TITLE PAGE

Title: Trajectory of social isolation following hip fracture: an analysis of the English Longitudinal

Study of Ageing (ELSA) cohort.

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ABSTRACT

Background: Social isolation is defined as a lack of meaningful and sustained communication or interactions with social networks. There is limited understanding on the prevalence of social isolation and loneliness in people following hip fracture and no previous understanding of how this changes over time.

Objective: To determine the prevalence and trajectory of social isolation and loneliness before a hip fracture, during the recovery phase and a minimum of two years post-hip fracture in an English population.

Methods: Data were from the English Longitudinal Study of Ageing (ELSA) cohort (2004/5-2014/15). The sample comprised of 215 participants who had sustained a hip fracture. Measures of social isolation and loneliness were analysed through multilevel modelling to determine their trajectories during three-time intervals (pre-fracture; interval at hip fracture and recovery; minimum two years post-fracture). The prevalence of social isolation and loneliness were determined pre- and post-fracture.

Results: Prevalence of social isolation was 19% post-hip fracture and loneliness 13% post-hip fracture. There was no statistically significant change in social isolation pre-fracture compared to a minimum of two years post-fracture (P=0.78). Similarly, there was no statistically significant change in loneliness pre-fracture compared to a minimum of two years post-fracture (P=0.12).

Conclusion: This analysis has determined that whilst social isolation and loneliness do not change over time following hip fracture, these remain a significant problem for this population. Interventions are required to address these physical and psychological health needs. This is important as they may have short and longer-term health benefits for people post-hip fracture.

Keywords: femoral fracture; loneliness; multimorbidities; older people; social inequality

INTRODUCTION

Social isolation is the lack of meaningful and sustained communication or interaction with friends, family and the wider community [1,2]. Loneliness refers to the subjective feeling of being alone, separated or apart from other people, and is a balance between desired and actual social contact [3]. Loneliness may be considered the psychological embodiment of social isolation [4]. Both social isolation and loneliness are associated with a reduced quality of life and are related to a number of adverse consequences including poor physical and mental health, mal-adaptive behaviours and an increased likelihood of institutionalisation [5,6]. People who report being lonely with greater social isolation also report less exercise participation, greater tobacco use and have a greater number of long-term medical conditions compared to those with less social isolation [6,7]. Older people are at greater risk of social isolation and loneliness with declining social networks and significant life changes [4,8]. These may ensue through retirement, bereavement of friends and family members, declining health status, increasing disability and change of residential status [8]. It has been estimated that approximately 5% of older people in England are categorised as 'completely' isolated [9], with an estimated 30% categorised as socially isolated [10]. The prevalence of severe loneliness in Western Europe has been estimated at 10% for those aged 65 years and older, with 30% classified as moderately lonely [11]

Hip fracture accounts for the majority of fragility fractures, estimated to be over 40% of the burden of osteoporosis worldwide [12]. In the European Union alone, there is an estimated annual incidence of 600,000 hip fractures [13]. This is expected to increase to 104,000 annually in the UK alone by 2025 [13]. Older people following hip fracture experience declining mobility, reduced independence in function and poorer health and quality of life, with higher rates of institutionalisation compared to age-matched controls [14,15].

There remains a paucity of literature on the impact of hip fracture on community, social or civic life and loneliness [15]. This study addresses this to determine whether sustaining a hip fracture is associated with social isolation and loneliness and how this may change over time.

METHODS

ELSA Cohort

Data were drawn from the English Longitudinal Study of Ageing (ELSA) cohort. The ELSA study is an ongoing national cohort of English community-dwelling adults born on or before February 29th 1952. It is a nationally representative sample of the non-institutionalised population [16]. From its 2002/2003 inception, participants were contacted every two years for a follow-up interview. A total of 11,391 participants were recruited at the first data collection phase (Wave 1).

Ethical approval was given by the London Multi-Centre Research Ethics Service (MREC/01/2/91) and written informed consent obtained from all participants. Anonymised unlinked data for this study were provided by the UK Data Service.

Participants

In this present analysis, we identified all people within a 10-year follow-up interval (2004/2005 to 2014/2015) who self-reported having undergone a unilateral hip fracture which was surgically managed. Both core responders from the original cohort and non-core responders from the 'Wave 4' refreshment cohort were eligible [16]. This ensured that it would be possible to ascertain social engagement or isolation in the follow-up wave prior to the hip fracture (within two years) termed the 'pre-fracture phase', the wave when the hip fracture and recovery occurred, termed the 'fracture-recovery phase' and the subsequent wave (minimum of two years post-fracture), termed the 'final follow-up phase'. Participants were included where data were available from their pre-fracture phase and the following two consecutive data collection phases. Those who had sustained

recurrent or bilateral hip fractures were excluded. Hip fracture was defined as a fracture of the proximal femur, thus excluding femoral shaft fractures, acetabular or pelvic fractures.

Measurements

All measurement data was collected during the routine face-to-face follow-up interval. Data on age, gender, ethnic classification (white/non-white), hip, knee, foot and low back pain measured using a visual analogue score, self-reported difficulties with dizziness and balance, and depression were collected. Depressive symptoms were assessed using the eight-item version of Center for Epidemiologic Studies Depression (CES-D) scale [17], with a cut-off value of four to classify someone with depressive symptoms [18]. We also gathered data to assess the ELSA Frailty Index (ELSA FI) [19]. This is a validated measure and has been reported as a predictor of mortality and institutionalization [19,20,21]. It includes data on functional and sensory impairments, self-reported comorbidities, self-rated health and global cognitive function. Through this, robust participants had an ELSA FI score of <0.2, prefrail were 0.2-0.35 and frail were >0.35 [19].

Social isolation was measured using the validated and previously reported Social Isolation Index [4,22]. This index is based on respondents being unmarried/not cohabiting, less than monthly contact (including face-to-face, telephone, or written/e-mail contact) with children, other family members, and friends, and if they did not participate in organisations such as social clubs or residents groups, religious groups or committees [4,22]. Scores range from zero to five where higher scores indicate greater social isolation.

Loneliness was measured using the validated three-item short form of the Revised University of California, Los Angeles (UCLA) Loneliness Scale [23]. This is based on responses to how frequently participants 'felt left out', 'isolated from others' and 'felt lonely', with response options of hardly ever or never, some of the time, and often. Ratings were summed to produce the loneliness score. Scores range from three to nine where higher scores indicate greater loneliness [23].

Statistical Analysis

Demographic characteristics were reported using mean and standard deviation values and frequencies. The frequency of responses for social isolation and loneliness were calculated at each of the assessment time-points. Prevalence of social isolation and loneliness with 95% confidence intervals (CI) were calculated for the three assessment intervals.

Change in social isolation and isolation over time was assessed by the three assessment intervals. 'Age' (continuous), 'Gender' (factor: male/female), 'Depressed' (factor: self-reported yes/no) and ELSA FI (continuous) were included as explanatory variables (in addition to the factor variable, 'Time') to explain some of the other variation in social isolation and loneliness. We also performed an age stratification analysis where change in social isolation and loneliness were stratified into 50 to 72 years and 73 to 89 years by reference to the median age (72 years).

Multilevel modelling was used to analyse the data. This determined whether the 'Time' variable (levels=base, during, post_1) was significant between any two of the levels (pairwise comparison). The model was built by including all the terms (explanatory variables) and none were removed if they were found to be non-significant during the fitting process. Random intercept models (where each participant's data were fitted with the same slope but different intercept) were compared to random intercept and slope models (where each participant's data were fitted with a different slope and intercept). In all cases, the random intercept models were preferred due to model parsimony/best fit tests. All analyses were performed in the R Statistics program (R Core Team 2015). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.) using the 'lmer' function in the 'lme4' package.

RESULTS

Of the 11,391 participants in the ELSA dataset, 280 were identified as having had a single hip fracture surgically managed with data for outcomes of interest available for the three assessment intervals. Full data were available and analysed for 215 participants. The demographic characteristics of these participants are presented in **Table 1**. The cohort comprised of 135 women and 80 men. At the pre-fracture phase, the mean age was 70.3 years (standard deviation: 16.8 years). It was not possible to include 65 participants whose data were either 'not defined' or 'not documented' for social isolation, loneliness and key demographic characteristics.

Table 2 illustrates the frequency of outcomes for social isolation and loneliness between the three assessment intervals.

Social Isolation

There was no statistically significant difference in social isolation before their fracture compared to the final (minimum of two years) follow-up phase (p=0.78). The prevalence of social isolation pre-fracture was 14% (95% CI: 10% to 21%), and 19% (95% CI: 13% to 27%) at the final follow-up phase. There was no difference in this measure of social isolation between pre-fracture to final follow-up phase when assessed for participants aged 50 to 72 years (p=0.93) or those aged 73 to 89 years (p=0.79).

There was no statistically significant difference in social participation between the fracture-recovery phase compared to the pre-fracture phase (p=0.25), nor from the fracture-recovery phase to the final follow-up phase (p=0.12; **Figure 1**). Frailty was an explanatory variable for this analysis, with greater frailty demonstrating greater social isolation than those who were less frail (p=0.003). Age, gender and depression were not explanatory factors (p>0.16).

Loneliness

There was no statistically significant difference in loneliness pre-fracture compared to the final follow-up phase (p=0.12). The prevalence of this measure of loneliness was 15% (95% CI: 10% to 23%) pre-fracture, decreasing to 13% (95% CI: 8% to 20%) at final follow-up. There was no difference in loneliness between pre-fracture to final follow-up phase when assessed for participants aged 50 to 72 years (p=0.23) or those aged 73 to 89 years (p=0.35).

At individual time-points, there was no difference in loneliness from pre-fracture compared to the fracture-recovery phase (p=0.17) and no significant difference in loneliness between the fracture-recovery phase and the final follow-up phase (p=0.91; **Supplementary Figure 1**). Frailty was a significant explanatory factor, with greater frailty demonstrating greater loneliness (p=0.002). Being depressed was also associated with a higher loneliness score (p<0.001). Age and gender were not significant explanatory factors for loneliness (p>0.17).

DISCUSSION

The results indicate that social isolation and loneliness occur in a significant proportion of people following hip fracture. Neither social isolation nor loneliness differ significantly before or after a minimum of two years post-hip fracture.

The ELSA data suggests a large proportion of people following hip fracture experience social isolation. This is comparable with other cohorts where approximately 18% of patients were catagorised as isolated or at a high risk of social isolation [4]. Similarly, the prevalence of loneliness was reported to be 13% post-hip fracture, which is comparable to the previously reported 10% estimated from Western Europe [11]. However sustaining a hip fracture did not appear to change (increase or decrease) social isolation or loneliness. Hip fracture therefore appears to neither increase nor decrease social networks or communication/interactions. This may be surprising given that it may be assumed that following a hip fracture, patients would come into greater contact with carers (formal and informal) and health care professionals during the recovery stage [13,15]. However, this does not appear to be reflected in the ELSA data. Based on these findings, whilst it may appear that hip fracture may not increase social isolation, the high continuing prevalence of this suggestions that these patients should be provided with support to increase social participation to negate the adverse health and social effects which social isolation and loneliness are associated with [5].

Social isolation and loneliness can have significant negative health and social consequences [5]. Interventions have been previously proposed to address this in older people. These have included: community ventures, mentoring, support to engage with online platforms and befriending schemes to improve access and rebuild social networks [24,25]. There has however been limited research on

specific social participation interventions for people following hip fracture, and how they relate to recovery. A research priority is therefore to develop and test interventions for this population, tailored to their residential and social networks, to provide sustained improvements in social engagement which can be incorporated into their rehabilitation following hip fracture. Given the prevalence of social isolation and loneliness in this population, targeting this population with evidence-based interventions is a clinical recommendation.

The findings of this analysis indicated that frailty was a significant explanatory factor for social isolation and loneliness in this population. This is in agreement with previous cohorts of older people which have reported an association between frailty and poor social functioning, and an increase in loneliness over time [26]. This has been partly explained by Steptoe et al [4] who suggested that reduced social participation with decreased physical activity particularly may have negative biological consequences which are important for health maintenance and higher risk of frailty.

A key issue which this paper raises is that of reverse causality between social isolation, loneliness and hip fracture. Because of the close association between fracture, consequential immobility and impairment and social isolation and loneliness, it is not possible to fully exclude the action of reverse caution in explaining the effects that have been observed, with one potentially causing the other. This could theoretically be mitigated through the use of a linear cross lagged panel model with fixed effect analysis. However, it was not the purpose of this analysis to explore the outcome of social isolation or loneliness for people following hip fracture. Furthermore, whilst we analysed whether there was a difference in trajectory for social isolation and loneliness over the three assessment periods for those who were socially isolated or lonely versus those who were not at baseline, the number of participants included in these analyses were low and insufficient to provide any

meaningful conclusions. Nonetheless, such consideration of reverse causality would therefore be paramount if an evaluation was undertaken of the effect of social isolation or loneliness post-hip fracture on a clinical outcome such as mortality.

The principle strength of this study is that it analysed data representative of the community-dwelling English population aged 60, with pre- and post-fracture data and data on a wide range of potential variables to social isolation and loneliness. It also has two notable weaknesses. First, due to the data available, it was not possible to determine the relationship between a number of potential covariates. Most notably it was not possible to assess the relationship of social isolation and loneliness for participants who live in rural communities rather than urbanised areas [27]. This would warrant further investigation across different datasets where such data are available. Second, this study design was required to answer the research question posed since it provided pre-fracture data on social isolation and loneliness which could not be collected prospectively. However, it was not possible to determine the actual date of hip fracture. The importance of this variable cannot be determined. Analysing by 'phase' negated this as it meant that the interval between operation to final follow-up was sufficient to ensure that all participants would have recovered from their injury given that functional trajectories plateau between six and 12 months post-hip fracture surgery [28]. Nonetheless not analysing the actual date of fracture was a potential limitation which we were unable to resolve.

To conclude, whilst social isolation and loneliness do not change over time for people following hip fracture, these remain significant problems for this population. Given this, the development and implementation of interventions to address these health challenge are warranted and should be a clinical and research priority for the post-operative care of older people following hip fracture.

KEYPOINTS:

- Older people are at potential risk of social isolation and loneliness, particularly after trauma such as a hip fracture.

- The prevalence of social isolation and loneliness after hip fracture is 19% and 13% respectively.

- Social isolation and loneliness do not change significantly from pre-hip fracture compared to a minimum of two years post-hip fracture.

ACKNOWLEDGEMENTS

DECLARATIONS

FIGURE AND TABLE LEGENDS

Figure 1: Scatter-graph illustrating change in mean and standard deviation values for social isolation at the pre-fracture, fracture-recovery phase and final follow-up phase.

Table 1: Demographic characteristics of the analysed cohort.

Table 2: Frequency (%) of Social Isolation Index and the Revised UCLA Loneliness Scale for this analysis (n=215).

Supplementary Figure 1: Scatter-graph illustrating change in mean and standard deviation values for loneliness at the pre-fracture, fracture-recovery phase and final follow-up phase.

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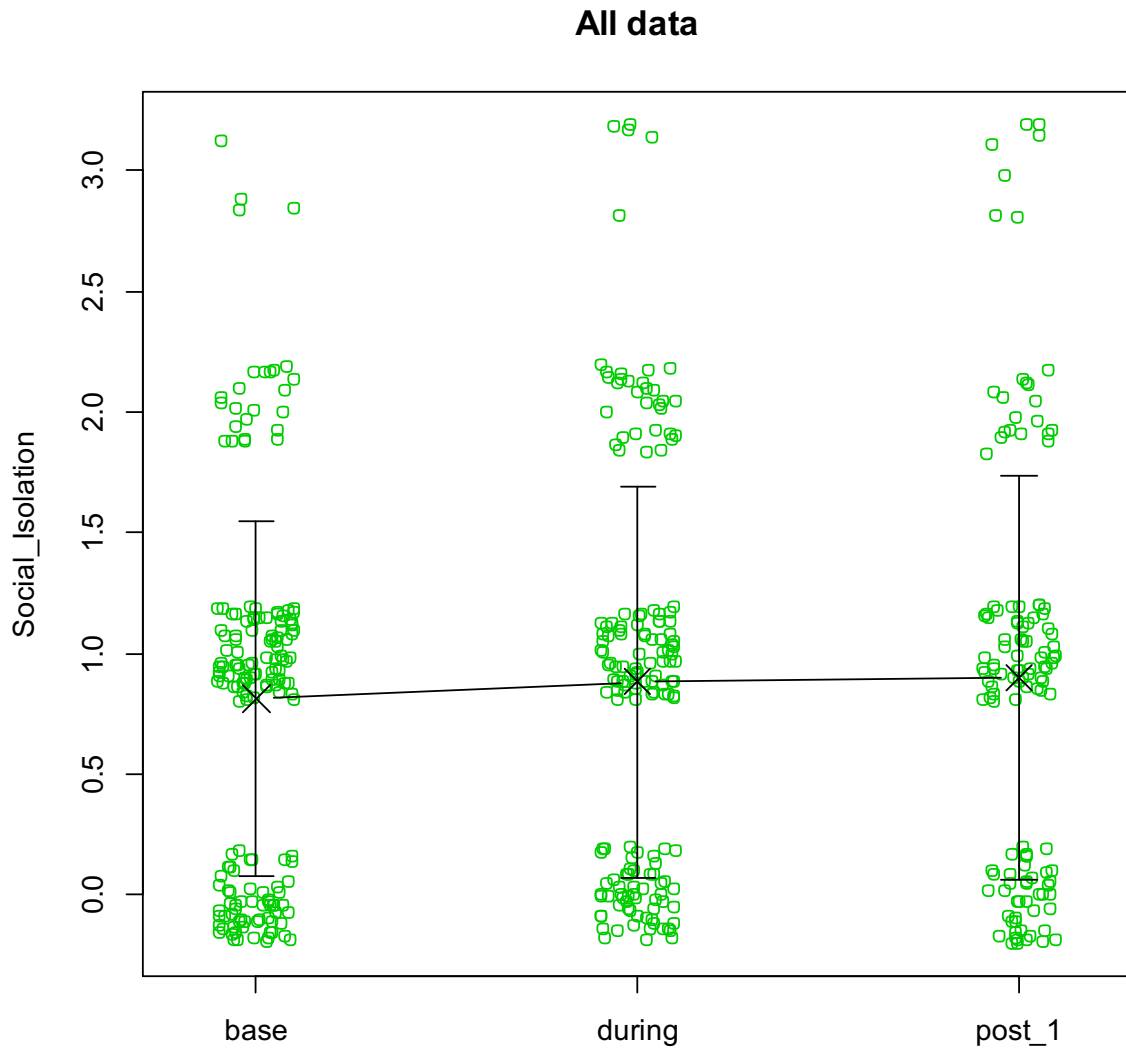
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Figure 1: Scatter-graph illustrating change in mean and standard deviation values for social isolation at the pre-fracture, fracture-recovery phase and final follow-up phase.

All data

Supplementary Figure 1: Scatter-graph illustrating change in mean and standard deviation values for loneliness at the pre-fracture, fracture-recovery phase and final follow-up phase.
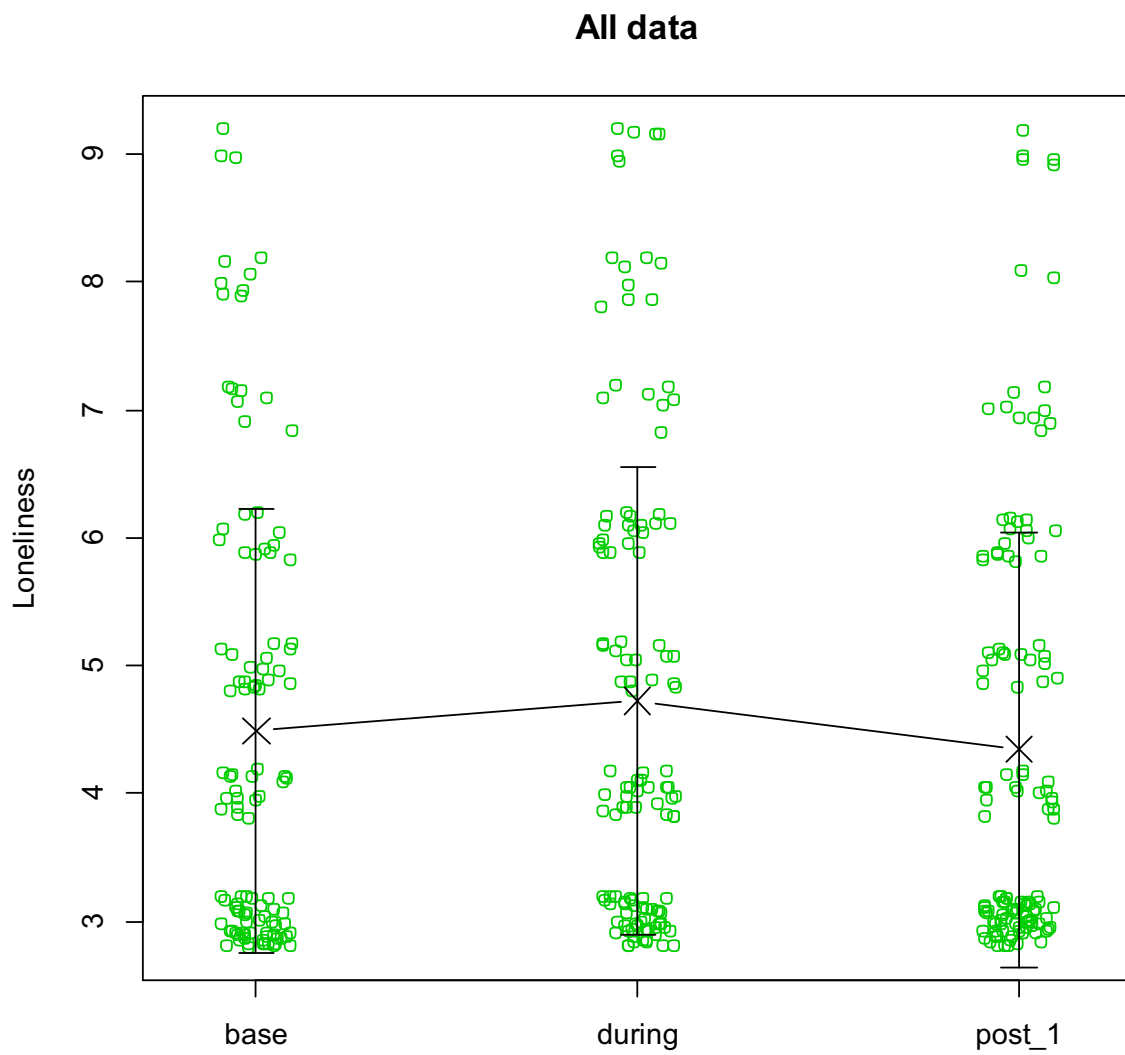
All data

Table 1: Demographic characteristics of the analysed cohort.

N	215
Gender (m/f)	80/135
Mean (SD) Age in Years	70.3 (16.8)
Ethnic Group (%)	58.6: White 15.8: Non-white 1.2: Not defined
Mean (SD) VAS Pain: LBP	4.10 (2.7)
Mean (SD) VAS Pain: hip pain	3.84 (3.4)
Mean (SD) VAS Pain: knee pain	4.14 (3.3)
Mean (SD) VAS Pain: foot pain	3.6 (3.1)
Self-reported problems with balance (%)	4.2: Always 3.7: Very often 3.3: Often 14.0: Sometimes 25.6: Never 48.8: Not reported
Self-reported problems with dizziness (%)	0.9: Always 1.9: Very often 1.4: Often 8.4: Sometimes 37.7: Never 50.2: Not reported
Self-reported depression (%)	9.3: Yes 48.8: No 41.9: Not reported
ELSA Frailty Index	49.8: Robust (score <0.2) 27.9: Pre-frail (score 0.2-0.35) 22.3: Frail (score >0.35)

f – female; m – male; N – number of participants; THR – total hip replacement; TKR – total knee replacement; SD – standard deviation; VAS – visual analogue scale.

Table 2: Frequency (%) of Social Isolation Index and the Revised UCLA Loneliness Scale for this analysis (n=215).

	Pre-Fracture Phase	Fracture-Recovery Phase	Follow-Up Phase
Social Isolation Index			
	0: 36	0: 36	0: 35
	1: 49	1: 43	1: 46
	2: 12	2: 18	2: 13
	3: 2	3: 3	3: 6
	4: 0	4: 0	4: 0
	5: 0	5: 0	5: 0
Loneliness			
	3: 44	3: 36	3: 48
	4: 15	4: 20	4: 14
	5: 16	5: 12	5: 12
	6: 10	6: 15	6: 13
	7: 6	7: 6	7: 7
	8: 6	8: 7	8: 2
	9: 3	9: 5	9: 4

Social Isolation Index: Score range from 0 to 5 where 0 equates to 'no' social isolation and 5 as 'maximum' social isolation.

Loneliness Index: Scores range from 3 to 9, where 3 equates to 'no' loneliness and 9 as 'maximum' loneliness.