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Loneliness and Cognitive Function in Older Adults: Longitudinal Analysis in 15 Countries

Laura Cachón-Alonso[1], Christian Hakulinen[1], Markus Jokela[1], Kaisla Komulainen[1], and Marko Elovainio[1, 2]

[1] Department of Psychology and Logopedics, Faculty of Medicine, University of Helsinki
[2] Finnish Institute for Health and Welfare, Helsinki, Finland

This study aims to evaluate the directionality of the association between loneliness and cognitive performance in older adults, accounting for confounding factors. Data were from 55,662 adults aged ≥50 years who participated in Waves 5–8 of the Survey of Health, Ageing and Retirement in Europe (SHARE). Loneliness was assessed with the Three-Item Loneliness Scale (TILS) and with a one-item direct question. Cognitive performance was assessed with four measures: verbal fluency, numeracy, immediate recall, and delayed recall. Age, sex, geographical area, educational attainment, partnership status, depressive symptoms, and previous chronic diseases at baseline were used as covariates. We analyzed the associations with three-wave random intercept cross-lagged panel models (RI-CLPM) and conducted age-stratified analysis among those younger versus older than 65 years. Full information maximum likelihood estimators were used to handle missing values in Waves 6–8 in the main analyses. We also conducted additional sensitivity analyses stratified by retirement status (retired vs. not) at baseline. At the within-person level, loneliness and cognitive performance were not associated with each other among those aged 50–64 years in the main time-lagged analysis. Among those aged ≥65 years, loneliness was associated with lower cognitive performance in the next wave in all four cognitive domains. In addition, lower verbal fluency predicted greater loneliness in the next waves among this age group. Similar patterns were found independently of retirement status at baseline. These results suggest that loneliness is a psychosocial risk factor for cognitive decline among older adults (≥65 years).

Public Significance Statement

The findings of this longitudinal study indicate that loneliness is associated with an accelerated decline of cognitive abilities such as memory and verbal fluency. Cognitive health interventions might benefit from considering people's social relationships, especially in older ages.

Keywords: loneliness, cognitive function, elderly, longitudinal, cross-national

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Laura Cachón-Alonso https://orcid.org/0000-0001-5712-4475
Christian Hakulinen https://orcid.org/0000-0001-8629-9960
Markus Jokela https://orcid.org/0000-0003-0117-0012
Kaisla Komulainen https://orcid.org/0000-0002-1576-7111
Marko Elovainio https://orcid.org/0000-0002-1401-1910
Kaisla Komulainen and Marko Elovainio share the last authorship.

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The data and materials for these analyses are available after registration at https://share-eric.eu/data/data-access. The code behind this analysis has been made publicly available and can be accessed at https://bit.ly/lca_repository. The ideas and data appearing in the article have not been disseminated before.

Correspondence concerning this article should be addressed to Laura Cachón-Alonso, Department of Psychology and Logopedics, Faculty of Medicine, University of Helsinki, Haartmaninkatu 3, P.O. Box 63, 00014 Helsinki, Finland. Email: laura.cachon@helsinki.fi

Loneliness is defined as the discrepancy between the desired and the actual quality and quantity of social relationships that a person has (Perlman & Peplau, 1981; Smith et al., 2020). Lonely people have been shown to have an increased risk of several detrimental health outcomes, such as worse cardiovascular health (Hakulinen et al., 2018; Valtorta, Kanaan, Gilbody, Ronzi, Hanratty, 2016), depressive symptoms (Cacioppo et al., 2006, 2010), reduced quality of life and well-being (Holt-Lunstad et al., 2015), and a higher risk of early mortality (Elovainio et al., 2017). Loneliness has also been associated with several cognitive measures among older individuals, including lower cognitive function (Shankar et al., 2013), cognitive decline (Donovan et al., 2017; Kuiper et al., 2016; Zhong et al., 2016), cognitive impairment (Lara et al., 2019b), and dementia (Elovainio et al., 2022; Li et al., 2023; Sutin et al., 2020; Wilson et al., 2007). Similarly, more frequent social contact has been associated with better cognitive function in later life: a systematic review and meta-analysis of longitudinal cohort studies showed that social connectedness, such as a large social network and engagement in social activity, is associated with better cognitive outcomes in later life (Evans et al., 2019).

There are several indirect and direct mechanisms through which loneliness could influence cognitive outcomes. Evolutionary and physiological explanations emphasize loneliness as a social stressor (Cacioppo & Cacioppo, 2018) that activates the hypothalamic–pituitary–adrenocortical (HPA) axis and leads to immune dysregulation and inflammation, especially if exposure is chronic (Eisenberger et al., 2017; Smith et al., 2020; Zhong et al., 2017). Moreover, loneliness has been associated with adverse health behaviors (e.g., alcohol use and smoking), fewer health-promoting behaviors (e.g., less physical activity, poor nutrition), and diminished sleep among older people (McLay et al., 2021), which may act as indirect paths linking loneliness with lower cognitive performance. The association between loneliness and cognitive performance might also flow in the other direction: impaired performance in key cognitive domains, such as memory or verbal ability, may hinder the maintenance of social relationships (Lee et al., 2022; Wascher et al., 2018).

Previous longitudinal studies have shown that loneliness is associated with lower cognitive performance. Ayalon et al. (2016) applied cross-lagged models to explore the reciprocal associations of loneliness and memory function in a U.S. sample aged >50 years, finding that poorer memory functioning predicted higher loneliness, but not the other way around, over a 4-year follow-up period. In a multilevel trajectory analysis among a representative sample of people from the United States over the age of 50, people with cognitive impairment experienced higher levels of loneliness, yet there was no evidence that cognitive impairment contributed to the worsening of loneliness over time (Lee et al., 2022). Results from latent variable cross-lagged panel analyses in the Chinese Longitudinal Healthy Longevity Survey (CLHLS) suggested that loneliness has an adverse impact on cognitive functioning but also that cognitive dysfunction may exacerbate loneliness, creating a "vicious cycle" that further damages cognition over time (Zhong et al., 2017). In contrast, using multistate modeling and generalized estimating equations, Wang et al. (2020) reported no association of loneliness with cognitive function changes over a 20-year follow-up in a sample of people from the United Kingdom aged at least 75 years old.

Associations between loneliness and cognitive function may represent both (a) between-person associations in which lonely individuals have poorer cognitive function than nonlonely individuals and (b) within-person associations in which changes in the level of loneliness for the same person over time are observed as changes in cognitive function. Drewelies et al. (2022) explored the between-person and within-person associations between loneliness and perceptual speed among German people aged 60 and older. While loneliness predicted individual differences in perceptual speed (between person), changes in loneliness were not associated with the rate of cognitive decline (within person). Perceptual speed did not predict loneliness. In contrast, results from dual change score models among the English Longitudinal Study of Ageing (ELSA) suggested that greater loneliness at baseline was associated with a more rapid decline in both memory and verbal fluency over a 10-year follow-up, but the within-person change in loneliness was not associated with an accelerated change in cognitive functioning. Better memory at baseline was linked to a slower worsening in loneliness, and the rate of decline in memory and verbal fluency also predicted an acceleration in loneliness over time, providing more consistent evidence of cognition influencing loneliness (Yin et al., 2019).

The diversity of analytical approaches in previous studies may explain to a certain extent the current heterogeneity of results. Furthermore, most of the previous studies have not explicitly separated between- and within-person effects when exploring the associations between loneliness and cognitive health. While between-person associations evaluate what happens at the population level (in this case, whether people who report higher levels of loneliness across time also score lower in different cognitive tests), within-person associations are interested in whether changes in loneliness would produce changes in cognitive functioning. Moreover, between-person associations are more easily affected by confounding factors than within-person associations because the latter are not influenced by any individual differences that stay stable across the multiple measurement times (Hamaker et al., 2015; Rohrer & Murayama, 2023). In this study, we explicitly differentiated between- and within-person associations to clarify our level of analysis and control for potential confounding factors of the within-person associations.

Moreover, loneliness trajectories are likely to vary across life stages. Previous studies reported different levels of prevalence of loneliness across age groups (Luhmann & Hawkley, 2016; Nicolaisen & Thorsen, 2014), with a recent systematic review and meta-analysis stating that older adults report more loneliness than young- and middle-aged adults (Surkalim et al., 2022). This may be explained by the different levels of exposure during the lifespan to age-related stressors that are risk factors for loneliness. For instance, older adults are more likely to suffer from poor health conditions (e.g., reduced mobility) and changes in social relationships (e.g., spousal loss) than younger adults (Hawkley & Kocherginsky, 2018; Yang, 2019). Also, cognitive decline is expected to increase with age (Deary et al., 2009; Ellwardt et al., 2013); thus, it is possible that the associations between loneliness and cognitive function differ by age. Therefore, it is of interest to go one step further and explore whether cognitive decline and loneliness, as they increase with age, are associated with each other at the individual level.

In this study, we explored the temporal direction of the association between loneliness and cognitive function in the aging population using data from the Survey of Health, Ageing and Retirement in Europe (SHARE). We use random intercept cross-lagged panel models (RI-CLPM), which provide information on the reciprocal associations between loneliness and cognitive function at the within-person level, and allow us to explore the directionality after accounting for stable trait-like differences between individuals over time (Hamaker et al., 2015). Thus, we extend previous studies examining the direction of the association, as well as previous studies conducted in SHARE (Luchetti et al., 2020; Vozikaki et al., 2018) to evaluation of the directionality by disentangling between- and within-person associations and including several measures of loneliness and cognitive performance.

In the present study, we use two measures of loneliness: the Three-Item Loneliness Scale (TILS) and a single-item direct question that assesses the frequency of feelings of loneliness. Previous evidence suggests to combine both type of measures (indirect and direct) in order to control for potential response bias (Nicolaisen & Thorsen, 2014; Office for National Statistics, 2018). We evaluate the associations with four measures of cognitive function: verbal fluency, numeracy, immediate recall, and delayed recall. Furthermore, because we hypothesized that the associations between loneliness and cognitive function may differ with age, we conducted the analyses among younger (50–64) and older (65–97) age groups separately. The main objectives were: (a) to determine if there is a lagged association between loneliness and cognitive function and in which direction, and (b) to explore if this association varies with age.

Method

Transparency and Openness

We report how we determined our sample, and describe all data exclusions, manipulations, and all measures in the study. We followed the Journal Article Reporting Standards (JARS) for quantitative research in psychology (Appelbaum et al., 2018). All data, analysis code, and research materials are available at http://www.share-project.org and https://bit.ly/lca_repository. Initial data manipulation was conducted in Stata (Version 17; StataCorp, 2021), and statistical analysis was performed using R (Version 4.1.2; R Core Team, 2021) applying lavaan, Version 0.6–12 (Rosseel, 2012) and semTools, Version 0.5–6 (Jorgensen et al., 2022) packages. This study's design and its analysis were not preregistered.

Participants

SHARE is a panel study for examining the effects of health, social–economic, and environmental policies over the life course. Since 2004, in-depth interviews with 140,000 people from 28 European countries and Israel have been conducted. The SHARE target population consists of people aged 50 years and older at the time of sampling who have their regular domicile in the respective SHARE country (people are excluded if they are incarcerated, hospitalized, out of the country during the entire survey period, or unable to speak the country's languages). The survey uses probability-based sampling to recruit age-eligible participants, and it is conducted every 2 years. Since Wave 2, one age-eligible person per household is included, plus their partners regardless of age (Bergmann et al., 2019; Börsch-Supan et al., 2013).

To date, SHARE consists of eight study waves. In this study, we used data from Waves 5 (2013), 6 (2015), 7 (2017), and 8 (2019/2020; Börsch-Supan, 2022a, 2022b, 2022c, 2022d). In order to focus on older adults (the target population of SHARE), we included participants aged 50 years or older at the baseline.

Wave 7 contains SHARELIFE modules (a questionnaire focused on people's life stories) for all participants who did not participate in the SHARELIFE modules in Wave 3, while participants who had already completed the SHARELIFE modules in the past completed the standard questionaries. As a result, there is a large amount of missing data on loneliness and cognitive function in Wave 7 (Mehrbrodt et al., 2019). To maximize the number of participants in our analysis, we combined data from Waves 7 and 8. For participants with missing values in Wave 7, we used data from Wave 8 when this was available. If the participant had valid data for both waves, values from Wave 7 were used for the analyses.

In SHARE, there are fluctuations in the number of countries involved in each study phase, as some countries did not participate in certain SHARE waves. We only included participants from countries that were covered in Wave 5 of SHARE. Of these 116,408 initially eligible participants, we excluded 25,587 participants that were younger than 50 years old at the baseline. Of the 90,821 people remaining, we excluded 35,159 participants who did not have complete data on loneliness measures, cognitive function, confounders, and effect modifiers (retirement status) measured in Wave 5. The final sample thus consisted of 55,662 people, of whom 26,040 (56% women) were younger than 65 years old at baseline and 29,622 (53,5% women) were 65 years or older.

SHARE is reviewed and approved by the Ethics Committee of the University of Mannheim and the Ethics Council of the Max Planck Society. More information on the assessment, sampling, and scales can be found at http://www.share-project.org.

Measures

Loneliness

In the primary analyses, loneliness was measured with the TILS, a short version of the Revised University of California, Los Angeles Loneliness Scale developed specifically for use as a telephone survey (Hughes et al., 2004). It asks respondents to rate feelings of lack of companionship, feeling left out, and feeling isolated from others on a 3-point Likert scale (*often*, *some of the time*, *hardly ever or never*). These responses were summed together, resulting in a final score ranging from 3 (*not lonely*) to 9 (*very lonely*). The scale showed an acceptable level of internal consistency (Cronbach's $\alpha = 0.76$). As secondary analyses, we assessed loneliness using a direct one-item question: "How much of the time do you feel lonely?" This question was answered on the same 3-point Likert scale (*often*, *some of the time*, *hardly ever or never*), resulting in a score that ranged from 0 (*never*) to 2 (*often*).

Cognitive Function

We used four different measures of cognitive function: verbal fluency, numeracy, immediate recall, and delayed recall.

Verbal fluency is a test of executive function. For this test, the respondents needed to name as many words as possible from the semantic category "animals" in 60 s (Ardila et al., 2006). The final score equals the total number of correct words named (0–100). Following previous studies, we recorded scores >45 as 45 (Litwin et al., 2017).

Numeracy was measured as the participant's mathematical performance in a subtraction task. The participant was first asked "One hundred minus seven equals what?" They were then asked to subtract seven from the previous result four more times. The resulting score ranged from 0 to 5, corresponding to the number of correct answers.

Immediate recall and delayed recall were evaluated with the 10-word recall test. The test used in SHARE is based on the Telephone Interview of Cognitive Status–Modified (TICS-M; Brandt et al., 1988). In this test, the respondent listened to a list of 10 words once and was asked to recall the list 2 times, once immediately after the encoding phase (immediate recall) and once after a delay time (delayed recall). Different lists were assigned randomly to the respondents. The total scores of these two tests ranged from 0 to 10, corresponding to the number of words the respondent was able to recall correctly.

Potential Confounders/Effect Modifiers

We adjusted for several potential confounders with known or hypothesized associations with both loneliness and cognitive function (Ellwardt et al., 2013; Shankar et al., 2013; Surkalim et al., 2022; Van As et al., 2022; Victor et al., 2000). These confounders were age, sex, geographical area, educational level, partner in the household, depression symptoms, and chronic disease diagnoses recorded at baseline (Wave 5).

Age and sex were self-reported. The age-stratified analyses were conducted in two age groups: younger (50–64 years old) and older (65–97 years old) at baseline. Continuous age (in years, at baseline) was included as a confounder in the analyses. Sex was coded as 0 for male and 1 for female.

Geographical area was recorded as a part of the data collection. Our sample included participants from 14 European countries and Israel. These were classified as (a) Northern Europe (Sweden and Denmark), (b) Western Europe (Austria, Germany, France, Switzerland, Belgium, Luxembourg, and the Netherlands), (c) Eastern Europe (Czech Republic, Slovenia, and Estonia), (d) Southern Europe (Spain and Italy), and (e) Israel. Four dummy variables for "geographical area" were included in the adjusted analyses to control for potential differences between these areas.

Educational attainment was self-reported and coded following the International Standard Classification of Education (ISCED; revised version of ISCED-97): preprimary education (0), primary education (1), lower secondary education (2), upper secondary education (3), postsecondary nontertiary education (4), the first stage of tertiary education (5), and the second stage of tertiary education (6; United Nations Educational, Scientific and Cultural Organization, 2006).

Partnership status was measured as the self-reported presence of a partner in the household, coded as 0 if the participant cohabited with a partner and 1 if they did not.

Depressive symptoms were self-reported with the 12-item EURO-D scale (Prince et al., 1999), which includes 12 dichotomous (yes/no) items measuring sad/depressed mood, pessimism, suicidality, guilt, sleep problems, diminished interest, irritability, changes in appetite, fatigue, concentration problems, lack of enjoyment, and tearfulness during the past month. The EURO-D sum score ranged from 0 to 12, greater scores indicating a greater number of depressive symptoms, and was included as a continuous variable in our sample.

The number of chronic diseases was measured as a count of self-reported diagnoses (ever/never) of diabetes, high blood pressure, stroke, heart attack, cancer diagnosis, and chronic lung disease, thus ranging from 0 to 6.

Retirement status was used for the additional sensitivity analyses and refers to the persons' retirement status at the study baseline. Retirement status was coded 0 if the person was employed (including self-employed), unemployed, or homemaker, and 1 if the person was retired from work or permanently sick or disabled.

Statistical Analysis

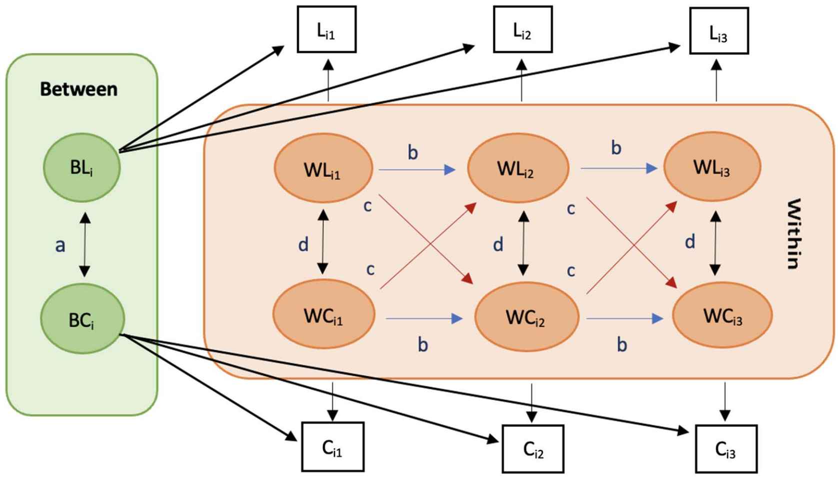
To investigate the bidirectional lagged association between loneliness and cognitive function, we applied the RI-CLPM modeling strategy proposed by Mulder and Hamaker (2021). Figure 1 represents the basic structure and components of the RI-CLPM. The RI-CLPM is an extension of the cross-lagged panel model (CLPM) that aims to account for stable, trait-like differences between individuals, so that the lagged effects obtained refer exclusively to within-person effects (Mulder & Hamaker, 2021). This is done by separating the within-person level from the between-person level by adding a random intercept that captures trait-like individual differences. The RI-CLPMs were conducted using structural equation modeling (SEM) and maximum likelihood estimation.

In the RI-CLPMs, autoregressive paths indicate to what extent prior differences from the participants' expected scores in loneliness and cognitive function predicted their within-person deviations in loneliness and cognitive function scores in the next wave. The cross-lagged paths reflect to what extent loneliness and cognitive function are linked bidirectionally and whether deviations from expected scores in loneliness predict deviations from expected scores in cognitive function (and vice versa) at each subsequent study wave (Hamaker et al., 2015; Mund et al., 2021). This allows us to study the directionality of the association by comparing the standardized cross-lagged parameters and their statistical significance in each direction (from levels of loneliness to levels of cognitive function in the next wave and vice versa).

The RI-CLPM requires data from at least three measurement points. We included participants with complete data in Wave 5 and handled missing values in the next waves by using full information maximum likelihood (FIML) estimation in our main analyses. Furthermore, we conducted additional analyses for the adjusted models using multiple imputation by chained equations (MICE) to deal with incomplete data following a procedure described previously (Sorjonen et al., 2023). All variables included in our models (loneliness, cognitive measures, retirement status, and confounders) were used in the imputation.

Following the procedure suggested by Mulder and Hamaker (2021), we first compared the fit of models with constrained versus unconstrained (all the parameters are freely estimated) regression coefficients to determine whether the lagged regression coefficients were time invariant. These comparisons were conducted with chi-square difference tests ($\Delta\chi^2$). Second, we compared the fit of models with the grand means constrained to be invariant over time with the unconstrained model to explore if our constructs—loneliness and

Figure 1
Graphic Representation of a Three-Wave RI-CLPM



Note. (a) covariance between stable traits of loneliness (BL_i) and cognitive function (BC_i) at the between-person level; (b) autoregressive paths between within-person levels of loneliness or cognitive function between waves (e.g., WL_{i1}-WL_{i2}); (c) cross-lagged paths between within-person levels of loneliness and within-person levels of cognitive function in the next wave (e.g., WL_{i1}-WC_{i2}) or vice versa (e.g., WC_{i1}-WL_{i2}); (d) cross-sectional paths between within-person levels of loneliness and cognitive function at each wave (e.g., WL_{i1}-WC_{i1}) (Mulder & Hamaker, 2021; Narmandakh et al., 2020). RI-CLPM = random intercept cross-lagged panel model. See the online article for the color version of this figure.

the cognitive function outcomes—remained stable at the population level over the follow-up (Mulder & Hamaker, 2021).

Next, we assessed the potential age differences in the associations between loneliness and the cognitive function measures. A dummy variable for age was created for this analysis, distinguishing two age groups: participants aged 50–64 versus ≥65. We compared the fit of a multiple group version of the RI-CLPM with no constrains among the groups with a model where the lagged regression coefficients were constrained to be the same in both age groups (Mulder & Hamaker, 2021).

The final analyses were conducted separately for the two age groups using fully constrained models in both groups. In the constrained models, the lagged parameters (autoregressive and cross-lagged effects), grand means, covariances between the residuals of the within-person measurements, and residual variances of the within-person measurements were constrained to be the same across time. We first ran the RI-CLPM models without adjustments and then adjusted for confounders by including them as time-invariant predictors of the random intercepts (Mulder & Hamaker, 2021).

Finally, we conducted additional sensitivity analyses exploring the potential moderation effect by retirement status in the associations between loneliness and cognitive performance. We conducted multiple group comparisons stratifying the sample by retirement status among both age groups separately.

All RI-CLPMs were conducted separately for the four indicators of cognitive function. To evaluate whether the findings were consistent across different measurement tools for loneliness, we conducted separate analyses using both the TILS and the one-item scale.

Model fit was evaluated using the comparative fit index (CFI), the Tucker–Lewis index (TLI), the root-mean-square error of approximation (RMSEA), and the standardized root-mean-square residual (SRMR). A good model–data fit is indicated if CFI > 0.95, TLI > 0.95, RMSEA < 0.06, and SRMR < 0.08 (Hu & Bentler, 1999; Xia & Yang, 2019). Due to the large sample size, associations with a p value of < .01 were considered statistically significant in the RI-CLPMs.

Data analyses were conducted in R (Version 4.1.2) using lavaan (Rosseel, 2012) and semTools (Jorgensen et al., 2022) packages. The R code to reproduce the main analysis can be found at https://bit.ly/lca_repository.

Results

Table 1 presents the baseline characteristics of the 55,662 participants included in the final sample. There were 26,040 people (56% women) with an age mean of 58.0 (*SD*: 4.0) in the younger group (50–64 years old) and 29,662 people (53.5% women) with an age mean of 73.6 (*SD*: 6.6) in the older group (65–97 years old). Overall, 89.8% of the participants reported lower levels of loneliness on the TILS (scores of 3, 4, or 5), and 78.6% of the sample reported never feeling lonely when asked directly with the one-item measure. The older group had lower scores in all cognitive function tests.

For the whole sample, the chi-square difference test comparisons show that, overall, the RI-CLPMs models had a better fit when they were unconstrained. This indicates that levels of loneliness and cognitive function and the dynamics of their association are likely to vary over time. However, the fit indexes remained satisfactory for the fully constrained models, so we used the constrained models in our main analysis, as this allowed us to maximize our statistical power.

Table 1
Characteristics of the Final Sample (N = 55,662)

Variable	50–64 (*N* = 26,040)	>64 (*N* = 29,622)	Total (*N* = 55,662)
Sex			
Man	11,464 (44.0%)	13,780 (46.5%)	25,244 (45.4%)
Woman	14,576 (56.0%)	15,842 (53.5%)	30,418 (54.6%)
Age			
M (*SD*)	58.0 (3.96)	73.6 (6.61)	66.3 (9.56)
Mdn (min, max)	58.0 [50.0, 64.0]	72.0 [65.0, 103]	65.0 [50.0, 103]
Partner			
Partner in household	20,952 (80.5%)	20,522 (69.3%)	41,474 (74.5%)
No partner in household	5,088 (19.5%)	9,100 (30.7%)	14,188 (25.5%)
Country			
Western Europe	12,646 (48.6%)	13,319 (45.0%)	25,965 (46.6%)
Eastern Europe	5,334 (20.5%)	6,765 (22.8%)	12,099 (21.7%)
Southern Europe	3,814 (14.6%)	4,238 (14.3%)	8,052 (14.5%)
Northern Europe	3,458 (13.3%)	4,385 (14.8%)	7,843 (14.1%)
Israel	788 (3.0%)	915 (3.1%)	1,703 (3.1%)
Education			
Preprimary	546 (2.1%)	1,047 (3.5%)	1,593 (2.9%)
Primary	2,144 (8.2%)	5,937 (20.0%)	8,081 (14.5%)
Lower secondary	4,638 (17.8%)	5,542 (18.7%)	10,180 (18.3%)
Upper secondary	10,080 (38.7%)	9,265 (31.3%)	19,345 (34.8%)
Postsecondary	1,262 (4.8%)	1,375 (4.6%)	2,637 (4.7%)
First stage of tertiary	7,113 (27.3%)	6,163 (20.8%)	13,276 (23.9%)
Second stage of tertiary	257 (1.0%)	293 (1.0%)	550 (1.0%)
Employment status			
Employed/seeking for a job	18,932 (72.7%)	3,452 (11.7%)	22,384 (40.2%)
Retired/permanent sick leave	7,108 (27.3%)	26,170 (88.3%)	33,278 (59.8%)
Number of chronic diseases			
M (*SD*)	0.580 (0.794)	1.04 (0.957)	0.826 (0.914)
Mdn (min, max)	0 [0, 6.00]	1.00 [0, 6.00]	1.00 [0, 6.00]
Depression			
M (*SD*)	2.15 (2.09)	2.33 (2.15)	2.24 (2.12)
Mdn (min, max)	2.00 [0, 12.0]	2.00 [0, 12.0]	2.00 [0, 12.0]
Loneliness (three item)			
Not lonely (3)	17,313 (66.5%)	18,099 (61.1%)	35,412 (63.6%)
4	4,336 (16.7%)	5,322 (18.0%)	9,658 (17.4%)
5	2,121 (8.1%)	2,794 (9.4%)	4,915 (8.8%)
6	1,220 (4.7%)	1,814 (6.1%)	3,034 (5.5%)
7	526 (2.0%)	819 (2.8%)	1,345 (2.4%)
8	252 (1.0%)	342 (1.2%)	594 (1.1%)
Very lonely (9)	272 (1.0%)	432 (1.5%)	704 (1.3%)
Loneliness (one item)			
Never	21,096 (81.0%)	22,639 (76.4%)	43,735 (78.6%)
Some of the time	3,871 (14.9%)	5,200 (17.6%)	9,071 (16.3%)
Often	1,073 (4.1%)	1,783 (6.0%)	2,856 (5.1%)
Immediate recall			
M (*SD*)	5.96 (1.58)	5.07 (1.70)	5.49 (1.70)
Mdn (min, max)	6.00 [0, 10.0]	5.00 [0, 10.0]	6.00 [0, 10.0]
Delayed recall			
M (*SD*)	4.77 (2.00)	3.60 (2.09)	4.15 (2.13)
Mdn (min, max)	5.00 [0, 10.0]	4.00 [0, 10.0]	4.00 [0, 10.0]
Numeracy			
M (*SD*)	4.17 (1.51)	3.88 (1.68)	4.01 (1.61)
Mdn (min, max)	5.00 [0, 5.00]	5.00 [0, 5.00]	5.00 [0, 5.00]
Fluency			
M (*SD*)	23.0 (7.18)	19.7 (6.99)	21.3 (7.27)
Mdn (min, max)	23.0 [0, 45.0]	19.0 [0, 45.0]	21.0 [0, 45.0]

Note. The SHARE has not been collecting data on participants racial identity or ethnicity. SHARE = Survey of Health, Ageing and Retirement in Europe; *Mdn* = median; min = minimum; max = maximum.

We found evidence for a moderation/interaction effect of age in the associations between loneliness and cognitive performance. At the multiple group RI-CLPM comparisons, the constraints were not tenable for four out of the eight models (Two Loneliness Measures × Four Cognitive Function Measures) in the chi-square difference test ($p < .05$). Thus, we decided to run all the subsequent models stratified by age to explore potential differences.

For the unadjusted models, values of the CFI and TLI were always >0.95. Values of RMSEA were <0.055 for all the models, and the SRMR was always <0.04. All model fit indexes for the unadjusted models can be found in Supplemental Table S1.

At the between-person level, there was always a significant negative association between loneliness and all cognitive scores regardless of age in the unadjusted models. All the between-person effects (unadjusted and adjusted) are described in Table S2. At the within-person level, the autoregressive parameters of loneliness and cognitive function were significant and positive, except for numeracy among both age groups and immediate recall among the younger group ($p > .01$). In terms of the cross-lagged associations, we found relatively large differences between age groups. While the associations between loneliness and cognitive function were never significant among the younger group (50–64 years), we consistently observed lagged associations between higher levels of loneliness and lower cognitive function among those aged ≥65. The lagged parameters and confidence intervals of the unadjusted models are shown in Supplemental Table S3 (unstandardized values).

In the fully adjusted models (adjusted for age, sex, country, educational level, partnership status, chronic diseases, and depression symptoms at baseline), the fit indexes remained good, except for TLI in the case of three-item loneliness and numeracy among the younger group (TLI = 0.946) and immediate recall among the older group (TLI = 0.945). All model fit indexes can be found in Supplemental Material for the fully adjusted models (Table S4). Lagged parameters and confidence intervals of the adjusted models are described in the Supplemental Table S5 for both age groups. Graphical representation of the RI-CLPMs when measuring loneliness with the three-item scale is shown in Figure 2 for both age groups.

At the between-person level, the associations remained significant and negative after adjustments among the younger subsample in seven out of eight models, but became nonsignificant among the older subsample. At the within-person level, the same patterns as in the unadjusted models remained. Again, most of the autoregressive parameters of loneliness and cognitive function were significant and positive in the adjusted models, except for numeracy among the older group ($p > .01$) and immediate recall among the younger group ($p > .01$).

In terms of the cross-lagged associations, we found the same differences between age groups after adjusting for confounders. While the associations between loneliness and cognitive function were never significant among the younger group (50–64 years), we consistently observed lagged associations between higher levels of loneliness and lower cognitive function among those aged >64. In the older group, when using the three-item measure of loneliness, there was a bidirectional lagged association between loneliness and verbal fluency (standardized $\beta = -0.035$; $p \leq .001$ and $\beta = -0.043$; $p \leq .001$) and unidirectional (loneliness predicting lower scores in later cognitive function) in the case of numeracy ($\beta = 0.000$; $p = .972$ and $\beta = -0.033$; $p = .003$) and immediate recall ($\beta = -0.006$; $p = .526$ and $\beta = -0.033$; $p \leq .001$). The association with delayed recall was not significant in the fully adjusted model. With the one-item loneliness measure, the adjusted association was again bidirectional between loneliness and verbal fluency ($\beta = -0.026$; $p = .009$ and $\beta = -0.033$; $p \leq .001$), and unidirectional in the case of immediate recall ($\beta = -0.013$; $p = .162$ and $\beta = -0.041$; $p \leq .001$) and delayed recall ($\beta = -0.019$; $p = .036$ and $\beta = -0.025$; $p = .003$). The relationship was not significant in the case of numeracy and one-item loneliness in the older age group. To facilitate the comparison between models (unadjusted vs. adjusted, and three-item vs. one-item loneliness) we have plotted the cross-lagged estimates in Supplemental Figures S1–S4.

Results from the adjusted models after multiple imputation by chained equations are shown in Supplemental Tables S6 and S7. Compared to the primary fully adjusted analyses, we observed a similar pattern of results among the younger group. Among the older group, the only differences were a unidirectional (instead of bidirectional) association between scores in the one-item loneliness scale and verbal fluency, and a bidirectional association (instead of unidirectional) in the case of delayed recall.

We ran additional sensitivity analyses to explore if the differences we observed between age groups could be explained by differences in retirement status, as the amount of people that was retired from work at the baseline was very different between age groups (27.3% in the younger subsample and 88.3% in the older subsample).

We compared a multiple group version of the RI-CLPM stratified by retirement status with no constraints across the groups with a model that constrains lagged regression coefficients to be same across groups in the two age groups separately. We found some evidence for a moderation effect among the younger subsample (the constraints were not tenable for the four models using the TILS), but not among the older subsample (all multiple group RI-CLPM chi-squared comparisons were not significant, indicating that the constraint was tenable).

However, in analyses stratified by retirement status among the younger age group, there was no significant lagged association ($p > .01$) between levels of loneliness and cognitive performance among participants who were retired or on a permanent sick leave ($n = 7{,}108$), nor among participants who were still working ($n = 18{,}932$).

Discussion

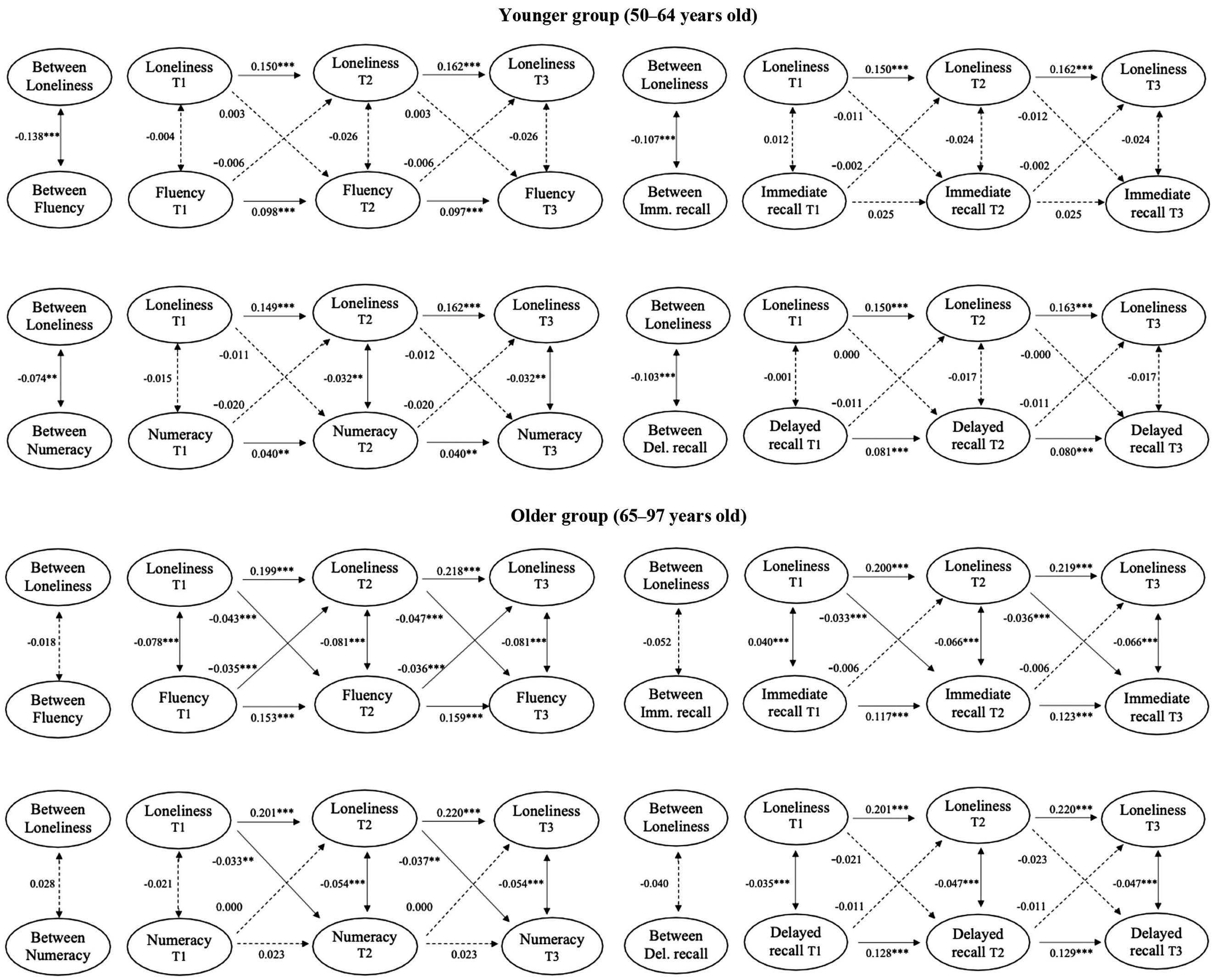
We assessed the bidirectional associations between loneliness and cognitive function in a cross-national sample of 55,622 people aged 50 or older who were evaluated repeatedly over a 7-year follow-up. Among participants aged 65 or older, the direction of the association at the within-person level was mostly from loneliness to later cognitive function: higher levels of loneliness predicted lower cognitive function across different cognitive domains, although we also found a bidirectional association between verbal fluency and later loneliness. In contrast, loneliness did not predict later cognitive function, or vice versa, among people between 50 and 64 years.

The between-person associations indicated that those who reported higher loneliness also scored lower in the cognitive functioning tests. These associations were confounded by factors such as poorer health status (chronic diseases and depressive symptoms) or living alone (partnership status), so that the fully adjusted associations were no longer significant in the older age group (65–97 years) and were attenuated in the younger age group.

Previous studies have reported conflicting findings regarding the direction of the association between loneliness and cognitive function. While many previous prospective studies reported bidirectional associations between loneliness and different cognitive outcomes (Donovan et al., 2017; Shankar et al., 2013; Yin et al., 2019; Zhong et al., 2017), Ayalon et al. (2016) found that lower levels of memory functioning predicted higher loneliness 4 years later—but not the other way around. In their study, Ayalon et al. (2016) used

Figure 2

Bidirectional Association Between Loneliness (Three Items) and Four Measures of Cognitive Function Among the Younger Group (50–64 Years Old) and the Older Group (65–97 Years Old)



Note. Statistically significant lines are solid, whereas nonsignificant lines are dotted. Imm. = immediate; Del. = delayed.
** $p \leq .01$. *** $p \leq .001$.

a cross-lagged panel model that did not account for differences between individuals (i.e., did not include a random intercept; Hamaker et al., 2015; Mund et al., 2021). In our study, when utilizing the RI-CLPM technique to evaluate the directionality in a large representative European cohort at the within-person level, we observed that the direction of the association was predominantly from loneliness to cognitive function, although this finding was only observed among participants ≥65 years old. Our findings among people aged 65 or older are in line with previous studies reporting associations of loneliness with lower cognitive function (Boss et al., 2015; Kuiper et al., 2016; Lara et al., 2019a) and provide support for the hypothesis that loneliness is a modifiable risk factor of lower cognitive function among older adults.

Moreover, we hypothesized that retirement might be one factor explaining the age differences, given that work is often a source of cognitive stimulation and social contacts (Kivimäki et al., 2021), and social relationships might then become more important in terms of cognitive stimulation after retirement. However, we observed no consistent evidence for effect modification by retirement status in our study. The associations between loneliness and cognitive performance remained nonsignificant in analyses stratified by retirement status in the younger age group, and there was no effect modification in the older group.

Acceleration of cognitive decline may be another possible explanation for the age difference (Murman, 2015). Normal cognitive aging can be accelerated by environmental and psychosocial risk factors (Harada et al., 2013; Qualter et al., 2015), and the relative lack of cognitive decline in the younger age group would be in line with this explanation. The accumulation of risk factors with age might explain why loneliness becomes more detrimental for cognitive health later in life, as social contacts may start playing a bigger role in maintaining cognitive abilities when cognitive decline starts to accelerate.

The subjective nature of loneliness makes it challenging to assess. Many different approaches have been used, from multi–item scales that evaluate emotions associated with loneliness (indirect measures; e.g., University of California, Los Angeles Loneliness Scale) to single-item measures that directly ask how often people feel lonely (direct measures; Valtorta, Kanaan, Gilbody, Hanratty, 2016). Previous studies have suggested that these measures work differently for people of different ages and backgrounds, probably because some groups are more reluctant than others to report feelings of loneliness (Nicolaisen & Thorsen, 2014). In our study, the findings were similar using both indirect (TILS) and direct measures of loneliness ("How much of the time do you feel lonely?"). Both types of measures are not exclusive but complementary, and the similar results we observed with both direct and indirect measures of loneliness add to the robustness of our findings.

Still, questions remain about how long loneliness should last until it starts being detrimental to health. According to theoretical approaches, it would be expected that loneliness starts damaging cognitive health when it becomes chronic due to the dysregulation of the HPA, immune dysfunction, and inflammatory processes (Cacioppo et al., 2002, 2015). In line with this, Li et al. (2023) found that among different late-life trajectories of loneliness over an 8-year period, long-term high loneliness showed the strongest correlation with incident dementia. In another study, people experiencing chronic loneliness were at a higher risk of presenting major depression at the follow-up than those presenting transient loneliness (Martín-María et al., 2021). However, Zhong et al. (2016) found that both transient and chronic loneliness were associated with cognitive decline, although the associations of chronic loneliness were greater.

Moreover, people experiencing chronic loneliness may be more likely to engage in adverse health behaviors (e.g., alcohol use and smoking) or fewer health-promoting behaviors (e.g., less physical activity, poor nutrition; Lauder et al., 2006; Leigh-Hunt et al., 2017), for instance, which in turn are associated with cognitive outcomes (Sabia et al., 2009; Zaninotto et al., 2018). These represent potential indirect paths through which loneliness may affect cognitive functioning (Cacioppo & Cacioppo, 2014; Freak-Poli et al., 2022; McHugh Power et al., 2020). Further research is needed to evaluate the potential role of these pathways in explaining our findings.

The main strengths of our study include a large cross-national longitudinal data set combined with a statistical approach that allowed us to study the bidirectional associations between loneliness and cognitive decline while accounting for stable, trait-like differences between individuals. We assessed cognitive function using four different well-established indicators in older populations (Mehrbrodt et al., 2019), and used direct and indirect measures of loneliness.

On the other hand, this study has some limitations. First, our sample included participants with data from three study waves taking place over 7 years. Like in any longitudinal cohort study, loss to follow-up is inevitable. Although we used full information maximum likelihood estimation to deal with missing values and obtained similar results after multiple imputation by chained equations, it is possible that selective attrition caused bias in our findings. Second, considering that our constructs of interest and the relationship between them seem to vary over time, the use of an unconstrained RI-CLPM could have been more appropriate. However, we opted for a constrained version of the RI-CLPM because this helped us maximize our statistical power, and the resulting model fit indexes remained satisfactory. Moreover, despite the inclusion of the random intercept, the RI-CLPM has limited potential to explore causal dynamics as it does not allow inference of potential causes that explain differences between people (Lüdtke & Robitzsch, 2021), and we cannot rule out the potential effect of time-varying factors affecting our results (Rohrer & Murayama, 2023). Future studies applying different longitudinal approaches would help shine light on the underlying causal associations (Lüdtke & Robitzsch, 2021; Usami et al., 2019). We evaluated age differences in the associations between loneliness and cognitive function using a cutoff at 65 years. Although age 65 marks the beginning of a new developmental stage and can thus be considered reasonable, any cutoff point is artificial to some extent and involves the risk of measurement error, especially in cross-national samples such as SHARE. Finally, previous studies have shown that the prevalence of loneliness varies between countries (e.g., Surkalim et al., 2022). Future studies are needed to explore potential differences in the associations between loneliness and cognitive functioning across different geographical areas.

Conclusion

We found that feelings of loneliness predicted lower cognitive functioning among those aged 65 or older in a large cross-national European sample. Our findings support previous evidence suggesting that loneliness is a psychosocial risk factor for cognitive function among older people. Loneliness is not an inevitable consequence of getting old (Bound-Alberti, 2019), and maintaining and forming social contacts can be important in terms of cognitive health. Further studies are needed to understand how loneliness could be affecting cognitive functioning differently depending on other factors, such as educational level, socioeconomic position, or cultural values. Moreover, studies focusing on the differential effects of transient and chronic loneliness could help in understanding the mechanisms through which loneliness affects health. Altogether, they would help to comprehend the phenomenon more in-depth and enable the development of more efficient prevention and intervention campaigns.

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