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**Title: Differential Impact of Transient and Chronic Loneliness on Health Status. A Longitudinal Study.**

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## **Abstract**

**Objective:** Loneliness is associated with worse health status outcomes. Yet, the present study is one of the first to identify how patterns of loneliness (transient and chronic), are associated with health over time.

**Design:** A total of 2,390 individuals were interviewed in 2011-12 and 2014-15 in a follow-up study conducted over a nationally representative sample of Spain. After confirming a longitudinal relationship between loneliness and health status, a Growth curve Mixture Modeling (GMM) was used to examine health trajectories.

**Main outcome measures:** The three-item UCLA Loneliness Scale was used to assess loneliness. Health status was measured with self-reported questions regarding ten domains (vision, mobility, and self-care, among others), and seven measured tests (including grip strength, walking speed and immediate and delayed verbal recall).

**Results:** A quarter of participants were lonely at baseline. Both the group of transient and chronic loneliness showed a negative significant relationship with health status at follow-up, ( $\beta = -0.063$  and  $\beta = -0.075$  respectively,  $p < 0.001$ ). Nevertheless, the health status did not change across time in any group.

**Conclusion:** People experiencing chronic loneliness had the worst health status. Different patterns of loneliness could benefit from the appropriate interventions.

**Keywords:** Transient loneliness, chronic loneliness, health status, longitudinal study.

## **Introduction**

Loneliness is associated with worse health status outcomes (Luo, Hawkey, Waite, & Cacioppo, 2012). Prevalence estimates all over the world show that loneliness throughout life ranges from 20 to 30%, these figures are high enough to justify a deeper study on this complex phenomenon, its causes, effects, and possible interventions (Liu & Guo, 2007; Perissinotto, Cenzer, & Covinsky, 2012; Yang & Victor, 2011).

Loneliness can be defined as a subjective experience of lack of satisfying relations (Weiss, 1973). Another frequently used description of loneliness is that it establishes an undesired discrepancy between the relationships one has and the ones one would like to have (Perlman & Peplau, 1981). Loneliness can show changes over time, so it needs a longitudinal assessment (Jylhä, 2004). As people age, the size of their social network can increase or decrease, as well as the chances to participate in social interactions due to changes in health. At the same time, older people may feel drops in desire for relationships or an increase in their quality (Dykstra, Van Tilburg, & Gierveld, 2005).

Different patterns of loneliness can be distinguished according to its course (De Jong-Gierveld & Raadschelders, 1982). Young (1982) set up a categorisation distinguishing between transient (referring to short and infrequent feelings of loneliness), and chronic loneliness (for individuals that were not satisfied with their social interactions for more than two years). The evolutionary theory of loneliness (Cacioppo et al., 2006) suggests that although transient loneliness played an important role in the evolution of the human species due to its function as an alarm to reconnect with others, increasing chances of survival and the transmission of genes to the future generation, it could be problematic when it becomes chronic (Goossens et al., 2015). This persistent typology could be explained by the self-reinforcing loneliness loop. Loneliness would be equivalent to feeling insecure, which could implement an unconscious hypervigilance, which in turn would lead to environment

cognitive biases (Cacioppo & Hawkley, 2009; Cacioppo et al., 2006). Lonely individuals tend to see interpersonal relationships as menacing, anticipate negative social contacts, and remember more negative social information; as a result, they may choose to distance themselves from would-be social partners, as they believe that their social isolation is due to others and is out of their own control (Hawkley & Cacioppo, 2010). Feelings of hostility, stress, pessimism, anxiety, and low self-esteem could also be present, conforming a dispositional trait that activates neurobiological and behavioural mechanisms that are partly responsible for detriments in health status (Cacioppo & Hawkley, 2009).

While transient loneliness might be the experience that occurs after suffering stressful life events such as bereavement or retirement, from which people recover after some time (Victor & Bowling, 2012) when family strain decreases (Hawkley & Kocherginsky, 2018), chronic loneliness is more stable and results from the inability of the individual to develop satisfying social relationships over the years (Shiovitz-Ezra & Ayalon, 2010). Those who suffer from chronic loneliness tend to live alone, are widowed, and experience poorer health and less perceived control more often compared with those who were persistently not lonely (Newall, Chipperfield, & Bailis, 2014). It is known that living alone is a major risk factor for the onset of loneliness in older adults (de Jong-Gierveld, 1987; Victor, Scambler, Bowling, & Bond, 2005).

The cross-sectional relationship between loneliness and worse health status has been shown before, associating loneliness with hypertension, inadequate quality of sleep, and an atypical response to stressful situations (Steptoe, Owen, Kunz-Ebrecht, & Brydon, 2004). Moreover, a cross-sectional multi-country study has found that loneliness has a greater relation with health status than any other element of the social network (number of individuals, frequency of contacts, or the presence of close relationships) (Rico-Uribe et al., 2016). Furthermore, recent meta-analyses showed that loneliness has a negative impact on

all-cause mortality (Holt-Lunstad, Smith, Baker, Harris, & Stephenson, 2015; Rico-Uribe et al., 2018). Specifically analysing different patterns of loneliness, a review of the loneliness' construct found that chronic loneliness has a higher impact on health status than short-lived loneliness (Luanaigh & Lawlor, 2008), is longitudinally significant and positively related to physician visits among older adults (Gerst-Emerson & Jayawardhana, 2015) and to an increased risk of mortality (Shiovitz-Ezra & Ayalon, 2010), a longitudinal relationship that is also found with recent changes in feelings of loneliness (Patterson & Veenstra, 2010). On the other hand, never or hardly ever experiencing loneliness is a strong predictor for good health status, as is the decrease in loneliness (that can be understood as its transient form) (Nummela, Seppänen, & Uutela, 2011). Finally, both transient and chronic loneliness have a significant impact on cognitive decline in older adults, the latter being more harmful to brain health, via inflammation and activation of the hypothalamic-pituitary-adrenal axis caused by depression and permanent stress (Xia & Li, 2018; Zhong, Chen, & Conwell, 2016). Despite all the evidence about this relationship, more longitudinal and experimental research in the field of loneliness is needed to better understand the effects of its onset on health status, as well as the effects of the distinct patterns of loneliness according to its course across time.

Concerns from several nations, such as the United States, Germany, Australia, and the United Kingdom, suggest that the world is dealing with a loneliness epidemic (Holt-Lunstad, 2017), raising up the possibility of a public health crisis. There is a north-south gradient in Europe, with loneliness being higher in southern countries (Sundström, Fransson, Malmberg, & Davey, 2009), which is linked to lower social integration and participation and greater expectations of family members in Southern European countries compared to the Northern ones (Dykstra, 2009; Litwin & Shiovitz-Ezra, 2010). That aside, a huge number in the elderly female population, socioeconomic problems, and lower health in southern countries such as Spain also contribute to the increased prevalence of loneliness (Fokkema,

De Jong Gierveld, & Dykstra, 2012; Victor et al., 2005). Moreover, epidemiology rates in Spain have always referred to social isolation, the objective aspect of loneliness defined by number of contacts (Cacioppo & Cacioppo, 2014), revealing that 10% of older adults are isolated (IMSERSO, 2016). There exists a lack of loneliness data for the Spanish population. The present study represents the first effort to contribute to clarify its national estimates.

To the best of our knowledge, this is one of the first studies that analyse the impact of distinct patterns of loneliness on health status, understood as a broad concept that embedded self-reported items and measured tests. The specific aims of the present work were to identify different patterns of loneliness (transient and chronic) and assess their association with health status over time. Considering both theoretical and empirical knowledge shown before, it is expected that people with chronic loneliness will present the worst health status at both waves (baseline and follow-up), followed by those with transient loneliness. The health status of individuals with chronic loneliness will tend to get worse over time.

## **Materials and Methods**

### ***Study Design and Participants***

A longitudinal household survey was conducted over a nationally representative sample in Spain. The first wave of the study took place between April 2011 and May 2012, and it was part of the *Collaborative Research on Ageing in Europe (COURAGE in Europe)* project (Leonardi et al., 2014), which included nationally representative samples of non-institutionalised people (aged 18 years or older) in three European countries: Finland, Poland, and Spain. A second wave, called *Edad con Salud*, was undertaken between December 2014 and June 2015 in Spain. The data employed in the present study are those

obtained from these waves conducted in Spain. The mean follow-up was 3.25 years ( $SD = 0.18$ ).

An age-stratified and a multi-stage clustered design was employed at baseline. Information on households was supplied by the Spanish Statistical Office. Specific details about the sample design can be found elsewhere (Miret et al., 2014). To summarise, respondents underwent face-to-face structured interviews using computer-assisted personal interviewing (CAPI). The survey included standardized physical examinations as well as neuropsychological evaluations. Professional interviewers who participated in a training course prior to the interview performed the interviews and the health evaluation. In the cases where participants had a severe enough cognitive impairment (judged at the interviewer's discretion) or had a family-reported dementia diagnosis, they were excluded from the study.

[Figure 1 near here]

A total of 4,061 individuals were interviewed at baseline after the exclusion of those who participated in the survey via a proxy respondent. From this number, at wave two, 21.21% participants ultimately refused to continue in the study, 10.81% were uninhabited houses or their occupants were elsewhere (on vacation or in another residence), 5.86% individuals were not found, 3.03% had passed away, and the remaining sample (0.24%) were lost to follow-up for other several reasons (partial interview and unsafe or dangerous area). Ultimately, the follow-up was completed by 2,390 subjects forming part of the analytical sample of the present study. The individual response rate was 69.9% at baseline. Quality assurance measures were implemented during fieldwork using well-accepted procedures and following the World Health Survey guidelines for multi-country studies (Üstun, Chatterji, Mechbal, & Murray, 2005). These quality assurance measures included the use of adequate sample selection methodology, the achievement of satisfactory response rates, the estimation of measures of reliability, and analyses for comparability of the data

across population samples and between different countries. Ethical approvals were obtained from the Ethics Review Committees of the Hospital Universitario de la Princesa (Madrid) and Parc Sanitari Sant Joan de Déu (Barcelona), as well as written informed consent from participants.

## ***Measures***

### *Loneliness*

In each wave, the three-item UCLA Loneliness Scale (Russell, 1996) was used to assess perceived loneliness. This scale has shown good internal consistency and both concurrent and discriminant validity (Hughes, Waite, Hawkley, & Cacioppo, 2004). In the present study, the three-item UCLA Loneliness Scale showed acceptable internal reliability (Cronbach's alpha = 0.88 and mean inter-item correlation = 0.72). Individuals responded on a three-point scale for each question (1 'hardly ever', 2 'some of the time', 3 'often'). A global score was obtained adding up the items. This score ranged from 3 to 9, with higher scores indicating higher loneliness. The global score was then dichotomised, and two categories were obtained: 'never or hardly ever feelings of loneliness' (if scored 1 in the three items) and 'presence of feelings of loneliness' (global score from 4 to 9). Transient loneliness was defined as the presence of feelings of loneliness in one of the two periods, at baseline or at follow-up, whereas chronic loneliness expressed the presence of these feelings, both at baseline and at the follow up.

### *Health status*

The conceptualisations for measuring health status from the World Health Organization (Salomon et al., 2003) and the International Classification of Functioning, Disability and Health (ICF) (World Health Organization, 2001) were employed as the conceptual foundations to create a metric of health status that allows for comparisons over time, defined as the individuals' inherent capacity and their interactions with their

environment. A set of seven measured tests and 43 self-reported health questions regarding ten domains were assessed: vision, mobility, self-care, cognition, interpersonal activities, pain and discomfort, sleep and energy, affect, domestic life and work, and hearing. These domains fit with the proposed minimal generic set of the ICF (Cieza, Oberhauser, Bickenbach, Chatterji, & Stucki, 2014), which operationalises health status in terms of domains of human functioning. A metric of health status was derived from these 50 items, conceptualising health status as a vector of functioning in different domains of human functioning that describe the actual impact of health conditions on people's lives. These domains are based on extensive, sophisticated, and multi-method studies (Sadana, 2002).

In the self-reported health questions, participants answered on a 5-point scale ranging from 1 ('no difficulty/problem') to 5 ('extreme difficulty/inability'). Measured tests were employed to obtain information about grip strength, walking speed, immediate verbal recall, delayed verbal recall, digit span backwards, digit span forward, and verbal fluency. All items were dichotomised as the presence or absence of difficulties (in the case of measured tests, the 25<sup>th</sup> percentile of the distribution was considered as cut-off point). The procedure employed to build the metric of health status is described elsewhere (Caballero et al., 2017) and is based on Bayesian Multilevel Item Response Theory (BMIRT), using the Markov Chain Monte Carlo approach to estimate all parameters simultaneously (Fox & Glas, 2001). This method allows for the comparison of health status scores across the two waves. A maximum of 20% of missing values across the 50 items considered was allowed before creating the metric. The latent score obtained was transformed into a 0-100 scale, with higher scores indicating better health status.

#### *Other Covariates*

***Physical multimorbidity.*** It was defined as the presence of two or more physical chronic conditions from the following list: chronic lung disease, asthma, diabetes,

hypertension, angina pectoris, stroke, and arthritis. They were diagnosed using combined criteria (except for diabetes, which was based only on self-report). Participants were asked whether they had had a medical diagnosis in the previous 12 months and if they fulfilled any of the available criteria, by asking about specific symptoms of each disease. Hypertension was measured with a blood pressure monitor. People with systolic blood pressure  $\geq 140$  mmHg and/or diastolic blood pressure  $\geq 90$  mmHg were considered to have hypertension (World Health Organization, 2013).

***Depression.*** The presence of depression during the previous 12 months was assessed by asking the participants whether they had been diagnosed with depression and using the World Mental Health Survey version of the Composite International Diagnostic Interview (CIDI) (Kessler & Üstun, 2004). Participants were considered to have suffered a depressive episode when they had been diagnosed during the previous 12 months with depression or when the algorithm, created according to ICD-10 Diagnostic Criteria for Research (World Health Organization, 1993), reported a positive case. This presence of depression is defined as follows: the presence of at least two of the three core symptoms considered (sadness or depressive mood, loss of interest or pleasure, and fatigue or low energy) and an additional symptom, until reaching a total of at least three symptoms. The list of additional symptoms is as follows: loss of appetite, insomnia, psychomotor agitation or retardation, worthlessness or excessive guilt, diminished ability to think or concentrate, and suicidal ideation, attempt or plan. Moreover, the period of the core symptoms was for more than two weeks and it was most of the day, nearly every day.

***Tobacco use.*** It was measured considering two categories: non-daily smokers and daily smokers.

***Alcohol consumption.*** It was categorised into two groups: 'heavy' drinkers for consumers of at least five (in men) or four (in women) standard alcoholic drinks per day on

at least one day during the week before the interview, and 'non-heavy' drinkers for those who had never consumed alcohol or had ever consumed alcohol but were not heavy drinkers (World Health Organization, 2000).

***Physical activity.*** It was assessed with the Global Physical Activity Questionnaire version 2 (GPAQ v2), (Bull, Maslin, & Armstrong, 2009). It collects information on physical activity participation in three settings (activity at work, travel to and from places, and recreational activities) and sedentary behaviour. Physical activity levels were categorised as high or moderate versus low, according to the GPAQ v2 guidelines.

Participants were also asked to provide socio-demographic information: age, gender, level of education (less than primary, primary, secondary, and tertiary), marital status (single, married or cohabiting, divorced or separated, and widowed), and household income. Household income was assessed by including the personal earnings income of all family members, as well as earnings coming from pensions, unemployment payment, and investments, in the last 12 months. A five-category variable was created based on the quintiles of the distribution. For the analysis included in the present manuscript, a dichotomous variable was considered (1<sup>st</sup> and 2<sup>nd</sup> quintiles of household income vs. 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> quintiles of household income).

### ***Statistical Analysis***

All data were weighted to account for the sampling design to generalise the study sample to the reference population. Post-stratification corrections were made to the weights to match the socio-demographic distributions of the Spanish population according to the census at the time of the first wave (Moussavi et al., 2007).

Descriptive statistics were used to summarise the sociodemographic characteristics of the sample. After observing that missing values were below 10% in all the variables considered in the present study, imputation strategies for missing values were not applied.

As an attrition analysis, differences in baseline characteristics between participants who completed the follow-up and participants who did not participate were assessed, reporting effect sizes when significant differences at the 95% confidence interval were found. Cramer's  $V$  was used for comparing frequencies in categorical variables (chi-square test), whereas Hedges'  $g$  was employed for comparing mean scores in continuous variables. Cohen's guidelines (Cohen, 1988) were used as a standard to evaluate the magnitude of the effect size. Cramer's  $V$  values of 0.10, 0.30, and 0.50 constitute small, medium, and large effect sizes; for Hedges'  $g$ , these values are 0.20, 0.50, and 0.80.

As a preliminary analysis, two multiple linear regression models were created to assess the relationship between loneliness and health status in each wave of the study, adjusting for age, gender, level of education, marital status, and quintile of household income, as well as for other covariates that could be potential confounders in the relationship between loneliness and health (presence of depression, being a daily smoker, being a heavy drinker, and practice a low level of physical activity). Since physical multimorbidity has been found to be a determinant of health status (Cott, Gignac, & Badley, 1999), it was also added as a covariate in order to adjust for its potential confounder effect. A multiple regression model was used to measure the longitudinal relationship between distinct groups based on the presence of feelings of loneliness and health status at follow-up, controlling for the above-mentioned covariates at baseline, and including health status. Non-standardised and standardised (Beta) regression coefficients were calculated. Beta coefficients ( $\beta$ ) could be seen as a measure of the effect sizes associated to the non-standardised regression coefficients.

After confirming the longitudinal relationship between loneliness and health status, a Growth curve Mixture Modeling (GMM) (Duncan, Duncan, & Strycker, 2013) was used to examine the trajectories of the dependent variable (health status) and how it changed across

time and among the different patterns based on the presence of feelings of loneliness in both waves, controlling for age and gender. The GMM approach was implemented based on a multilevel mixed-effect model. Random effects models were fitted to estimate the rate of change occurring linearly over time.

While the regression model was adjusted for a list of potential confounders, the GMM was only adjusted for age and gender. The GMM was included as an advanced double-check analysis and the fact that health status scores should be adjusted for a minimum set of covariates was considered, also in terms of convergence of the model. In this sense, age and gender were considered the most relevant socio-demographic covariates that should be taken into account in the analyses of these trajectories of health across groups of loneliness, another reason being that they are the main risk factors associated with loneliness (Pinquart & Sörensen, 2003).

As an additional analysis, a Generalised Estimating Equation (GEE) model (Hilbe & Hardin, 2008) was conducted considering the global score on the UCLA Loneliness Scale as a continuous variable to examine the association between a higher loneliness and a deterioration of health status. All analyses were performed with Stata software, version 14 (StataCorp, 2015).

## **Results**

The final sample included in the analyses comprised 2,390 individuals after excluding those who could not be followed up on ( $n = 1,671$ ). In terms of the attrition analysis conducted, and after comparing baseline characteristics between participants who completed the follow-up and those who did not (Table S1 Supplementary Material), there were significant differences for marital status ( $p = 0.006$ , Cramer's  $V = 0.043$ ) and multimorbidity ( $p = 0.011$ ; Cramer's  $V = 0.040$ ), although the effect sizes associated were small in both cases, indicating that substantial differences were not found based on the

sample excluded from the analysis. Mean health status scores based on different baseline characteristics of participants who completed the follow-up are shown in Table 1.

[Table 1 near here]

Mean age was 58.67 years (SD = 16.42) at baseline, with 1,288 (53.89%) being women. More than a half of the sample was married or cohabiting (63.05%) and one third had two or more chronic conditions (32.43%). A total of 581 (25.00%) participants were lonely at baseline, 12.01% suffered from chronic loneliness, and 23.58% had transient loneliness. Mean scores in the UCLA scale were 3.69 at baseline and 3.64 at follow-up, with a significant difference between them ( $p = 0.089$ ). Focusing on the mean health status scores, there were no statistically significant differences (confidence intervals overlapped) between waves in any of the variables considered. Men, people with a higher level of education, those who were single, and those who had a higher household income had a better health status. By contrast, people widowed, with depression, with two or more chronic conditions, and a low level of physical activity, showed the poorest health status. Regarding patterns of loneliness, major changes in mean health status were observed in people with transient loneliness (the mean score increased from 57.89 points at baseline to 58.47 points at follow-up). Chronic loneliness showed the worst mean health status score at both times (53.63 points at baseline and 53.26 at follow-up). The baseline socio-demographic characteristics of each group based on the presence of feelings of loneliness are shown in Table S2 (Supplementary Material).

The results of the regression models performed with loneliness as the independent variable and health status for each wave as dependent variable are displayed in Table S3 (Supplementary Material). Loneliness showed a significant relationship with health status at baseline ( $\beta = -0.130$ ,  $p < 0.001$ ), but also at follow up ( $\beta = -0.122$ ,  $p < 0.001$ ). The results of the final multiple regression framework used to assess the longitudinal relationship between

distinct groups based on the presence of feelings of loneliness and health status scores at follow-up and controlling for covariates at baseline, are shown in Table 2.

[Table 2 near here]

Both the transient and chronic loneliness group showed a significant relationship with health status at follow-up,  $\beta = -0.063$  ( $p < 0.001$ ) in the former group, and  $\beta = -0.075$  ( $p < 0.001$ ) in the chronic one. Results from the GEE model conducted to assess the relationship between loneliness as a continuous variable and health status indicated that a higher loneliness was significantly related with a lower health status (coef. = 0.21;  $p < 0.001$ ) after adjusting for potential confounders.

Mean health status scores estimated from the GMM approach, based on a multilevel mixed-effect model, are shown in Table 3.

[Table 3 near here]

The graphic representation (Figure 1) shows the trajectories for health status in each group based on the presence of feelings of loneliness, controlling for age and gender.

[Figure 2 near here]

As can be seen, none of the groups (never or hardly ever lonely, transient or chronic loneliness) experienced a significant change in health status over time, which is to say, health status was stable, even in the chronic loneliness group, which represents the worst health status score of the three groups at follow-up.

## **Discussion**

To our knowledge, this is one of the first studies that analysed the impact of distinct groups based on the presence of feelings of loneliness on health status, identifying different patterns (transient and chronic) and assessing their association with health status over time. The results showed a significant relationship between both, the group of transient and chronic loneliness and health status at follow-up. Nevertheless, the health status of every

group (never or hardly ever lonely, transient or chronic loneliness) did not change across time after controlling for the effect of both age and gender, which had shown to be the main drivers of loneliness (Pinquart & Sörensen, 2003).

Previous cross-sectional studies have shown an association between loneliness and poor health status (Richard et al., 2017; Stickley et al., 2013). Evidence compiled in several reviews of the state-of-the-art indicates that loneliness impairs health status (Cacioppo & Cacioppo, 2014; Hawkey & Cacioppo, 2010; House, Landis, & Umberson, 1988). In this direction, one longitudinal study with a U.S. nationally representative sample also concluded that loneliness was a risk factor for morbidity and increased depressive symptoms and functional limitations (Luo et al., 2012).

The possible mechanisms that underlie this association remain unclear, but the existing literature links the onset of loneliness and health status to the detriment of the physiological and the immune stress response in lonely population (Hawkey & Cacioppo, 2010; Pressman et al., 2005). Cole et al. (2007) found a genomic explanation for the high risk of inflammatory disorder in people suffering from chronic loneliness, involving a hampered transcription of glucocorticoid regulation. Moreover, chronic loneliness has been associated with an impairment of the executive functioning and with unhealthy behaviours such as smoking, alcohol consumption, less exercise, poor sleep quality, and worse eating habits, contributing to higher rates of morbidity and mortality in lonely older adults (Hawkey & Cacioppo, 2010; Rico-Uribe et al., 2018). In contrast, other studies do not support the hypothesis that loneliness is related to higher mortality (Steptoe, Shankar, Demakakos, & Wardle, 2013) or morbidity (Stessman, Rottenberg, Shimshilashvili, Ein-Mor, & Jacobs, 2013). A caveat of the latter study is that it used a single-item question, which could be less reliable than other measures that are better established.

People with chronic loneliness had the worst health status scores in both waves. This finding is in line with the recent study of Zhong et al. (2016), who found that both chronic and transient loneliness were significantly associated with cognitive decline in older adults, with the former having a worse effect on the brain health of the participants.

The transition from feeling lonely at baseline but not at follow-up, or the opposite, could be explained by the evolutionary theory of loneliness (Cacioppo et al., 2006), according to which transient states of loneliness represent an important function in the evolution of the human species, motivating some individuals to reconnect their relationships with others (Hawkley & Cacioppo, 2010), thus increasing chances of survival and the transmission of genes to the next generation. When this reconnection does not occur within a brief period, chronic feelings of loneliness may settle in the person's life. Young (1982) already set out that individuals who suffer from chronic loneliness tend to exhibit more long-term interpersonal difficulties than those with transient loneliness. In the same way that a wound serves as a warning call to respond to physical pain, transient loneliness is a symptom of a social problem, which should not be disregarded since it could lead to further health problems.

Even though a longitudinal relationship between transient and chronic loneliness and health status exists, the health status did not change across time by group of loneliness, even in the chronic group. This finding indicates that more experimental and longitudinal research with longer follow-ups and that includes control groups is needed to better understand the specific consequences that distinct types of loneliness may have on the future health status.

A better screening of this type of feeling, together with the appropriate intervention, could accelerate its improvement (Gardiner, Geldenhuys, & Gott, 2018). Since transient loneliness tends to be related to stressful life events such as bereavement or retirement, programmes based on increasing social recreation and social interaction with peers,

involving shared interest topic groups (Cohen-Mansfield & Parpura-Gill, 2007) or friendship enrichment programmes (Martina & Stevens, 2006), would benefit these group of people. Meanwhile, the stability of chronic loneliness over the years and the loss of perceived control that it implies (Newall et al., 2014), requires a deeper intervention geared towards changing maladaptive social cognitions through a cognitive therapy (Tse et al., 2010; Winningham & Pike, 2007). Moreover, taking into account that those who suffer from chronic loneliness tend to experience poorer health, programmes focusing on health promotion (Ollonqvist et al., 2008) and increasing subjective well-being would improve both the physical and emotional health of those worst affected by loneliness (Saito, Kai, & Takizawa, 2012). Finally, since living alone is a major risk factor for the onset of loneliness in older adults (de Jong-Gierveld, 1987; Victor et al., 2005), people in this circumstance would benefit from animal assisted therapy and other initiatives focused on leisure activities and social skills, including gardening, use of new technologies, volunteer work, holidays, and physical activity (Brown, Allen, Dwozan, Mercer, & Warren, 2004; Heo, Chun, Lee, Lee, & Kim, 2015; Pettigrew & Roberts, 2008; Toepoel, 2013). Despite the existing literature on interventions for loneliness, a recent meta-analysis conducted by Masi, Chen, Hawkey, and Cacioppo (2011) found that only the therapies aimed at modifying maladaptive social cognition achieved the best results in terms of effectiveness.

The present study was able to capture transient loneliness across time and measures its impact on health status understood as a broad concept that embedded self-reported items and measured tests. This study used the three-item UCLA Loneliness Scale to measure perceived loneliness, an instrument that has shown acceptable internal reliability and a good validity (Hughes et al., 2004); this measure implies an improvement over single-item questions and over questionnaires that use the word 'loneliness', which could lead to the

underestimation of loneliness due to the probable stigma of being perceived like that (Shiovitz-Ezra & Ayalon, 2012).

The procedure employed for creating the metric of health in the present study allows for comparing health status across time. This procedure and the associated psychometric characteristics have been described in depth elsewhere (Caballero et al., 2017; de la Fuente et al., 2018) using data from the English Longitudinal Study of Ageing (ELSA) (Stephote, Breeze, Banks, & Nazroo, 2012) and the Health and Retirement Study (HRS) (Sonnega et al., 2014). Both surveys are focused on ageing population, but they also include young adults for comparison purposes, such as the case of the COURAGE in Europe project. For this reason, and considering the adequate properties shown, the metric of health derived from this procedure has been used in this study for assessing longitudinal relationships and changes in health status across time.

A combined methodology using regression models and GMM has been employed in this study. The two techniques addressed two different issues: the regression model was used to identify the longitudinal relationship between distinct groups of loneliness (never or hardly ever lonely vs. transient and chronic loneliness) and health status, but this approach is not useful to assess whether there is a change in health over time; the GMM allowed for observing changes in health status across time by group of loneliness and assessing whether these changes were significant.

### ***Limitations***

Despite the attrition of the sample, which conforms one limitation of the present study, a socio-demographic comparison was carried out between people who completed the follow-up and those who did not, and in general terms, all the effect sizes associated with the differences found could be explained because of the large sample size of the study. Second, changes in loneliness were examined while changes in health status were observed.

Therefore, although the analyses were adjusted for health status at baseline, reversed causality cannot be ruled out from the results of the regression model. Another limitation of the study is the fact that there was only a two points of time study, which hardly shows shapes and variations over time, only straight-lines.

At least one additional wave of data is needed to test whether changes in mean health scores remain stable or not across time. Despite focusing on data over two points of time, a sample size large enough to produce meaningful findings was retained, and our results are a pioneer in clarifying the national estimates of loneliness in the Spanish population. Trying to deal with all these problems, the third wave of the *Edad con Salud* study has already started, which will allow measuring change more precisely. With more than two follow-ups, the validity of the straight-line growth model for the trajectory can be evaluated (for instance, calculating test for nonlinearity). Moreover, the precision of parameter estimates will tend to increase along with the number of observations for each participant (Duncan et al., 2013), and clear patterns of loneliness could be designed.

Additionally, although the present study focused on a global measure on health status, future research could be conducted to disentangle the specific impact that distinct types of loneliness can have on different domains of health (e.g., physical, emotional, and cognitive health), which could lead to improved social care provision as well as better health status outcomes. Regarding the measure of loneliness, the global score on the UCLA Loneliness Scale was dichotomised in order to assess the relationship between health status and different transition states, which could lead to a loss of nuance. However, this decision was based on previous research (Gerst-Emerson & Jayawardhana, 2015; Perissinotto et al., 2012), and to aid in the interpretation of the results. Alternative cut-off points employed for dichotomising loneliness were considered in a sensitivity analysis, obtaining equivalent results to those provided in the present article. Moreover, a sensitive analysis was conducted

considering loneliness as a continuous variable and similar results were obtained, observing a negative relationship between loneliness and health status.

Lastly, since this study focused on the Spanish population, further evidence is needed to corroborate these findings in other international cohorts in order to evaluate the generalisability of the results.

### ***Conclusions***

Since the prevalence of loneliness is increasing all over the world (Liu & Guo, 2007; Perissinotto et al., 2012; Victor & Yang, 2012), further longitudinal and experimental studies examining the relationship of loneliness with health status are needed to determine the mechanisms involved, as well as studies that analyse how to improve health status and quality of life of people who suffer from loneliness. Despite having observed that transient loneliness is reversible, more research distinguishing people who experience temporary versus chronic loneliness is also required to better differentiate those who would need help from a specific intervention from those who are only experiencing an occasional but positive state of loneliness that they can cope with. Efforts should be made to curb loneliness and avoid its chronification in order to improve the health status of the population.

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### **Declaration of interest statement**

No conflicts of interest declared.

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**Table 1.** Mean health status scores based on different baseline characteristics (2011-12) of participants who completed the follow-up (2014-15). Spain weighted data.

	<u>Total sample (n=2390)</u> <u>n (%)</u>	<u>Mean health status</u> <u>at baseline (95% CI)</u>	<u>Mean health status</u> <u>at follow-up (95% CI)</u>	<i>p</i>
Overall	-	62.31 (61.43, 63.19)	62.68 (61.78, 63.59)	
Gender				
Female	1288 (53.89)	59.45 (58.29, 60.60)	59.41 (58.21, 60.61)	
Male	1102 (46.11)	65.26 (63.96, 66.57)	66.06 (64.79, 67.32)	
Level of education				
No/basic education	621 (25.98)	50.46 (48.67, 52.25)	50.56 (48.52, 52.60)	
Primary	665 (27.83)	60.01 (58.23, 61.79)	60.78 (59.02, 62.53)	
Secondary	753 (31.51)	65.97 (64.56, 67.39)	67.00 (65.69, 68.31)	
Tertiary	351 (14.69)	67.92 (66.22, 69.63)	66.71 (64.65, 68.76)	
Marital status				
Single	360 (15.05)	67.21 (65.49, 68.93)	67.47 (65.84, 69.09)	
Married or cohabiting	1507 (63.05)	62.21 (61.28, 63.52)	62.96 (61.83, 64.09)	
Divorced or separated	173 (7.24)	60.96 (57.80, 64.13)	61.32 (57.32, 65.31)	
Widowed	350 (14.64)	47.40 (45.09, 49.71)	46.93 (44.19, 49.67)	
Household income				
1 <sup>st</sup> or 2 <sup>nd</sup> quintile	836 (38.85)	60.87 (59.39, 62.36)	62.82 (61.21, 64.43)	
3 <sup>rd</sup> , 4 <sup>th</sup> or 5 <sup>th</sup> quintile	1316 (61.15)	62.50 (61.29, 63.71)	62.05 (60.87, 63.23)	
Physical multimorbidity	775 (32.43)	47.63 (46.22, 49.05)	49.58 (47.99, 51.17)	
Depression	434 (18.16)	49.30 (47.11, 51.50)	51.62 (49.33, 53.91)	
Daily smokers	572 (23.93)	64.02 (62.37, 65.67)	65.42 (63.83, 67.02)	
Heavy alcohol consumption	79 (3.31)	63.85 (60.93, 66.76)	65.85 (61.92, 69.78)	
Low level of physical activity	711 (29.75)	57.52 (55.77, 59.28)	59.62 (57.69, 61.56)	
<b>Presence of feelings of loneliness</b>				
Never or hardly ever lonely	1497 (64.41)	65.27 (64.25, 66.29)	65.86 (64.83, 66.90)	0.64
Transient loneliness	548 (23.58)	57.89 (56.01, 59.77)	58.47 (56.40, 60.54)	0.81
Chronic loneliness	279 (12.01)	53.63 (50.98, 56.29)	53.26 (50.90, 55.61)	0.83

Note. 95% CI: 95% confidence intervals.

Table 2. Multiple linear regression model between different groups of loneliness and health status at follow-up (2014-15), controlling for covariates at baseline (2011-12) in Spain.

<u>Covariates at baseline</u>	<u>Health status at follow-up</u>		
	<u>Non-standardised coefficient (SE)</u>	$\beta$	$p$
Presence of feelings of loneliness (ref.=never or hardly ever lonely)			
Transient loneliness	-2.386 (0.628)	-0.063	<0.001***
Chronic loneliness	-3.643 (0.828)	-0.075	<0.001***
Health status	0.444 (0.021)	0.433	<0.001***
Age	-0.279 (0.021)	-0.263	<0.001***
Gender (ref.=male)	-2.695 (0.542)	-0.083	<0.001***
Level of education (ref.=lower than secondary school)	1.440 (0.566)	0.044	0.011*
Marital status (ref.=married or cohabiting)	1.370 (0.554)	0.041	0.013*
Household income (ref.=1 <sup>st</sup> /2 <sup>nd</sup> quintile)	-2.040 (0.520)	-0.062	<0.001***
Physical multimorbidity (ref.=no)	-1.276 (0.614)	-0.037	0.038*
Depression (ref.=no)	-2.271 (0.716)	-0.054	0.002**
Tobacco use (ref.=not daily smoker)	0.322 (0.620)	0.008	0.604
Alcohol consumption (ref.=not heavy drinker)	-1.449 (1.376)	-0.017	0.292
Low physical activity (ref.=moderate or high level)	-1.489 (0.554)	-0.042	0.007**

Note. SE: standard error, ref.: reference, \* $p<0.05$ , \*\* $p<0.01$ , \*\*\* $p<0.001$ ,  $\beta$ : Beta (standardised) coefficient.

Table 3. *Significant change in health status across time (2011-12 and 2014-15) in Spain in the different groups of loneliness controlling for age and gender, after conducting a Growth curve Mixture Model.*

<u>Presence of feelings of loneliness</u>	<u>Mean health status at baseline (SE)</u>	<u>Mean health status at follow-up (SE)</u>	<i>p</i>
Never or hardly ever lonely	90.96 (1.13)	91.11 (0.35)	0.664
Transient loneliness	85.78 (1.40)	85.62 (0.57)	0.774
Chronic loneliness	82.83 (1.71)	82.65 (0.80)	0.820

*Note.* SE: standard error, \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ .

Figure 1. *Flowchart of the study sample. Note that individuals at baseline were eligible for analysis if they did not have cognitive impairment.*

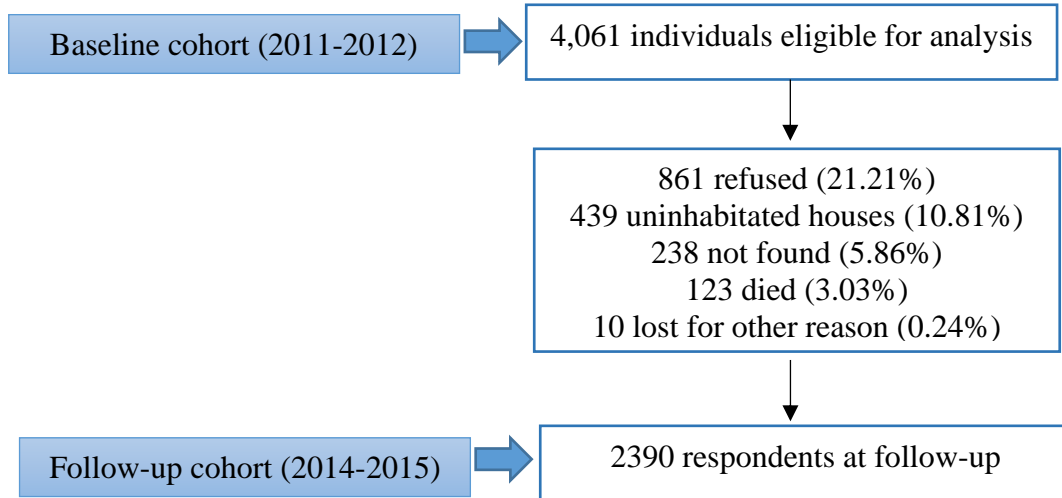
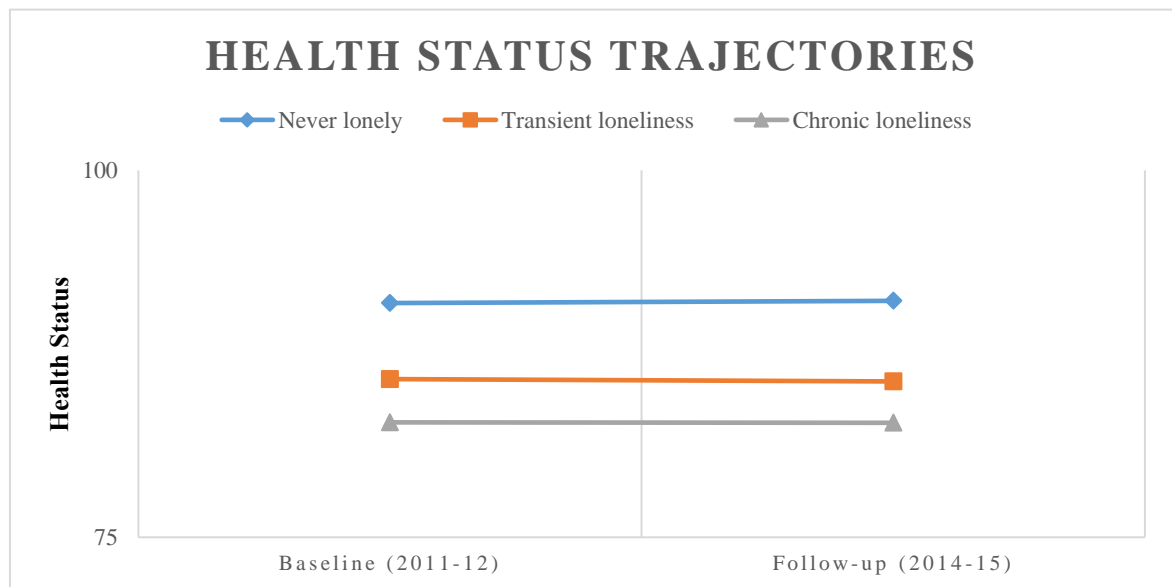


Figure 2. *Trajectories for health status in each group based on the presence of feelings of loneliness in Spain, controlling for age and gender.*



*Note.* Higher scores indicate better health status.