wealth status (Demakakos et al., 2006); recent immigration (Wenger and Burholt, 2004), lower levels of community participation (Newall et al., 2009). Predictors of social isolation 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, et al., 1995) and having a physical disability (Golden et al., 2009). The access to a car (Lee

et al, 2011) and public transport (Shergold and Parkhurst, 2012) explanatory variables were included because they have been shown to be specifically important for the maintenance of social functioning in rural areas.

Some explanatory variables were chosen due to hypothesized relationships between certain behaviours and either loneliness of social isolation. Contact with children, either face to face or over the phone was a significant cross-sectional predictor of loneliness data form the English Longitudinal Study of Ageing (ELSA) (Demakakos et al., 2006), and the authors argued that phone contact with children was important for parents who lived far from their kin. In a rural context, it can be expected that many children have moved away to find better employment opportunities and affordable housing (Wenger, 2001). Thus, access to a mobile phone was chosen as a predictor variable.

Physical activity variables were included asit is argued that individuals who feel lonely due to maladaptive social cognition may withdraw themselves from the company of others, perceiving the social exchanges to be of negative nature, and that this may then lead to less accumulated physical activity (Hawkley and Cacioppo, 2010). In the reverse direction, less engagement with physical activity for any reason could also decrease the opportunities for social contact, and in this manner increase both social isolation and loneliness.

The range of explanatory variables were grouped thematically in order to perform a stepped regression analysis, and to exclude collinear variables within thematic groups. The themes included a) socio-demographic and socio-economic (SDSE) variables; b) health-related variables; and c) behavioural variables.

The SDSE variables comprised: '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, 2007). 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).

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 (Spearman's rho= 0.229, p<0.001).

Eight behavioural variables were computed: 'local social participation' (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); frequency of 'walking in the

countryside', frequency of 'gardening' (both 'never', 'at least once a month', 'at least once a week' and 'most days'); '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'). Other variables were 'telephone use' ('never/ don't own one', 'less than once a week', 'weekly' and 'daily'), 'use of public transport' ('less than once a month', 'in last month', in last week') and '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 and Yang, 2012) have been associated with loneliness, and older age (Goldern et al., 2009; Jivraj et al., 2012; Wenger, et al., 1995) and being male (Jivraj et al., 2012) associated with social isolation 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.

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 SDSE 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 and Skondral, p.591, 2012), was used in all analysis. The resultant odds ratios (OR) and associated 95 per cent confidence intervals 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, between all explanatory variables was tested 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. SDSE 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 global social isolation (isolation from both family and the community) added to the loneliness model, or loneliness added to the isolation 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 social isolation.

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.

Results

Participant characteristics

Table 1 summarises the participant characteristics. The gender distribution was relatively equal (57.9% women), though younger respondents were over-represented. The average age was 71.5 (SD 8.2, range 60-97) and respondents were evenly distributed between the three pre-defined rural area types.

Table 1. Sample characteristics

	Whole sample (%) (n=884)	Men (%) (n= 357)	Women (%) (n=512)	Difference across:	
				Genders* (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	p<0.001	p<0.001
Missing responses	1.6	2.5	1.0		
Education				p<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.	p<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.	p<0.001
Missing responses	6.3	6.7	6.3		
IMD National Quintiles (Q.)				ns.	p=0.047
1st Q. 'least deprived'	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. 'most deprived'	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

* Independent samples t-test for continuous or bivariate variables, one-way ANOVA for ordered variables.

The excluded cases were more likely to live alone (included 30% vs. 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.

Prevalence of loneliness and isolation variables

Figure 1 shows the prevalence of the loneliness and isolation: 13 per cent (111/884) were classified as lonely. Eight per cent of the respondents (70/884) responded positively and five per cent (41/884) showed uncertainty ('don't know') to the direct loneliness question; 49 per cent (437/884) were isolated from their family; 9 per cent (80/884) were isolated from their community; and 5 per cent (45/884) were isolated from both family and community. While significantly more men were isolated from their family than women (54.1% vs. 46.3%, p=0.024), no gender differences were observed for loneliness or isolation from the community (Figure 1). Significantly higher proportions of older respondents reported loneliness (p=0.018), and to a lesser extent isolation from family (p=0.040), although no differences were observed in isolation from the community (Figure 1).
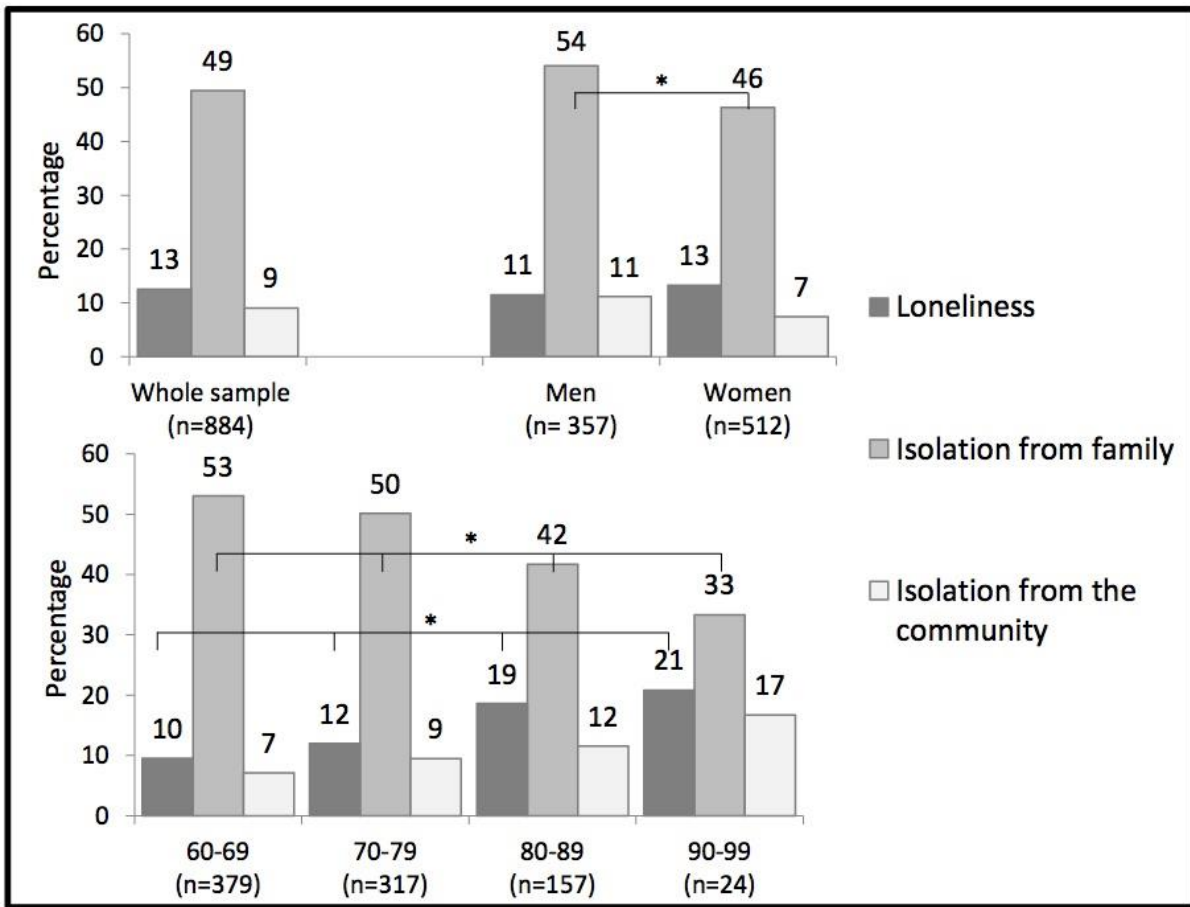
Figure 1. Prevalence of loneliness and two types of isolation for the whole sample and across genders and age groups (*difference in prevalence across category, $p<0.05$).

Only 1.4 per cent (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 2. Univariate, controlled associations for each independent and dependent variable

		Loneliness		Isolation from family		Isolation from the community	
	n	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)
SD and SE variables							
Widowed							
(ref = not widowed)	181	1.87[a]	(1.43, 2.44)	0.54	(0.28, 1.05)	0.79	(0.35, 1.81)
Highest qualification							
None (ref)	193	1.00		1.00		1.00	
School	218	0.67	(0.42, 1.08)	0.90	(0.59, 1.37)	0.89	(0.63, 1.27)
College	173	0.57	(0.28, 1.17)	1.36	(0.68, 2.69)	0.90	(0.58, 1.41)
Tertiary	160	0.76	(0.52, 1.13)	1.73	(0.88, 3.39)	0.93	(0.48, 1.82)
Overall trend	744	0.86[b]	(0.74, 1.00)	1.24	(0.96, 1.58)	0.98	(0.78, 1.23)
Years of residence							
<5 years (ref)	175	1.00				1.00	
6-10 years	128	0.73	(0.41, 1.30)	1.28	(0.73, 2.24)	0.94	(0.42, 2.09)
11-20 years	164	0.91	(0.50, 1.64)	0.98	(0.74, 1.29)	0.57[b]	(0.36, 0.91)
21-30 years	145	0.50[a]	(0.33, 0.76)	0.73[a]	(0.60, 0.89)	0.75	(0.49, 1.13)
>30 years or always	261	0.39[b]	(0.19, 0.82)	0.26[a]	(0.14, 0.50)	0.39[b]	(0.18, 0.84)
Overall trend	873	0.80[a]	(0.69, 0.93)	0.71[a]	(0.62, 0.81)	0.81[a]	(0.70, 0.95)
Car access							
(ref = no car access)	725	0.62[b]	(0.39, 0.99)	1.35	(0.87, 2.12)	1.00	
Perceived financial coping							1.71	(0.79, 3.72)
Living comfortably (ref)	320	1.00		1.00			
Doing alright	301	1.44	(0.87, 2.39)	0.90	(0.64, 1.27)	1.00	
Perceived difficulty	244	1.68[a]	(1.34, 2.10)	0.70[a]	(0.56, 0.87)	0.80	(0.44, 1.45)
Overall trend	865	1.29[a]	(1.15, 1.45)	0.84[a]	(0.75, 0.94)	1.10	(0.52, 2.33)
National IMD Quintiles (Q.)							1.04	(0.69, 1.56)
1st Q. 'least deprived' (ref)	146	1.00		1.00		1.00	

2nd Q.	167	0.83	(0.52, 1.33)	0.93	(0.56, 1.57)	0.80	(0.26, 2.51)
3rd Q.	153	0.71	(0.40, 1.27)	0.93	(0.68, 1.26)	0.78	(0.25, 2.44)
4th Q.	132	1.59[b]	(1.04, 2.44)	1.30	(0.75, 2.27)	1.16	(0.34, 4.00)
5th Q. 'most deprived'	170	0.76	(0.51, 1.12)	0.87	(0.54, 1.38)	0.72	(0.28, 1.82)
Overall trend	768	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)	159	1.00		1.00		1.00	
Very little	269	1.33	(0.61, 2.92)	1.07	(0.78, 1.48)	1.33	(0.73, 2.42)
To some extent	241	2.19[a]	(1.38, 3.47)	0.78	(0.52, 1.16)	1.21	(0.43, 3.43)
Quite a lot	140	2.16[b]	(1.02, 4.58)	1.03	(0.81, 1.29)	1.02	(0.51, 2.05)
Very limited	52	3.45[a]	(1.35, 8.84)	0.60	(0.33, 1.08)	2.29	(0.99, 5.31)
Overall trend	861	1.30[a]	(1.16, 1.46)	0.92	(0.83, 1.01)	1.09	(0.89, 1.33)

Limited by mental health

Not at all (ref)	522	1.00		1.00		1.00	
Slightly	182	1.39	(0.72, 2.65)	0.81	(0.58, 1.14)	0.85	(0.42, 1.70)
Moderately	85	2.35[b]	(1.00, 5.50)	1.30	(0.94, 1.80)	1.19	(0.71, 1.99)
Quite a lot / very much	74	2.83[a]	(1.65, 4.85)	0.80	(0.47, 1.35)	1.06	(0.55, 2.04)
Overall trend	863	1.44[a]	(1.22, 1.71)	0.97	(0.82, 1.15)	1.02	(0.82, 1.27)

Behavioural variables

Community engagement

None (ref)	375	1.00		1.00		1.00	
One activity	213	0.59	(0.29, 1.19)	0.96	(0.64, 1.45)	0.76[a]	(0.67, 0.87)
Two activities	140	0.44	(0.19, 1.01)	0.97	(0.67, 1.40)	0.30[b]	(0.11, 0.83)
Three activities	87	0.46[b]	(0.25, 0.84)	1.41	(1.00, 2.01)	0.15[b]	(0.04, 0.65)
Four+ activities	69	0.66[a]	(0.50, 0.86)	0.68	(0.42, 1.11)	1.00	(1.00, 1.00)
Overall trend	884	0.81[a]	(0.70, 0.94)	0.98	(0.88, 1.10)	0.54[a]	(0.41, 0.71)

Assisting others

(ref = not assisting)	409	0.93	(0.66, 1.30)	0.98	(0.77, 1.25)	0.49[b]	(0.27, 0.89)
Total weekly active pursuits							
None (ref)	119	1.00		1.00		1.00	
One	210	0.78	(0.46, 1.33)	1.22	(0.69, 2.14)	0.73	(0.31, 1.72)
Two	203	0.72	(0.46, 1.13)	0.96	(0.58, 1.58)	0.86	(0.50, 1.48)
Three	197	0.83	(0.35, 1.96)	1.18	(0.62, 2.24)	0.62	(0.31, 1.21)
Four +	155	0.81	(0.28, 2.38)	1.82[b]	(1.01, 3.29)	1.05	(0.66, 1.68)
Overall trend	884	0.97	(0.75, 1.27)	1.12	(0.99, 1.27)	1.01	(0.92, 1.10)
Walking in the countryside							
Never (ref)	376	1.00		1.00		1.00	
At least once a month	94	1.64	(0.89, 3.03)	1.08	(0.67, 1.73)	0.59	(0.23, 1.47)
At least once a week	165	0.92	(0.56, 1.53)	1.17	(0.71, 1.92)	1.41	(0.83, 2.39)
Most days	249	1.35	(0.62, 2.93)	1.39[a]	(1.09, 1.78)	0.80	(0.45, 1.42)
Overall trend	884	1.07	(0.83, 1.38)	1.11[b]	(1.01, 1.23)	0.98	(0.88, 1.09)
Gardening							
Never (ref)	203	1.00		1.00		1.00	
At least once a month	58	0.57	(0.13, 2.47)	1.43	(0.77, 2.65)	1.55	(0.72, 3.30)
At least once a week	225	0.86	(0.45, 1.62)	1.12	(0.87, 1.43)	1.09	(0.61, 1.93)
Most days	398	0.86	(0.52, 1.44)	1.20	(0.91, 1.59)	0.99	(0.61, 1.60)
Overall trend	884	0.97	(0.82, 1.15)	1.05	(0.94, 1.17)	0.98	(0.82, 1.16)
Caring for pets							
(ref = no pet)	296	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)	619	1.00		1.00		1.00	
In last month	120	1.34	(0.94, 1.91)	1.21	(0.73, 2.01)	0.91	(0.46, 1.81)
In last week	145	0.77	(0.48, 1.24)	0.83	(0.54, 1.29)	0.43	(0.18, 1.00)
Overall trend	884	0.94	(0.79, 1.11)	0.95	(0.73, 1.23)	0.70	(0.46, 1.06)
Telephone use							
Never/don't own one (ref)	214	1.00		1.00		1.00	
< Once a week	333	0.66[b]	(0.46, 0.95)	1.60[a]	(1.19, 2.17)	1.55	(0.75, 3.17)

Weekly	153	0.93	(0.36, 2.42)	1.57[b]	(1.01, 2.43)	1.31	(0.96, 1.79)
Daily	174	0.82	(0.30, 2.29)	0.91	(0.56, 1.46)	0.82	(0.31, 2.17)
Overall trend	874	0.98	(0.66, 1.44)	0.95	(0.81, 1.11)	0.93	(0.77, 1.13)

[a] p< 0.01, [b] p< 0.05

Factors associated with loneliness

In preliminary univariate models all six SDSE variables, both physical and mental health variables, and two behavioural variables (community engagement, telephone use) were significantly associated with reports of being lonely (Table 2). However, in the final, fully adjusted Model (Table 3), car access was dropped due to collinearity with widowhood and community engagement was dropped as it supressed 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 vs. lowest), living in the 4th highest deprivation quintile vs. 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 vs. 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, vs. <5 years). When social isolation 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.

Factors associated with isolation from one's family

In preliminary univariate models (Table 2) two SDSE variables (length of residence, perceived financial coping), and three behavioural variables (total weekly active pursuits, walking in the countryside, telephone use) were significantly associated with being isolated from one's family. However, in the fully adjusted Model (Table 3), only the two SDSE 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 vs. lowest category). When adding loneliness to the final model, it did not predict isolation from family, and did not change any of the associations between the predictors and isolation from family. For the control variables in the fully adjusted model, being male increased odds of family isolation (OR=0.25, 95% CI: 1.02 to 1.52) but age and country were not associated with isolation from family.

Factors associated with isolation from the community

In preliminary univariate models (Table 2) only one SDSE variable (length of residence), and two of the behavioural variables (community engagement, assisting others) were significantly associated with being isolated from the community. In the fully adjusted Model (Table 3) only length 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 community isolation (OR=0.56, 95% CI: 0.41 to 0.77), with three or more community engagement activities decreasing the odds by over 80 per cent (OR=0.16, 95% CI: 0.03 to 0.73). When loneliness was added to the final model, it did not significantly predict community isolation, but showed a very small mediating effect (reducing the associations) between community engagement and community isolation, and a strong mediating effect between older age and community isolation. For the control variables in the fully adjusted model, being male increased odds of community isolation (OR=1.46, 95% CI: 1.07 to 1.99) but age and country were unrelated to community isolation loneliness were not significant.

Table 3. Final multivariate models showing the factors significantly related to loneliness, isolation from one's family and isolation from the community.

	n	Loneliness OR	(95% CI)	Isolation from family OR	(95% CI)	Isolation from the community OR	(95% CI)
SD and SE variables							
Widowed	181	2.03[a]	(1.56, 2.64)				
(ref = not widowed)							
Years of residence							
< 5 years (ref)	175	1.00		1.00		1.00	
11-20 years	128	0.61	(0.30, 1.23)	1.35	(0.78, 2.31)	1.06	(0.44, 2.55)
21-30 years	164	0.90	(0.50, 1.64)	0.97	(0.72, 1.32)	0.56[b]	(0.33, 0.95)
21-30 years	145	0.51[b]	(0.28, 0.93)	0.73[a]	(0.61, 0.87)	0.87	(0.59, 1.29)
>30 years or always	261	0.36[b]	(0.17, 0.79)	0.27[a]	(0.15, 0.49)	0.48[b]	(0.25, 0.95)

	N						
Overall trend	873	0.80[a]	(0.68, 0.94)	0.71[a]	(0.63, 0.80)	0.85[b]	(0.75, 0.96)
Perceived financial coping							
Living comfortably (ref)	320	1.00		1.00			
Doing alright	301	1.48	(0.77, 2.84)	0.92	(0.62, 1.37)		
Perceived difficulty	244	1.33[b]	(1.01, 1.75)	0.67[a]	(0.53, 0.84)		
Overall trend	865	1.15[b]	(1.01, 1.32)	0.83[a]	(0.74, 0.93)		
National IMD Quintiles (Q.)							
1st Q. 'least deprived'(ref)	146	1.00					
2nd Q.	167	0.88	(0.57, 1.37)				
3rd Q.	153	0.76	(0.43, 1.32)				
4th Q.	132	1.81[b]	(1.09, 2.99)				
5th Q. 'most deprived'	170	0.81	(0.48, 1.36)				
Overall trend	768	1.03	(0.91, 1.17)				

Health-related

variables

	N						
Limited by physical health							
Not at all (ref)	159	1.00					
Very little	269	1.19	(0.52, 2.72)				
To some extent	241	1.78[b]	(1.03, 3.07)				
Quite a lot	140	1.74	(0.75, 4.01)				
Very limited	52	2.46	(0.80, 7.60)				
Overall trend	861	1.25[b]	(1.04, 1.50)				
Limited by mental health							
Not at all (ref)	522	1.00					
Slightly	182	1.37	(0.68, 2.74)				
Moderately	85	1.90	(0.75, 4.81)				
Quite a lot / very much	74	2.33[a]	(1.23, 4.38)				
Overall trend	863	1.33[a]	(1.08, 1.64)				

Behavioural variables

Community engagement

	n	Model 1 OR	CI	Model 2 OR	CI	Model 3 OR	CI
None (ref)	375					1.00	
Two activities	213					0.88	(0.67, 1.16)
Two activities	140					0.33[b]	(0.11, 0.98)
Three activities	87					0.16[b]	(0.03, 0.73)
Four+ activities	69					1.00	(1.00, 1.00)
Overall trend	884					0.56[a]	(0.41, 0.77)

Control variables

Age

	n	Model 1 OR	CI	Model 2 OR	CI	Model 3 OR	CI
60-69 (ref)	379	1.00		1.00		1.00	
70-79	317	1.36	(0.98, 1.90)	0.94	(0.76, 1.16)	1.38	(0.79, 2.43)
80-89	156	1.73[b]	(1.05, 2.85)	0.75	(0.48, 1.16)	1.66	(0.91, 3.04)
90-99	24	1.33	(0.54, 3.30)	0.58	(0.26, 1.30)	2.53	(0.82, 7.84)
Overall trend	884	1.23[b]	(1.03, 1.47)	0.86	(0.73, 1.02)	1.31	(0.99, 1.73)

Gender

	n	Model 1 OR	CI	Model 2 OR	CI	Model 3 OR	CI
Male (ref = female)	351	0.95	(0.64, 1.42)	1.25[b]	(1.02, 1.52)	1.46[b]	(1.07, 1.99)

Country

	n	Model 1 OR	CI	Model 2 OR	CI	Model 3 OR	CI
Wales (ref = England)	447	0.87	(0.67, 1.15)	1.12	(0.79, 1.59)	0.90	(0.65, 1.24)

Other social variables

	n	Model 1 OR	CI	Model 2 OR	CI	Model 3 OR	CI
Socially Isolated (ref = not)	45	2.59[b]	(1.09, 6.14)				
Lonely (ref = not)	111			1.35	(0.93, 1.96)	2.33	(0.89, 6.08)
Constant		0.07[a]	(0.02, 0.24)	1.33	(0.94, 1.88)	0.13[a]	(0.07, 0.24)

[a] p< 0.01, [b] p< 0.05.

Discussion

This study explored the differences in predictors of loneliness and two types of social isolation (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 co-factors of these social variables in a large, diverse rural sample since the late 1980s (Burholt and Dobbs, 2012; Stockdale, 2011). As hypothesised, loneliness and the two isolation types had different, independent cross-sectional predictors, as supported by previous research (Havens et al., 2004; Wenger and Burholt, 2004). Being a newcomer in the community was the only predictor common to all three social deficit variables. Widowhood, older age and poor mental or physical health were only related to loneliness.

In our rural sample eight per cent agreed to being lonely and five per cent showed uncertainty ('don't know') to the loneliness question, which was interpreted as an underlying loneliness not expressed due to the taboo associated with loneliness (Perlman, 2004). The proportion of definite cases of loneliness seems similar to the 9 per cent who were 'severely' lonely in a nationally-representative sample of UK older adults, which included more urban than rural-living participants (Victor and Bowling, 2012). However, it is not possible to compare these questions due to their difference in wording and response categories. The level of social isolation (from both family and the community) was comparable to UK nationally-representative data at around 5 per cent (Jivraj et al., 2012), though again, the constructs used to measure these were also worded differently, precluding accurate comparison. We found that 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 social isolation, supporting previous findings that older men in England 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 English (Jivraj et al., 2012; Shankar et al., 2013) and cross-sectional Irish data (Drennan et al., 2008). Given the over representation of adults aged 60 to 69, it may be that a large percentage of younger respondents were still working (Emmerson and 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 et al., 2005; Victor et al., 2005). The current findings and previous reports show that rural-living individuals are not different in this regard (Wenger and Burholt, 2004; Wenger et al., 1996). The relation of widowhood only to loneliness, not types of social isolation, supports the Cacioppo et al.'s (2015) differentiation between loneliness arising from loss of an intimate relationship, from that arising from a lack of wider relations or the collective community. 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 et al., 2013). Thus, adaptation to widowhood might not be as easy as gaining other close social contacts.

Physical and mental health has frequently been linked to the prevalence of loneliness across British, other European and American samples (Hawkley and 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) and Alzheimer Disease (Boss et al. 2015) and lower self-rated health (Hawkley et al., 2009). In a 20-year follow-up of older adults in rural Wales, deteriorating health was related to the onset of loneliness, but not social isolation (Burholt and Wenger, 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 et al., 2012; Victor and 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 isolation from the community is similar to findings that wealth was not related to overall social isolation across 5 waves in the 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 6-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 et al., 2013).

Engagement with more community activities was found to be associated with a lower risk for isolation from one's community. Community participation and altruistic behaviours, such as volunteering, inextricably involve social contact and have been related to increased psychological well-being and reduced all-cause mortality (Barron et al., 2009; Cattan et al., 2011). The lack of association with loneliness was therefore a little surprising, given Canadian findings 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 (Newall et al. 2009). A possible explanation might be related to the classification of loneliness by Cacioppo et al. (2015) in three dimensions: intimate, relational and collective. It may be that community engagement activities can decrease the collective loneliness, which refers to "a person's valued social identities or 'active network' wherein an individual can connect to similar others at a distance in the collective space" (Cacioppo et al., 2015, p. 241). Intimate loneliness, which relates to the perceived absence of a significant close other, and relational loneliness, which relates to the perceived absence of quality friendships or family connections, are more likely to be related to widowhood and distance from kin. In this study, loneliness was measured as a unidimensional concept. Further investigation of dimensions of loneliness is needed to further differentiate its predictors in a rural setting.

Similar to the findings of this study, Burholt and Wenger (2004) found that for the 30 survivors of a 20-year study in rural Wales, 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 social isolation 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 social isolation.

This study clearly reiterated the conceptual independence of loneliness and social isolation also reported in other studies (Cornwell and Waite, 2009; Havens et al., 2004). However, overall social isolation 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 social isolation, certain situations (widowhood and deteriorating health) predispose older individuals to both loneliness and social isolation, and that at these points in life individuals need increased support.

Practical implications

Our findings strongly support the need to stop using the terms loneliness and social isolation interchangeably. They are conceptually distinct, occur in different population sub-groups and are associated with different health and social outcomes. Together with longitudinal findings from large European studies (Holwerda et al., 2012; Jivraj et al., 2012; Tilvis et al., 2011), our data supports the need for a shift in policy focus to include loneliness as well as social isolation, but to measure these independently. It is likely that practitioners and policy makers have focussed on social isolation in the past because it is more easily represented by routinely recorded data, such as the number of people living in a household.

The current study's predictors of loneliness suggest factors which may be used to identify those at risk of loneliness in a rural older population. Nevertheless, this should not replace health practitioners directly discussing loneliness issues with their patients. Identifying and addressing loneliness is an important aspect of the emerging 'social prescribing' movement in which primary care services refer patients with social, emotional or practical needs to a range of local, non-clinical services, often provided by the voluntary or community sector (Jopling, 2016). Primary care practitioners are in a prime position to identify those at risk of loneliness, as they are often the first to know about an older adult's declining physical or mental health or bereavements which are important predictors of loneliness.

The findings of this study also highlight the importance of ageing in place with regards to social connections. Our data and previous reports show that migrating to a new area at an older age may put both rural (Wenger et al., 1996; Wenger and Burholt, 2004) and urban-dwelling (Jivraj et al., 2012) individuals at risk of loneliness and/or social isolation. In a qualitative case study comparison between urban and rural-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, rural-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 rural-living older adults are over 30 per cent more likely to move (either to a rural or urban place) than those living in Major Conurbations (Wu et al., 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 (ILC) (Sinclair and Watson, 2013). However increased effort is necessary to facilitate rural-living older adults to remain in their community 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 and 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.

Strengths, limitations and recommendations

The GaPL dataset represents a large, diverse sample of people aged 60 and over living across six geographically and demographically different rural sites across one of the UK's most rapidly ageing regions, the South West (Office for National Statistics, 2012). Nevertheless, by design the six case studies approach, though well motivated, does not provide a probability sample and therefore 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 research, however the hypotheses generated here should be tested with newly collected large, representative and ideally longitudinal data of rural-living older adults in the UK.

As with any secondary analysis, we were constrained by the existing measures available. For example, the wording for the social isolation 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 isolation from one's family and one's community members. Another limitation was the 'outdoor active pursuits' variable, which was a proxy for physical activity, and the 'community engagement' variable which was constructed from nine pre-defined activities. Thus these behavioural independent variables may not have been valid or sensitive enough to detect associations that have been identified in previous research (Newall et al., 2009; 2013). Future investigations using physical activity levels as predictor of loneliness or social isolation should use objective physical activity measurements, as self-reported physical activity is limited by recall accuracy (Colbert et al., 2012) and measure social activity through activity diaries. The findings of our study support the need to investigate the predictors of different dimensions of loneliness in rural populations as these are presented by Cacioppo and colleagues (2015), and different dimensions of social isolation (i.e. from family or from the community).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 social isolation need to be treated with caution.

Conclusions

The findings of this study strongly support the conceptual difference between loneliness and social isolation, whether from one's community or family, and highlight a range of important predictors of loneliness and social isolation in rural living older adults. Researchers and practitioners are urged to use the appropriate measure of social isolation or loneliness depending on the focus of their programme. Widowhood, declining mental or physical health and financial difficulties were related independently to loneliness, regardless

of social isolation, and so may be used to identity 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 isolation, warranting focussed public strategies to facilitate ageing in place and successful social integration of newcomers in rural areas.

References

Age UK 2013. *Later life in rural England.* Available online at: http://www.ageuk.org.uk/latest-press/archive/the-challenges-of-rural-living-for-older-people/ [Accessed 20 July 2012].

Barron, J. S., Tan, E. J., Yu, Q., Song, M., McGill, S. and Fried, L. P. 2009. Potential for intensive volunteering to promote the health of older adults in fair health. *Journal of Urban Health*, **86**, 4, 641-653. doi: 10.1007/s11524-009-9353-8.

Boss, L., Kang, D. H. and Branson, S. 2015. Loneliness and cognitive function in the older adult: a systematic review. *International Psychogeriatrics*, **27**, 04, 541-553. doi:http://dx.doi.org/10.1017/S1041610214002749.

Brown, G. 2005. Mapping spatial attributes in survey research for natural resource management: methods and applications. *Society and Natural Resources,* **18,** 17-39.

Burholt, V. 2012. The dimensionality of 'place attachment' for older people in rural areas of South West England and Wales. *Environment and Planning A,* **44**, 2901-2921.

Burholt, V. and Dobbs, C. 2012. Research on rural ageing: Where have we got to and where are we going in Europe? *Journal of rural studies*, **28**, 4, 432-446. doi:10.1016/j.jrurstud.2012.01.009.

Cacioppo, S., Grippo, A. J., London, S., Goossens, L. and Cacioppo, J. T. 2015. Loneliness Clinical Import and Interventions. *Perspectives on Psychological Science*, **10**, 2, 238-249. doi: 10.1177/1745691615570616.

Cacioppo, J. T. and Cacioppo, S. 2014. Social relationships and health: The toxic effects of perceived social isolation. *Social and personality psychology compass*, **8**, 2, 58-72. doi:10.1111/spc3.12087.

Cacioppo, J. T., Hawkley, L. C. and Berntson, G. G. 2003. The anatomy of loneliness. *Current directions in psychological science*, **12** 3, 71-74. doi: 10.1111/1467-8721.01232.

Cacioppo, J. T., Hawkley, L. C. and Thisted, R. A., 2010. Perceived social isolation makes me sad: 5-year cross-lagged analyses of loneliness and depressive symptomatology in the Chicago Health, Aging, and Social Relations Study. *Psychology and aging*, **25**, 2, 453. doi: 10.1037/a0017216.

Cattan, M., Hogg, E. and Hardill, I. 2011. Improving quality of life in ageing populations: What can volunteering do? *Maturitas*, **70,** 4, 328-332. doi:10.1016/j.maturitas.2011.08.010.

Cattan, M., White, M., Bond, J. and Learmouth, A. 2005. Preventing social isolation and loneliness among older people: a systematic review of health promotion interventions. *Ageing and society*, **25**, 01, 41-67. doi:http://dx.doi.org/10.1017/S0144686X04002594.

Caspi, A., Harrington, H., Moffitt, T. E., Milne, B. J. and Poulton, R. 2006. Socially isolated children 20 years later: risk of cardiovascular disease. *Archives of pediatrics & adolescent medicine*, **160***,* 8, 805-811. doi:10.1001/archpedi.160.8.805.

Colbert, L. H., Matthews, C. E., Havighurst, T. C., Kim, K. and Schoeller, D. A. 2011. Comparative validity of physical activity measures in older adults. *Medicine and science in sports and exercise*, **43,** 5, 867-876. doi:10.1249/MSS.0b013e3181fc7162.

Communities and Local Government 2007. *The English Indices of Deprivation.* Available online at: http://geoconvert.mimas.ac.uk/help/imd-2007-manual.pdf [Accessed 3 February 2016].

Cornwell, E. Y. and Waite, L. J. 2009. Social disconnectedness, perceived isolation, and health among older adults. *Journal of health and social behavior*, **50**, 1, 31-48.

Curry, N. and Fisher, R. 2013. Being, belonging and bestowing: Differing degrees of community involvement amongst rural elders in England and Wales. *European Journal of Ageing*, **10**, 32-333.

De Jong Gierveld, J., van Tilburg, T. and Dykstra, P. A. 2006. Loneliness and social isolation. In: Cambridge handbook of personal relationships. A. Vangelist and D. Perlman, eds. Cambridge: Cambridge University Press, 2006, p.485-500.

De Jong-Gierveld, J. and Kamphuls, F. 1985. The development of a Rasch-type loneliness scale. *Applied psychological measurement*, **9**, 3, 289-299.

De Koning, J., Stathi, A. and Fox, K. R. 2015. Similarities and differences in the determinants of trips outdoors performed by UK urban-and rural-living older adults. *Journal of aging and physical activity*, **23,** 4, 613-621.

DEFRA [Department for Environment, Food and Rural Affairs] 2013. *The rural-urban classification for England.* Available online at: https://www.gov.uk/government/statistics/rural-urban-classification-leaflet. [Accessed 20 May 2015].

DEFRA 2015. *Statistical digest of rural England.* Available online at: https://www.gov.uk/government/statistics/statistical-digest-of-rural-england-2013. [Accessed 20 May 2015].

Demakakos, P., Nunn, S. and Nazroo, J. 2006. Loneliness, relative deprivation and life satisfaction. In: Banks J., Breeze, E., Lessof, C. and Nazroo, J. (Eds.) 2006. Retirement, health and relationships of the older population in England: The 2004 English Longitudinal Study of Ageing (Wave 2).

Devon County Council (2013). *Rural health and wellbeing strategy for 2010-2013.* Available online at: http://www.devonhealthandwellbeing.org.uk/wp-content/uploads/2012/08/Rural-Health-and-Wellbeing-Strategy-2010-13.pdf. [Accessed 6 April 2015].

Dickens, A. P., Richards, S. H., Greaves, C. J. and Campbell, J. L. 2011. Interventions targeting social isolation in older people: a systematic review.*BMC public health*, **11**, 1, 647. http://www.biomedcentral.com/1471-2458/11/647.

Drennan, J., Treacy, M., Butler, M., Byrne, A., Fealy, G., Frazer, K. and Irving, K. 2008. The experience of social and emotional loneliness among older people in Ireland. *Ageing and Society*, **28**, 08, 1113-1132. doi: 10.1017/S0144686X08007526.

Dykstra, P. A., Van Tilburg, T. G. and de Jong Gierveld, J. 2005. Changes in older adult loneliness results from a seven-year longitudinal study. *Research on aging*, **27**, 6, 725-747. doi: 10.1177/0164027505279712.

Economic Social Research Council [ESRC] 2015. *Grey and Pleasant Land? An interdisciplinary exploration of the connectivity of older people in rural civic society.* Available online at: http://www.researchcatalogue.esrc.ac.uk/grants/RES-353-25-0011/read [Accessed 28 September 2015]

Ellwardt, L., Aartsen, M., Deeg, D. and Steverink, N. 2013. Does loneliness mediate the relation between social support and cognitive functioning in later life? *Social science & medicine*, **98**, 116-124. http://dx.doi.org/10.1016/j.socscimed.2013.09.002.

Emmerson, C. and Tetlow, G. 2006. Labour market transitions. In: Banks J., Breeze, E., Lessof, C. and Nazroo, J. (Eds.) 2006. Retirement, health and relationships of the older population in England: The 2004 English longitudinal study of ageing (wave 2).

Fokkema, T., De Jong Gierveld, J. and Dykstra, P. A. 2012. Cross-national differences in older adult loneliness. *The Journal of psychology*, **146**, 1-2, 201-228.

Havens, B., Hall, M., Sylvestre, G. and Jivan, T. 2004. Social isolation and loneliness: Differences between older rural and urban Manitobans. *Canadian Journal on Aging/La Revue canadienne du vieillissement*, **23**, 02, 129-140. doi: 10.1353/cja.2004.0022.

Hawkley, L. C. and Cacioppo, J. T. 2010. Loneliness matters: a theoretical and empirical review of consequences and mechanisms. *Annals of Behavioral Medicine*, **40**, 2, 218-227. doi: 10.1007/s12160-010-9210-8.

Hawkley, L. C., Thisted, R. A. and Cacioppo, J. T. 2009. Loneliness predicts reduced physical activity: cross-sectional & longitudinal analyses. *Health Psychology*, **28**, 3, 354. doi: 10.1037/a0014400.

Hennessy, C., Means, R. and Burholt, V. (eds.) 2014. Countryside connections older people, community and place in rural Britain. Bristol: University of Bristol Policy Press.

Holt-Lunstad, J., Smith, T. B. and Layton, J. B. 2010. Social relationships and mortality risk: a meta-analytic review. *PLoS medicine*, **7**, 7, e1000316. doi: 10.1371/journal.pmed.1000316.

Holt-Lunstad, J., Smith, T. B., Baker, M., Harris, T. and Stephenson, D. 2015. Loneliness and Social Isolation as Risk Factors for Mortality A Meta-Analytic Review. *Perspectives on Psychological Science*, **10**, 2, 227-237. doi: 10.1177/1745691614568352.

Holwerda, T. J., Beekman, A. T. F., Deeg, D. J. H., Stek, M. L., Van Tilburg, T. G., Visser, P. J. and Schoevers, R. A., 2012. Increased risk of mortality associated with social isolation in

older men: only when feeling lonely? Results from the Amsterdam Study of the Elderly (AMSTEL). *Psychological medicine*, **42**, 04, 843-853. doi: 10.1017/S0033291711001772.

House of Lords 2013. *Report of Session 2012–13: Ready for Ageing? Select Committee on Public Service and Demographic Change.* London: The Stationery Office Limited. Available online at:

http://www.cpahq.org/cpahq/cpadocs/UK%20Parliament%20HOL%20Ready%20for%20the%20Ageing.pdf [Accessed 3 February 2016].

Jivraj, S., Nazroo, J. and Barnes, M. 2012. Change in social detachment in older age in England. In: Banks, J., Nazroo, J. and Steptoe, A., 2012. The Dynamics of Ageing. Evidence from the English Longitudinal Study of Ageing 2002-2010 (Wave 5). Available online at: http://www.ifs.org.uk/ELSA/publicationDetails/id/6367 [Accessed 20 March 2013].

Jopling, K., 2015. *Promising approaches to reducing loneliness and isolation in later life.* Age UK: London. Available online at: http://www.gulbenkian.org.uk/files/25-06-15-Promising%20approaches%20to%20reducing%20loneliness%20and%20isolation%20in%20later%20life.pdf [Accessed 3 February 2016].

Kerwin, K.C., 2004. Is Retirement Depressing? Labor Force Inactivity and Psychological Well-Being in Later Life. A*ccounting for Worker Well-Being Research in Labor Economics*, **23**, 269–299.

Le Mesurier, N. 2003. The hidden store - older people's contributions to rural communities. Age Concern report. Available online at:

http://www.leveson.org.uk/stmarys/resources/The%20Hidden%20Store.pdf [Accessed 3 February 2016].

Lee, S.J., Steinman, M.A. and Tan, E.J. 2011. Volunteering, driving status, and mortality in US retirees. *Journal of the American Geriatrics Society*, **59***, 2, 274-280.

Litwin, H. and Shiovitz-Ezra, S. 2011. Social network type and subjective well-being in a national sample of older Americans. *The Gerontologist*, **51**, 3, 379-388. doi:10.1093/geront/gnq094.

Luo, Y., Hawkley, L. C., Waite, L. J. and Cacioppo, J. T. 2012. Loneliness, health, and mortality in old age: A national longitudinal study. *Social science & medicine*, **74**, 6, 907-914.doi:10.1016/j.socscimed.2011.11.028.

Masi, C. M., Chen, H. Y., Hawkley, L. C. and Cacioppo, J. T. 2010. A meta-analysis of interventions to reduce loneliness. *Personality and Social Psychology Review*, **15**, 3, 219-266. doi: 10.1177/1088868310377394.

Naef, R., Ward, R., Mahrer-Imhof, R. and Grande, G. 2013. Characteristics of the bereavement experience of older persons after spousal loss: An integrative review. *International journal of nursing studies*, **50**, 8, 1108-1121. http://dx.doi.org/10.1016/j.ijnurstu.2012.11.026.

Newall, N. E., Chipperfield, J. G., Bailis, D. S. and Stewart, T. L. 2013. Consequences of loneliness on physical activity and mortality in older adults and the power of positive emotions. *Health Psychology*, **32**, 8, 921-924. doi: 10.1037/a0029413.

Newall, N. E., Chipperfield, J. G., Clifton, R. A., Perry, R. P., Swift, A. U. and Ruthig, J. C. 2009. Causal beliefs, social participation, and loneliness among older adults: A longitudinal study. *Journal of Social and Personal Relationships*, **26**, 2-3, 273-290. doi: 10.1177/0265407509106718.

Newall, N., McArthur, J. and Menec, V. H. 2015. A longitudinal examination of social participation, loneliness, and use of physician and hospital services. *Journal of aging and health*, **27**, 3, 500-518. doi: 10.1177/0898264314552420.

Norfolk County Council, 2013. Mental health needs assessment. Dr. Alabady, K., Dr Hillman, L. and Rennie, C. (Eds.). Available online at: http://www.norfolkinsight.org.uk/jsna/mentalhealth#summary [Accessed 6 April 2015].

ONS [Office for National Statistics] 2012. *Mid-2011 population estimated for local authority areas*. Available online at: http://www.ons.gov.uk/ons/rel/pop-estimate/population-estimates-for-england-and-wales/mid-2011--2011-census-based-/stb---mid-2011-census-based-population-estimates-for-england-and-wales.html.[Accessed 26 June 2012].

Office for National Statistics [ONS] 2016. Rural/urban local authority (LA) classification (England). Available online at: http://www.ons.gov.uk/ons/guide-

method/geography/products/area-classifications/rural-urban-definition-and-la/rural-urban-local-authority--la--classification--england-/index.html [Accessed 3 February 2016].

Peplau, L. A. and Perlman, D. 1982. Perspectives on loneliness. In: L. A. Peplau and D. Perlman (Eds.) 1982. Loneliness: A sourcebook of current theory, research and therapy (p.1-18). New York: Wiley.

Perlman, D. 2004. European and Canadian studies of loneliness among seniors. *Canadian Journal on Aging/La Revue canadienne du vieillissement*, **23**, 02, 181-188.

Philip, L. J. and Gilbert, A. 2007. Low income amongst the older population in Great Britain: A rural/non-rural perspective on income levels and dynamics. *Regional Studies*, **41**, 6, 735-746. doi: 10.1080/00343400701281717.

Rabe-Hesketh, S. and Skondral, A. 2012. Multilevel and longitudinal modelling using Stata; Volume II: Categorical responses, counts and survival (Third Edition). Stata Press: texas, US.

Scharf, T. and de Jong Gierveld, J. 2008. Loneliness in urban neighbourhoods: an Anglo-Dutch comparison. *European Journal of Ageing*, **5**, 2, 103-115. doi: 10.1007/s10433-008-0080-x.

Shankar, A., Hamer, M., McMunn, A. and Steptoe, A. 2013. Social isolation and loneliness: relationships with cognitive function during 4 years of follow-up in the English Longitudinal Study of Ageing. *Psychosomatic medicine*, **75**, 2, 161-170. doi: 0033-3174/13/7502Y0161.

Shergold, I. and Parkhurst, G. 2012. Transport-related social exclusion amongst older people in rural Southwest England and Wales. *Journal of rural studies*, **28**, 4, 412-421. doi:10.1016/j.jrurstud.2012.01.010.

Shor, E. and Roelfs, D. J. 2015. Social contact frequency and all-cause mortality: A meta-analysis and meta-regression. *Social Science & Medicine*, **128**, 76-86. http://dx.doi.org/10.1016/j.socscimed.2015.01.010.

Sinclair, D. and Watson, J. 2013. *Making our communities ready for ageing: A call to action.* Community matters ILC-UK and Age UK Seminar Series. Available online at: http://www.ilcuk.org.uk/index.php/publications/publication_details/community_matters_maki ng_our_communities_ready_for_ageing_a_call_to_action [Accessed 3 February 2016].

Statistics for Wales 2008. *Welsh Index of Multiple Deprivation.* Available online at: http://gov.wales/docs/statistics/2008/080609wimd2008leafleten.pdf [Accessed 3 February 2016].

Stockdale, A. 2011. A review of demographic ageing in the UK: opportunities for rural research. *Population, Space and Place*, **17**, 3, 204-221. doi: 10.1002/psp.591.

Sundström, G., Fransson, E., Malmberg, B. and Davey, A. 2009. Loneliness among older Europeans. *European Journal of Ageing*, **6**, 4, 267-275. doi: 10.1007/s10433-009-0134-8.

Thomas, J. 2015. *Insights into Loneliness, Older People and Well-being.* Office for National Statistics. Available online at: http://www.ons.gov.uk/ons/rel/wellbeing/measuring-national-well-being/older-people-s-well-being/art-older-people-s-well-being-2015.html [Accessed 3 February 2016].

Tilvis, R. S., Routasalo, P., Karppinen, H., Strandberg, T. E., Kautiainen, H. and Pitkala, K. H. 2012. Social isolation, social activity and loneliness as survival indicators in old age; a nationwide survey with a 7-year follow-up. *European Geriatric Medicine*, **3**, 1, 18-22. doi:10.1016/j.eurger.2011.08.004.

Victor, C. R., Bond, J. and Bowling, A. 2003. *Loneliness, social isolation and living alone in later life.* Economic and Social Research Council. Available online at: www.growingolder.group.shef.ac.uk/ChristinaVic_F17.pdf [Accessed 27 March 2012].

Victor, C. R., Scambler, S. J., Bowling, A. N. N. and Bond, J. 2005. The prevalence of, and risk factors for, loneliness in later life: a survey of older people in Great Britain. *Ageing and Society*, **25**, 06, 357-375. doi: 10.1017/S0144686X04003332.

Victor, C. R., Scambler, S. J., Marston, L., Bond, J. and Bowling, A. 2006. Older people's experiences of loneliness in the UK: does gender matter? *Social Policy and Society,* **5**, 01, 27-38. doi: 10.1017/S1474746405002733.

Victor, C. R. and Bowling, A. 2012. A longitudinal analysis of loneliness among older people in Great Britain. *The Journal of psychology*, **146**, 3, 313-331. http://dx.doi.org/10.1080/00223980.2011.609572.

Victor, C. R. and Yang, K. 2012. The prevalence of loneliness among adults: a case study of the United Kingdom. *The Journal of psychology*, **146**, 1-2, 85-104. http://dx.doi.org/10.1080/00223980.2011.613875.

Watkins, F. and Jacoby, A. 2007. Is the rural idyll bad for your health? Stigma and exclusion in the English countryside. *Health & Place*, **13**, 4, 851-864. doi:10.1016/j.healthplace.2007.02.002.

Wenger, G. C. and Burholt, V., 2004. Changes in Levels of Social Isolation and Loneliness among Older People in a Rural Area: A Twenty–Year Longitudinal Study. *Canadian Journal on Aging/la revue canadienne du vieillissement*, **23**, 02, 115-127. doi:10.1353/cja.2004.0028.

Wenger, G. C., Davies, R., Shahtahmasebi, S. and Scott, A. 1996. Social isolation and loneliness in old age: Review and model refinement. *Ageing and Society*, **16**, 03, 333-358.

Wenger, G. C. 1995. A comparison of urban with rural support networks: Liverpool and North Wales. *Ageing and Society*, **15**, 01, 59-81.

Wenger, G. C. 1997. Review of findings on support networks of older Europeans. *Journal of Cross-Cultural Gerontology,* **12,** 1–21.

Wenger, G. C. 2001. Myths and realities of ageing in rural Britain. *Ageing and Society*, **21**, 117–130.

Wiltshire Council 2013. *Joint strategic assessment Wiltshire 2012/13*. Available online at:

http://www.intelligencenetwork.org.uk/joint-strategic-assessment/ [Accessed 6 April 2015].

Wu, Y. T., Prina, A. M., Barnes, L. E., Matthews, F. E. and Brayne, C. 2015. Relocation at

older age: results from the Cognitive Function and Ageing Study. *Journal of Public Health*,

fdv050. doi:10.1093/pubmed/fdv050.

Yang, K. and Victor, C. R. 2011. Age and loneliness in 25 European nations. *Ageing and

Society*, **31**, 08, 1368-1388. doi: 10.1017/S0144686X1000139X.