



The role of meaning in life in the association between loneliness and depression: a mediation study among older adults from 26 European countries

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Abstract

Loneliness and depression are serious public mental health problems. Meaning in life (MIL) is associated with reduced loneliness and depression. This study aimed to: (1) investigate associations between loneliness, MIL, and depression, differentiated by sex in individuals aged ≥ 50 years, residing in 26 European countries and Israel, and (2) to examine in men and women separately whether MIL mediated the relationship between loneliness and depression. We included 41,372 individuals (23,789 women) who responded to wave 8 of the SHARE project. The variables analyzed were loneliness (UCLA), depression (EURO-D scale), and MIL (CASP-19). The analytical procedures included regression analysis and exploratory mediation analysis. Among men and women, the odds of loneliness increasing depression were 3.6 and 3.3 times higher, respectively. Among men, feeling MIL sometimes or often had odds for reducing depression by 0.53 and 0.21, respectively. In women, feeling MIL sometimes or frequently reduced the odds of depression by 0.37 and 0.19, respectively. Regardless of sex, mediation analyses showed a positive association between loneliness and depression, while MIL was negatively associated with loneliness and depression. MIL partially mediated the association between LON and depression in male and female models by approximately 83.2% and 80.7%, respectively. No differences were found between men's and women's mediation models. Regardless of sex, high levels of MIL seem to be effective in benefiting the mental health of Europeans aged 50 and over. MIL proved to be a significant mediator of the relationship between loneliness and depression, while loneliness and depression strengthened each other.

Keywords Mental health · Vulnerability · Meaning in life

Introduction

At any time in life, several risk factors can increase mental health problems [1]. Among them, there is loneliness considered a growing public health and public policy concern; responsible for serious consequences for longevity, health, and well-being [2]. A recent meta-analysis study estimated the prevalence of loneliness at 27.6% in the 65–75 age group

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and 31.3% from age 75 onwards, with lower levels in Northern European countries and higher in the region Southern and Eastern Europe [3]. In turn, these results were confirmed in a meta-analysis that includes 113 countries, highlighting the older population of Eastern European countries with a higher prevalence of loneliness [4].

Loneliness is a consequence of a perceived discrepancy between desired social relationships and those achieved [5]. In cases where the feeling of loneliness is persistent, it is possible for this perception to become chronic, evolving into an unhealthy state [6]. Thus, it is possible that the individual will not be able to reestablish their social obligations, and consequently become increasingly isolated. It is unclear whether loneliness increases or decreases across the lifespan [7]. A current study showed that the feeling of loneliness is not linear, but dynamic, fluctuating over the years [8], being less prevalent at younger ages and increasing after 75 years [9]. Regarding sex, there are small differences between men and women. However, at an older age, loneliness tends to be more prevalent in women [10]. This comes from life changes that make this group more vulnerable than men, such as widowhood [11], as well as hormonal factors linked to depression [12]. Loneliness can even be the trigger for new feelings associated with mental health, such as mood [13] and anxiety [14], with a high potential for developing depression [15].

Globally, depression is a leading and growing cause of disability and worry [16], responsible for adverse health problems, including increasing the risk of morbidity and mortality [17]. Recently, it was estimated that depression affected approximately 280 million people, representing more than 47 million disability-adjusted life years [18]. Over the years, studies have reported sex differences in depression [19], revealing that women tend to be twice as likely to report depressive symptomatology [20]. However, findings remain inconsistent [21]. A population-based cohort study in England (ELSA; 50 years and older) associated higher loneliness scores at baseline with more severe depression during 12 years of follow-up [22]. Similarly, in the Netherlands Study of Depression in Older Persons (NESDO; age ≥ 60 years), higher loneliness scores were associated with more severe depression at the 2-year follow-up [23]. In turn, comparatively, severely lonely older Dutch adults indicated lower odds of achieving remission after 2 years than those who did not feel lonely.

One possible strategy to improve mental health, including loneliness [24] and depression [25], is to have a greater sense of meaning in life (MIL). Previous research has shown associations between MIL and better mental health [26, 27]. MIL is a subjective construction based on past experiences, responsible for feelings that build the purpose of living [28]. MIL can also be seen as a "web of connections" [29]. More specifically, MIL is a psychic structure that assists human processes of interpretation and understanding, favoring the understanding of experiences and consequently the formulation and planning of future life strategies. MIL plays a role in the energy each individual puts forth to achieve their desired future [26]. According to the literature, MIL is made up of facets, the three main ones are: (1) understanding or coherence (considered the cognitive component) specifically, the understanding of life experience, which gives meaning to facts from the present, past, and future [30], (2) purpose, represented by the feeling that drives and stimulates the individual's behavior to achieve life goals, managing a sense of meaning [31], and (3) existential mattering/significance which refers the notion and belief that existence makes sense to oneself and others [32].

The MIL principle was first presented by Victor Frankl's Existential Theory [33]. According to Frankl, individuals have a primary motivational force directed towards the search for meaning. In turn, the inability to formulate this meaning can trigger psychological suffering. Thus, both a low MIL and meaninglessness, if not addressed, can lead

to existential psychopathology, including drug and alcohol abuse, depression, and suicide [25]. On the other hand, the literature reports that a high sensation of MIL is capable of reducing morbidities such as myocardial infarction [34] and mild cognitive diseases during aging [35]. In the Barcelona Brain Health Initiative (BBHI; 40–68 years), cross-sectional data showed that the inability to attribute “value and meaning” to life was significantly associated with loneliness [24]. In turn, a study carried out with the Belgian population (70–103 years old) revealed that participants with higher MIL reported a lower prevalence of depressive feelings than those with low MIL [27]. In turn, findings are scarce regarding differences between sexes in relation to the levels of MIL.

Our interest in studying MIL’s associations with loneliness and depression arises from the fact that, especially in the older population, these relationships have not yet been extensively investigated. [32, 33], more research is needed in the area of health that expand the understanding of the relationships between MIL, loneliness, and depression. In turn, there are still gaps regarding the role of the sexes in the contexts of depression and loneliness, as well as their link when mediated by MIL. To our knowledge, no population-based study has investigated these aspects in the older European population. Thus, to empirically examine the mechanisms outlined in more depth, this study aimed to investigate associations between loneliness, MIL, and depression, differentiated by sex in individuals aged ≥ 50 years, residing in 26 European countries and Israel. Also, this study endeavored to examine in men and women separately whether MIL mediated the relationship between loneliness and depression. Finally, our study also intended to test six hypotheses (H_1 – H_6):

Hypothesis 1: Loneliness and depression will be more prevalent among women.

Hypothesis 2: Men and women will differ significantly in MIL.

Hypothesis 3: Loneliness and depression will be positively associated.

Hypothesis 4: High MIL scores will indicate a negative association with depression.

Hypothesis 5: MIL will mediate the relationship between loneliness and depression in both sexes.

Hypothesis 6: The mediating role of MIL in the relationship between loneliness and depression may differ between sexes, however due to the lack of systematic prior empirical research, no specific a priori hypotheses could be formulated.

Methods

Participants and procedure

This mediation study analyzed data from the European Health, Aging, and Retirement Survey (SHARE) (www.share-project.org). SHARE is a transnational longitudinal panel study on health, socioeconomic status, social networks, and spouses [36]. This study uses data from the eighth wave (W-8). Due to the circumstances of the COVID-19 pandemic, W-8 was suspended with 70% of the data collected (March 2020). The data was collected through face-to-face interviews, using a computer (CAPI), in citizens’ homes. The SHARE survey includes individuals aged 50 and over. Therefore, this was the minimum age cut-off for the study. Participants with Alzheimer’s disease, dementia, or senility were excluded due to possible memory problems during the interviews (risk of bias). Individuals with missing data for the variables of interest in the study (depression, loneliness, MIL) were also excluded from the analyses. Thus, of the 46,500 citizens who responded to the W-8, a

total of 41,372 individuals were considered eligible for our study. Our data comes from 26 countries: Austria, Belgium, Bulgaria, Croatia, Czech Republic, Cyprus, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Israel, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Slovakia, Slovenia, Spain, Sweden, and Switzerland. All interviewees provided consent to participate in the study. The SHARE protocol has been approved by the Ethics Committee of the University of Mannheim and the Ethics Committee of the Max Planck Society for the Advancement of Science. The procedures followed the ethical guidelines and regulations of the Declaration of Helsinki. Informed consent was obtained from all participants.

Measures

Loneliness

The three-item version of the Revised UCLA Loneliness Scale was used [37]. The scale has scores ranging from 3 to 9. Higher values indicate greater loneliness. The loneliness classification occurred depending on the intention of the statistical procedures. The scale had a Cronbach standardized alpha of 0.72. In the present study, depending on the intention of the analyses, three evaluation systems were adopted: (1) Classification: never, rarely, sometimes, often; (2) Total score, as well as (3), a binary measure to differentiate loners from non-loners. Therefore, we classify the first, second and third quartiles of total loneliness as non-lonely. In contrast, individuals in the fourth quartile formed the solitary group. This measurement was carried out based on previous studies [38, 39].

Meaning in life

MIL was obtained using the original control-autonomy-pleasure-self-realization scale (CASPI-19), used to assess the quality of life of older adults [40]. Based on a previous study [41], a unidimensional measure was used, extracted from the pleasure domain, entitled "How often do you feel that your life has meaning?" (Cronbach's alpha = 0.78). The response was presented on a 4-point Likert-type scale from 1 (Often) to 4 (Never).

Depression

Depression was assessed using the 12-item EURO-D scale. The cutoff point to screen for depressive symptoms was a score ≥ 4 . The EURO-D is recognized for diagnosing clinically significant cases of depressive symptomatology's [42]. A detailed description of the 12 items of this scale, including the validation process and results, has been previously reported [43]. The scale was considered adequately internally consistent (Cronbach's alpha = 0.72).

Covariates

Four variables were considered as confounding factors: age, partner in household, education, and comorbidities: (1) Age was considered a confounding factor because depression and loneliness are expected to increase with advanced age [40, 41]. To check whether participants had a partner in their homes, we included the following binary (yes/no) answer: "Do you have a partner in the household?" The choice of this variable was made based

on the fact that it is more adequate when it comes to loneliness than actual marital status (i.e., married, widowed, divorced, separated); (3) Level of education was obtained by the International Type Classification of Education (ISCED) [44], aggregated into three categories: a) ISCED 0–1: no education or a low level of education, b) ISCED 2–4: intermediate level of education, and c) ISCED 5–6: higher level of education, and (4) The aging process is accompanied and often negatively affected by a series of chronic diseases that cause health problems [45]. A group of comorbidities (self-reports) were considered: diabetes, hypertension, heart disease, cholesterol, rheumatoid arthritis, osteoarthritis, morbid obesity, cancer, lung disease, kidney disease, and neurological diseases. All information was accompanied by a medical report covering the last 12 months. This measure establishes the individual's general health status and is considered reliable [46].

Statistical analyses

Data normality was checked using the Kolmogorov–Smirnov test. The sample was stratified according to sex. Descriptive statistics were processed using frequencies (%), thus testing H_1 , as well as using mean and standard deviation (SD). Differences between groups were determined using the chi-square test (categorical variables) or Student's T test (continuous variables), which was also used to test H_2 . Through regression analysis, associations between the variables of interest were verified. We chose the group “with depression” as a reference for analysis: (1) the association between depression (dependent variable, binary) and loneliness (independent variable, binary) was obtained using binary logistic regression, and (2) the association between depression (dependent variable, binary) and MIL (independent variable, ordinal) was processed using multivariate analyses. Consequently, based on loneliness and MIL scores, the odds of participants presenting DEP was assessed. In both regression analyses we calculated two different models: Model 1 unadjusted and Model 2 adjusted for confounders (i.e., age, years of education, partner in household, comorbidities). The results were presented for each sex using odds ratios (OR) and their respective confidence intervals (95% CI). Through these analyses we tested H_3 and H_4 . Finally, we performed an exploratory analysis to examine whether the continuous variable loneliness (x) was associated with the continuous variable depression (y) mediated by the indirect effect of the continuous variable MIL (m) (see Fig. 1). Two models were calculated, one for men and one for women. For both models, the following paths were calculated: Path $a \times b$ = indirect effect (LON → MIL → DEP); Path c' = direct effect ($x \rightarrow y$); Path c = total effect. Thus,

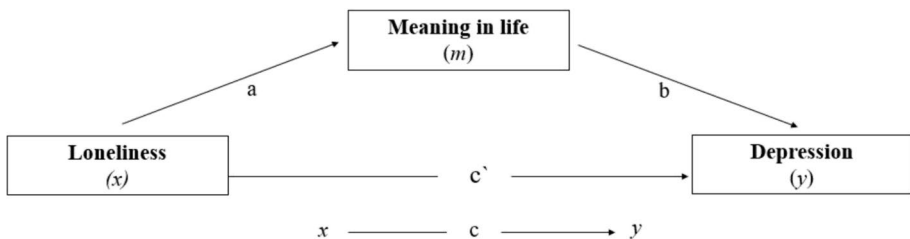


Fig. 1 Mediation model to determine the mediating effect of MIL on the association between LON and DEP. Path (a)=association between the independent variable LON (x) with the MIL mediator (m); Path (b)=association between the MIL mediator (m) and the dependent variable of DEP (y); Path (c')=direct effect ($x \rightarrow y$); Path (c)=total effect

H_5 was tested through path "c" (see Fig. 1), while H_6 was verified in detail by the difference between the Models of men and women in paths a, b, c' (Fig. 1).

Results were presented as standardized estimates, standard errors, p -values < 0.05 , confidence intervals (95% CI) for direct effect coefficients, as well as bootstrap confidence intervals (10,000) for indirect effects. Mediation analyses were estimated by the PROCESS computational complement (Model 4) [47]. We used confidence intervals that did not include zero as indicators of mediation statistical significance. In turn, complete mediation was considered when, after the simultaneous inclusion of the mediating variable (MIL), the size of the association between the independent variable (loneliness) and the dependent variable (DEP) did not become significant, which was indicated by the confidence interval including zero [48]. On the other hand, partial mediation was considered if, after including the mediator variable (MIL), the relationship between loneliness and depression became weaker. The mediation procedures were controlled for confounding factors (i.e., age, years of education, partner in household, comorbidities). We also calculate the proportion mediated (PM). The PM calculation, after including the mediator variable in the model, was the subtraction of 1 minus the result of dividing the direct effect and the total effect [49]. Finally, to check whether there were significant differences between men and women in the path a x b, respective CIs were compared. Thus, in the case of an overlap between CIs, it was assumed that there was no significant difference between the sexes [50]. For all analyses, a significance level of $p < 0.05$ was assumed. Statistical procedures were performed using the IBM-SPSS 29.0 program.

Results

Sample characteristics

Of the 41,372 participants, 57.5% were women (Table 1). The average age of the sample was 70.13 ± 9.11 . The most frequent age groups were 60–69 (36.8%) and 70–79 (33.2%). The vast majority had 1–3 comorbidities (65.2%), had 1 to 4 years of education (73.9%), and lived with a partner in their household (73.9%). Women reported higher scores for loneliness and depression than men ($p < 0.001$). Regarding the inference of MIL, 67% of participants often attributed MIL and 24.5% sometimes. Comparatively, men indicated a higher prevalence of MIL for often (68%) and also for sometimes (66.2%) ($p < 0.001$).

Associations between depression and loneliness

According to bivariate analyses (Table 2), the unadjusted model showed significant associations ($p < 0.001$). Men with loneliness indicated a 5.78 (CI 5.204—6.303) times greater odds of developing depression. Women with loneliness had a 4.78 (CI 4.450—5.130) times greater odds to develop depression. When the analysis was adjusted for confounders (i.e., age, years of education, family partner, and comorbidities), associations were smaller, but still remained significant ($p < 0.001$). Men with loneliness showed a 3.61 (CI 2.938—4.453) times greater odds of developing depression. In turn, women with loneliness had a 3.36 (CI 2.865—3.958) times greater odds of developing depression (Table 2).

Table 1 Descriptive analysis of the variables studied

| Variable | Total (n = 41,372) | Men (n = 17,583) | Women (n = 23,789) | p-Value |
|-----------------------------|-----------------------|---------------------|-----------------------|----------|
| Age (years) | | | | < 0.001* |
| Total (mean ± SD) | 70.13 ± 9.11 | 70.44 ± 8.77 | 69.90 ± 9.35 | |
| 50–59, n (%) | 5,393 (13.3) | 1,993 (11.3) | 3,400 (14.3) | |
| 60–69, n (%) | 15,229 (36.8) | 6,530 (37.1) | 8,699 (36.6) | |
| 70–79, n (%) | 13,716 (33.2) | 6,093 (34.7) | 7,623 (32.0) | |
| 80–89, n (%) | 6,239 (15.1) | 2,671 (15.2) | 3,568 (15.0) | |
| 90–99, n (%) | 795 (1.9) | 296 (1.7) | 499 (2.1) | |
| Comorbidities, n (%) | | | | < 0.001† |
| 0 | 8,152 (19.7) | 3,627 (20.6) | 4,525 (19.0) | |
| 1–3 | 26,985 (65.2) | 11,604 (66.0) | 15,381 (64.7) | |
| 4–6 | 5,708 (13.8) | 2,174 (12.4) | 3,534 (14.9) | |
| 7–9 | 487 (1.2) | 164 (0.9) | 323 (1.4) | |
| 10–12 | 40 (0.1) | 14 (0.1) | 26 (0.1) | |
| Education, n (%) | | | | < 0.001† |
| None | 1,365 (3.3) | 369 (2.1) | 809 (3.4) | |
| 1–4 years | 30,574 (73.9) | 13,451 (76.5) | 17,318 (72.8) | |
| 5–12 years | 9,433 (22.8) | 3,763 (21.4) | 5,662 (23.8) | |
| Partner in the house, n (%) | | | | < 0.001† |
| Yes n (%) | 28,708 (69.4) | 14,188 (80.7) | 14,520 (61.0) | |
| No n (%) | 12,664 (30.6) | 3,395 (19.3) | 9,269 (39.0) | |
| Loneliness | | | | < 0.001* |
| Total (mean ± SD) | 3.96 ± 1.40 | 3.82 ± 1.30 | 4.07 ± 1.48 | |
| Yes, n (%) | 6,162 (14.9) | 2,128 (12.1) | 4,034 (17.0) | |
| No, n (%) | 35,210 (85.1) | 15,455 (87.9) | 19,755 (83.0) | |
| Depression | | | | < 0.001* |
| Total (mean ± SD) | 2.40 ± 2.22 | 1.95 ± 2.00 | 2.70 ± 2.32 | |
| Yes, n (%) | 10,884 (26.3) | 3,363 (19.1) | 7,521 (31.6) | |
| No, n (%) | 30,488 (73.7) | 14,229 (80.9) | 16,268 (68.4) | |
| Meaning of life n (%) | | | | 0.002† |
| Never | 773 (1.9) | 323 (1.8) | 450 (1.9) | |
| Rarely | 2,746 (6.6) | 1,128 (6.4) | 1,618 (6.8) | |
| Sometimes | 10,145 (24.5) | 4,178 (23.8) | 5,967 (25.1) | |
| Often | 27,708 (67.0) | 11,954 (68.0) | 15,754 (66.2) | |

Abbreviation: SD, standard deviation† Chi-square test; * Student T-test

Associations between depression and MIL

In multivariate analyses, the unadjusted model for men showed significant associations ($p < 0.001$). Men who reported feeling rarely MIL did not indicate a statistically different result (OR = 1.199; CI 0.130–0.203), showing that a low MIL score was not associated with depression (Table 2). On the other hand, MIL classification of sometimes and often indicated a 0.46 (CI 0.368–0.581) and a 0.16 (CI 0.130–0.203) times lower odds

Table 2 Bivariate and Multivariate analyses for the association between loneliness, depression, and meaning in life, according to sex

| Variable | Model 1 | | Model 2 | |
|-----------|---------------------|----------|---------------------|----------|
| | OR (95% CI) | <i>p</i> | OR (95% CI) | <i>p</i> |
| Men | | | | |
| LON | | | | |
| No | 1 | | 1 | |
| Yes | 5.728 (5.204—6.303) | <0.001 | 3.617 (2.938—4.453) | <0.001 |
| MIL | | | | |
| Never | 1 | | 1 | |
| Rarely | 1.199 (0.130—0.203) | 0.151 | 1.307 (0.755—2.264) | 0.339 |
| Sometimes | 0.462 (0.368—0.581) | <0.001 | 0.531 (0.318—0.887) | 0.016 |
| Often | 0.162 (0.130—0.203) | <0.001 | 0.212 (0.127—0.355) | <0.001 |
| Variable | Model 1 | | Model 2 | |
| | OR (95% CI) | <i>p</i> | OR (95% CI) | <i>p</i> |
| Women | | | | |
| LON | | | | |
| No | 1 | | 1 | |
| Yes | 4.778 (4.450—5.130) | <0.001 | 3.367 (2.865—3.958) | <0.001 |
| MIL | | | | |
| Never | 1 | | 1 | |
| Rarely | 0.980 (0.803—1.252) | 0.980 | 0.862 (0.504—1.476) | 0.589 |
| Sometimes | 0.376 (0.307—0.461) | <0.001 | 0.372 (0.224—0.618) | <0.001 |
| Often | 0.147 (0.120—0.179) | <0.001 | 0.195 (0.117—0.323) | <0.001 |

Abbreviations: LON, Loneliness; MIL, Meaning in life. Model 1, unadjusted; Model 2, adjusted for confounders (age, years of education, partner in household, comorbidities). Bivariate analysis (LON); Multivariate analysis (MIL)

of developing depression, respectively, compared to those who never felt MIL. After controlling for possible confounding factors (i.e., age, years of education, family partner, comorbidities), men who reported feeling rarely MIL did not indicate a statistically different outcome (OR = 1.30; CI 0.755—2.264). In turn, men who felt MIL sometimes and frequently indicated a 0.53 (CI 0.318—0.887) and a 0.21 (CI 0.127—0.355) times lower odds to develop depression, respectively, compared to men who never felt MIL.

In the case of women, the unadjusted analysis (Model 1) showed significant results ($p < 0.001$). Women who never conceived MIL did not report a statistically different result (OR = 0.980; CI 0.803—1.252). On the other hand, those who reported the MIL classifications sometimes and often indicated a 0.37 (CI 0.307—0.461) and a 0.14 (CI 0.120—0.179) times lower odds of developing depression, respectively, compared to those who never felt MIL. In Model 2 (Table 2), controlled for covariates (i.e., age, years of education, household partner and comorbidities), there was no significant result for women who reported “rarely” regarding MIL (OR = 0.862; CI 0.504—1.476). On the other hand, those who reported MIL as sometimes and frequently showed a 0.37 (CI 0.224—0.618) and a 0.19 (CI 0.117—0.323) times lower odds of presenting with depression than those who never felt MIL.

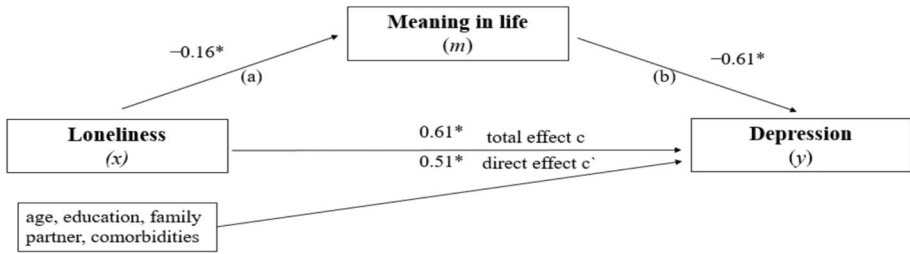


Fig. 2 Analysis of the association of loneliness (LON) on depression (DEP) mediated by meaning in life (MIL) in men

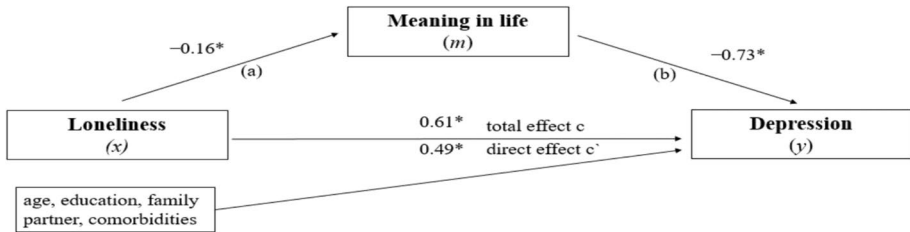


Fig. 3 Analysis of the association with loneliness (LON) on depression (DEP) mediated by meaning in life (MIL) in women

Mediation analysis for men

The model obtained was statistically significant (Fig. 2). Mediation analysis confirmed MIL as a significant mediator of the relationship between men’s loneliness and depression [F(3)=743,6578; $p < 0.001$; $R^2 = 0.271$]. Moreover, loneliness negatively and significantly affected MIL ($\beta = -0.16$, $t(3) = 108,5875$, $p < 0.001$). MIL acted negatively and significantly on depression ($\beta = -0.61$, $t(4) = -31,3219$, $p < 0.001$). The direct effect of the loneliness pathway on depression was positive and significant ($\beta = 0.51$, $t(4) = 47,6732$, $p < 0.001$). Finally, the total effect of the model (X–Y) revealed a positive and significant association ($\beta = 0.61$, $t(3) = 58,5772$, $p < 0.001$). The analysis based on 10,000 bootstrap samples indicated positive and significant results for the indirect effect of the path LON → MIL → DEP ($\beta = 0.1030$, $SE = 0,0052$, $95\% \text{ CI BCa} = 0.0930\text{--}0.1134$). The proportion mediated by MIL in the relationship between loneliness and depression was approximately 83.2%.

Mediation analysis for women

The model was statistically significant (Fig. 3). We found that MIL proved to be a mediator of the relationship between loneliness and depression among women [F(3)=1489,5727; $p < 0.001$; $R^2 = 0.267$]. Loneliness acted negatively and significantly on MIL ($\beta = -0.16$, $t(3) = -55.3576$, $p < 0.001$). MIL indicated a negative and significant association with depression ($\beta = -0.73$, $t(4) = -37.5204$, $p < 0.001$). This result showed the benefit that an increase in MIL can offer in the treatment of depression. The direct effect of the loneliness

pathway on depression was positive and significant ($\beta=0.49$, $t(4)=53.1901$, $p<0.001$). The total effect of the model ($X-Y$) showed a positive and significant association ($\beta=0.61$, $t(3)=67.9985$, $p<0.001$). Analysis based on 10,000 bootstrap samples revealed positive and significant results for the indirect effect of the path $LON \rightarrow MIL \rightarrow DEP$ ($\beta=0.1182$, $SE=0.0047$, $95\% \text{ CI BCa}=0.1091-0.1274$). Finally, the proportion mediated by MIL in the relationship between loneliness and depression was up to 80.7%.

Differential mediation patterns between men and women

Comparatively, men indicated descriptively higher PM than women on the path between loneliness, MIL, and depression. Yet, due to the overlap of the CIs of all mediation paths of the models for men and women, we concluded that there was no significant differentiation between the sexes ($p>0.05$).

Discussion

Our study aimed to investigate associations between loneliness, MIL, and depression, differentiated by sex in individuals aged ≥ 50 years, residing in 26 European countries and Israel. Also, we sought to examine in men and women separately whether MIL mediated the relationship between loneliness and depression. As far as we know, this was the first empirical study to show differences between older adult men and women on the topics investigated. Comparatively, the prevalence of loneliness and depression among women was higher. The finding confirmed H_1 and were in line with previous studies that reported a higher prevalence of loneliness among women in Germany [51] and in England, Scotland and Wales [52]. The findings also recognized sex as a factor related to depression [53], reporting women being more susceptible than men [12, 19, 50].

In a study that evaluated the widowhood experiences of men and women in four European regions [54] (≥ 50 years) and their relationship with depression, although the feeling of loneliness was greater in widowed women and was negatively associated with mental health, no differences were found between the genders. Even before experiencing bereavement, compared to men, women were at a higher risk for depression. According to the authors, possible explanations for the lack of difference between the genders could be the genetic characteristics of men and women, but also behavioral and social factors experienced by each citizen in their respective countries. Depression was higher, for example, in countries located in European regions with greater social inequality, such as Southern and Eastern Europe, proving that there is a link between depression and greater social vulnerability [54]. In turn, the combination of genetic factors and social vulnerabilities highlight underlying factors of aging that make individuals more susceptible to voluntary exclusion from social exchanges, as well as to depressive disorders. Furthermore, the combination of widowhood and reduced financial resources due to retirement, is a fact that can trigger or increase depression [52, 53].

Regarding MIL, we found statistically significant differences between the genders, with men showing lower scores than women. Therefore, H_2 was supported. Our findings were in line with a previous population-based study carried out in three linguistic regions in Switzerland to assess MIL as a significant determinant of perceived quality of life [55]. In this, women reported a higher MIL score, however, the difference was statistically significant only in the French sample. A possible explanation for the difference in social roles

related to gender could be the tendency that men and women have towards their life goals. Generally, women emphasize expressive and community values (i.e., creativity, sensitivity, experience with nature, and family), as well as health care. Men, however, give greater meaning to instrumental values (i.e., work, achievement, power), and adjustments that lead to self-protection, stability, self-expansion and self-affirmation [56]. In this context, future studies can investigate which of these factors may be more or less decisive for the MIL of each gender. A previous study reported, that compared to men, women in early adulthood express a greater desire to materialize life goals, such as marriage, children, and a job (Steiger, 2009). This works as a driving force (purpose) to realize the meaning of life (George, 2016), as well as existential mattering/significance (Costin, 2020).

Association analyses indicated a positive relationship between loneliness and depression for both sexes. Thus, we confirm H_3 . Previous studies have highlighted the potential of loneliness to increase depression symptomatology [14, 57]. The negative experience related to the inability to establish social connections tends to lead to social isolation, which can intensify depression [4]. Studies showed that the association between loneliness and depression favors the development of new negative feelings, such as sadness [58], anxiety [59], stress [60], and disturbed sleep [61]. All of this contributes to a low perception of quality of life and well-being [58, 59].

In detail, our findings showed that among men, for each increase in standard deviation (SD) of loneliness, the chance of an increase in depression was approximately 5.7 times higher. After controlling for covariates (i.e., age, years of education, age, family partner, comorbidities), the chances of experiencing depression were reduced to 3.6 times higher. In the case of women, for each increase in the standard deviation (SD) of loneliness, the chance of an increase in depression was approximately 4.7 times higher. After controlling for confounding factors (i.e., age, years of education, family partner, comorbidities), the chances of having depression were reduced, but still 3.3 times greater. However, subsequent analyses showed that this result did not differ significantly from women. On the other hand, a current study revealed that older Austrian women with higher levels of loneliness, at a given time, showed an accelerated increase in depressive symptomatology's two weeks later, but the same was not observed in men [62]. In the USA, a positive and significant association was found between depression and loneliness for women, but not for men [63]. Therefore, it is necessary that more investigations are carried out to investigate in more depth different underlying factors of loneliness and depression in older men and women from the 26 European countries included in the present study.

Association analyses revealed that the higher the MIL score, the greater the chances of a reduction in depression. With this finding we confirm H_4 . In turn, men and women who reported having suffered MIL sometimes had an odds of depression reduction of 47% and 63%, respectively. While, men and women who reported having frequent MIL, the odds of not developing depression were considerably higher, 79% and 81%, respectively. Notably, the values were higher among women, suggesting that increasing MIL may be an effective complement in the treatment of depression symptomatology in this group. Over the years, different studies have detailed the benefits of high MIL scores in depressed individuals [27, 64, 65]. Among the benefits that high levels of MIL offer for mental health are the experience of less stress-related distress and fewer repetitive negative thoughts [66].

According to the mediation analysis, when inserting the MIL variable as a mediator simultaneously with loneliness and depression controlled for confounding factors (i.e., age, years of education, partner in household, and comorbidities), the direct and total effects of the trajectory between loneliness and depression ($x - y$) remained significant. This result confirms our H_5 . Thus, the mediation analysis reiterated that loneliness has

a negative relationship with MIL, with equal values for men and women and a positive relationship with depression. On the other hand, MIL negatively affected depression in both genders, with no statistically significant difference regarding the mediation effect. Hence, we did not corroborate H_6 .

Our results were in line with a study that evaluated the association of loneliness with MIL. The study used a multivariate network approach, specifically resting-state fMRI functional connectivity, finding a negative association between the two [67]. Although loneliness negatively affected neural functions, high MIL values modulated connectivity between limbic networks, benefiting their functioning pattern. The results corroborated the fact that loneliness is related to lower levels of MIL, which consequently leads the individual to develop depressive behavior [24, 68]. The negative relationship between MIL and depression highlights the link between depression and existential vacuum [69], specifically the loss of vital interests and lack of initiative and proactivity, which are triggers for feelings of inner emptiness and meaninglessness. Viktor Frankl [33] titled the lack of meaning as the neurotic triad or existential neurosis, and highlighted that, when it is not treated, it can lead to depression, as well as addictions and aggression.

Finally, although the association of MIL with depression was greater in women, the comparative analysis between the mediation models of men and women indicated no differences in the mediating effect of MIL on the relationship between loneliness and depression. Based on this result, our H_6 was not supported. The finding did not rule out the moderating role that MIL played in the relationship between loneliness and depression. In particular, results suggested that MIL has the potential to benefit the mental health of both men and women [25, 65].

Implications for public health policies and practices

Social disconnection responsible for MIL has been declared by the World Health Organization to be a serious and growing public health crisis [70]. And if that isn't enough, several mental disorders, including depression, are also a global health concern [1]. Especially after the end of the COVID-19 pandemic [66, 67], high levels of loneliness and depression are an alert for the need to implement measures that monitor the mental health of the assessed population [70, 71]. Thus, our findings suggested that elevated MIL levels may function as a strategy to mitigate loneliness and depression in men and women over 50 years. Among the strategies is the creation of social and mental support networks so that individuals recognize reasons for being alive. Consequently, they would feel satisfaction in experiencing the present moment, which would then be followed by good expectations for the future. Therefore, these measures must promote happiness and positive affect, leading to less psychological suffering and negative affect. In relation to the older population, specific policies that promote digital inclusion may be useful [72], in addition to those that favor the integration of the individual into society (i.e., socialization groups, intergenerational activities, regular sports, tourism, culture, late-life learning). Furthermore, strengthening MIL can also be achieved by showing older adults that they are not marginalized in the political decisions of their community and country. Therefore, it would be important to create communities that are more friendly to older adults, with better accessibility to the environment and transport, including the learning of new information and communication technologies [2].

Strengths, limitations, and future directions

Among the strengths of the present study is the inclusion of a large sample of citizens aged 50 and over living in 26 European countries and Israel. Furthermore, the analyses were differentiated according to sex. On the other hand, the study has limitations: First, causal associations were limited due to the correlational cross-sectional design. Second, we could not detail the type of meaning participants attributed to their lives: each individual or culture individually constructs the meaning of their own life. Third, although we controlled the analyses for age and comorbidities, the range was 50 to 103 years. This may have generated bias in the analyses, since each age group may tend to experience different MIL feelings due to physical, mental, and cognitive health status [73, 74]. Fourth, although all data collected were obtained using validated and internationally recognized scales, they consisted of self-reports. Thus, there may have been discrepancies between what participants believed they were doing or feeling and what they reported or felt. Fifth, analyses did not include the presence or absence of psychiatric history or pharmacotherapy, as this information was not present in the SHARE database. The presence or absence of a previous psychiatric diagnosis can favor the association of loneliness with depression, and loneliness can act as a trigger to favor a depressive relapse [15, 75]. Sixth, the variables included as confounding factors did not cover the range of agents involved in aging, loneliness and depression. Seventh, the results obtained cannot be generalized to populations from other European countries not included in the study, as well as outside the European continent. Eighth, considering the cross-sectional design adopted, the possibility of reverse causality between the variables of interest, as well as bidirectional effects, must be considered.

Based on the described limitations, we propose the following advancements for future research avenues: a) We expand the understanding of the causal associations between loneliness, depression and MIL over time, with special interest in individuals over 50, with outcomes differentiated according to gender, b) Focus on understanding the culturally specific meanings that individuals attribute to their lives, c) Qualitative methodologies such as in-depth interviews or ethnographic studies can provide a broader understanding of how European cultural, social, and personal contexts shape MIL's perceptions and experiences in the older population, d) It is suggested that one compare more restricted age ranges to take into account possible variations in physical, mental, and cognitive health status. It would be interesting to replicate our analyses comparing data by different age groups, years of education, monthly income, level of physical activity, as well as different regions of Europe, e) In relation to the measures necessary to develop personalized interventions and support systems for the mental health of different populations, one could explore the effects of external stressors that possibly act on the reported levels of loneliness, depression, and MIL in different countries, f) Our study did not aim to investigate the underlying factors of MIL. Thus, it is suggested that future investigations explore mechanisms that determine individuals' feelings of satisfaction with life. Perhaps this could help in the prevention and treatment of a series of mental illnesses, g) It would be interesting if future studies also explored the moderating role of MIL in the association between loneliness and depression, and h) It would be useful to include populations outside the European continent and also include regions from the Global South to achieve a more comprehensive understanding of the generalizability of the results around the world. By exploring the role of cultural, social, and regional differences, researchers can broaden the scope of study implications and better inform the development of culturally sensitive interventions capable of promoting mental well-being among older adults around the world.

Conclusions

MIL proved to be a significant mediator of the relationship between loneliness and depression, while loneliness and depression strengthened each other. Individuals who reported feeling MIL sometimes or frequently had a higher chance of reducing depression and loneliness. When we compared the mediation analyses by gender, we found no significant differences in the role played by MIL in the relationship between loneliness and depression. It is suggested that there is a need to implement personalized interventions and support systems that promote and increase MIL levels in the older population in Europe. Strengthening the self in relation to the different meanings of life, and expanding social connections, is fundamental to improving mental health and well-being. Our results can serve as a warning about the mental health status of the older population in the countries investigated. Understanding individual differences is crucial to developing effective policies and monitoring interventions that can help combat loneliness and depression in adulthood.

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Declarations

Ethics approval and consent to participate The SHARE protocol was approved by the Ethics Committee of the University of Mannheim and by the Ethics Council of the Max-Planck-Society for the Advancement of Science, verifying the procedures to guarantee confidentiality and data privacy.

Conflict of Interest The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Competing interests The authors declare that they have no competing interests.

References

1. WHO-World Health Organization. Depression and other common mental disorders: global health estimates. Switzerland Geneva; 2017.
2. WHO-World Health Organization. Advocacy brief: Social isolation and loneliness among older people. Switzerland Geneva; 2021.
3. Chawla K, Kunonga TP, Stow D, Barker R, Craig D, Hanratty B. Prevalence of loneliness amongst older people in high-income countries: A systematic review and meta-analysis. *PLoS One*. 2021;16:e0255088. <https://doi.org/10.1371/journal.pone.0255088>.
4. Surkalim DL, Luo M, Eres R, Gebel K, van Buskirk J, Bauman A, et al. The prevalence of loneliness across 113 countries: systematic review and meta-analysis. *BMJ*. 2022;376:e067068. <https://doi.org/10.1136/bmj-2021-067068>.

5. Shiovitz-Ezra S, Ayalon L. Situational versus chronic loneliness as risk factors for all-cause mortality. *Int Psychogeriatrics*. 2010;22:455–62. <https://doi.org/10.1017/S1041610209991426>.
6. Saporta N, Scheele D, Lieberz J, Stuhr-Wulff F, Hurlemann R, Shamay-Tsoory SG. Opposing Association of Situational and Chronic Loneliness with Interpersonal Distance. *Brain Sci*. 2021;11:1135. <https://doi.org/10.3390/brainsci11091135>.
7. Qualter P, Vanhalst J, Harris R, Van Roekel E, Lodder G, Bangee M, et al. Loneliness Across the Life Span. *Perspect Psychol Sci*. 2015;10:250–64. <https://doi.org/10.1177/1745691615568999>.
8. Hawkey LC, Buecker S, Kaiser T, Luhmann M. Loneliness from young adulthood to old age: Explaining age differences in loneliness. *Int J Behav Dev*. 2022;46:39–49. <https://doi.org/10.1177/0165025420971048>.
9. Lasgaard M, Friis K, Shevlin M. “Where are all the lonely people?” A population-based study of high-risk groups across the life span. *Soc Psychiatry Psychiatr Epidemiol*. 2016;51:1373–84. <https://doi.org/10.1007/s00127-016-1279-3>.
10. 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*. 2015;19:409–17. <https://doi.org/10.1080/13607863.2014.944091>.
11. Beal C. Loneliness in older qome: A Review of the Literature. *Issues Ment Health Nurs*. 2006;27:795–813. <https://doi.org/10.1080/01612840600781196>.
12. Derry HM, Padin AC, Kuo JL, Hughes S, Kiecolt-Glaser JK. Sex Differences in Depression: Does Inflammation Play a Role? *Curr Psychiatry Rep*. 2015;17:78. <https://doi.org/10.1007/s11920-015-0618-5>.
13. Spiegel TJ. Loneliness and Mood. *Topoi*. 2023. <https://doi.org/10.1007/s11245-023-09937-y>.
14. Lim MH, Eres R, Vasani S. Understanding loneliness in the twenty-first century: an update on correlates, risk factors, and potential solutions. *Soc Psychiatry Psychiatr Epidemiol*. 2020;55:793–810. <https://doi.org/10.1007/s00127-020-01889-7>.
15. Erzen E, Çikrikci Ö. The effect of loneliness on depression: A meta-analysis. *Int J Soc Psychiatry*. 2018;64:427–35. <https://doi.org/10.1177/0020764018776349>.
16. James SL, Abate D, Abate KH, Abay SM, Abbafati C, Abbasi N, et al. Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. *Lancet*. 2018;392:1789–858. [https://doi.org/10.1016/S0140-6736\(18\)32279-7](https://doi.org/10.1016/S0140-6736(18)32279-7).
17. Gilman SE, Sucha E, Kingsbury M, Horton NJ, Murphy JM, Colman I. Depression and mortality in a longitudinal study: 1952–2011. *CMAJ*. 2017;189:E1304–10. <https://doi.org/10.1503/cmaj.170125>.
18. Vos T, Lim SS, Abbafati C, Abbas KM, Abbasi M, Abbasifard M, et al. Global burden of 369 diseases and injuries in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. *Lancet*. 2020;396:1204–22. [https://doi.org/10.1016/S0140-6736\(20\)30925-9](https://doi.org/10.1016/S0140-6736(20)30925-9).
19. Girgus JS, Yang K. Gender and depression. *Curr Opin Psychol*. 2015;4:53–60. <https://doi.org/10.1016/j.copsyc.2015.01.019>.
20. Zhao L, Han G, Zhao Y, Jin Y, Ge T, Yang W, et al. Gender Differences in Depression: Evidence From Genetics. *Front Genet*. 2020;11:562316. <https://doi.org/10.3389/fgene.2020.562316>.
21. Bracke P, Delaruelle K, Dereuddre R, Van de Velde S. Depression in women and men, cumulative disadvantage and gender inequality in 29 European countries. *Soc Sci Med*. 2020;267:113354. <https://doi.org/10.1016/j.socscimed.2020.113354>.
22. Lee SL, Pearce E, Ajnakina O, Johnson S, Lewis G, Mann F, et al. The association between loneliness and depressive symptoms among adults aged 50 years and older: a 12-year population-based cohort study. *The Lancet Psychiatry*. 2021;8:48–57. [https://doi.org/10.1016/S2215-0366\(20\)30383-7](https://doi.org/10.1016/S2215-0366(20)30383-7).
23. Holvast F, Burger H, de Waal MMW, van Marwijk HWJ, Comijs HC, Verhaak PFM. Loneliness is associated with poor prognosis in late-life depression: Longitudinal analysis of the Netherlands study of depression in older persons. *J Affect Disord*. 2015;185:1–7. <https://doi.org/10.1016/j.jad.2015.06.036>.
24. Macià D, Cattaneo G, Solana J, Tormos JM, Pascual-Leone A, Bartrés-Faz D. Meaning in Life: A Major Predictive Factor for Loneliness Comparable to Health Status and Social Connectedness. *Front Psychol*. 2021;12:1–12. <https://doi.org/10.3389/fpsyg.2021.627547>.
25. Glaw X, Kable A, Hazelton M, Inder K. Meaning in Life and Meaning of Life in Mental Health Care: An Integrative Literature Review. *Issues Ment Health Nurs*. 2016;38:1–13. <https://doi.org/10.1080/01612840.2016.1253804>.
26. King LA, Hicks JA. The Science of Meaning in Life. *Annu Rev Psychol*. 2021;72:561–84. <https://doi.org/10.1146/annurev-psych-072420-122921>.

27. Van der Heyden K, Dezutter J, Beyers W. Meaning in Life and depressive symptoms: a person-oriented approach in residential and community-dwelling older adults. *Aging Ment Health*. 2015;19:1063–70. <https://doi.org/10.1080/13607863.2014.995589>.
28. Martela F, Steger MF. The three meanings of meaning in life: Distinguishing coherence, purpose, and significance. *J Posit Psychol*. 2016;11:531–45. <https://doi.org/10.1080/17439760.2015.1137623>.
29. Steger MF. Experiencing meaning in life: optimal functioning at the nexus of spirituality, psychopathology, and well-being. The human quest for meaning. In: P. T. P. Wong, editor. *Hum. quest Mean*. 2nd ed., New York: Routledge; 2012, p. 165–84.
30. Heintzelman SJ, King LA. Life is pretty meaningful. *Am Psychol*. 2014;69:561–74. <https://doi.org/10.1037/a0035049>.
31. George LS, Park CL. Meaning in Life as Comprehension, Purpose, and Mattering: Toward Integration and New Research Questions. *Rev Gen Psychol*. 2016;20:205–20. <https://doi.org/10.1037/gpr0000077>.
32. Costin V, Vignoles VL. Meaning is about mattering: Evaluating coherence, purpose, and existential mattering as precursors of meaning in life judgments. *J Pers Soc Psychol*. 2020;118:864–84. <https://doi.org/10.1037/pspp0000225>.
33. Frankl VE. *The unheard cry for meaning Psychotherapy and humanism*. New York, N Y: Simon & Schuster; 2011.
34. Kim ES, Sun JK, Park N, Kubzansky LD, Peterson C. Purpose in life and reduced risk of myocardial infarction among older U.S. adults with coronary heart disease: a two-year follow-up. *J Behav Med*. 2013;36:124–33. <https://doi.org/10.1007/s10865-012-9406-4>.
35. Boyle PA, Buchman AS, Barnes LL, Bennett DA. Effect of a Purpose in Life on Risk of Incident Alzheimer Disease and Mild Cognitive Impairment in Community-Dwelling Older Persons. *Arch Gen Psychiatry*. 2010;67:304. <https://doi.org/10.1001/archgenpsychiatry.2009.208>.
36. Börsch-Supan A, Brandt M, Hunkler C, Kneip T, Korbmacher J, Malter F, et al. Data Resource Profile: The Survey of Health, Ageing and Retirement in Europe (SHARE). *Int J Epidemiol*. 2013;42:992–1001. <https://doi.org/10.1093/ije/dyt088>.
37. Hughes ME, Waite LJ, Hawkle LC, Cacioppo JT. A Short Scale for Measuring Loneliness in Large Surveys. *Res Aging*. 2004;26:655–72. <https://doi.org/10.1177/0164027504268574>.
38. World Health Organization (WHO). WHO-Ageing. 2022.
39. European Comision. Eurostat. Past and Future Population Ageing Trends in the EU. 2015. https://commission.europa.eu/statistics_en (accessed March 13, 2023).
40. Wiggins RD, Netuveli G, Hyde M, Higgs P, Blane D. The Evaluation of a Self-enumerated Scale of Quality of Life (CASP-19) in the Context of Research on Ageing: A Combination of Exploratory and Confirmatory Approaches. *Soc Indic Res*. 2008;89:61–77. <https://doi.org/10.1007/s11205-007-9220-5>.
41. Sutin AR, Luchetti M, Stephan Y, Terracciano A. Meaning in life and risk of cognitive impairment: A 9-Year prospective study in 14 countries. *Arch Gerontol Geriatr*. 2020;88:104033. <https://doi.org/10.1016/j.archger.2020.104033>.
42. Gallagher D, Savva GM, Kenny R, Lawlor BA. What predicts persistent depression in older adults across Europe? Utility of clinical and neuropsychological predictors from the SHARE study. *J Affect Disord*. 2013;147:192–7. <https://doi.org/10.1016/j.jad.2012.10.037>.
43. Prince MJ, Reischies F, Beekman AT, Fuhrer R, Jonker C, Kivela SL, Copeland JR. Development of the EURO-D scale – A European, Union initiative to compare symptoms of depression in 14 European centres. *Br J Psychiatry*. 1999;174:330–8.
44. Schneider SL. *The International Standard Classification of Education 2011*. Comp. Soc. Res., vol. 30, Emerald Group Publishing Limited; 2013, p. 365–79. [https://doi.org/10.1108/S0195-6310\(2013\)0000030017](https://doi.org/10.1108/S0195-6310(2013)0000030017).
45. Franceschi C, Garagnani P, Morsiani C, Conte M, Santoro A, Grignolio A, et al. The Continuum of Aging and Age-Related Diseases: Common Mechanisms but Different Rates. *Front Med*. 2018;5:61. <https://doi.org/10.3389/fmed.2018.00061>.
46. Hansen H, Schäfer I, Schön G, Riedel-Heller S, Gensichen J, Weyerer S, et al. Agreement between self-reported and general practitioner-reported chronic conditions among multimorbid patients in primary care - results of the MultiCare Cohort Study. *BMC Fam Pract*. 2014;15:39. <https://doi.org/10.1186/1471-2296-15-39>.
47. Hayes AF, Rockwood NJ. Regression-based statistical mediation and moderation analysis in clinical research: Observations, recommendations, and implementation. *Behav Res Ther*. 2017;98:39–57. <https://doi.org/10.1016/j.brat.2016.11.001>.
48. Hayes AF. *Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach 7 Second*. New York NY; 2018.
49. Ditlevsen S, Christensen U, Lynch J, Damsgaard MT, Keiding N. The Mediation Proportion. *Epidemiology*. 2005;16:114–20. <https://doi.org/10.1097/01.ede.00001471107.76079.07>.

50. Schenker N, Gentleman JF. On judging the significance of differences by examining the overlap between confidence intervals. *Am Stat.* 2001;55:182–6. <https://doi.org/10.1198/000313001317097960>.
51. Beutel ME, Klein EM, Brähler E, Reiner I, Jünger C, Michal M, et al. Loneliness in the general population: prevalence, determinants and relations to mental health. *BMC Psychiatry.* 2017;17:97. <https://doi.org/10.1186/s12888-017-1262-x>.
52. Victor CR, Rippon I, Quinn C, Nelis SM, Martyr A, Hart N, et al. The prevalence and predictors of loneliness in caregivers of people with dementia: findings from the IDEAL programme. *Aging Ment Health.* 2021;25:1232–8. <https://doi.org/10.1080/13607863.2020.1753014>.
53. Chang S-C, Pan A, Kawachi I, Okereke OI. Risk factors for late-life depression: A prospective cohort study among older women. *Prev Med (Baltim).* 2016;91:144–51. <https://doi.org/10.1016/j.ypmed.2016.08.014>.
54. Schmitz A. Gendered experiences of widowhood and depression across Europe. *J Affect Disord.* 2021;280:114–20. <https://doi.org/10.1016/j.jad.2020.11.091>.
55. Bernard M, Braunschweig G, Fegg MJ, Borasio GD. Meaning in life and perceived quality of life in Switzerland: results of a representative survey in the German, French and Italian regions. *Health Qual Life Outcomes.* 2015;13:160. <https://doi.org/10.1186/s12955-015-0353-y>.
56. Isaac R, Shah A. Sex Roles and Marital Adjustment in Indian Couples. *Int J Soc Psychiatry.* 2004;50:129–41. <https://doi.org/10.1177/0020764004040960>.
57. Calasanti T, Carr D, Homan P, Coan V. Gender Disparities in Life Satisfaction After Retirement: The Roles of Leisure, Family, and Finances. *Gerontologist.* 2021;61:1277–86. <https://doi.org/10.1093/geront/gnab015>.
58. Cheeta S, Beevers J, Chambers S, Szameitat A, Chandler C. Seeing sadness: Comorbid effects of loneliness and depression on emotional face processing. *Brain Behav.* 2021;11:1–9. <https://doi.org/10.1002/brb3.2189>.
59. Syed Elias SM, Neville C, Scott T. The effectiveness of group reminiscence therapy for loneliness, anxiety and depression in older adults in long-term care: A systematic review. *Geriatr Nurs (Minneapolis).* 2015;36:372–80. <https://doi.org/10.1016/j.gerinurse.2015.05.004>.
60. 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;21:140–51. <https://doi.org/10.1037/0882-7974.21.1.140>.
61. Deng M, Qian M, Lv J, Guo C, Yu M. The association between loneliness and sleep quality among older adults: A systematic review and meta-analysis. *Geriatr Nurs (Minneapolis).* 2023;49:94–100. <https://doi.org/10.1016/j.gerinurse.2022.11.013>.
62. Mayerl H, Schultz A, Freidl W, Stolz E. Short-term dynamics of loneliness and depressive symptoms: Gender differences in older adults. *Arch Gerontol Geriatr.* 2024;123:105423. <https://doi.org/10.1016/j.archger.2024.105423>.
63. Chang EC. Relationship between loneliness and symptoms of anxiety and depression in African American men and women: Evidence for gender as a moderator. *Pers Individ Dif.* 2018;120:138–43. <https://doi.org/10.1016/j.paid.2017.08.035>.
64. Beridze G, Ayala A, Ribeiro O, Fernández-Mayoralas G, Rodríguez-Blázquez C, Rodríguez-Rodríguez V, et al. Are Loneliness and Social Isolation Associated with Quality of Life in Older Adults? Insights from Northern and Southern Europe. *Int J Environ Res Public Health.* 2020;17:8637. <https://doi.org/10.3390/ijerph17228637>.
65. Vaughan L, Goveas J, Corbin A. Depression and frailty in later life: a systematic review. *Clin Interv Aging.* 2015;10:1947. <https://doi.org/10.2147/CIA.S69632>.
66. Ostafin BD, Proulx T. Meaning in life and resilience to stressors. *Anxiety, Stress Coping.* 2020;33:603–22. <https://doi.org/10.1080/10615806.2020.1800655>.
67. Mwilambwe-Tshilobo L, Ge T, Chong M, Ferguson MA, Mistic B, Burrow AL, et al. Loneliness and meaning in life are reflected in the intrinsic network architecture of the brain. *Soc Cogn Affect Neurosci.* 2019;14:423–33. <https://doi.org/10.1093/scan/nsz021>.
68. Maryam Hedayati MA, Mahmoud Khazaei MA. An Investigation of the Relationship between Depression, Meaning in Life and Adult Hope. *Procedia - Soc Behav Sci.* 2014;114:598–601. <https://doi.org/10.1016/j.sbspro.2013.12.753>.
69. Psarra E, Kleftharas G. Adaptation to Physical Disabilities: The Role of Meaning in Life and Depression. *Eur J Couns Psychol.* 2013;2:79–99. <https://doi.org/10.5964/ejcop.v2i1.7>.
70. Courtet P, Olié E, Debien C, Vaiva G. Keep Socially (but Not Physically) Connected and Carry on. *J Clin Psychiatry.* 2020;81(3):15527. <https://doi.org/10.4088/JCP.20com13370>.
71. Helm PJ, Jimenez T, Galgali MS, Edwards ME, Vail KE, Arndt J. Divergent effects of social media use on meaning in life via loneliness and existential isolation during the coronavirus pandemic. *J Soc Pers Relat.* 2022;39:1768–93. <https://doi.org/10.1177/02654075211066922>.

72. Welch V, Ghogomu ET, Barbeau VI, Boulton E, Boutin S, Haitas N, et al. PROTOCOL: Digital interventions to reduce social isolation and loneliness in older adults: An evidence and gap map. *Campbell Syst Rev.* 2022;19(4):e1369. <https://doi.org/10.1002/cl2.1260>.
73. Rajkumar RP. COVID-19 and mental health: A review of the existing literature. *Asian J Psychiatr.* 2020;52:102066. <https://doi.org/10.1016/j.ajp.2020.102066>.
74. Palgi Y, Shrira A, Ring L, Bodner E, Avidor S, Bergman Y, et al. The loneliness pandemic: Loneliness and other concomitants of depression, anxiety and their comorbidity during the COVID-19 outbreak. *J Affect Disord.* 2020;275:109–11. <https://doi.org/10.1016/j.jad.2020.06.036>.
75. Okruszek Ł, Aniszewska-Stańczuk A, Piejka A, Wiśniewska M, Żurek K. Safe but Lonely? Loneliness, Anxiety, and Depression Symptoms and COVID-19. *Front Psychol.* 2020;11:1–11. <https://doi.org/10.3389/fpsyg.2020.579181>.
76. Giné-Garriga M, Jerez-Roig J, Coll-Planas L, Skelton DA, Inzitari M, Booth J, et al. Is loneliness a predictor of the modern geriatric giants? Analysis from the survey of health, ageing, and retirement in Europe. *Maturitas.* 2021;144:93–101. <https://doi.org/10.1016/j.maturitas.2020.11.010>.
77. Niedzwiedz CL, Richardson EA, Tunstall H, Shortt NK, Mitchell RJ, Pearce JR. The relationship between wealth and loneliness among older people across Europe: Is social participation protective? *Prev Med (Baltim).* 2016;91:24–31. <https://doi.org/10.1016/j.ypmed.2016.07.016>.
78. Lorenzo EC, Kuchel GA, Kuo C-L, Moffitt TE, Diniz BS. Major depression and the biological hallmarks of aging. *Ageing Res Rev.* 2023;83:101805. <https://doi.org/10.1016/j.arr.2022.101805>.
79. O'Shea BQ, Finlay JM, Kler J, Joseph CA, Kobayashi LC. Loneliness Among US Adults Aged ≥ 55 Early in the COVID-19 Pandemic. *Public Health Rep.* 2021;136:754–64. <https://doi.org/10.1177/00333549211029965>.
80. Olsen CDH, Möller S, Ahrenfeldt LJ. Sex differences in quality of life and depressive symptoms among middle-aged and elderly Europeans: results from the SHARE survey. *Aging Ment Health.* 2023;27:35–42. <https://doi.org/10.1080/13607863.2021.2013434>.
81. Acciai F, Hardy M. Depression in later life: A closer look at the gender gap. *Soc Sci Res.* 2017;68:163–75. <https://doi.org/10.1016/j.ssresearch.2017.08.003>.
82. Holt-Lunstad J, Smith TB, Baker M, Harris T, Stephenson D. Loneliness and Social Isolation as Risk Factors for Mortality. *Perspect Psychol Sci.* 2015;10:227–37. <https://doi.org/10.1177/1745691614568352>.
83. Miller ED. Loneliness in the Era of COVID-19. *Front Psychol.* 2020;11:18–20. <https://doi.org/10.3389/fpsyg.2020.02219>.
84. Steger MF, Oishi S, Kashdan TB. Meaning in life across the life span: Levels and correlates of meaning in life from emerging adulthood to older adulthood. *J Posit Psychol.* 2009;4:43–52. <https://doi.org/10.1080/17439760802303127>.
85. Hooker SA, Masters KS, Park CL. A Meaningful Life is a Healthy Life: A Conceptual Model Linking Meaning and Meaning Salience to Health. *Rev Gen Psychol.* 2018;22:11–24. <https://doi.org/10.1037/gpr0000115>.
86. Ahadi B, Hassani B. Loneliness and Quality of Life in Older Adults: The Mediating Role of Depression. *Ageing Int.* 2021;46:337–50. <https://doi.org/10.1007/s12126-021-09408-y>.

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