Trajectories of loneliness in later life – Evidence from a 10-year English panel study

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Although the prevalence of loneliness is high among older people and is projected to rise, few studies have examined longitudinal patterns of loneliness. Using data from six waves of the English Longitudinal Study of Ageing (2008/09 to 2018/19, N=4740), we used group-based trajectory modelling to identify distinctive trajectories of loneliness. Multinomial regression models were then used to examine characteristics associated with these trajectories, with a particular focus on size, support, closeness, and frequency of contact with social networks. We identified 5 groups of loneliness trajectories, with 10% classified as "stable high" lonely throughout and similar percentages of respondents who increasingly or decreasingly reported high loneliness. Results suggest that relationships and health are important determinants of loneliness trajectories: those with poor and deteriorating health as well as low quality of relationships with both friends and family were significantly more likely to be classified as having "high stable" or "increasing high" loneliness.

1. Introduction

Although loneliness is experienced by all age groups and is not unique to old ages, loneliness peaks have been observed among those aged in their 60s and older across different countries (Barreto et al., 2021; Hawkley et al., 2022; C. R. Victor & Yang, 2012). As loneliness in old age has adverse consequences for well-being, physical and mental health, and mortality (Holt-Lunstad et al., 2015; Rico-Uribe et al., 2018), several studies have investigated factors associated with loneliness in older adults.

Loneliness is defined as a negative feeling that arises from discrepancies in individuals' desired and actual social interactions and emotional support derived from these social contacts (Perlman & Peplau, 1981). This presents the paradox that individuals may have a wide circle of family and friends, but experience loneliness because these relationships do not fulfil their expectations. Conversely others may have a small number of social relationships, but not experience loneliness because of their quality. Conceptually, loneliness is sometimes conflated with concepts of social isolation. Although having fewer social contacts is a risk factor for loneliness (Aartsen & Jylhä, 2011), not all individuals who have lower social interaction feel lonely. For example, several authors have posited that as people age, they may *gain* or *lose* friends and partners as well as opportunities to socialize or may even experience changes in the quality of relationships (Aartsen & Jylhä, 2011; Cohen-Mansfield, Shmotkin, & Goldberg, 2009; Dykstra, van Tilburg, & Gierveld, 2005).

Understanding the factors that affect loneliness in later life, and in particular the emergence of loneliness in later life (and how this can be prevented) continues to be a public health priority that has drawn considerable academic attention. In particular, as longitudinal data are becoming available from different countries, studies examining change in loneliness over time are beginning to emerge, indicating that loneliness is generally a dynamic phenomenon and people can also overcome loneliness over time. However, to date, most of the longitudinal studies have assessed changes in loneliness at two points in time; with many restricting their analyses to specific subgroup of the population; and have used single items to measure loneliness (see Dahlberg et al. (2022) for a recent systematic review of the evidence using longitudinal data).

Although both cross-sectional and longitudinal studies substantiate the importance of social factors to loneliness in later life, often (because of data availability) studies have mostly focused on more "objective" measures such as partnership status, the number of social contacts and close relationships. To date, few studies have further considered relationship quality, and those who did have mostly focused on marital satisfaction and quality (Margelisch et al., 2017; Warner & Adams, 2015), with only a few considering also quality of the relationship with and support from family and friends (Dahlberg, Andersson, & Lennartsson, 2018; Hawkley & Kocherginsky, 2018).

In this paper, therefore, we aim to understand loneliness patterns over time to better capture the dynamic nature of loneliness as people age. We also aim to identify individual sociodemographic, economic, health, and social characteristics associated with trajectories of loneliness. For social relationships, we use many different aspects that include not only the presence of family members and friends, but also the frequency of interactions with them as well as the support and closeness of these relationships.

2. Methods

2.1 Study Design and Participants

Data were obtained from the English Longitudinal Study of Ageing (ELSA), an interdisciplinary ongoing cohort of older adults aged 50 years and older living in private households in England (Banks et al., 2021). The study started in 2002 and data are collected

biennially using face-to-face personal interviews and self-completion questionnaires. The most recent full wave of data collection was wave 9 (in 2018–19). Details of the survey's sampling frame and methodology and the questionnaires can be found at www.elsa-project.ac.uk. ELSA was approved by the London Multicentre Research Ethics Committee (MREC/01/2/91). Informed consent was obtained from all participants. All data are available through the UK Data Service (SN 5050).

Our sample consisted of non-proxy participants who had been successfully interviewed between waves 4 (2008/9) and 9 (2018/9) and who had filled in the self-completion questionnaire (where the main variable of interest is collected) at least in both waves 4 and 9. We did not include waves 1-3 in this analysis because a large refreshment sample (to ensure that the complete age profile from 50 years and older is maintained) was added at wave 4 (A. Steptoe et al., 2013). Moreover, loneliness (our main variable of interest) was not collected in the first wave of the study. The final analytical sample consisted of 4740 participants (93% of which were present in all six waves under study, with 80% who completed the self-completion questionnaire at all waves).

2.2 Main Measurements of Interest

Outcome

Loneliness was measured in the self-completion questionnaire using the short revised version of the University of California, Los Angeles (R-UCLA) Loneliness Scale (Hughes et al., 2004). We used the R-UCLA loneliness scale in preference to single-item loneliness measures (such as "Have you felt lonely much of the time during the past week?" or "How often do you feel lonely?") because UCLA scale is designed to measure loneliness without directly mentioning the word "loneliness". There are concerns about the reliability of the direct questions about loneliness among older people as they may mask feelings of loneliness as consequence of its stigmatization and might elicit socially desirable answers, potentially under-reporting feelings of loneliness (Borys & Perlman, 1985; C. Victor et al., 2000). The R-UCLA loneliness scale includes three questions: "How often do you feel you lack companionship?", "How often do you feel left out?" and "How often do you feel isolated from others?". Responses were scored from 1 (*hardly ever or never*) to 3 (*often*), with total scores ranging from 3 to 9 and higher values indicating greater loneliness. The scale has high validity and is internally consistent (Cronbach's alpha = 0.82). There is no specified threshold score for the R-UCLA loneliness scale; however, in line with several studies that have used the R-UCLA loneliness scale (Davies et al., 2021; Gale, Westbury, & Cooper, 2017; Andrew Steptoe et al., 2013) and because of its positively skewed distribution (mean=4.1; median=mode=3), we categorised scores into low (3, that is those who answered "*hardly ever or never*" to all three questions), medium (4–5), and high (≥6, in the top quintile of the distribution).

Baseline covariates

In line with the risk factors for loneliness examined in the most recent reviews (Dahlberg et al., 2022), we accounted for a wide range of demographic; socioeconomic; social relationships; and health-related covariates. All covariates were assessed at Wave 4, hereafter also referred to as "baseline" measurements. As demographic factors we considered gender and age modelled as a categorical variable, distinguishing those aged 50-59, 60-69, and 70+. Socioeconomic factors included education and wealth, and employment status. Educational level was recoded into low (below secondary), middle, and high (university or above) following the International Standard Classification of Education (http://www.uis.unesco.org/). Wealth was equal to the total net non-pension non-housing wealth, and respondents were categorised into being in the top 40 percentiles or below. For employment, we classified respondents as

being in paid work, retired, or "other" (i.e., "unemployed," "permanently sick or disabled," "homemaker," or "other").

Among indicators of social relationships, we considered several questions that accounted not only for the presence of partners, children, immediate family, and friends, but also for their support and frequency of contact with them. For each relationship domain (with partner, children, family, and friends) respondents were asked to rate their perception of *support* (with six statements including how much they "can rely on them" or "understand the way they feel" and response choices ranging from "1 - not at all" to "4 - a lot"). Respondents who had available relationships were also asked to report how close their relationship was with their partner (very close vs less) and how many close children, family members, and friends they have a close relationship with. ELSA participants were also asked to report, on average, how often they meet up, speak on the phone, or write/email with children, family, and friends (with answers ranging from "three or more times a week" to "less than once a year or never"). Similarly to Litwin and Stoeckel (2016), we created two scales (one for family and one for friends) that incorporated all of these characteristics into composite measures to capture key facets of social network resources (*size*, *support*, *closeness*, and *frequency of contact*) within one indicator. We then used quartiles of the resultant scales. We also considered whether respondents reported volunteer work or informal care provision in the previous month. It is worth mentioning that although, as one would expect, those with no partner, no children, no friends, or no immediate family were more likely to fall in the bottom quartile of the relationship scales, this was not a sufficient condition to be categorised as having overall low social resources. For instance, among those in the bottom quartile, 60% have a partner, 52% have children, 14% have immediate family, and 81% report having at least one friend (see Supplementary Table 1), with only 2% reporting no family at all (and 28% of those at the bottom quartile having all three family domains). This suggests that having friends and family in one's network is a relatively crude measure of relationships that overlooks important aspects of quality and support of these networks.

Supplementary Table 1. Percent distribution of presence of partner, children, family, and friends by quartiles of the overall indicator of social network resources

	Bottom quartile	2nd quartile	3rd quartile	Highest quartile
No **partner**	39.9	21.0	16.5	12.0
No **children**	48.3	7.8	0.1	0.0
No **immediate family**	14.3	8.3	2.3	0.2
No **family at all**	2.1	0.0	0.0	0.0
No **friends**	18.6	0.0	0.0	0.0

Source: ELSA waves 4-9 (N=4740).

Health-related factors included self-perceived health, physical disability, depression, as well as vision and hearing difficulties. Self-rated health (SRH) was measured on a five-point ordinal scale (excellent, very good, good, fair, or poor). The five SRH items were dichotomised into "fair or poor" versus better health. Physical disability was assessed using limitations in activities of daily living (ADL, such as such as getting out of bed and walking across a room) and instrumental ADL (such as shopping for groceries and preparing a hot meal). Participants who reported limitations with one or more activities were defined as having physical impairments. Mental health was measured using the 8-item short version of the Centre for Epidemiologic Studies Depression (CES-D) scale, which has been validated as a reliable measure of depressive symptomatology in older adults (Karim et al., 2015). The scale includes eight binary (no/yes) questions that enquire about whether respondents experienced any depressive symptoms, such as feeling sad or having restless sleep, in the week before the

interview. We classified respondents who reported four or more depressive symptoms on the CES-D scale as having elevated depressive symptoms. Finally, respondents were asked to rate their eyesight and hearing with answers ranging from excellent to poor. People were defined as having difficulties with vision or hearing if they rated their vision or hearing as fair or poor (including if they were using glasses and hearing aids).

Life events

As the covariates mentioned above were assessed in all ELSA waves, we also considered most of the social relationships and health indicators also in terms of changes over the 10-year follow-up period. Depending on the variables considered and their distributions, we considered changes either as improvements, worsening, or no change over time (for health variables as well as support and contacts, for instance). We also considered binary indicators to capture disruptive events such as death of spouse.

Statistical Analysis

First, the percentages of each of the three categories of loneliness were calculated at each wave under study. Group-based trajectory modelling (Nagin & Odgers, 2010) was then applied to identify distinctive trajectory patterns of loneliness. This method takes into account the dependency of observations and assumes a mixture of subpopulations with different individual trajectories within the target population and identifies distinctive groups within which individuals share similar developmental trajectories (Herle et al., 2020; Nguena Nguefack et al., 2020). To determine the number of trajectory groups within our sample, we fit a series of group-based trajectory models with up to six groups. Missing data were handled using full information maximum likelihood estimation. In selecting the appropriate number of trajectory groups, we considered a wide range of criteria including the Akaike Information Criterion (AIC), the Bayesian Information Criterion (BIC), and its sample size-corrected version (c-BIC). For each of these, lower scores indicate (relatively) better fitting models. Moreover, we additionally considered the average posterior probabilities of group membership as a measure of classification quality (entropy index, with values approaching 1.0 indicating a favourable classification); group size (and the avoidance of too small classes that may lead to lack of reproducibility of the results); the usefulness of the number of groups in terms of the similarities/differences in their trajectory shapes; and the interpretability of the distinctive trajectories (Nagin & Odgers, 2010; Nguena Nguefack et al., 2020).

Once the trajectories were identified, we first examined the (un-adjusted) differences among these trajectory groups in terms of demographic; socioeconomic; social relationships; and health-related covariates at baseline (using chi-squared or ANOVA tests, depending on the nature of the covariate). Second, we used multinomial logistic regression analyses to examine the combined effects of these risk factors on respondents' group membership of different loneliness trajectories. To ease interpretation of the results, we present average marginal effects (AMEs) that, due to the categorical nature of our outcomes and covariates, are to be interpreted as the difference between the predicted probabilities (in percentage points) across the categories of the covariates being examined. Finally, we examined the associations between loneliness trajectories and changes in selected social relationships and health indicators (controlling for baseline basic demographic characteristics). Trajectories were determined using Mplus; data management and statistical analyses were performed using Stata 18.

3. Results

3.1 Loneliness trajectories

Table 1 shows the distribution of the longitudinal R-UCLA loneliness categories across all six waves under study. Overall, each of the three categories of loneliness calculated for ELSA

participants shows stable probabilities over time. The majority of respondents (about 56%) are classified as having low loneliness scores across all waves, with about 16/18% of respondents reporting high levels of loneliness (R-UCLA ≥6) at each wave.

In order to summarise the development of loneliness over time and determine the optimal number of trajectory groups, a series of group-based trajectory models were fitted (with a specification of up to seven trajectory groups). Based on the criteria mentioned above (see Supplementary Table 2), we identified five as the number of trajectories ("classes") that best fits the data. The cumulative predictive probabilities of each of the three loneliness categories varied substantially across classes (see Figure 1). Class 1 (40.4%) and Class 5 (10.6%) identify groups of respondents who report respectively low and high scores of R-UCLA loneliness with high and fairly stable probabilities. Respondents in these groups could be classified as "*stable low loneliness*" and "*stable high loneliness*" respectively. Class 3 (25.8%) is made up of respondents who overall report similar probabilities of low to medium loneliness, with a slight increase in probabilities of reporting low loneliness over time (and hereafter referred to as "*overall medium to low loneliness*"). The remaining two classes show time-varying probabilities: Class 2 (13.9%) and Class 4 (9.4%) comprise respondents who progressively increasingly and progressively decreasingly report high levels of loneliness (and can be labelled as "*increasing high loneliness*" and "*decreasing high loneliness*"). Supplementary Table 3 quantifies how the average reported R-UCLA loneliness scores vary by classes over time to provide a numerical representation of the classes. The average scores of loneliness are quite stable in Classes 1 and 5, whereas they increase by ~1 point in Class 2 over the 10 years considered and decrease by 1.6 points in Class 4.

Table 1 Summary of longitudinal data on R-UCLA loneliness score

	N	Low (R-UCLA=3)	Medium (R-UCLA =4 or 5)	High (R-UCLA≥6)
Wave 4	4,740	2,490 (52.5%)	1,400 (29.6%)	850 (17.9%)
Wave 5	4,470	2,490 (55.7%)	1,212 (27.1%)	768 (17.2%)
Wave 6	4,408	2,414 (54.8%)	1,215 (27.5%)	779 (17.7%)
Wave 7	4,366	2,530 (57.9%)	1,146 (26.3%)	690 (15.8%)
Wave 8	4,372	2,477 (56.7%)	1,177 (26.9%)	718 (16.4%)
Wave 9	4,740	2,684 (56.6%)	1,220 (25.7%)	836 (17.6%)

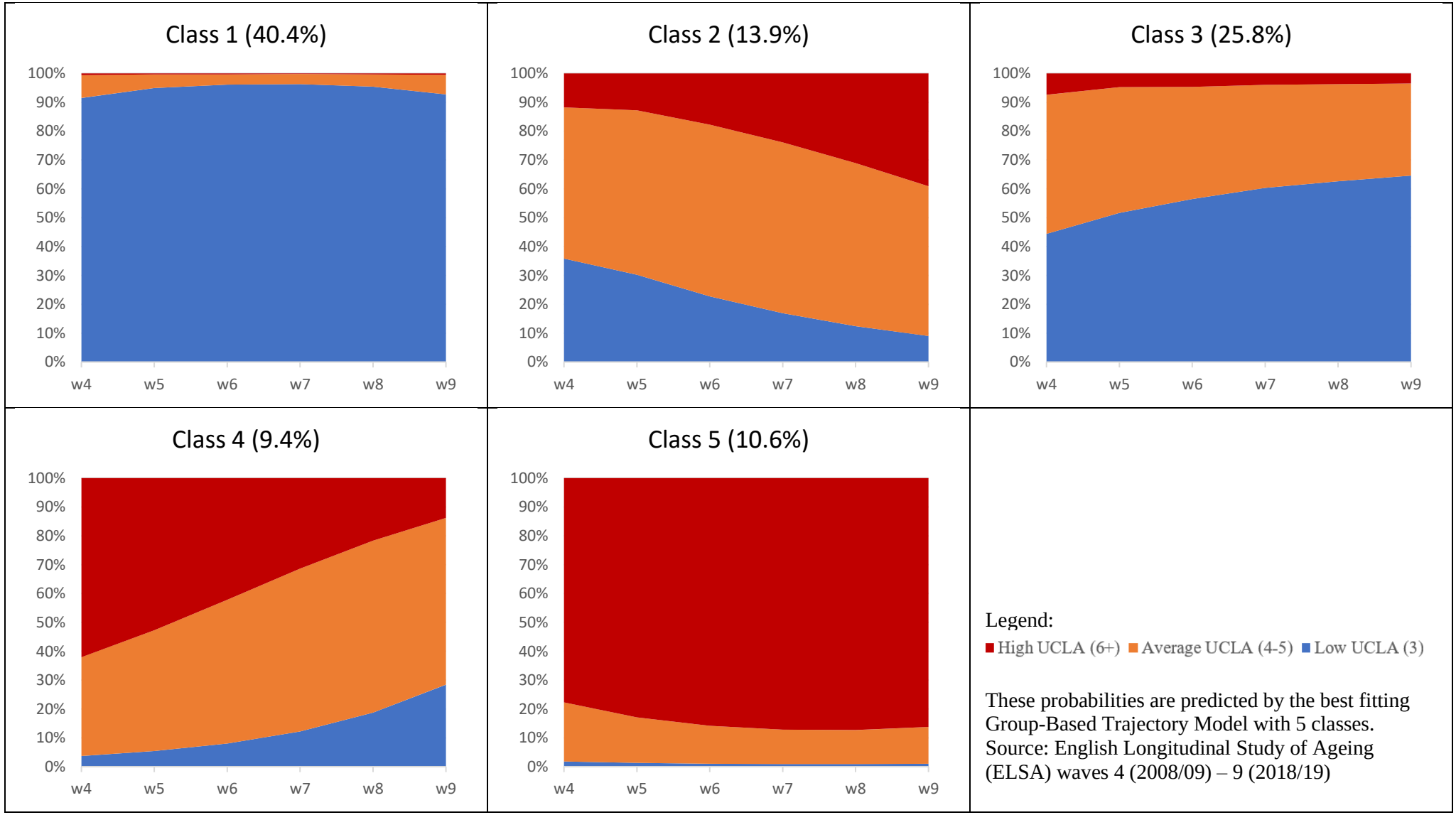
Source: ELSA waves 4-9

Supplementary Table 2. Comparison of goodness of fit criteria for group-based trajectory modelling models of longitudinal loneliness

N classes	AIC	BIC	cBIC	Entropy	Class membership
1	53224.82	53250.68	53237.97	1	
2	43988.92	44040.63	44015.21	0.865	62.0%; 38.0%
3	41986.14	42063.70	42025.57	0.823	47.5%; 16.0%; 36.5%
4	41707.29	41810.72	41759.87	0.733	10.4%; 21.9%; 37.1%; 30.6%
5	**41524.33**	**41653.60**	**41590.05**	**0.718**	**37.4%, 14.1%, 27.7%, 10.3%, 10.5%**
6	41415.12	41570.25	41493.99	0.731	6.3%, 22.5%, 10.0%, 38.1%, 17.2%, 5.8%
7	41371.93	41552.91	41463.94	0.750	37.9%; 18.0%; 4.8%; 21.9%; 6.7%; 9.9%; 0.8%

Source: ELSA waves 4-9 (N=4740). Notes: AIC=Akaike Information Criterion; BIC=Bayesian Information Criterion; c-BIC=sample size corrected BIC

Figure 1. Stacked predicted probabilities of R-UCLA loneliness categories (low, medium, high)



Supplementary Table 3 - Average R-UCLA loneliness scores over time across classes

	Wave 4	Wave 5	Wave 6	Wave 7	Wave 8	Wave 9
Class 1 - *stable low loneliness*	3.11	3.06	3.05	3.04	3.05	3.10
Class 2 - *increasing high loneliness*	3.99	4.18	4.55	4.74	5.11	5.03
Class 3 - *overall medium/low loneliness*	3.99	3.84	3.78	3.57	3.56	3.58
Class 4 - *decreasing high loneliness*	5.93	5.62	5.42	4.91	4.49	4.29
Class 5 - *stable high loneliness*	6.45	6.50	6.56	6.46	6.63	6.51

Source: English Longitudinal Study of Ageing (ELSA) waves 4 (2008/09) – 9 (2018/19)

3.2 Baseline characteristics of trajectories of loneliness

Table 2 summarises ELSA respondents' baseline characteristics and shows the distributions of potential risk factors among the five loneliness trajectory groups. Overall, women are more likely to be in the "stable high loneliness" group, and those aged 70 and older are more likely to be in the "increasing high loneliness" group. Those in the "stable low loneliness" group tend to be socioeconomically better off (with a higher percentage of respondents in this group having medium-high levels of education, in the top wealth distribution, and in paid work).

When social relationships are considered, Table 2 shows that those who report no partner, no children, no immediate family, and no friends at baseline are more likely to belong to the "stable high loneliness" group. However, among those who do have partner, children, immediate family, friends, both the quality of the relationship and the frequency of contact are associated with the different loneliness trajectories. Particularly for partners and children, respondents who belong to the "low stable loneliness" group are most likely to report supportive relationships in these domains as well as to have at least weekly phone or text contacts and in-person meetings with their children. Also among those who report having immediate family members and friends, particularly the supportiveness of these domains relate to the loneliness trajectories – once again, respondents who have the most supportive family and friends are those most likely to belong to the "low stable loneliness" group. Unexpectedly, ELSA respondents in the "stable high loneliness" groups are the least likely to report supportive relationships. When the two summary measures are considered, results confirm that respondents who at baseline had the highest average scores of social relationships with both their family members and their friends were more likely to fall in the "stable low" loneliness group whereas, those in the "stable high" loneliness group reported on average the lowest scores of support, closeness, and contacts with their family members and friends. In bivariate associations, no differences were found among the loneliness trajectories by whether respondents were engaged, at baseline, in caring or volunteering activities.

Finally, stark health contrasts were found between respondents in the "stable low" and "stable high" loneliness categories, with respondents in the former group least likely to report any of the health issues considered and those in the latter reporting the poorest mental and physical health.

Table 2 – Baseline sample characteristics, by loneliness trajectories and overall

		Class 1 *Stable low*	**Class 2** *Increasing high*	**Class 3** *Overall medium/low*	**Class 4** *Decreasing high*	**Class 5** *Stable high*	***Total***	***P value***
Demographic & Socio-economic characteristics	Female	51.9	59.1	54.5	64.0	67.5	56.3	<0.001
	50-59	38.0	33.2	40.7	40.5	40.4	38.5	<0.001
	60-69	43.4	38.8	39.1	39.9	39.0	40.9	
	70+	18.5	28.0	20.2	19.6	20.5	20.6	
	High education	25.2	19.4	23.5	22.1	16.9	22.8	<0.001
	Medium education	50.0	45.2	45.9	18.4	49.2	48.1	
	Low education	24.8	35.4	30.1	29.5	33.9	19.1	
	Top 40% wealth	55.4	40.5	47.1	41.4	32.7	47.5	<0.001
	In paid work	48.4	36.4	46.4	42.1	37.9	44.5	<0.001
	Retired	45.4	51.5	42.7	42.6	42.1	44.5	
	Other employment	6.2	12.1	10.9	15.3	20.9	10.7	
Social Relationships	No **partner**	11.9	24.0	21.2	39.9	45.2	22.1	<0.001
	Supportive partner*	63.2	42.9	46.5	23.7	21.3	50.4	<0.001
	"Very close" to partner	86.5	73.9	72.5	48.5	42.5	75.1	<0.001
	No **children**	12.9	15.1	11.8	15.8	15.5	13.5	0.073
	Supportive children*	56.7	41.5	43.8	35.8	30.4	46.6	<0.001
	Mean N of close children* (SD)	2.14 (0.96)	2.06 (1.05)	2.10 (1.01)	1.99 (1.15)	1.84 (1.03)	2.08	<0.001
	+weekly contact w/ children*	89.7	90.4	87.5	85.0	81.1	88.0	<0.001
	+weekly meeting w/ children*	59.1	57.3	61.3	53.4	51.5	57.6	0.004
	No **immediate family**	6.8	8.5	4.8	5.6	6.7	6.5	0.027
	Supportive family*	32.9	22.5	25.4	20.7	15.9	26.5	<0.001
	Mean N of close family* (SD)	2.69 (2.70)	2.62 (2.72)	2.52 (2.55)	2.39 (2.67)	2.01 (2.46)	2.53	<0.001
	+weekly contact w/ family*	57.8	57.8	59.1	59.9	61.3	58.8	0.612
	+weekly meeting w/ family*	32.4	35.0	32.0	31.7	27.5	32.0	0.146
	No **friends**	2.1	4.3	4.1	4.1	7.5	3.7	<0.001
	Mean N of close friends* (SD)	4.15 (3.78)	3.60 (2.97)	3.53 (3.36)	3.18 (2.53)	2.94 (2.56)	3.70	<0.001
	Supportive friends*	48.6	39.2	41.1	35.6	32.4	42.5	<0.001
	+weekly contact w/ friends*	64.3	61.6	62.0	63.4	65.4	63.4	0.525
	+weekly meeting w/ friends*	55.8	56.2	53.6	54.5	53.8	55.0	0.737
	Mean Social Relationships -family	**14.64**	**13.07**	**13.68**	**11.72**	**10.91**	**13.51**	**<0.001**
	Mean Social Relationships-friends	**9.77**	**8.91**	**9.01**	**8.74**	**8.23**	**9.20**	**<0.001**
	Volunteered	19.6	18.3	16.9	17.3	16.3	18.2	0.249
	Provided care	10.3	13.9	11.6	11.5	10.8	11.3	0.147
Health	Fair/poor SRH	10.5	19.8	16.8	24.3	35.3	17.4	<0.001
	Disability	11.9	22.3	16.8	27.9	32.9	18.4	<0.001
	Depressed	3.3	8.6	7.7	21.2	36.5	10.4	<0.001
	Fair/Poor Vision	5.8	8.6	9.2	11.3	14.5	8.5	<0.001
	Fair/Poor Hearing	15.1	17.3	16.5	18.2	20.1	16.6	0.064
	Respondents (%)	**1,913 (40.4%)**	**660 (13.9%)**	**1,221 (25.8%)**	**444 (9.4%)**	**502 (10.6%)**	**4,740**	

Source: English Longitudinal Study of Ageing (ELSA) waves 4 (2008/09) – 9 (2018/19). P-value from chi-squared or ANOVA tests. Note: * these percentages are restricted to respondents who report having social relationships in the different domains considered (partner, children, immediate family, friends).

Table 3. Average marginal effects for a multinomial logistic regression model for loneliness trajectories

	Class 1 *Stable low*	**Class 2** *Increasing high*	**Class 3** *Overall medium/low*	**Class 4** *Decreasing high*	**Class 5** *Stable high*
Female	-7.18***	1.33	-1.89	3.11***	4.62***
Age (Ref: 50-59)					
60-69	1.03	0.22	-2.59	0.21	1.13
70+	-3.54	4.04**	-1.34	-0.29	1.14
Education (Ref: High)					
Medium education	0.45	0.25	-2.12	0.31	1.72
Low education	-2.25	2.13	1.15	-1.29	0.25
Top 40% wealth	7.80***	-2.89***	-0.19	-1.26	-3.46***
Employment (Ref: In paid work)					
Retired	0.33	2.28	-0.97	-0.58	-1.06
Other employment	-10.5***	3.12	1.56	1.97	3.82**
Lowest Social Rel quartile - Family	-6.81***	-0.16	-1.22	3.38***	4.81***
2nd Social Rel quartile – Family (Ref)					
3rd Social Rel quartile – Family	4.71**	-1.91	1.93	-1.30	-3.43***
Highest Social Rel quartile - Family	14.5***	-3.08**	0.25	-4.63***	-7.02***
Lowest Social Rel quartile – Friends	-5.12**	0.33	1.59	2.95	2.90**
2nd Social Rel quartile – Friends (Ref)					
3rd Social Rel quartile – Friends	1.60	-0.67	1.40	-1.46	-0.87
Highest Social Rel quartile - Friends	8.58***	-2.70**	-0.21	-1.76	-2.07
Volunteered	0.84	0.17	-1.62	-0.13	0.73
Provided care	4.36**	-3.96**	-1.33	0.08	0.84
Fair/poor SRH	-6.15***	1.72	1.89	0.16	2.37**
Disability	-7.74***	2.03	-1.52	4.33***	2.89**
Depressed	-22.7***	-2.54	-3.49	8.66***	20.0***
Fair/Poor Vision	-5.86**	-0.87	3.53	1.14	2.07
Fair/Poor Hearing	-1.36	-0.02	-0.81	-0.76	-1.42

Table 3 shows results from the multinomial logistic regression analyses regarding demographic, socioeconomic, social relationships, and health factors measured at baseline as predictors of trajectories of loneliness over the subsequent five waves. To ease interpretation of results, the findings are reported as average marginal effects (AMEs) for the explanatory variable. Due to the categorical nature of our outcomes and explanatory variables, the AMEs are to be interpreted as the discrete effect of the independent variable (compared to the reference category), i.e., as the difference between the predicted probabilities (in percentage points) across the groups being compared.

Results suggest that women were more likely than men to report higher levels of loneliness at baseline. After adjustment for other explanatory variables, respondents aged 70 and older at baseline were significantly more likely to be classified in the "increasing high" loneliness group than respondents in their 50s. Results also suggest socioeconomic differences across the loneliness trajectories: for instance, those in the top 40% wealth distribution were 7.8 percentage points more likely to be in the "stable low" loneliness group care weekly and about 3 percentage points less likely to be in the "increasing" or "stable" high loneliness groups. Compared to those in paid work, respondents in "other" employment were 10.5 percentage points less likely to be in the "stable low" loneliness group but about 4 percentage points more likely to be in the "stable high" one.

The indicators of social relationships suggest that overall, both for family and friends, those in the lowest quartile of the distributions were more likely to report high levels of loneliness to start with, and even more so to remain in the group of respondents with "stable high" levels of loneliness over time. For instance, compared to the second lowest quartile of family relationships, those in the bottom are almost 5 percentage point more likely to be in the "stable high" group but 7 percentage points less likely to be in the "stable low". Conversely, respondents at the highest end of family relationships are 14 percentage points more likely to be in the "stable low" loneliness group and 7 percentage points less likely to be in the "stable high" one.

Finally, health seems to be also an important factor. Generally speaking, respondents in poor health were less likely to be in the "stable low" loneliness group but significantly more likely to report high levels of loneliness to start with and to be in the "stable high" loneliness group. For instance, older people who reported elevated depressive symptoms at baseline were 23 percentage points less likely to be classified in the group "stable low" loneliness but 9 and 20 percentage points more to be in the "decreasing high" and "stable high" ones respectively.

Table 4 shows the relationships between the classes of informal care trajectories and changes in selected family and health compositions variables. Both changes in family and friends relationships and in health are significantly associated also with trajectories of changes in loneliness over time. For instance, respondents who experienced a marital disruptions (mostly widowhood) during the years under study are more likely to be in the "increasing high" loneliness group. If overall social relationships deteriorate over time, the most marked drops were observed in the "increasing high" and "stable high" loneliness groups. When looking at changes in relationships over time, those whose overall network, quality, and support deteriorated over the years were the most likely to be classified in the "increasing high" loneliness group. Conversely, those whose relationships with friends have improved are more likely to be in the "decreasing high" loneliness group. For both family and friends relationships, those in stable high loneliness are the most likely to have experienced no changes and to have remained in poor quality relationships overall. Changes in health are also related to different loneliness trajectories, with those whose health deteriorated in the 10 years under study more likely to belong to the "increasing high" loneliness group. Descriptive results also suggest that improving mental and physical health over time is associated with decreasing high loneliness.

Table 4. Changes in selected characteristics between Wave 6 and 9 by caring trajectories – ELSA respondents

	Class 1 *Stable low*	**Class 2** *Increasing high*	**Class 3** *Overall medium/low*	**Class 4** *Decreasing high*	**Class 5** *Stable high*	***Total***	P value
Marital disruption	5.4	19.2	9.3	7.4	15.9	9.6	<0.001
Disruptions in friendship	3.8	7.5	5.3	6.3	12.5	5.8	<0.001
Absolute change in Relationships – Family	-0.22	-0.94	-0.35	0.06	-0.75	-0.38	<0.001
Absolute change in Relationships – Friends	-0.60	-0.74	-0.37	-0.33	-0.96	-0.57	0.007
Family Rel – no change, still low	34.4	47.6	40.7	54.5	64.3	42.9	<0.001
Family Rel – no change, still high	40.5	24.0	31.8	22.3	12.9	31.3	
Family Rel – improved	11.2	11.1	12.4	12.4	9.8	11.5	
Family Rel – deteriorated	13.9	17.3	15.2	10.8	12.9	14.3	
Friends Rel – no change, still low	30.1	39.6	36.2	39.2	47.0	35.6	<0.001
Friends Rel – no change, still high	41.9	30.2	34.3	32.8	23.3	35.5	
Friends Rel – improved	10.7	10.3	11.8	17.7	13.2	9.5	
Friends Rel – deteriorated	17.3	19.9	17.7	14.8	20.2	17.8	
Has poor/fair SRH	11.2	21.4	13.1	16.8	17.0	14.2	<0.001
No longer poor/fair SRH	4.7	6.0	6.7	7.7	9.8	6.2	
Now IADL/ADL disabled	11.8	19.6	13.7	14.9	19.3	14.5	<0.001
No longer disabled	5.7	7.9	6.6	10.2	8.2	6.9	
Now depressed	2.5	13.5	4.8	8.1	17.2	6.7	<0.001
No longer depressed	2.7	5.5	6.6	16.3	15.6	6.7	
Now has vision difficulty	6.3	11.5	8.4	11.7	14.5	9.0	<0.001
No longer vision difficulty	3.6	4.7	5.8	7.2	7.2	5.0	
Now has hearing difficulty	11.1	17.1	12.1	16.2	15.3	13.1	<0.001
No longer hearing difficulty	7.2	5.3	6.3	7.4	8.4	6.8	

Source: English Longitudinal Study of Ageing (ELSA) waves 4 (2008/09) – 9 (2018/19). P values obtained from mlogit when controlling for baseline age, gender, and wealth (testparm)

4. Discussion

This study shows that overall loneliness in later life is dynamic in nature, with the probability of experiencing high levels of loneliness over time highly dependent on health and social relationships with family and friends. Using data from six waves of ELSA (that span 10 years), we found that almost one in ten older English people reported high levels of loneliness throughout, with roughly similar percentages increasing or decreasing their overall loneliness over time. We also found that family and social relationships as well as health are particular important determinants of loneliness trajectories. In particular, those who overall have low levels of support, closeness, and contacts with friends and family are significantly more likely to be classified as having “high stable” or “increasing high” loneliness. Similarly, having poor physical and mental health is associated with higher levels of loneliness throughout. Changes in loneliness over time are also linked to changes to the respondents’ health and social relationships. In particular, those whose health deteriorated over time and those whose social networks and support reduce over time are the most likely to experience increasing loneliness over time. It is important, however, to highlight that the role of social relations is more complex that just having partners, children, or friends and it is essential to focus on the role that these networks play in people's lives. Although not having any networks is undoubtedly associated with higher risk of persistent loneliness, having family and friends is not enough if people do not feel close to them, do not feel supported by them, and do not spend time with them.

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