

RESEARCH ARTICLE

The bi-directional association between loneliness and depression among older adults from before to during the COVID-19 pandemic

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Abstract

Background: Older adults have both the highest risk of contracting SARS-CoV-2 and in many jurisdictions have had additional restrictions placed on the social interactions. As a result, the COVID-19 pandemic has led to increased depression and loneliness among older adults. Using data from an established cohort of older adults, the aims of this study was to describe changes in loneliness and depression and to examine the directionality of the association between depression and loneliness over a 5-year period that included the early months of the pandemic.

Methods: Data were from The Irish Longitudinal Study on Ageing (TILDA), a large cohort of community-dwelling adults aged 54+. We applied an auto-regressive cross-lagged panel modelling approach to estimate the effect of depression on loneliness and vice versa over three time points.

Results: Both depression and loneliness increased significantly in the early months of the pandemic. While the association between loneliness and depression was bi-directional, loneliness was a stronger predictor of depression.

Conclusion: The strength and bi-directionality of the association between loneliness and depression suggests that interventions to alleviate loneliness may also help reduce depressive symptoms and vice versa.

KEYWORDS

ageing, COVID-19, depression, loneliness, older adults

Key points

- Loneliness and depressive symptomology among older adults increased during the COVID-19 pandemic.
- The association between loneliness and depression was bi-directional.
- Interventions to alleviate loneliness or depression may also reduce the other.

1 | INTRODUCTION

The effect of the COVID-19 pandemic on older people has been twofold. Firstly, they are at an increased risk from infection whereby if they do contract SARS-CoV-2, older people are more likely to become unwell, to require hospitalisation, and ultimately to die from the virus.¹ Secondly, in many jurisdictions, including Ireland, at-risk groups and older adults have been disproportionately affected by restrictions placed on social contacts. These measures have led to concerns about increased loneliness^{2,3} and deteriorating mental health.⁴

'Shielding' or 'cocooning' at home and reduced face-to-face contacts to prevent transmission of SARS-CoV-2, has been advised at various times during the pandemic, particularly for older and other at-risk groups. In Ireland, people aged ≥ 70 years were directed to stay indoors, have groceries and medicines delivered, and avoid contact with friends and family in order to minimise the spread of the virus among this high-risk group, and consequently delay peaks in case numbers and relieve pressure on health services.⁵ The sudden and dramatic impact of the pandemic on people's lives constitutes a stressful event that has been implicated in increased psychological distress,⁴ declining self-reported mental health,⁵ and increased depression and loneliness.^{2,3,6–11}

Loneliness refers to the subjective assessment of an individual's satisfaction with the quality of their social relationships and is typically considered the psychological embodiment of social isolation.^{12,13} Loneliness has been shown to be harmful to both physical and psychological wellbeing.^{14–17} Indeed, a recent meta-analysis by Holt-Lunstad et al. reported that the risk of mortality associated with loneliness was comparable to that of established risk factors, including smoking.¹⁸ Concern about the negative impact of loneliness on older adults has heightened since the onset of the COVID-19 pandemic as public health responses to the pandemic have greatly curtailed opportunities for social interactions. The negative impacts of the subsequent reduced social interactions on the physical and psychological well-being of older adults are not yet understood but are likely to be dramatic and potentially long lasting.

The association between loneliness and depression is well established and both physiological and psychological mechanisms have been proposed to explain this association.^{19,20} While theoretically there is some overlap between loneliness and depression, empirically they are distinct constructs and only moderately correlated.²¹ However, in practice loneliness is oftentimes considered a symptom of depression in its own right, including in the Center for Epidemiological Studies Depression (CES-D) measurement tool used in our analysis.²² Contrary to this, cognitive discrepancy theory holds that depression may lead to a greater feeling of loneliness via cognitive influences that result in individuals evaluating the quality of their social relationships and interactions more negatively.^{14,23} Other possible explanations of the association between depression and loneliness that has been observed among older adults include the interpersonal theory of depression²⁴ and the stress-generation theory.²⁵ Both of these theories describe how depression can damage

relationships via inter-personal conflict thereby reducing the quality of relationships leading to increased loneliness.⁹

The fundamental difference between many of these competing explanations is the hypothesised directionality of the association between loneliness and depression. Some studies have examined the potentially reciprocal nature of the association but results have been inconsistent.^{9,12,21,26–30} Using a cross-lagged panel design, Cacioppo et al. (2010) found that loneliness predicted changes in depressive symptomatology but that depression did not predict future loneliness.¹⁹ On the other hand, a study conducted by Groarke et al. (2020) during the early months of the pandemic and over a far shorter period of time (4 months compared to 5 years) found a bi-directional association between depression and loneliness.⁹

The current study adds to the limited literature on the potential bi-directional nature of the association between loneliness and depression, and importantly, does so with data collected from a large cohort of older adults before and during the COVID-19 pandemic. Our analyses had three aims. Firstly, we describe changes in both depression and loneliness from before to during the COVID-19 pandemic among older adults. Secondly, we estimated the strength of the association between depression and loneliness across time, and thirdly, using a cross-lagged panel design with three time points over a 5-year timeframe, we examined the potential bi-directionality of this association.

2 | METHODS

Our analyses included three waves of data collected as part of The Irish Longitudinal Study on Ageing (TILDA). TILDA is a prospective nationally representative study of community-dwelling adults aged 50 years and older in the Republic of Ireland. Details of the methodologies used by TILDA are described elsewhere.^{31–34} At baseline, participants were selected using multi-stage stratified random sampling whereby 640 geographical areas, stratified by socioeconomic characteristics, were initially selected. Forty households were then randomly selected within each of these areas. The Irish GeoDirectory listing of all residential addresses provided the sampling frame. The first wave of data collection was conducted between 2009 and 2011. At Wave 1, 8175 Computer Assisted Personal Interviews (CAPIs) were completed with a response rate of 62%. Eighty five percent ($n = 6915$) of these respondents also returned Self-Completion Questionnaires (SCQs). At each round of data collection, the CESD-8 depression scale²² was completed as part of the CAPI while the UCLA loneliness scale³⁵ was included in the SCQ. In the current analyses, we included three waves of data. Wave 4 was collected in 2016, wave 5 in 2018 and a special COVID-19 SCQ between July and November 2020. Details of the sample maintenance strategies used by TILDA are also reported elsewhere³¹ and the study protocol for the TILDA COVID-19 is also available elsewhere.³⁶ The COVID-19 study included 3964 participants which represented a response rate of 72%.

2.1 | Outcome variable

Depression was measured at each wave using a revised version of the short-form Center for Epidemiological Studies Depression (CES-D8) scale. This validated scale measures the frequency that respondents have experienced a variety of depressive symptoms within the past week, with higher scores indicating increased depressive symptomatology.^{22,37,38} As the UCLA loneliness scale was our key independent variable, we excluded the CES-D item that asked whether a respondent 'felt lonely'.^{13,19} The resulting scores ranged from 0 to 21 with higher scores indicating more depressive symptoms. This 7-item version of the CES-D scale had good reliability at each wave—wave 4: $\alpha = 0.94$, wave 5: $\alpha = 0.97$, wave 6: $\alpha = 0.75$. These Cronbach's Alphas were comparable to the alphas for the 8-item version of the CES-D scale which were 0.91, 0.97, and 0.78.

2.2 | Independent variable

Loneliness was measured at each wave using the five-item version of the University of California Los Angeles (UCLA) Loneliness scale.³⁵ This measurement tool consists of five items: how often do you feel you lack companionship?; how often do you feel left out?; how often do you feel isolated from others?; how often do you feel in tune with the people around you?; how often do you feel lonely? Each question has three response options (hardly ever or never = 0, some of the time = 1, often = 2). Responses to the five items were summed, resulting in an overall score ranging from 0 (not lonely) to 10 (extremely lonely).

2.3 | Covariates

The adjusted models controlled for gender, age in years, and whether participants lived alone or with others. While Groarke et al. (2021) found that both loneliness and depression were stable over the first 4 months of the pandemic others have reported that loneliness may have varied over time as people adapted to the pandemic and in response to changes in the levels of restrictions imposed on populations.³⁹ To account for the fact that the experience of the pandemic may have changed over time, we further controlled for the timing that survey questionnaires were returned. To do this, we added a further control variable in the COVID-19 wave regression paths thereby adjusting the estimates for depression and loneliness during COVID-19 (the third time point). As a large proportion of the questionnaires (40%) were returned by participants within 4 weeks, a dichotomous variable was created to capture whether questionnaires were returned before or after the 1 August 2020. Finally, we controlled for the use of any antidepressant medications at Waves 4 and 5 (yes/no). Self-reported antidepressant medication (Anatomic Therapeutic Chemical Classification N06A) use was verified by examination of medication records in participants' home during the CAPI interview.

2.4 | Statistical analysis

As we were interested in the direction of the association between loneliness and depression over time, we applied an auto-regressive cross-lagged panel modelling approach to estimate the effect of depression on loneliness and vice versa over three time points.^{25,40} The auto-aggressive nature of this approach is the main advantage of this modelling technique compared to other longitudinal analytic techniques as it enables us to examine the potential bi-directional association between depression and loneliness. Another strength of this analytic approach is that potential confounding due to unobserved time-invariant factors that may be correlated with both depression and loneliness are controlled for as within-individual variation is used to estimate the association between variables.⁴⁰ Standardised coefficients (β) with 95% confidence intervals are reported throughout to allow for easy interpretation of the comparative strength of the estimated regression paths. The cross-lagged panel model framework as applied here is presented in Figure 1.

A range of indicators were used to assess model fit. These were the root mean square error of approximation (RMSEA), as well as two comparative fit indices, the Comparative Fit Index (CFI) and the Tucker–Lewis Index (TLI). A RMSEA of <0.05 indicates a 'close fit' while <0.08 is considered 'reasonable fit'.^{41,42} The CFI and TLI return values between 0 and 1 with values >0.90 and >0.95 , respectively, indicating satisfactory and excellent fit.⁴¹ The adjusted Chi-square statistic is also reported, although this tends to reject the model when sample sizes are large.^{41,43}

2.5 | Missing data

Missing data were addressed using full information maximum likelihood (FIML) estimation, specifically maximum likelihood with missing values (mlmv) so that parameter estimates were calculated using all available information, including cases with missing data on covariates.⁴⁴ By this method, the analytic sample consisted of 5977 participants (See Figure S1.). In sensitivity analysis we also estimated our models using the default maximum likelihood method (listwise deletion) to test if results from the two estimation methods differed. We

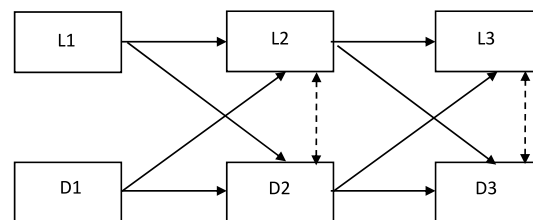


FIGURE 1 Cross-lagged panel model framework to test the association between loneliness and depressive symptomatology across three time points including pre- and during the COVID-19 pandemic. L, UCLA loneliness; D, CESD-7; solid lines represent regression paths; dashed lines represent covariances.

also estimated gender specific models to test for model invariance. All analyses were conducted using Stata/MP 14.2.⁴⁵

2.6 | Ethics

Ethical approval for the wider TILDA study was granted by the Faculty of Health Sciences Research Ethics Committee in Trinity College Dublin. TILDA adheres to the guidelines set out in the 1964 Helsinki declaration and its later amendments. Ethical approval for the COVID-19 study was obtained from the Irish National Research Ethics Committee COVID-19 on 17 June 2020 (Application number: 20-NREC-COV-030-2).

3 | RESULTS

The characteristics of the participants at baseline and mean CESD-7 and UCLA loneliness scores at each wave are reported in Table 1. The average age of participants was 68 years and 56% were female. One quarter (26%) lived alone. One-in-ten older adults reported antidepressant use at both Time 1 and Time 2. Forty percent of the SCQs were returned within four weeks of their being sent to participants with the remainder returned between August and November 2020. There was little change in average UCLA loneliness scores between Time 1 and Time 2 while they increased to 4.4 (from a maximum of 10) in the early months of the COVID-19 pandemic. A similar pattern was observed for CESD-7 depression scores which did not change between Time 1 and Time 2 but increased to 4.7 (from a maximum of 21) at Time 3.

As shown in Table 2, our model fit was satisfactory as assessed by RMSEA (0.06), CFI (0.97), and TLI (0.90). The path coefficients are

presented in the path diagram (Figure 2) and in Table 2. These show that loneliness at Time 1 was associated with loneliness at Time 2 ($\beta = 0.68$, 95% CI: 0.66, 0.70) and loneliness at Time 2 was also associated with loneliness at Time 3 although the strength of the latter temporal association was weaker ($\beta = 0.42$, 95% CI: 0.39, 0.46). There was a similar pattern of associations for depression. Each of the cross-lagged paths were also significant. There was a positive association between depression at Time 1 and loneliness at Time 2 ($\beta = 0.10$, 95% CI: 0.08, 0.13) as well as depression at Time 2 and loneliness at Time 3 ($\beta = 0.06$, 95% CI: 0.03, 0.10). Our model also provides support for the bi-directional nature of the association between depression and loneliness with loneliness at Time 1 positively associated with subsequent depression at Time 2 ($\beta = 0.19$, 95% CI: 0.17, 0.22) and similarly from loneliness at Time 2 to depression at Time 3 ($\beta = 0.31$, 95% CI: 0.28, 0.35).

Comparing the strength of the cross-lagged paths, the association between depression and subsequent loneliness was similar from Time 1 to Time 2 and Time 2 to Time 3 ($\beta = 0.10$ and 0.06 respectively). On the other hand, the strength of the association between loneliness and subsequent depression was stronger from Time 2 to Time 3 ($\beta = 0.31$ vs. 0.19 between Time 1 and Time 2). Furthermore, the cross-sectional association between loneliness and depression was significantly stronger at Time 3 than at Time 2. These associations were robust after controlling for age, gender, whether participants lived alone or with others, and how promptly completed SCQs were returned.

3.1 | Results of sensitivity analyses

To test if our choice of estimation method to address missing cases impacted our findings, we estimated the same model using Maximum

	T1 Wave 4 (2016) % (95% CI)	T2 Wave 5 (2018) % (95% CI)	T3 COVID-19 wave (2020) % (95% CI)
Male	44.0 (42.7, 45.3)		
Female	56.0 (54.7, 57.3)		
Lives alone	26.1 (24.7, 27.5)		
Lives with others	73.9 (72.5, 75.3)		
Age (mean years)	68.4 (68.1, 68.6)		
Antidepressant medication	10.2 (9.5, 11.0)	10.7 (9.9, 11.6)	
No antidepressant medication	89.8 (89.0, 90.5)	89.3 (88.4, 90.1)	
SCQ returned before 1 August 2020			39.8 (38.5, 41.0)
SCQ returned after 1 August 2020			60.2 (59.0, 61.5)
	Mean (95% CI)	Mean (95% CI)	Mean (95% CI)
UCLA loneliness	1.7 (1.6, 1.8)	1.6 (1.5, 1.7)	4.4 (4.4, 4.5)
CESD-7 depression	2.9 (2.8, 3.0)	2.9 (2.8, 3.0)	4.7 (4.6, 4.8)

TABLE 1 Participant characteristics at baseline and distribution of loneliness and depressive symptomology at each time point

TABLE 2 Full cross-lagged panel model standardised parameter estimates and goodness of fit statistics ($N = 5977$)

Predictor	Standardised Beta coefficients (95% CIs)			
	Loneliness T2	Loneliness T3	Depression T2	Depression T3
Loneliness T1	0.68 (0.66, 0.70)***		0.19 (0.16, 0.21)***	
Depression T1	0.10 (0.08, 0.13)***		0.44 (0.42, 0.47)***	
Loneliness T2		0.42 (0.39, 0.46)***		0.31 (0.27, 0.34)***
Depression T2		0.06 (0.02, 0.10)**		0.33 (0.29, 0.36)***
Covariances				
Loneliness T2 * Depression T2	0.22 (0.19, 0.25)***			
Loneliness T3 * Depression T3	0.31 (0.27, 0.34)***			
Goodness of fit statistics				
χ^2 (df)	RMSEA	CFI	TLI	
7090.5 (38)	0.06 (0.05, 0.06)	0.97	0.90	

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

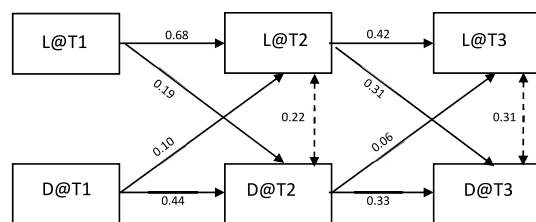


FIGURE 2 Cross-lagged panel model showing estimates for each path. L, UCLA loneliness; D, CESD-7; solid lines represent regression paths; dashed lines represent covariances. All paths are significant at <0.001 .

Likelihood (with listwise deletion) and similar estimates were observed. However, the model fit was poorer with an RMSEA of 0.08 and TLI of 0.87 (Supplementary Table S2). To test for model invariance, we also estimated our model separately for men and women and again similar estimates were observed. The exception was that depression at Time 2 was not associated prospectively with loneliness at Time 3 among women ($p = 0.16$). Also, model fit was better for the women only model (Supplementary Tables S3 and S4).

4 | DISCUSSION

This study is the first to document changes in both loneliness and depression from before to during the COVID-19 pandemic among a large cohort of older adults. While the prevalence of both loneliness and depression was stable among this cohort in the years preceding the pandemic, there was a dramatic increase in both during the early months of the pandemic. These findings are similar to those reported by smaller scale studies^{5,10} and those conducted during the pandemic.^{7,9} In terms of mental health, our findings are similar to those reported from the United Kingdom Household Longitudinal Study which reported a significant increase in mental distress among

the over 70s and other groups.⁴ The extent of the increase in loneliness and deterioration in mental health shows that fears for the damaging effect of the pandemic and public health restrictions are well founded.^{2,3,6}

A key strength of our analyses is that we included data collected at two time points before the COVID-19 pandemic as well as during the pandemic. In doing so we were able to compare the rate of usual or normal changes in loneliness and depression among this cohort to the magnitude of change associated with the onset of the pandemic. Having observed no significant increase in either loneliness or depression prior to the pandemic and then a large increase in both during the pandemic, it is likely that the pandemic and associated public health measures to reduce social contacts have had a dramatic negative effect on both loneliness and depression among older adults. As such, the pandemic can be considered a serious external stressor for older adults. Furthermore, when the data presented here was collected, very few of the participants had contracted the virus nor knew of friends or colleagues who had done so. Therefore, it is reasonable to suggest the main driver of the increase in loneliness and depression was the restrictions placed on social interactions rather than the result of illness or bereavement. This contention is supported by previous research among older adults attending ambulatory care services in a large general hospital where 40% of participants reported worsened mental health since restricting their movements.⁵

As well as describing changes in loneliness and depression due to the COVID-19 pandemic, we have also demonstrated the bi-directionality of this association. Unlike Cacioppo et al. (2010) but similar to Groarke et al. (2021) we found that the association between depression and loneliness was reciprocal. This bi-directional nature of the association between depressive symptoms and loneliness suggests that loneliness can both be considered a symptom of depression²² and that depression may foment a negative evaluation of an individual's social interactions as described by cognitive

discrepancy theory.¹⁴ However, the gender specific analysis conducted as part of the sensitivity analysis suggests that depressive symptoms prior to the pandemic were more strongly associated with loneliness during the pandemic among men than women which may provide stronger support for the veracity of cognitive discrepancy theory among older men. Furthermore, cross-sectionally, the strength of the association between depression and loneliness was far stronger during the pandemic than 2-years prior to it, which suggests that increased social isolation and attendant loneliness due to COVID restrictions is complicit in increased depression among older adults.

Also noteworthy is the question of whether the bi-directional nature of the association can be generalised beyond the specific context of the pandemic. Empirically, it may be that the association between depression at T2 and loneliness at T3 is weaker than may typically be the case due to the size of the increase in the prevalence in loneliness that was specific to the pandemic. However, it is somewhat unclear as to whether or not this is the case as the difference in the coefficients for both of these associations were quite similar at ($\beta = 0.10$ and 0.06 respectively).

Our findings have important implications for addressing both depressive symptoms and loneliness among older adults. Crucially, the bi-directional association between the two suggests that interventions to alleviate loneliness may also help reduce depressive symptoms and vice versa. Indeed, Lee et al. have estimated that 11%–18% of cases of depression could be prevented if loneliness were eliminated.⁴⁶ That this reciprocal association was observed both before and during the pandemic means that it is not a unique response to a particular external stressor. Therefore, the findings can inform interventions to alleviate the damage done by the pandemic and beyond that context. Furthermore, this study and others has shown that certain groups of older adults are at a heightened risk for both loneliness and depression, particularly those who live alone.⁴⁷ Depression in later life is oftentimes viewed as an inevitable consequence of ageing and multimorbidity and it is both under-diagnosed and under-treated.⁴⁸ There is evidence that cognitive behaviour therapy interventions targeting depression and anxiety may also reduce the burden of loneliness.⁴⁹

Our study has some potential limitations. Our measure of depression is not a clinical diagnostic tool, however, it is a commonly used measure of depressive symptoms in observational studies and has been previously validated in numerous cohorts, including TILDA.^{37,38} Also, only one measurement was available from participants during the pandemic and data collection was completed before the largest third wave of the pandemic in December 2020. Therefore, it was not possible to examine fully whether the initial damaging impact of the pandemic waned over time as older adults adjusted to their new normality. It will be possible to examine this when the sixth wave of TILDA data, collected between February and November 2021, is available for analysis. This is of critical importance as an increase in later life depression can have important implications for healthcare services and the wellbeing of the older population in an ageing society.

5 | CONCLUSIONS AND IMPLICATIONS

The COVID-19 pandemic has clearly had a damaging effect on older adults' wellbeing, the extent of which requires further investigation so that we can better understand the immediate, short and, longer term effects. It is important that health assessment and healthcare provision is sensitive to later life depression as its negative impacts on the lives of older adults are well documented. Interventions to treat depression and alleviate loneliness should also be cognisant of the inter-relationship between the two and that measures to address one should positively impact the other. Our findings therefore support the need for healthcare professionals to consider loneliness during clinical assessments of their patients. Finally, the COVID-19 pandemic has clearly shown the importance of social relationships and activities to the wellbeing of older adults by highlighting just how detrimental it is to mental health when people's social lives are restricted. As we emerge from the pandemic, we hope that these and other social determinants of health are to the fore in efforts to ensure that populations remain healthy well into older age.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are openly available in Irish Social Science Data Archive (ISSDA) at <https://www.ucd.ie/issda/data/tilda/>.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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