Loneliness and Health: The Moderating Effect of Cross-cultural Individualism/Collectivism

Abstract

Objectives: The adverse health effects of loneliness are well documented, but less is known about cultural moderators of this relationship. Contributing to the literature we examined whether cross-cultural differences in individualism moderate the effect of loneliness on health.

Methods: We used population-based longitudinal data of 14 countries (N = 40797), as provided by the SHARE data. Multilevel regression analyses were employed. Moderating effects were analyzed for multiple health outcomes: ADL, IADL, grip strength, life satisfaction, depression, memory performance, verbal fluency, and numeracy.

Results: Cultural individualism significantly moderated the effect of loneliness on health regarding most health outcomes. In general, the effect of loneliness on health became stronger in less individualistic / more collectivistic countries.

Discussion: Cultural individualism proved to be one important moderator of the loneliness-health relationship. As previous studies mostly used samples from highly individualistic countries, the current literature might severely underestimate the global public health burden of loneliness.

Keywords: Loneliness; Collectivism; Individualism; Health; Cross-cultural

Loneliness and Health: The Moderating Effect of Cross-cultural Individualism/Collectivism

Loneliness is the subjective feeling of having inadequate social relationships (Hawkley & Cacioppo, 2010). Loneliness, as the *subjective* aspect of an individual's social connectedness, has thus to be distinguished from social isolation, which represents an individual's objective social connectedness (Valtorta et al., 2016). Whereas transient feelings of loneliness are common and pose little harm, severe and chronic feelings of loneliness represent a major health risk (Rico-Uribe, Caballero, Martin-Maria, Cabello, Ayuso-Mateos & Miret, 2018; Holt-Lunstad, Smith, Baker, Harris, & Stephenson, 2015; Cacioppo & Cacioppo, 2014; Beller & Wagner, 2017). Loneliness is argued to be a central factor to overall health and well-being of people of all age groups (Hawkley & Cacioppo, 2010). However, older adults seem to suffer from loneliness the most: The prevalence of loneliness has been found to generally increase with age (Yang & Victor, 2011). Loneliness negatively impacts nearly every aspect of health, including physical, cognitive and mental health (Beller & Wagner, 2017). For example, via several inter-related pathways of diminished health behaviors, reduced sleep quality, neurobiological dysregulation, and reduced immune functioning (Hawkley & Cacioppo, 2010; Cacioppo et al., 2002), loneliness has been linked to outcomes such as depression (Liu et al., 2016; Luo, Hawkley, Waite & Cacioppo, 2012; Cacioppo, Hughes, Waite, Hawkley & Thisted, 2006), Alzheimer's disease (Wilson et al., 2007), hypertension (Sorkin, Rook & Lu, 2002), and mortality (e.g. Beller & Wagner, 2018).

Loneliness is thought to arise by evaluating one's subjective social connectedness unfavorably against culturally determined norms and values (Peplau & Perlman, 1982; Weiss,

1973; Holt-Lunstad, 2018; Swader, 2019). One such cultural dimension that might be associated with loneliness is individualism vs collectivism (IDV-COLL) (Hofstede, 2011). IDV-COLL as a cultural dimension represents the degree to which people in a society are integrated into groups. Following Hofstede, people in cultures at the individualistic end of the scale are focused on the individual. They emphasize self-expression, pursue individuality over group goals, and are satisfied with loose social networks (Hofstede, 2011). People in cultures on the collectivistic end of the scale, on the other hand, are focused on the group, value groups over individuality and prefer to be integrated into tightly knit social networks. Correspondingly, studies have found that older adults in the more collectivistic southern and eastern European countries report higher levels of loneliness than older adults living in the more individualistic northern Europe (Yang, & Victor, 2011; Fokkema, de Jong Gierveld & Dykstra, 2012). Similarly, on a community level, Jylhä and Jokela (1990) found that older adults living alone were more likely to experience loneliness when their surrounding social system was characterized by communality. Besides the emergence of loneliness, studies have also shown that the cultural context affects other aspects of the loneliness phenomenon. For example, coping strategies against loneliness seem to differ across cultures (Rokach, Bacanli & Ramberan, 2000). As another example, Lykes and Kemmelmeier (2014) found that predictors of loneliness differed according to culture: In individualistic societies loneliness seemed to be predicted mainly by a subjective lack of intimate friendships, whereas in collectivistic societies, lack of familial interactions were more important.

However, although moderators like age, gender and socio-economic status have been analyzed, no study to date has examined whether culture also influences the effect of loneliness on health. Such effects might even be expected (for a review of other moderators see National Academies of Sciences, Engineering, and Medicine, 2020): From a theoretical perspective, Holt-

Lunstad (2018) proposed a social ecological model of loneliness that explicitly includes societal factors like culture as being important in more fully understanding the loneliness-health relationship. From an empirical perspective, cultural variables have been repeatedly shown to moderate the effects of other constructs on health. For example, Hong-Hui and colleagues (2017) found that collectivism on an individual level strengthened the negative influence of social anxiety on mental health. And, in a recent study Miyamoto and colleagues (2013) found that the effect of negative emotions on inflammation differed between US-American and Japanese participants. Therefore, although culture has been shown to play an important role in the emergence of loneliness, and although it might be expected that culture also affects the effect of loneliness on health, no study to date has analyzed whether culture actually influences the loneliness-health relationship.

The current study strives to fill this gap in the literature. Using large representative samples of middle-aged and older adults from 14 countries (N = 40797; Austria, Belgium, Switzerland, Czech Republic, Germany, Denmark, Estonia, Spain, France, Israel, Italy, Luxembourg, Sweden and Slovenia), we examine whether culture moderates the effect of loneliness on health: Based on Hofstede's model of individualism-collectivism, we hypothesize that the effect of loneliness is stronger in low-individualistic/high-collectivistic societies. We ask: Does individualism-collectivism moderate the loneliness-health relationship?

Methods

Samples and Measures

Samples were taken from the public release of the Survey of Health, Ageing and Retirement in Europe (SHARE), which is a multidisciplinary longitudinal study on aging and provides

comparative data across Europe and Israel (Börsch-Supan et al., 2013). In general, population-based samples of the non-institutionalized population aged 50 and older are provided, mostly collected via multi-stage sampling. The countries themselves had to obtain funding to finance their sampling. Therefore, there are differences in the sampling process across countries and time periods. We used data from all participants of all countries that participated in both wave 5 (sampled in 2013) and wave 6 (sampled in 2017). In total, 14 countries (Austria, Belgium, Switzerland, Czech Republic, Germany, Denmark, Estonia, Spain, France, Israel, Italy, Luxembourg, Sweden and Slovenia) participated in both survey waves and a sample size of N = 40797 participants resulted, with a mean age of 68 years (about 57% female). Informed consent was obtained, and the SHARE data collection was approved by an ethics committee.

Given the strong correlations between independent measures of individualism and collectivism (r > 0.80), IDV-COLL is typically measured on one dimension (Fincher et al. 2008). Here, in accordance with large parts of the literature, cultural Individualism vs. Collectivism was operationalized using the published scores of Hofstede's Individualism Index (Hofstede, Hofstede & Minkov, 2010). Hofstede (1980) introduced the idea that cultural differences can be measured according to universal dimensions nearly 40 years ago, based on interview data of IBM employees located in different countries. Since then, several subsequent and independent analyses have confirmed the centrality of individualism-collectivism to cross-cultural differences (Oyserman et al., 2002; Schimmack et al., 2005; Hofstede., 2011). Societies high in the index are individualistic, whereas societies low in the index are collectivistic. Accordingly, the USA, Australia, United Kingdom and Netherlands are among the most individualistic countries and have high scores on this scale, whereas Guatemala, Ecuador, Panama and Venezuela are among the most collectivistic countries and have low scores. Data on the individualism-collectivism

scores for each country were obtained from the most recently published list of cultural dimension scores (Hofstede, Hofstede & Minkov, 2010). Further information on Hofstede's cultural dimensions, including the scores on the different value dimensions for each country, can be obtained from Hofstede and colleagues (2010).

Loneliness scores were retrieved from wave 5, the first SHARE wave to include a measure of loneliness. To assess loneliness, a short version of the Revised UCLA Loneliness scale (Hughes et al., 2004; Russell et al., 1978; Russell et al., 1980) was used consisting of three items (e.g., "How often do you feel isolated from others?"). The sum score of the scale was used. Indicators of physical, mental and cognitive health were operationalized from wave 6 and served as dependent variables. For physical health, the number of limitations with activities of daily living (ADL; e.g., whether participants were able to dress themselves), the number of limitations with instrumental activities of daily living (IADL; e.g., whether participants were able to prepare their own meals) and maximum grip strength (measured on a continuous scale by trained interviewers via a handheld dynamometer) were used. Depression and life satisfaction served as indicators of mental health and were measured using the EURO-D depression scale and CASP-12, respectively (Prince et al., 1999; Hyde et al., 2003). Regarding cognitive health, memory performance was assessed via a recall test where the participant is asked to recall a list of ten unrelated words immediately and after several minutes; verbal fluency was operationalized as the maximum number of many animal names the participants could verbalize within one minute; numeracy was operationalized via performance on a subtraction task. Additionally, we used age, gender, educational level (scored according to the International Standard Classification of Education) and the number of self-reported chronic conditions as covariates from wave 5.

Data Analysis

Correlation and multilevel regression analyses were conducted to determine possible effects of loneliness on physical, mental and cognitive health outcomes and whether the effect of loneliness on health outcomes was moderated by individualism. As covariates we included gender, age, education and number of chronic diseases in the regression analysis. In each multilevel regression model, loneliness, sampled from Wave 5, predicted one aspect of health, sampled from Wave 6, thus enabling the analysis of longitudinal effects. All analysis were conducted with R (R Core Team, 2013).

Results

Country-wise means and standard deviations are reported in Table 1. Loneliness was highest in the Czech Republic (M = 4.11), Italy (M = 4.06), and Estonia (M = 3.97). Loneliness was lowest in Denmark (M = 3.35), Switzerland (M = 3.45), and Austria (M = 3.46). Table 2 depicts the results of the cross-country correlation analyses and descriptive statistics: Loneliness of wave 5 correlated with every other variable, and was, in general, associated with worse health outcomes. The sizes of the correlations were small to medium of size. The strongest associations were found between loneliness and mental health outcomes (EURO-D: r = .33; CASP-12: r = -.36), followed by loneliness and physical health (ADL: r = .15; IADL: r = .18; Grip strength: r = -.15), and loneliness and cognitive health (Memory: r = -.12; Verbal fluency: r = -.13; Numeracy: r = -.12).

Table 3 depicts the results of the multilevel regression analyses controlling for gender, age, education, and the number of chronic diseases (Table A1 depicts the full results). Seconding the correlation analysis, loneliness predicted worse health for each of the eight outcomes (CASP-

12: β = -1.61; EURO-D: β = 0.55; Verbal fluency: β = -0.54; Grip strength: β = -0.50; IADL: β = 0.13; Memory: β = -0.12; Numeracy: β = -.10; ADL: β = 0.07). Additionally, significant interaction effects between loneliness and individualism emerged in six of the eight outcomes (with one p-value < .10). Only the interaction effects for grip strength and depression turned out to be non-significant. The resulting interaction effects are visualized in Figure 1. For ADL, IADL, Memory, Verbal Fluency and Numeracy the effect of loneliness decreased with higher individualism scores: The adverse effects of loneliness on health were weaker in more individualistic countries. The reverse was found in the case of life satisfaction. Here the effect of loneliness increased with higher individualism scores: The adverse effect of loneliness on life-satisfaction was stronger in more individualistic countries. Thus, apart from life satisfaction and the non-significant interaction terms, we found that the health effects of loneliness were weaker in more individualistic countries and stronger in more collectivistic countries.

Discussion

We asked whether the effect of loneliness on health is moderated by individualism. We found that loneliness predicted worse physical, mental and cognitive health for each outcome. Adding to the literature, we found that this effect was moderated by cultural individualism: The adverse effects of loneliness on health decreased with individualism for physical and cognitive health and increased with individualism for life satisfaction. Only in the case of grip strength and depression we found no significant interaction effect. Hence, in accordance with our hypothesis, the effect of loneliness on health appears to be culturally moderated: Loneliness' adverse effects on health are stronger in less individualistic/more collectivistic countries.

These results are in accordance with previous studies. As already stated in the introduction, loneliness has been extensively documented to harm health (Hawkley & Cacioppo, 2010). Our results have replicated this finding: Across 14 countries we found that loneliness longitudinally predicted worse health for every outcome analyzed in our study, including life satisfaction, depression, activities of daily living, instrumental activities of daily living, grip strength, numeracy, verbal fluency and memory. Thus, the current study replicates the finding that loneliness is a global health hazard with the potential to harm every aspect of health.

Going beyond previous studies, we found that individualism moderates this effect of loneliness on health. Some theories and empirical evidence regarding loneliness has suggested that cultural dimensions like individualism might influence important aspects of the loneliness phenomenon. For example, Holt-Lunstad (2018) proposed in her social ecological model of loneliness that cultural factors might moderate the loneliness-health relationship. Furthermore, Hong-Hui and colleagues (2017) found that the negative influence of social anxiety on mental health was increased by collectivism. However, empirical studies on the putatively moderating effect of individualism-collectivism in the case of loneliness and health had been missing. Consequently, we investigated whether individualism might also influence the effect of loneliness on health, which was confirmed by our results. Thus, the current study adds to the literature that cultural-societal factors seem to be important in determining the effect of loneliness on health. Thereby, this study also strongly supports theoretical frameworks that explicitly include macro levels of analysis like culture or time in their theoretical models of loneliness (e.g. Berkman, Glass, Brissette & Seeman, 2000; Holt-Lunstad, 2018).

Most importantly, these results imply that current research underestimates the impact of loneliness on health on a global scale. Multiple meta-analyses and reviews have quantified the

effect of loneliness to be comparable to other classical clinical risk factors like obesity, physical inactivity or smoking. However, the data on which these conclusions are drawn stem mostly from samples of the USA, United Kingdom, and Netherlands, which are among the most individualistic countries in the world. Thus, if the studied samples were more representative of the world population—by including more samples from countries with collectivistic cultures like Indonesia, Brazil, China, Venezuela, or India—one might expect meta-analyses and reviews to find substantially larger effects of loneliness on health. Perhaps the effect of loneliness on health even surpasses the effects of classical clinical risk factors like obesity or smoking. Thus, one important goal for future research is to examine this potentiality by studying the health hazard of loneliness in more diverse cultures.

Following the thought that the health hazard of loneliness might have been systematically underestimated, prevention and treatment of loneliness becomes a greater priority, especially in collectivistic countries. Given the importance of culture in the emergence of loneliness, perhaps culture-specific approaches are needed to best target loneliness. For example, following Lykes and Kemmelmeier (2014), older adults' loneliness in collectivistic countries might be more strongly relieved through contacts with family rather than through contacts with friends. Enlarging the social network as an intervention may therefore need to take into account the composition of the network with respect to predominant cultural values to reduce loneliness effectively.

There are several limitations to the current study. First, although the current study provided empirical evidence for moderation effects of culture in the relationship between loneliness and health, the current study cannot provide empirically verified explanations as to why these interaction effects occur. As such, future studies should investigate the mechanisms by

which individualism changes the effect of loneliness on health. For example, one might speculate that people from different cultures tend to have differential thresholds of loneliness. Transient feelings of loneliness are not dangerous to health, only intense and/or chronic feelings of loneliness are said to be a health hazard. Perhaps cultures differ, due to culturally determined norms and values, at which point the amount of loneliness becomes dangerous to health (Chung & Rimal, 2016; Beller, 2020). Another possible explanation for the observed interaction effects might be that the mechanisms by which loneliness impacts health differ between cultures. For example, as discussed in the introduction, coping strategies against loneliness differ between cultures (Rokach, Bacanli & Ramberan, 2000), which might lead to differential health hazard of loneliness across cultures. Clarifying these mechanisms might be especially important in the current case. While the adverse effects of loneliness were generally stronger in more collectivistic countries, the contrary was true in the case of life satisfaction. Here, the adverse effects of loneliness were stronger in more individualistic countries. One important avenue for future research is thus to explain these diverging effects.

Second, regarding the operationalization of our individualism variable, we used the model suggested by Hofstede, which is also preferentially used in the literature. However, there are other approaches, and future studies should test whether our results using country-level individualism can be replicated using these other, often individual level, operationalizations of individualism. One promising approach might be to employ the construct of independent and inter-dependent self-construals (Singelis, 1994). Based on our results loneliness should have stronger negative effects on health for individuals that emphasize connectedness and inter-dependence in their self-image.

Lastly, some limitations concern the generalizability of our results. Loneliness, individualism, and health are all subject to cross-temporal change (Beller et al., 2019; Beller & Epping, 2020; Hawkley et al., 2019; Hamamura, 2020; Santos et al., 2017). Therefore, it must be investigated to what extend the current results can be replicated in the future. Additionally, although we used a large, multi-national sample, this sample is still restricted to non-institutionalized older adults aged 50 years and older. Older adults might be especially prone to loneliness and its health effects and might hence be a good sample for this study (Choi et al., 2018). However, loneliness has been shown to be also especially relevant to younger adults' health. Consequently, future studies should examine whether our results can also be replicated in other samples, possibly including younger participants and including even more diverse countries.

Summing up, we found that cultural individualism moderated the effect of loneliness for 6 out of 8 analyzed outcomes. For the majority of these interaction effects, the negative health effects of loneliness got significantly stronger in less individualistic/more collectivistic countries. As loneliness is currently mostly studied in individualistic countries, these results suggest that current research likely underestimates the global health hazard of loneliness. Future studies should replicate and expand upon these results. It seems especially important to study the health effect of loneliness in more diverse cultures.

Citation Requirements

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Conflicting Interests

The Authors declare that there is no conflict of interest.

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Table 1

Means and standard deviation for loneliness and each health outcome within countries.

Country	N	Loneliness		ADL		IADL		Grip Strength		EURO-D		CASP-12		Memory		Verbal Fluency		Numeracy	
		M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Austria	2583	3.46	0.97	0.15	0.60	0.39	1.12	33.56	11.59	1.93	1.91	40.16	5.34	5.43	1.79	23.94	7.54	4.64	0.88
Belgium	3837	3.84	1.38	0.21	0.64	0.43	1.13	34.03	11.53	2.44	2.15	38.55	5.75	5.06	1.80	21.70	7.16	4.49	1.07
Switzerland	2415	3.45	0.97	0.09	0.40	0.19	0.71	34.19	11.19	1.85	1.75	40.90	4.68	5.41	1.72	21.93	6.85	4.56	0.98
Czech Republic	3753	4.11	1.33	0.19	0.66	0.35	1.02	33.48	10.74	2.08	1.99	35.76	5.22	5.06	1.70	23.97	7.86	4.44	1.08
Germany	3918	3.71	1.13	0.16	0.61	0.26	0.93	35.77	11.55	2.18	1.93	39.31	5.26	5.22	1.72	23.19	7.39	4.52	0.93
Denmark	3103	3.35	0.91	0.12	0.57	0.25	0.91	36.74	12.17	1.73	1.84	41.49	4.56	5.34	1.74	24.64	7.29	4.49	1.01
Estonia	3877	3.97	1.38	0.28	0.84	0.56	1.40	32.00	11.54	2.90	2.17	35.40	6.21	4.65	1.86	22.16	7.86	4.29	1.19
Spain	3976	3.59	1.20	0.15	0.68	0.37	1.24	29.04	10.78	2.24	2.43	36.33	6.17	3.68	1.73	16.61	6.61	3.03	1.96
France	2794	3.78	1.28	0.20	0.64	0.35	1.04	32.24	11.11	2.76	2.20	38.11	5.83	4.75	1.80	18.46	5.86	4.75	1.80
Israel	1170	3.88	1.44	0.22	0.82	0.57	1.55	28.50	10.42	2.21	2.28	35.31	5.84	4.90	1.72	20.65	8.33	4.23	1.35
Italy	3098	4.06	1.55	0.13	0.57	0.25	0.98	32.14	11.25	2.60	2.39	35.25	6.30	4.11	1.63	16.72	6.50	3.97	1.46
Luxemburg	973	3.81	1.30	0.13	0.58	0.27	1.04	34.18	11.27	2.32	2.06	39.93	5.34	5.27	1.85	19.42	6.39	4.44	1.10
Sweden	3134	3.56	1.05	0.11	0.47	0.22	0.75	34.78	11.68	1.88	1.77	39.68	4.96	4.96	1.72	23.55	7.20	4.46	1.01
Slovenia	2166	3.63	1.15	0.20	0.73	0.39	1.16	33.73	11.93	2.17	2.05	38.66	5.61	4.38	1.79	21.43	7.32	4.12	1.32

Notes. N = sample size; M = mean, *SD*= standard deviation.

Table 2

Means, standard deviations and correlations of loneliness, individualism and physical, mental and cognitive health outcomes across countries (N = 40797).

	M / %	SD	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1. Loneliness	3.74	1.25	-												
2. Individualism	63.47	12.19	0.01*	-											
3. ADL	0.17	0.64	0.15***	-0.02***	-										
4. IADL	0.34	1.08	0.18***	-0.04***	0.63***	-									
5. Grip strength	33.27	11.57	-0.15***	0.07***	-0.17***	-0.25***	-								
6. EURO-D	2.25	2.11	0.33***	0.01*	0.25***	0.29***	-0.26***	-							
7. CASP-12	38.07	5.94	-0.36***	0.08***	-0.25***	-0.31***	0.23***	-0.52***	-						
8. Memory	4.83	1.83	-0.12***	0.10***	-0.16***	-0.25***	0.18***	-0.17***	0.26***	-					
9. Verbal Fluency	21.42	7.67	-0.13***	0.02***	-0.15***	-0.22***	0.24***	-0.19***	0.26***	0.52***	-				
10. Numeracy	4.24	1.32	-0.12***	0.12***	-0.11***	-0.19***	0.22***	-0.19***	0.22***	0.39***	0.35***	-			
11. Gender (female)	56%	-	0.09***	-0.03***	0.02**	0.06***	-0.69***	0.18***	-0.06***	0.11***	0.01	-0.09***	-		
12. Age	68.03	9.59	0.09***	-0.03***	0.17***	0.27***	-0.33***	0.10***	-0.15***	-0.41***	-0.32***	-0.18***	-0.04***	-	
13. Education	2.96	1.48	-0.10***	0.08***	-0.09***	-0.12***	0.19***	-0.13***	0.23***	0.38***	0.38***	0.33***	-0.05***	-0.19***	-
14. Chronic illnesses	1.72	1.55	0.18***	-0.05***	0.27***	0.31***	-0.21***	0.32***	-0.31***	-0.18***	-0.16***	-0.12***	0.04***	0.28***	-0.13***

Notes. * $p < .05$; ** $p < .01$; *** $p < .001$.

Table 3

Multilevel regression results of loneliness and individualism predicting physical, mental and cognitive health (N = 40797).

Variable	*B*	95% CI	*β*	χ^2	*p*
DV: ADL (R^2 =.10)					
Loneliness	0.093	[0.067; 0.119]	0.065	431.619	< .001
Individualism	0.002	[0.000; 0.004]	-0.007	0.474	.491
Loneliness*Individualism	-0.001	[-0.001; 0.000]	-0.010	10.047	.002
DV: IADL (R^2 = .16)					
Loneliness	0.175	[0.133; 0.217]	0.131	650.732	< .001
Individualism	0.002	[-0.002; 0.007]	-0.025	1.017	.313
Loneliness*Individualism	-0.001	[-0.002; 0.000]	-0.017	11.178	< .001
DV: Grip strength (R^2 = .65)					
Loneliness	-0.263	[-0.557; 0.032]	-0.496	195.970	< .001
Individualism	0.036	[-0.046; 0.119]	0.347	0.483	.487
Loneliness*Individualism	-0.002	[-0.007; 0.002]	-0.032	0.830	.362
DV: EURO-D (R^2 = .21)					
Loneliness	0.376	[0.296; 0.455]	0.547	3182.619	< .001
Individualism	0.001	[-0.010; 0.013]	0.055	0.716	.398
Loneliness*Individualism	0.001	[0.000; 0.002]	0.013	1.984	.159
DV: CASP-12 (R^2 = .28)					
Loneliness	-0.902	[-1.126; -0.699]	-1.605	3922.287	< .001
Individualism	0.045	[-0.030; 0.117]	0.272	0.374	.541
Loneliness*Individualism	-0.006	[-0.009; -0.003]	-0.091	12.798	< .001
DV: Memory (R^2 = .30)					
Loneliness	-0.152	[-0.216; -0.087]	-0.121	240.809	< .001
Individualism	0.007	[-0.008; 0.021]	0.119	1.815	.178
Loneliness*Individualism	0.001	[0.000; 0.002]	0.013	2.954	.086
DV: Verbal fluency (R^2 = .26)					
Loneliness	-0.721	[-0.998; -0.444]	-0.539	257.295	< .001
Individualism	-0.021	[-0.110; 0.069]	-0.044	0.008	.931
Loneliness*Individualism	0.005	[0.000; 0.009]	0.070	4.456	.035
DV: Numeracy (R^2 = .17)					
Loneliness	-0.199	[-0.249; -0.149]	-0.104	288.026	< .001
Individualism	0.000	[-0.013; 0.014]	0.089	1.157	.282
Loneliness*Individualism	0.002	[0.001; 0.003]	0.028	21.471	< .001

Notes. All regression analyses have been corrected for sex, age, education, and number of chronic illnesses. *B* = regression coefficient; *95% CI* = 95% confidence interval of *B*; *β* = standardized regression coefficient; *χ2* = *χ2*-value of *B*; *p* = *p*-value of *B; DV* = dependent variable; R^2 = variance explained.

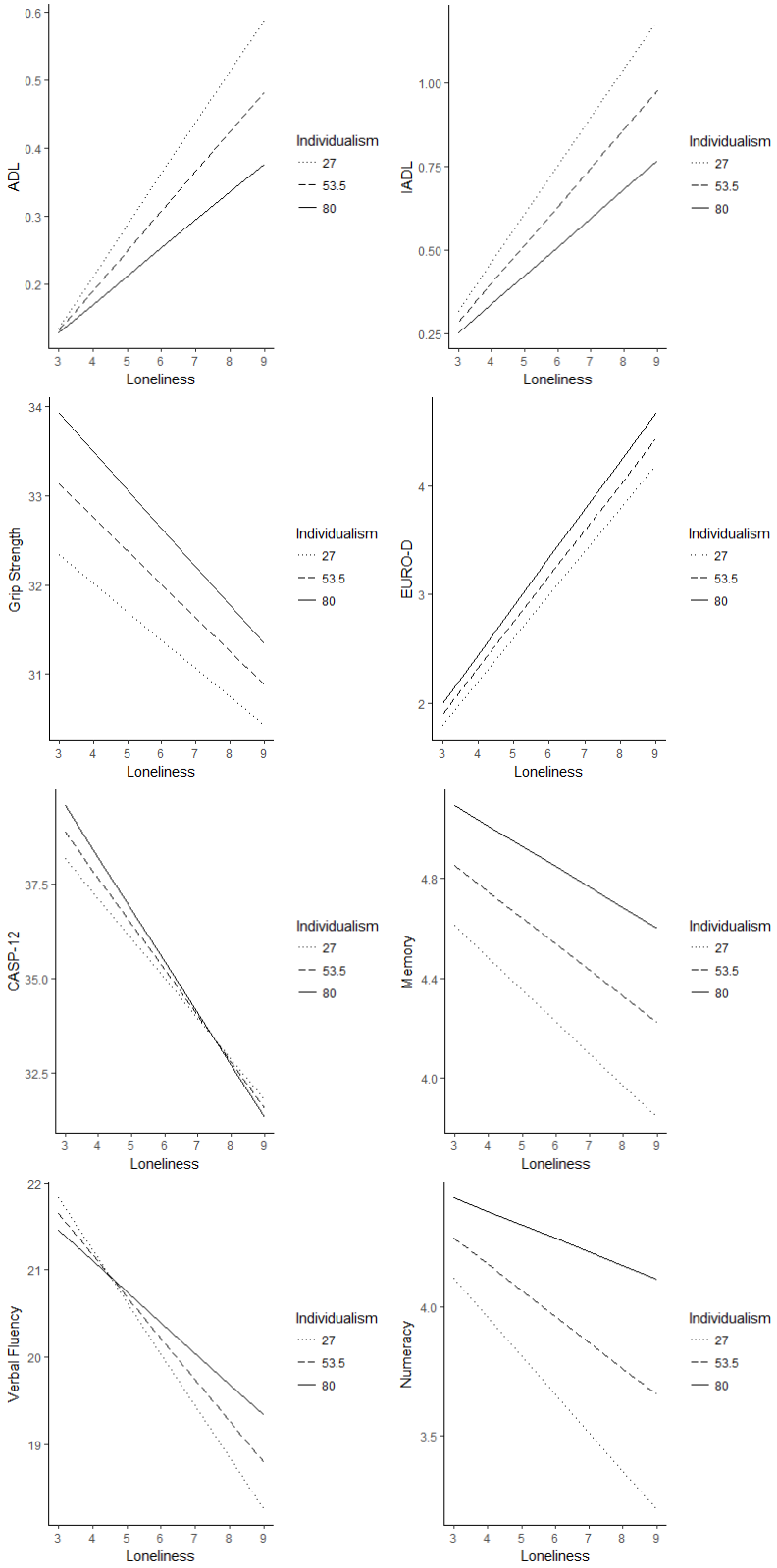

Figure 1. *Interaction effect plots of loneliness (N = 40797). In each panel, the effect of loneliness (x-axis) on a different aspect of health (y-axis) is displayed, with varying levels of Individualism.*

The straight line represents the effect of loneliness in low-individualism countries; the dashed line represents the effect of loneliness in average-individualism countries; and the dotted line represents the effect of loneliness in high-individualism countries.

APPENDIX

Table A1

Full multilevel regression results of loneliness, individualism, sex, age, education, and number of chronic illnesses predicting physical, mental and cognitive health (N = 40468).

Variable	*B*	95% CI	*β*	χ^2	*p*
DV: ADL (R^2 =.10)					
Loneliness	0.094	[0.068; 0.120]	0.065	425.847	< .001
Individualism	0.002	[0.000; 0.004]	-0.008	0.497	.481
Gender (female)	-0.005	[-0.017; 0.008]	-0.005	0.533	.465
Age	0.006	[0.006; 0.007]	0.059	326.771	< .001
Education	-0.020	[-0.024; -0.015]	-0.029	74.265	< .001
Chronic illnesses	0.090	[0.086; 0.094]	0.140	1853.483	< .001
Loneliness*Individualism	-0.001	[-0.001; 0.000]	-0.010	10.376	.001
DV: IADL (R^2 = .16)					
Loneliness	0.175	[0.133; 0.218]	0.131	645.162	< .001
Individualism	0.002	[-0.002; 0.007]	-0.025	1.046	.306
Gender (female)	0.082	[0.062; 0.101]	0.082	65.431	< .001
Age	0.023	[0.022; 0.024]	0.214	1629.385	< .001
Education	-0.043	[-0.05; -0.036]	-0.064	131.926	< .001
Chronic illnesses	0.154	[0.147; 0.161]	0.238	2032.063	< .001
Loneliness*Individualism	-0.001	[-0.002; 0.000]	-0.017	11.146	< .001
DV: Grip strength (R^2 = .65)					
Loneliness	-0.269	[-0.564; 0.026]	-0.494	192.418	< .001
Individualism	0.036	[-0.046; 0.118]	0.352	0.504	.478
Gender (female)	-16.237	[-16.374; -16.1]	-16.237	53920.487	< .001
Age	-0.404	[-0.412; -0.396]	-3.798	10729.618	< .001
Education	0.214	[0.163; 0.265]	0.318	68.137	< .001
Chronic illnesses	-0.578	[-0.625; -0.532]	-0.896	597.823	< .001
Loneliness*Individualism	-0.002	[-0.006; 0.003]	-0.030	0.724	.395
DV: EURO-D (R^2 = .21)					
Loneliness	0.377	[0.297; 0.456]	0.539	3139.389	< .001
Individualism	0.001	[-0.010; 0.013]	0.054	0.664	.415
Gender (female)	0.605	[0.568; 0.642]	0.605	1026.118	< .001
Age	0.000	[-0.002; 0.002]	-0.003	0.096	.756
Education	-0.089	[-0.102; -0.075]	-0.131	160.071	< .001
Chronic illnesses	0.349	[0.337; 0.362]	0.541	2986.819	< .001
Loneliness*Individualism	0.001	[0.000; 0.002]	0.013	1.839	.175
DV: CASP-12 (R^2 = .28)					
Loneliness	-0.913	[-1.126; -0.699]	-1.604	3879.754	< .001
Individualism	0.044	[-0.030; 0.117]	0.271	0.371	.543

Gender (female)	-0.123	[-0.222; -0.024]	-0.123	5.898	.015
Age	-0.023	[-0.028; -0.017]	-0.214	64.902	< .001
Education	0.441	[0.404; 0.478]	0.654	550.790	< .001
Chronic illnesses	-0.842	[-0.876; -0.808]	-1.304	2419.570	< .001
Loneliness*Individualism	-0.006	[-0.009; -0.003]	-0.088	11.942	< .001
DV: Memory (R^2 = .30)					
Loneliness	-0.154	[-0.218; -0.089]	-0.123	244.39	< .001
Individualism	0.007	[-0.008; 0.021]	0.120	1.812	.178
Gender (female)	0.417	[0.387; 0.447]	0.417	742.166	< .001
Age	-0.065	[-0.067; -0.063]	-0.611	5789.959	< .001
Education	0.318	[0.306; 0.329]	0.471	3123.287	< .001
Chronic illnesses	-0.058	[-0.068; -0.048]	-0.089	124.149	< .001
Loneliness*Individualism	0.001	[0.000; 0.002]	0.013	3.012	.083
DV: Verbal fluency (R^2 = .26)					
Loneliness	-0.735	[-1.012; -0.457]	-0.545	261.314	< .001
Individualism	-0.021	[-0.110; 0.069]	-0.039	0.006	.938
Gender (female)	0.185	[0.056; 0.314]	0.185	7.938	.005
Age	-0.206	[-0.214; -0.199]	-1.941	3167.627	< .001
Education	1.229	[1.181; 1.277]	1.823	2532.971	< .001
Chronic illnesses	-0.282	[-0.326; -0.239]	-0.437	160.994	< .001
Loneliness*Individualism	0.005	[0.000; 0.009]	0.072	4.717	.030
DV: Numeracy (R^2 = .17)					
Loneliness	-0.201	[-0.251; -0.150]	-0.104	284.417	< .001
Individualism	0.000	[-0.013; 0.014]	0.089	1.164	.281
Gender (female)	-0.194	[-0.217; -0.171]	-0.194	264.659	< .001
Age	-0.016	[-0.018; -0.015]	-0.152	594.753	< .001
Education	0.194	[0.185; 0.202]	0.287	1911.899	< .001
Chronic illnesses	-0.036	[-0.044; -0.029]	-0.056	81.628	< .001
Loneliness*Individualism	0.002	[0.001; 0.003]	0.028	22.271	< .001

Notes. *B* = regression coefficient; *95% CI* = 95% confidence interval of *B*; *β* = standardized regression coefficient; *χ2* = *χ2*-value of *B*; *p* = *p*-value of *B; DV* = dependent variable; R^2 = variance explained.

Table A2

Multilevel regression results of loneliness and individualism predicting physical, mental and cognitive health separately for women and men (N_{Women} = 22713, N_{Men} = 17755).

Variable	*B*	95% CI	*B*	95% CI
DV: ADL (R^2_{Women} =.10; R^2_{Men} = .08)				
Loneliness	0.076	[0.043; 0.110]	0.129	[0.087; 0.171]
Individualism	0.002	[-0.000; 0.004]	0.003	[0.000; 0.006]
Loneliness*Individualism	-0.000	[-0.001; 0.000]	-0.001	[-0.002; 0.000]
DV: IADL (R^2_{Women} = .18; R^2_{Men} = .12)				
Loneliness	0.208	[0.153; 0.268]	0.117	[0.049; 0.184]
Individualism	0.005	[0.000; 0.024]	-0.002	[-0.007; 0.003]
Loneliness*Individualism	-0.002	[-0.003; -0.001]	0.000	[-0.001; 0.001]
DV: Grip strength (R^2_{Women} = .32; R^2_{Men} = .36)				
Loneliness	-0.420	[-0.721; -0.120]	-0.472	[-1.050; 0.107]
Individualism	0.011	[-0.057; 0.080]	0.051	[-0.048; 0.150]
Loneliness*Individualism	0.002	[-0.003; 0.006]	-0.003	[-0.011; 0.006]
DV: EURO-D (R^2_{Women} = .20; R^2_{Men} = .16)				
Loneliness	0.480	[0.375; 0.585]	0.181	[0.057; 0.306]
Individualism	0.007	[-0.006; 0.020]	-0.009	[-0.021; 0.004]
Loneliness*Individualism	-0.001	[-0.002; 0.001]	0.004	[0.002; 0.005]
DV: CASP-12 (R^2_{Women} = .29; R^2_{Men} = .25)				
Loneliness	-1.194	[-1.462; -0.925]	-0.393	[-0.750; -0.037]
Individualism	0.029	[-0.045; 0.104]	0.069	[-0.008; 0.145]
Loneliness*Individualism	-0.002	[-0.006; 0.003]	-0.013	[-0.019; -0.008]
DV: Memory (R^2_{Women} = .32; R^2_{Men} = .26)				
Loneliness	-0.125	[-0.206; -0.044]	-0.176	[-0.283; -0.069]
Individualism	0.010	[-0.008; 0.028]	0.003	[-0.001; 0.016]
Loneliness*Individualism	0.001	[-0.001; 0.002]	0.001	[0.000; 0.003]
DV: Verbal fluency (R^2_{Women} = .30; R^2_{Men} = .21)				
Loneliness	-0.538	[-0.877; -0.199]	-1.060	[-1.539; -0.580]
Individualism	-0.014	[-0.110; 0.083]	-0.034	[-0.119; 0.051]
Loneliness*Individualism	0.003	[-0.003; 0.008]	0.008	[0.001; 0.016]
DV: Numeracy (R^2_{Women} = .20; R^2_{Men} = .13)				
Loneliness	-0.168	[-0.234; -0.102]	-0.240	[-0.319; -0.162]
Individualism	0.002	[-0.015; 0.019]	-0.001	[-0.011; 0.009]
Loneliness*Individualism	0.001	[0.000; 0.002]	0.003	[0.001; 0.004]

Notes. All regression analyses have been corrected for sex, age, education, and number of chronic illnesses. *B* = regression coefficient; *95% CI* = 95% confidence interval of *B*; β =

standardized regression coefficient; $\chi 2$ = $\chi 2$-value of *B*; *p* = *p*-value of *B; DV* = dependent variable; R^2 = variance explained.