RESEARCH ARTICLE

International Journal of Geriatric Psychiatry **WILEY**

Social network size, loneliness, physical functioning and depressive symptoms among older adults: Examining reciprocal associations in four waves of the Longitudinal Aging Study Amsterdam (LASA)

Joan Domènech-Abella[1,2,3] | Jordi Mundó[1] | Lise Switsers[4,5] | Theo van Tilburg[6] |
Daniel Fernández[7,8] | Ignacio Aznar-Lou[3,9]

[1]Department of Sociology, Universitat de Barcelona, Barcelona, Spain

[2]Centro de Investigación Biomédica en Red de Salud Mental (CIBERSAM), Instituto de Salud Carlos III, Madrid, Spain

[3]Research, Innovation and Teaching Unit, Institut de Recerca Sant Joan de Déu, Esplugues de Llobregat, Spain

[4]Faculty of Psychology and Educational Sciences, Vrije Universiteit Brussel, Brussel, Belgium

[5]Research Foundation Flanders (FWO), Flemish Government, Brussels, Belgium

[6]Department of Sociology, Vrije Universiteit Amsterdam, Amsterdam, The Netherlands

[7]Serra Húnter fellow. Department of Statistics and Operations Research, Polytechnic University of Catalonia (UPC)-BarcelonaTech, Barcelona, Spain

[8]Department of Statistics and Operations Research, Polytechnic University of Catalonia, Barcelona, Spain

[9]Centro de Investigación Biomédica en Red de Epidemiología y Salud Pública (CIBERESP), Instituto de Salud Carlos III, Madrid, Spain

Correspondence
Joan Domènech-Abella, Department of Sociology, Facultat d'Economia i Empresa, Universitat de Barcelona, Diagonal, 690, Barcelona, Spain.
Email: j.domenech@pssjd.org

Abstract

Introduction: Previous research indicates that social isolation, loneliness, physical dysfunction and depressive symptoms are interrelated factors, little is known about the potential pathways among them. The aim of the study is to analyse simultaneously reciprocal relationships that could exist between the four factors to clarify potential mediation effects.

Methods: Within a large representative sample of older people in the Longitudinal Aging Study Amsterdam (LASA), participants aged 75 and over were followed up over a period of 11 years (four waves). We tested cross-lagged and autoregressive longitudinal associations of social network size, loneliness, physical functioning and depressive symptoms using structural equation modelling (SEM).

Results: Several statistically significant cross-lagged associations were found: decreasing physical functioning (Coef. = −0.03; $p < 0.05$), as well as social network size (Coef. = −0.02; $p < 0.05$), predicted higher levels of loneliness, which predicted an increase in depressive symptoms (Coef. = 0.17; $p < 0.05$) and further reduction of social network (Coef. = −0.20; $p < 0.05$). Decreasing physical functioning also

predicted an increase in depressive symptoms (Coef. = −0.08; $p < 0.05$). All autoregressive associations were statistically significant.

Conclusion: Interventions focused on promoting social activities among older adults after negative life events, such as loss of social contacts or declining physical function, may alleviate feelings of loneliness and act as mental health protector.

KEYWORDS

depressive symptoms, loneliness, older adults, physical functioning, social isolation

Key points

1. Decreasing physical functioning, as well as social network size, predicted higher levels of loneliness among older adults.
2. Loneliness predicted an increase in depressive symptoms and further reduction of social network.
3. Decreasing physical functioning also predicted an increase in depressive symptoms.

1 | INTRODUCTION

Loneliness has been defined as an unpleasant feeling which occurs when available social relationships are perceived as deficient in a quantitative or qualitative sense.[1] Loneliness has been interpreted both as a unidimensional[2] and as a multidimensional concept. Among the multidimensional conceptualizations, those proposed by Robert Weiss[3] distinguish between emotional loneliness, stemming from the absence of a close emotional attachment, and social loneliness, stemming from the absence of an engaging social network. Loneliness is more prevalent in Eastern and Southern Europe than in Western and Northern Europe.[4] According to European Social survey data, the prevalence of frequent loneliness is 5.2% in Northern Europe, 6.6% in Western Europe, 8.9% in Southern Europe and 10.8% in Eastern Europe.[4] Socioeconomic and sociodemographic features frequently related to higher levels of loneliness are female sex, previously married, being unemployed or retired, and low socioeconomic status.[5]

It is well known that loneliness as well as social isolation are related to mental and physical health,[6] but the directions of the associations among physical functioning, depressive symptoms, social isolation and loneliness are not clear. There are contrasting results about the possible associations among these conditions and most studies focused on the effects of some of them separately.[6–20] However, the evolutionary theory of loneliness (ETL) proposed a conceptual model allowing the inclusion of all these conditions.[21] According to this, changes in the social network as well as in physical functioning cause loneliness. Loneliness has short-term and long-term effects. In the short-term, the individual develops depressive symptoms and tends to withdraw into their most intimate social environment, which causes a reduction in the size of their social network. In the medium or long-term, the individual tends to reduce the symptoms of depression and expand their social contacts.

In a previous study from the Longitudinal Aging Study Amsterdam (LASA) with participants followed up over a period of 13 years (five waves), a favorable course of depression was found to be associated with increases in social network size and decreases in loneliness level over time,[22] which could be coherent with the consequences of loneliness at long-term according to the proposed model. Researchers from the LASA considered the size of the personal network important in the study of psychosocial well-being in older adults, particularly in the case of late-life depression. Extended networks show the potential to avoid social isolation and generate more social support than smaller networks.[23] Moreover, it is known that contact with network members is often disturbed in older adults with a chronic course of late-life depression[24,25]. So, it may be expected that incidence of depression could be related to a decrease in social network size at short-term whereas a remittance of depression could be related to a stabilization or even increase in the network size at long-term.

The present study does not aim to demonstrate nor refute the evolutionary theory of loneliness (ETL), but to evaluate whether changes in the variables of interest are consistent with that theory. According to this, in order to analyze expected causes (i.e., decreases in social network size and physical functioning) and expected consequences (i.e., depressive symptoms and further decreases in social network) of loneliness at short-term, we analyzed 4 consecutive LASA waves through structural equation models (SEM) including the restriction according to which changes of interest variables are the same among waves, so we did not analyze courses of conditions but associations at short-term. We have the following hypothesis:

First, we expect to find the association between a shrinking social network and increasing loneliness to be bidirectional.[7] Second, we also expect to find that loneliness mediates the association between social isolation and depression as well as those between physical dysfunction and depression. Previous studies proposed that the negative effect of social network on health among older adults is moderated by the existence of loneliness[8,9] and, contrastingly, other researchers proposed an independent effect of the two

conditions[6,10]. Moreover, whether loneliness causes depression[11,12] or depression increases feelings of loneliness[13,14], or both[2,15], has not been fully established. Although loneliness and depressive symptoms are strongly interrelated factors', previous studies found loneliness and depressive symptoms as being distinct conditions statistically and functionally[2,16,17]. According to Weiss,[3] loneliness is about how people feel about their social connections in particular and depression is about how people feel generally.

Regarding the association between loneliness and physical functioning there are inconsistent results showing that the condition has been found to predict or to be predicted by loneliness[18,19]. Finally, we have no expectation regarding the causal association between changes in physical functioning and depressive symptomatology. Some researchers proposed that access to high-quality social relations can ameliorate the effects of disability on psychosocial well-being[20] whereas other researchers found that physical disability predicts depressive symptoms.[26]

On the whole, the objective of the present study is to analyze simultaneously reciprocal relationships that could exist between physical functioning, social isolation, loneliness and depressive symptomatology to clarify potential mediation effects. We analyzed results obtained of four consecutive waves (from 2005 to 2016) of a population-based sample study among older Dutch adults which was born in 1934 or earlier (i.e., approx. more than 70 years old at the start of the first wave and more than 80 years old at the end of the last wave). We expect to find that decreases in social network size and physical functioning predict loneliness, which predicts depressive symptomatology and further decreases in social network size.

2 | METHODS

2.1 | Study design

Data are from the Longitudinal Aging Study Amsterdam (LASA). LASA is an ongoing population-based sample study among older Dutch adults. Starting in 1992 3,107 participants aged 55–85 years at baseline were recruited from municipality registries within three geographic regions and followed up every 3 or 4 years. For full details on the study characteristics, we refer to Huisman et al. (2011). Our study used data collected in 2005–2006 (W1); in 2008–2009 (W2); in 2011–2012 (W3); and in 2015–2016 (W4). The 895 participants included in the study were born in 1934 or earlier and responded to questions about loneliness through valid values at least in one questionnaire. Of these 895 participants, 858 responded to W1 questions about loneliness, 656 to W2, 461 to W3, and 269 to W4.

2.2 | Ethics Statement

In accordance with legal requirements in the Netherlands, informed consent was obtained from all respondents in the study. The Medical

Ethical Committee at VU University Medical Centre approved the study.

2.3 | Measurements

Social network size was defined as the total number of participants' socially active relationships of the participant, based on the names of persons with whom they had regular contacts important to them in the past year. These questions were staged in seven domains, including household members, children, children-in-law, siblings, siblings-in-law, neighbours and other relatives. Those aged 18 or above were included.[27]

Loneliness was measured using the 11-item De Jong Gierveld Scale[28] which showed sufficient validity and reliability and is widely used.[29,30] The scale ranges from 0 to 11 and the higher the values, the higher the levels of loneliness.

Depressive symptoms were measured through the 20-item self-report CES-D.[31] The Dutch version of the CES-D showed the same good psychometric properties in measuring depressive symptoms in samples of older adults as the original instrument, which was developed to obtain measures in the community.[32] Higher scores mean more depressive symptoms. A cut-off score of 16 is commonly used to detect a clinically relevant level of depressive symptoms.[32]

Physical functioning was measured through a self-report questionnaire. Questions were asked about the degree to which the respondent had difficulty performing seven usual daily activities: going up and down stairs, getting (un-)dressed, sitting down and rising from a chair, cutting own toenails, walking 400 m, using own or public transportation and taking a bath or a shower.[33] Respondents could indicate whether they were able to perform the activity without difficulty, with some difficulty, with much difficulty, only with help, or not at all. These response categories were coded as 5, 4, 3, 2, and 1, respectively, and sum scores (range 7–35) were calculated, with lower scores indicating more limitations in physical functioning.

Sample characteristics selected and considered as covariates included sex, age, partner status (married or in a partnership vs. not) and years of education. Sex, year of birth and years of education were measured at baseline whereas marital status was considered as a time-variant covariate.

2.4 | Statistical analysis

Descriptive analyses were conducted to characterize the study sample. These analyses included frequencies and proportions for categorical variables and means and standard error for continuous variables. Outcomes means (i.e., loneliness, physical functioning, depressive symptoms and social network size) from W1 to W4 were compared using the Student's T-test. Zero order correlations for the key variables were also calculated.

We tested cross-lagged and autoregressive associations among social networks size, physical functioning, loneliness and depressive

TABLE 1 Characteristics of the study sample

Characteristic	Wave 1 N = 858	Wave 2 N = 656	Wave 3 N = 461	Wave 4 N = 269	p-value W1→W4
Age (>70)[a]	79.0 (0.2)	78.2 (0.2)	77.2 (0.2)	75.9 (0.2)	-
Female N (%)	503 (58.6)	391 (59.6)	278 (60.3)	164 (61.0)	-
Married N (%)	422 (49.2)	292 (44.5)	196 (42.8)	102 (38.1)	-
Education (5–18) years	9.3 (0.1)	9.3 (0.1)	9.4 (0.1)	9.9 (0.2)	-
Loneliness (0–11)	2.4 (0.1)	2.4 (0.1)	2.6 (0.1)	2.6 (0.2)	<0.001
Physical functioning (7–35)	29.7 (0.2)	29.2 (0.3)	28.3 (0.3)	28.2 (0.4)	<0.001
Social network size (0–60)	14.8 (0.3)	14.5 (0.4)	14.5 (0.4)	14.2 (0.6)	<0.001
Depressive symptoms (0–50)	13.5 (0.2)	13.5 (0.2)	13.8 (0.2)	13.8 (0.3)	<0.05

Note: N = frequency. Means of the outcomes from W1 to W4 were compared using Student's T-test. Mean and standard errors are shown in parenthesis except for sex and marital status where frequency and percentage are displayed.
[a]Age according to year of birth (71 = 1934, 72 = 1933, etc.).

symptoms using cross-lagged panel model (CLPM), which is commonly used to estimate reciprocal effects and assess whether a set of results is consistent with a causal model.[34] We conducted CLPM through structural equation modelling (SEM) with the observed variables for depressive symptomatology, physical functioning, loneliness and social networks size, adjusting for sex, age, marital status and years of education. We used the maximum likelihood for missing values (MLMV) estimation method.[35] The MLMV method includes the assumption that missing values are missing at random, which means that missingness on outcomes uncorrelated with the unobserved values of outcomes, after adjusting for observed variables.[36] Therefore, we assumed that attrition both from death and from non-response are not correlated with loneliness, physical dysfunction, social network size and depressive symptomatology. In order to test our assumption, we carried out three logistic regression models for the three first study waves with these variables (i.e., loneliness, physical dysfunction, social network size and depressive symptomatology) and adjustment variables (i.e., sex, age, marital status and years of education) as covariates and participation in the next wave as outcome. We also assumed synchronicity (i.e., the measures at each time point occurred at the same exact times) and constancy of structural effects. Therefore, constrained to the equality of autoregressive and cross-lagged associations (i.e., W1–W2, from W2 to W3, and from W3 to W4). We also constrained the correlations of residual variances between variables within follow-up waves to be equal. Beta coefficients and 95% confidence interval of cross-lagged and autoregressive associations as well as correlations coefficients included in the CLPM were not reported (but available upon request). To clarify the results of the CLPM, coefficients and predicted linear values graphs of the statistically significant cross-lagged associations were reported.

The model fit was assessed by several indices comparing the tested model to the saturated model. The absolute fit index of minimum discrepancy $\chi2$ p-value, which must be greater than 0.05, could be ignored if the sample size is greater than 200.[37] Therefore, we took into account the relative chi-square, dividing it by degrees of freedom ($\chi2$/DF), which is an index of how much the fit of data to model has been reduced by dropping one or more paths. The accepted thresholds for that index should be less than 3.[38] The Root Mean Square Error of Approximation (RMSEA) and its 90% confidence interval (CI) estimates lack of fit compared to the saturated model.[39] RMSEA is recommended to be up to 0.05, whereas up to 0.08 is considered a fair fit.[39] Finally, CFI, GFI and TLI are three more indices about the quality of fit commonly used. CFI stands for comparative fit index, GFI stands for goodness of fit index and TLI stands for Tucker-Lewis index.[40] The values of CFI, GFI and TLI should be greater than 0.90[40,41]. Stata 13[42] was used in all statistical analysis.

3 | RESULTS

The characteristics of the study sample are shown in Table 1. About a 59% of the participants were women and the mean of age ranged from 79 in Wave 1 to 76 in Wave 4. Married people proportion ranged from 49% in wave 1% to 38% in Wave 4. The mean years of education was above 9 years. Loneliness (from 2.4 to 2.6), physical functioning (from 29.7 to 28.2), social network size (from 14.8 to 14.2) and depressive symptoms (from 13.5 to 13.8) worsened throughout the waves. Mean differences from W1 to W4 were statistically significant ($p < 0.05$). Table 2 reports the zero order correlations for the variables of interest.

All autoregressive beta coefficients were statistically significant ($p < 0.05$) whereas several statistically significant cross-lagged associations were found. As Figure 1 shows, decreasing physical functioning (Coef. = −0.03; $p < 0.05$), as well as social network size (Coef. = −0.02; $p < 0.05$), predicted higher levels of loneliness, which predicted an increase in depressive symptoms (Coef. = 0.17; $p < 0.05$) and further reduction of social network size (Coef. = −0.20; $p < 0.05$), whereas decreasing physical functioning

TABLE 2 Correlations for variables of interest

Social network size	Social network size				Loneliness				Physical functioning				Depressive symptoms			
	w1	w2	w3	w4	w1	w2	w3	w4	w1	w2	w3	w4	w1	w2	w3	w4
w1	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
w2	0.63	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-
w3	0.64	0.67	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-
w4	0.62	0.56	0.63	1.00	-	-	-	-	-	-	-	-	-	-	-	-
Loneliness																
w1	−0.27	−0.22	−0.24	−0.19	1.00	-	-	-	-	-	-	-	-	-	-	-
w2	−0.25	−0.25	−0.26	−0.25	0.70	1.00	-	-	-	-	-	-	-	-	-	-
w3	−0.18	−0.24	−0.28	−0.28	0.64	0.68	1.00	-	-	-	-	-	-	-	-	-
w4	−0.21	−0.24	−0.24	−0.32	0.63	0.67	0.74	1.00	-	-	-	-	-	-	-	-
Physical functioning																
w1	0.14	0.12	0.16	0.07	−0.18	−0.21	−0.27	−0.21	1.00	-	-	-	-	-	-	-
w2	0.13	0.15	0.22	0.03	−0.21	−0.22	−0.26	−0.22	0.78	1.00	-	-	-	-	-	-
w3	0.07*	0.09*	0.140	−0.01*	−0.23	−0.22	−0.26	−0.22	0.75	0.83	1.00	-	-	-	-	-
w4	0.04*	0.09*	0.05*	0.06*	−0.18	−0.18	−0.18	−0.16	0.47	0.63	0.71	1.00	-	-	-	-
Depressive symptoms																
w1	−0.06*	−0.06*	−0.01*	−0.03*	0.20	0.16	0.14	0.03*	−0.29	−0.22	−0.21	−0.20	1.00	-	-	-
w2	−0.07*	−0.07*	−0.07*	−0.09*	0.21	0.20	0.23	0.15	−0.29	−0.32	−0.24	−0.26	0.46	1.00	-	-
w3	−0.01*	−0.03*	−0.03*	−0.10*	0.18	0.19	0.23	0.10*	−0.28	−0.23	−0.28	−0.21	0.42	0.47	1.00	-
w4	−0.10*	−0.08*	−0.09*	−0.14	0.25	0.25	0.28	0.23	−0.20	−0.15	−0.16	−0.29	0.33	0.49	0.44	1.00

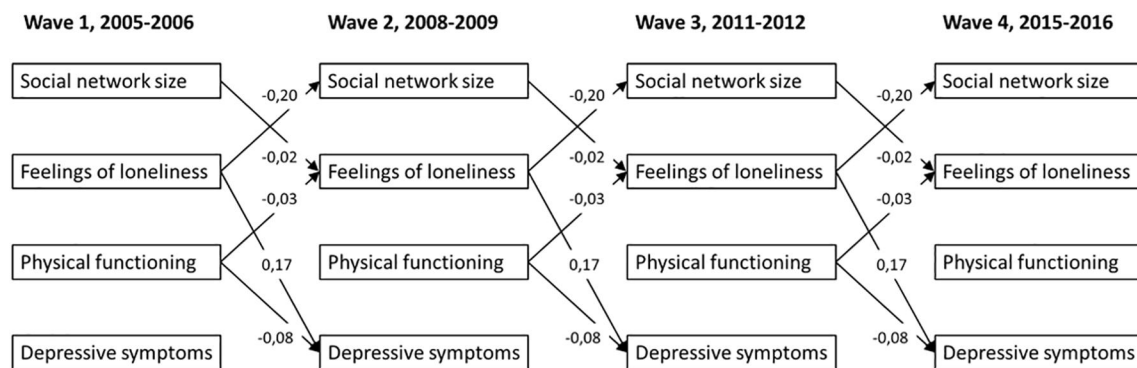*$p > 0.05$, all other correlations $p < 0.05$.

FIGURE 1 Cross-lagged longitudinal associations for loneliness, social network size, physical functioning and depressive symptoms. Coefficients of statistically significant ($p < 0.05$) cross-lagged associations are shown

also predicted an increase in depressive symptoms (Coef. = −0.08; $p < 0.05$). Figure 2 shows predicted linear values of statistically significant cross-lagged associations from W1 to W2. It would be generalized to the other two consecutive waves as the constraint is the same across them.

Table 3 show model fit indices. In our final model χ2/DF = 2.97, RMSEA = 0.05 (0.04, 0.05), CFI = 0.93 GFI = 0.91 and TLI = 0.90, so the model was a good fit model.

4 | DISCUSSION

To the best of our knowledge, this is the first study simultaneously analysing the reciprocal associations of loneliness, objective social isolation, physical disability and depressive symptoms. Loneliness was found to be predicted by declines in social network size and physical functioning. Loneliness also predicted further decreases in social network as well as increases in depressive symptoms.
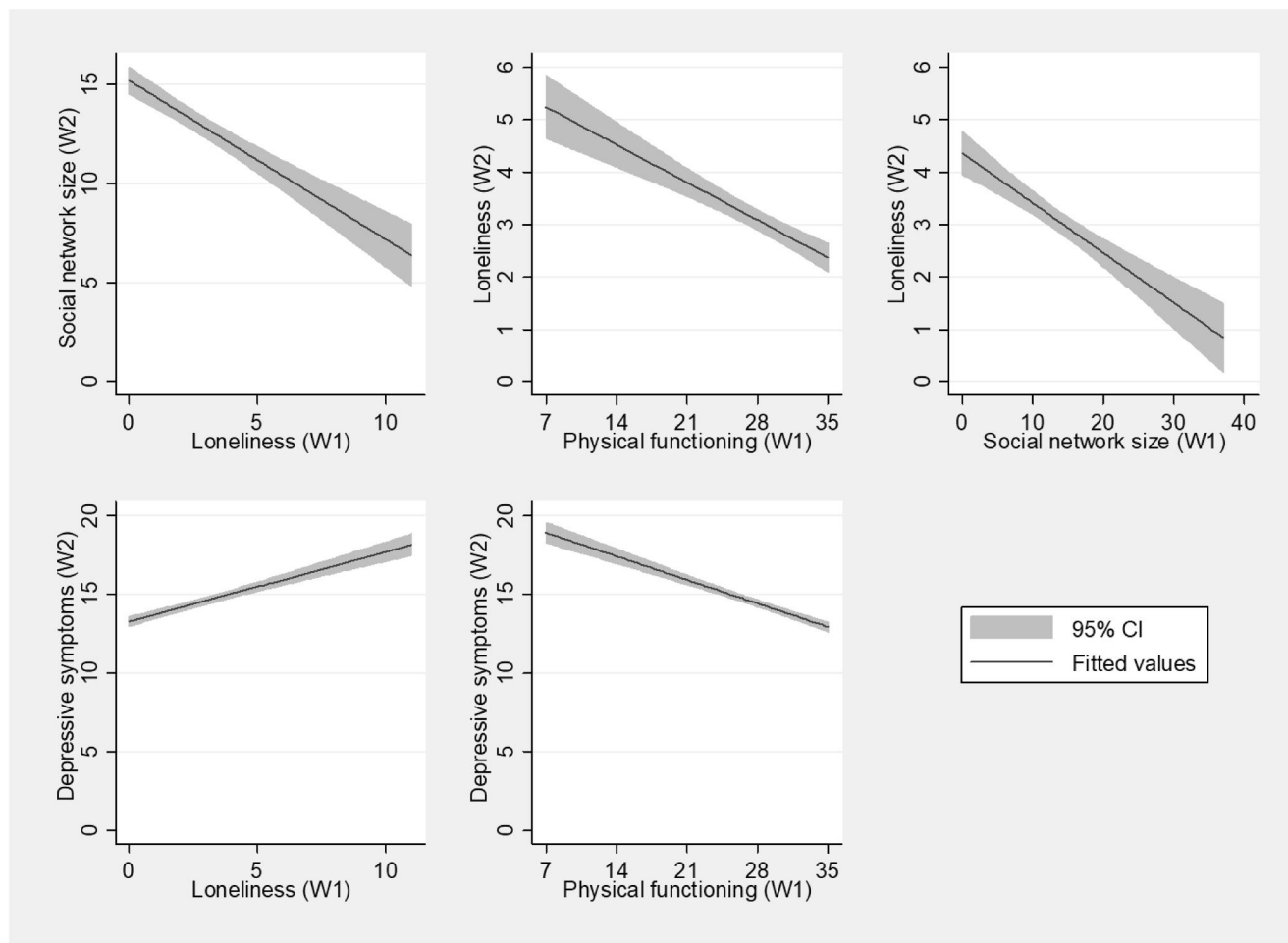
FIGURE 2 Cross-lagged associations of loneliness, social network size, physical functioning and depressive symptoms. Predicted linear values. Only W1–W2 associations are shown since coefficients were constrained to be the same across waves (from W1 to W2, from W2 to W3 and from W3 to W4)

TABLE 3 Model fit indices: threshold and results

	χ^2/DF	CFI[a]	GFI[a]	TLI[a]	RMSEA (CI)[a]
Threshold	<3	0.90–0.95	0.90–0.95	0.90–0.95	0.05–0.08
Results	2.97	0.93	0.91	0.90	0.05 (0.04, 0.05)

[a]Model fit indices threshold range according to distinct proposals.

Globally, our results are coherent with our proposed theoretical model, according to which negative events such as decreases in social networks and physical functioning cause loneliness, which leads to motivation to withdraw from most intimate relationships and to be alert to potential social threats at the service of self-preservation at short-term. Depressive symptoms reinforce that motivation.[21]

Our results confirm that increasing loneliness and decreasing social network size could act in a synergistic way to reduce mental well-being among middle-aged and older adults.[7] According to our hypotheses and in contrast with researchers who suggested an independent effect of loneliness and social isolation on mental health[6,10], social isolation affects loneliness, which mediates the association between social isolation and depression. Our results also support previous evidence obtained through cross-lagged analyses according to which loneliness predicts subsequent changes in depressive symptomatology, but not vice versa.[11] This highlights the need to address the subjective factors of social isolation through interventions aimed to improve the characteristics of social environments of older adults to improve their mental health.

Finally, physical disability directly predicted depressive symptoms. This is in line with previous researchers, which suggests that the association between physical disability and depressive symptoms are not only due to its effect on social networks. In fact, previous studies proposed that the association between older adults' physical activity and depression is weaker in those with high levels of perceived social support[20] whereas pain and low sense of mastery may contribute to aggravating this association.[43]

The present study addressed the consequences of loneliness at short-term and future studies should also analyze the possible consequences of loneliness in the long-term. According to the theories proposing loneliness as an evolutionary mechanism, lonely individuals will be motivated to reconnect, which is in line

with a previous study indicating that the remission of depressive symptomatology is related to a decrease in loneliness and an increase in social network size.[22] However, when, at short-term, the initial emotional environment is not available, or it is qualitatively inadequate, and alternative social relationships are not accessible,[30] loneliness may have deleterious effects on well-being due to its probable chronification,[21] which is in line with studies reporting a different effect of transient and chronic loneliness on depression.[44]

This consideration could contribute to reconciling the contrasts existing in the first proposals in social gerontology such as activity perspective and the recommendation to expand -or maintain- social roles when people get older[45] as the antithesis of disengagement perspective and the mutual withdrawal between aging persons and society.[46] These perspectives have influenced more recent models and theories such as active and successful aging models[47] and socioemotional selectivity theory,[48] respectively.

Like socioemotional selectivity theory, our proposed theoretical model is coherent with a reduction in social interactions when people get older, which limits them to the most emotionally safe contacts, which protect their psychosocial well-being. According to socioemotional selectivity theory, this is a consequence of the perception of life-span as a particularly limited resource which is caused by aging or negative events.[49] However, our proposed theoretical model does not allow the prescribing of optimal interpersonal distances for the psychosocial well-being of older people, but rather, they depend on their social resources available to deal with loneliness.[21]

Our results are coherent with findings by researchers proposing the necessity for strategies to promote health and psychosocial wellbeing prior to older age, with the aim of preventing subsequent feelings of loneliness, creating healthier and more fulfilled post-employment years and promoting social activities among older adults after negative life events rather than prescribing an internment in their intimate environment.[47]

4.1 | Limitation and strengths

The strengths of our study include the use of a large amount of community-representative data, with a sample of older adults from a variety of socio-economic backgrounds, an extensive follow-up and the ability to control for confounding factors. However, we need to consider some limitations associated with our findings. First, some of the SEM assumptions such as synchronicity might have been affected by the fact that the time between waves is not always the same. Furthermore, there are distinct interpretations of the goodness of fit indicators and the present study would not pass the most conservative interpretations. However, the goodness of fit cut-off points used in the present study have been used in similar previous studies[50,51]. Second, it is possible that some of the findings are influenced by the distorted perception of individuals with depressive symptoms,[52] although we cannot exclude the subjects as this aspect is a symptom of their condition. Finally, variables were collected through self-report, which may result in recall or reporting bias. Nevertheless, recall biases are usually relatively minor,[53] and in our study, recall periods were short and well-defined, to minimize recall bias.

5 | CONCLUSION

According to our results, decreasing social network and physical functioning cause loneliness whereas loneliness causes further decreases in social networks and depressive symptoms. Therefore, interventions focused on promoting social activities among older adults after negative life events, such as loss of social contacts or declining physical function, may alleviate feelings of loneliness and act as mental health protector.

The proposed theoretical model could be partially considered within the parameters of the evolutionary psychology, which may be able to establish a pivotal connection between biological and psychological factors, so allowing proposals regarding causal explanations for human behavior.[54] Future studies will need to consider whether it is possible to predict the trajectory and effect of loneliness on social behavior and mental health through an objective assessment of available social resources.

AUTHOR'S CONTRIBUTION

The study design was planned by Joan Domènech-Abella, Lise Switsers and Theo van Tilburg. Joan Domènech-Abella conducted the data analyses. Joan Domènech-Abella and Jordi Mundó drafted the article. Ignacio Aznar-Lou supervised the data analyses and development of the paper. The paper was edited and reviewed by all the authors.

CONFLICT OF INTEREST

The authors declare that they have no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

DATA AVAILABILITY

Data from the LASA database are available for use for specific research questions provided that an agreement is made up. Research proposals should be submitted to the LASA steering group with an analysis proposal form.

ORCID

Joan Domènech-Abella https://orcid.org/0000-0001-7605-3887

REFERENCES

1. Perlman D, Peplau L. Toward a social psychology of loneliness. In: Duck S, Gilmour R, eds. *Personal relationships in disorder*. Vol 3, pp. 31-56. London: Academic Press; 1981. https://doi.org/10.1037/0003-066X.41.2.229

2. Cacioppo JT, Hughes ME, Waite LJ, Hawkley LC, Thisted RA. Loneliness as a specific risk factor for depressive symptoms: cross-sectional and longitudinal analyses. *Psychol Aging*. 2006;21(1):140-151. https://doi.org/10.1037/0882-7974.21.1.140

3. Weiss RS. *Loneliness: The Experience of Emotional an Social Isolation*. MIT Press; 1973.

4. d'Hombres B, Schnepf S, Barjakovà M, Teixeira F. *Loneliness—An Unequally Shared Burden in Europe*; 2018. https://ec.europa.eu/jrc/sites/jrcsh/files/fairness_pb2018_loneliness_jrc_i1.pdf

5. Cohen-Mansfield J, Hazan H, Lerman Y, Shalom V. Correlates and predictors of loneliness in older-adults: a review of quantitative results informed by qualitative insights. *Int Psychogeriatr*. 2016;28(4):557-576. https://doi.org/10.1017/S1041610215001532

6. Leigh-Hunt N, Bagguley D, Bash K, et al. An overview of systematic reviews on the public health consequences of social isolation and loneliness. *Publ Health*. 2017;152:157-171. https://doi.org/10.1016/j.puhe.2017.07.035

7. Cacioppo JT, Fowler JH, Christakis NA. Alone in the Crowd: The Structure and Spread of Loneliness in a Large Social Network. *J Pers Soc Psychol*. 2009;97(6):977-991. https://doi.org/10.1037/a0016076

8. Holwerda TJ, Beekman ATF, Deeg DJH, et al. Increased risk of mortality associated with social isolation in older men: only when feeling lonely? Results from the Amsterdam Study of the Elderly (AMSTEL). *Psychol Med*. 2012;42(4):843-853. https://doi.org/10.1017/S0033291711001772

9. Holwerda TJ, Deeg DJH, Beekman ATF, et al. Feelings of loneliness, but not social isolation, predict dementia onset: results from the Amsterdam Study of the Elderly (AMSTEL). *J Neurology, Neurosurg Psychiatry*. 2014;85(2):135-142. https://doi.org/10.1136/jnnp-2012-302755

10. Courtin E, Knapp M. Social isolation, loneliness and health in old age: a scoping review. *Health Soc Care Community*. 2017;25(3):799-812. https://doi.org/10.1111/hsc.12311

11. Cacioppo JT, Hawkley LC, Thisted RA. Perceived social isolation makes me sad: 5-year cross-lagged analyses of loneliness and depressive symptomatology in the Chicago Health, Aging, and Social Relations Study. *Psychol Aging*. 2010;25(2):453-463. https://doi.org/10.1037/a0017216

12. Domènech-Abella J, Mundó J, Haro JM, Rubio-Valera M. Anxiety, depression, loneliness and social network in the elderly: longitudinal associations from the Irish Longitudinal Study on Ageing (TILDA). *J Affect Disord*. 2019;246:82-88. https://doi.org/10.1016/J.JAD.2018.12.043

13. Dahlberg L, Andersson L, McKee KJ, Lennartsson C. Predictors of loneliness among older women and men in Sweden: a national longitudinal study. *Aging Ment Health*. 2014;19:409-417. https://doi.org/10.1080/13607863.2014.944091

14. Saris IMJ, Aghajani M, van der Werff SJA, van der Wee NJA, Penninx BWJH. Social functioning in patients with depressive and anxiety disorders. *Acta Psychiatr Scand*. 2017;136(4):352-361. https://doi.org/10.1111/acps.12774

15. Hsueh Y-C, Chen C-Y, Hsiao Y-C, Lin C-C. A longitudinal, cross-lagged panel analysis of loneliness and depression among community-based older adults. *J Elder Abuse Negl*. 2019;31(4-5):281-293. https://doi.org/10.1080/08946566.2019.1660936

16. Cacioppo JT, Hawkley LC, Ernst JM, et al. Loneliness within a nomological net: an evolutionary perspective. *J Res Personality*. 2006;40(6):1054-1085. https://doi.org/10.1016/j.jrp.2005.11.007

17. Hawkley LC, Masi CM, Berry JD, Cacioppo JT. Loneliness is a unique predictor of age-related differences in systolic blood pressure. *Psychol Aging*. 2006;21(1):152-164. https://doi.org/10.1037/0882-7974.21.1.152

18. Perissinotto CM, Stijacic Cenzer I, Covinsky KE. Loneliness in older persons. *Arch Intern Med*. 2012;172(14):1078-1083. https://doi.org/10.1001/archinternmed.2012.1993

19. Shankar A, McMunn A, Demakakos P, Hamer M, Steptoe A. Social isolation and loneliness: prospective associations with functional status in older adults. *Health Psychol*. 2017;36(2):179-187. https://doi.org/10.1037/hea0000437

20. Cohen S. Social relationships and health. *Am Psychol*. 2004;59(8):676-684. https://doi.org/10.1037/0003-066X.59.8.676

21. Cacioppo JT, Cacioppo S. Loneliness in the modern age: an evolutionary theory of loneliness (ETL). *Adv Exp Soc Psychol*. 2018;58:127-197. https://doi.org/10.1016/BS.AESP.2018.03.00

22. Houtjes W, Van Meijel B, Van De Ven PM, Deeg D, Van Tilburg T, Beekman A. The impact of an unfavorable depression course on network size and loneliness in older people: a longitudinal study in the community. *Int J Geriatr Psychiatr*. 2014;29(10):1010-1017. https://doi.org/10.1002/gps.4091

23. van Tilburg T. Losing and gaining in old age: changes in personal network size and social support in a four-year longitudinal study. *J Gerontology Ser B Psychol Sci Soc Sci*. 1998;53B(6):S313-S323. https://doi.org/10.1093/geronb/53B.6.S313

24. Van Wijngaarden B, Schene AH, Koeter MWJ. Family caregiving in depression: impact on caregivers' daily life, distress, and help seeking. *J Affect Disord*. 2004;81(3):211-222. https://doi.org/10.1016/S0165-0327(03)00168-X

25. Domènech-Abella J, Lara E, Rubio-Valera M, et al. Loneliness and depression in the elderly: the role of social network. *Soc Psychiatr Psychiatr Epidemiol*. 2017;52(0):381-390. https://doi.org/10.1007/s00127-017-1339-3

26. Bierman A, Statland D. Timing, social support, and the effects of physical limitations on psychological distress in late life. *J Gerontology Ser B Psychol Sci Soc Sci*. 2010;65B(5):631-639. https://doi.org/10.1093/geronb/gbp128

27. Huisman M, Poppelaars J, van der Horst M, et al. Cohort profile: the longitudinal aging study Amsterdam. *Int J Epidemiol*. 2011;40(4):868-876. https://doi.org/10.1093/ije/dyq219

28. De Jong-Gierveld J, Kamphuls F. The development of a Rasch-type loneliness scale. *Appl Psychol Meas*. 1985;9(3):289-299.

29. De Jong Gierveld J, Van Tilburg T. The De Jong Gierveld short scales for emotional and social loneliness: tested on data from 7 countries in the UN generations and gender surveys. *Eur J Ageing*. 2010;7(2):121-130. https://doi.org/10.1007/s10433-010-0144-6

30. Pinquart M, Sorensen S. Influences on loneliness in older adults: a meta-analysis. *Basic Appl Soc Psychol*. 2001;23(4):245-266. https://doi.org/10.1207/153248301753225702

31. Radloff LS. The CES-D scale. *Appl Psychol Meas*. 1977;1(3):385-401. https://doi.org/10.1177/014662167700100306

32. Beekman AT, van Limbeek J, Deeg DJ, Wouters L, van Tilburg W. [A screening tool for depression in the elderly in the general population: the usefulness of Center for Epidemiological Studies Depression Scale (CES-D)]. *Tijdschr Gerontol Geriatr*. 1994;25(3): 95-103.

33. Guralnik JM, Branch LG, Cummings SR, Curb JD. Physical performance measures in aging research. *J Gerontology*. 1989;44(5): M141-M146. https://doi.org/10.1093/geronj/44.5.M141

34. Finkel SE. *Causal Analysis with Panel Data (No. 105)*. Sage publications; 1995.

35. Acock AC. *Discovering Structural Equation Modeling Using Stata*. Stata Press books; 2019. Published online 2013. https://ideas.repec.org/b/tsj/spbook/dsemus.html. Accessed December 11.

36. Allison PD. *Missing Data | SAGE Publications Inc*. Sage publications. 2001.

37. Jöreskog KG, Sörbom D. *LISREL 8: User's reference guide*. Chicago: Scientific Software International; 1993.

38. Marsh HW, Hocevar D. Application of confirmatory factor analysis to the study of self-concept: first- and higher order factor models and their invariance across groups. *Psychol Bull*. 1985;97(3):562-582. https://doi.org/10.1037/0033-2909.97.3.562

39. Browne M, Cudeck R. Alternative ways of assessing model fit. In: Bollen KA, Long JS, (Eds.) *Testing Structural Equation Models*. Sage; 1993:136-162.

40. Bentler PM. Comparative fit indexes in structural models. *Psychol Bull*. 1990;107(2):238-246. https://doi.org/10.1037/0033-2909.107. 2.238

41. Hu Lt, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. *Struct Equ Model A Multidisciplinary J*. 1999;6(6):1-55. https://doi.org/10.1080/10705519909540118

42. StataCorp. *Stata Statistical Software: Release 13*. Statacorp LP, 2013.

43. Backe IF, Patil GG, Nes RB, Clench-Aas J. The relationship between physical functional limitations, and psychological distress: considering a possible mediating role of pain, social support and sense of mastery. *SSM - Popul Health*. 2018;4:153-163. https://doi.org/10.1016/j.ssmph.2017.12.005

44. Martín-María N, Caballero FF, Lara E, et al. Effects of transient and chronic loneliness on major depression in older adults: a longitudinal study. *Int J Geriatr Psychiatry*. 2021;36(1):76-85.Published online August 13. https://doi.org/10.1002/gps.5397. gps.

45. Havighurst RJ. Successful Aging. *Gerontologist*. 1961;1(1):8-13. https://doi.org/10.1093/geront/1.1.8

46. Cumming E, Henry WE. *Growing Old, the Process of Disengagement*. Basic books; 1961.

47. Foster L, Walker A. Active and successful aging: a European policy perspective. *Gerontol*. 2015;55(1):83-90. https://doi.org/10.1093/geront/gnu028

48. Carstensen LL, Fung HH, Charles ST. Socioemotional selectivity theory and the regulation of emotion in the second half of life. *Motiv Emot*. 2003;27(2):103-123. https://doi.org/10.1023/A:1024569803230

49. Carstensen LL. The influence of a sense of time on human development. *Science*. 2006;312(5782):1913-1915. https://doi.org/10.1126/science.1127488

50. Schuez-Havupalo L, Lahti E, Junttila N, et al. Parents' depression and loneliness during pregnancy and respiratory infections in the offspring: a prospective birth cohort study. *PLoS One*. 2018;13(9): e0203650. https://doi.org/10.1371/journal.pone.0203650

51. Bosmans MWG, van der Velden PG. Cross-lagged associations between posttraumatic stress symptoms and coping self-efficacy in long-term recovery: a four-wave comparative study. *Soc Sci Med*. 2017;193:33-40.

52. Amann G. Social network and social support deficits in depressed patients: a result of distorted perception? *Eur Arch Psychiatr Clin Neurosci*. 1991;241(1):49-56. https://doi.org/10.1007/BF02193755

53. Kriegsman DMW, Penninx BWJH, Van Eijk JTM, Boeke AJP, Deeg DJH. Self-reports and general practitioner information on the presence of chronic diseases in community dwelling elderly. *J Clin Epidemiol*. 1996;49(12):1407-1417. https://doi.org/10.1016/S0895-4356(96)00274-0

54. Mundó J. Filosofía, ciencia social y cognición humana: de la folk psychology a la psicología evolucionaria. *Pap Rev Soc*. 2006;80:257. https://doi.org/10.5565/rev/papers/v80n0.1777