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OPEN The association between loneliness and pain, and the role of physical health and distress: an analysis in 139 countries

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Loneliness has been found to be associated with high levels of physical pain, health problems, and poor mental health. Questions remain about how these factors are interrelated and how the relationships vary across sexes and the lifespan. Here, we used data from the 2023 and 2024 Gallup World Poll (GWP) to explore global associations between loneliness and physical pain, while accounting for health problems, and psychological distress. Our sample had data from 256,760 individuals aged 15–100 from 139 countries. Fully adjusted regressions showed that lonely individuals had 2.1 times higher odds of experiencing physical pain, had 1.8 times higher odds of having health problems, and were 25.8% more likely to experience distress than non-lonely ones. Demographic characteristics and satisfaction with social support and opportunities to meet people statistically accounted for 14% of the association between loneliness and pain. Health problems statistically accounted for 18.9% of the same association, whereas distress statistically accounted for 60.2%. In formal regression models, the associations between loneliness and pain were slightly more pronounced in females than males, but similar across ages. Our findings show a strong association between loneliness and physical pain, that was to a large degree statistically accounted for by psychological distress, and to a lesser extent by physical health, and socio-economic disadvantage. Importantly, these associations varied in strength across countries, pointing towards the importance of cultural factors. These findings shed light on the necessity for further cross-cultural and longitudinal research into the relationship among loneliness, pain, and distress.

Loneliness can be defined as an aversive state related to lack of belonging or the perceived difference between one's desired and actual social relationships^{1–3}. It is associated with poor physical and mental health^{4–6} including an increased risk for cardiovascular disease, diabetes⁷ stroke⁸ depression, anxiety, psychosis, suicidal ideation^{9,10} and mortality¹¹. In individuals with mental health disorders, loneliness predicts poorer clinical outcomes, suicidality, and longer treatment durations¹². As such, loneliness poses a significant burden to individuals and healthcare systems¹³ and it is now recognized as a health priority issue that affects individuals globally^{14–17}. The World Health Organization (WHO) and governments worldwide have launched efforts to investigate and address what has been described as a “pressing health threat”^{18–20}.

Loneliness is often described as a form of psychological pain and has been associated not only with aversive psychological states, but also with a higher likelihood of experiencing physical pain^{21–24}, an unpleasant sensory experience. Physical pain is typically associated with tissue damage. However, the biopsychosocial model views pain as more than a result of somatic inputs, highlighting the importance of psychological processes, such as perceived coping, affect, and contextual factors. It has been suggested that a person's social context can fundamentally alter how pain is experienced and expressed²⁵. Relevant aspects in the social context of pain may include the individual perceptions of loneliness, but also people's beliefs about how much support is available from their social connections, as well as perceived social opportunities²⁶. Loneliness, pain, and negative affect cluster together²⁷. Negative affect may reduce pain coping²⁸ and has been shown to increase feelings of loneliness¹⁰. Thus, the relationship of pain and loneliness might be, at least partly, accounted for by psychological distress. The identification of such associations can inform further research and interventions, highlighting the importance of examining individuals' perceptions of their social connections and psychological distress in relation to pain experiences.

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Loneliness has traditionally been viewed as a state that particularly affects individuals in old age²⁹. Yet, the available data are heterogeneous³⁰. Several studies showed higher loneliness levels in young adults and the oldest elderly, as compared to adults in mid adulthood and early old age^{31–33}. Importantly, variations in loneliness and related risk factors across the life span are thought to arise from age-specific social demands and societal contexts^{30,34}. For example, loneliness in young people may be due to challenging social transitions that lead to a lack of perceived belonging. Health and pain are also age-related phenomena^{35–37}. Thus, loneliness in the elderly may be more likely due to physical illness, pain and decreased mobility that impedes social interaction and/or the loss of loved ones^{32,38,39}. Accordingly, it is plausible that the associations between loneliness and pain change with age, across the life span. However, this has not yet been investigated.

Previous work in Canadian adolescents⁴⁰ and elderly Chinese individuals found no sex differences regarding the relationship between loneliness and pain³⁹. However, knowledge gaps remain for the wider adult life span. Sex differences might be particularly pronounced during reproductive years where such differences might arise from a multitude of factors, higher levels of sex-related physical illness in females, as well as genetic, hormonal, caring, and reproductive factors⁴¹. In addition, levels of pain in females also have been found to vary with economic recession⁴² suggesting that the differences in social contexts and social-economic inequalities that females face are likely to play a role⁴³. Importantly, the investigation of such sex-specific relationships can give insights about whether specific psycho-social interventions might be needed.

The aim of this cross-sectional analysis was to contribute to the understanding of the relationship between loneliness and pain across the adult life span and sexes. To contribute further to the understanding of the interrelationship between pain, health problems, and psychological distress⁴⁴ as defined by the biopsychosocial model^{45,46}, we also explored individual associations between these factors and the extent to which health problems and distress account for the link between loneliness and physical pain. In our regression models, we considered key aspects of satisfaction with social support and opportunities to meet people, as well as relevant demographic characteristics, including relationship status, individual-level deprivation, employment status, and household composition. Exploratory cross-cultural analyses are reported. The analyses were conducted in the nationally representative data from the Gallup World Poll (GWP) 2023 and 2024 from 139 countries and over 250,000 respondents. While this cross-sectional data does not allow us to establish causality, the analyses still address important knowledge gaps that can serve as further pointers for longitudinal and experimental research.

Results

In the full sample, 22.7% of respondents reported feeling lonely, 34.5% reported to have felt physical pain the previous day, 30.7% felt distressed, and 26.4% reported to have health problems that limited their day-to-day functioning. The mean age of the sample was 42.9 (s.d.= 18.07) years and 52.8% (s.d.= 49.9) of the sample were female (see Table S.1 in the SM). For global variations in pain, distress, health problems, and loneliness see Fig. S.1 in the SM.

Table 1 shows the demographic characteristics and descriptive statistics for physical pain, health problems, overall distress (a composite of worry, sadness, stress, and anger), for people who felt lonely a lot the previous day and those who did not. Those who reported a lot of loneliness were more likely to be single (32.4% vs. 29.8%), separated (4.4% vs. 2.4%), divorced (6.7% vs. 4.2%), or widowed (14.2% vs. 5.3%), to have elementary education (36.7% vs. 23.7%), to be unemployed (8.4% vs. 5.3%), to work part time wanting full time (11.1% vs. 7.7%), and to have lower personal income than those who did not feel lonely (\$8392 vs. \$11723). Lonely individuals were 22.8% more likely to experience physical pain (52.2% vs. 29.4%), 17.8% more likely to experience health problems (40.2% vs. 22.4%), and 29.4% more likely to feel distress (53.4% vs. 24%), constituted by higher levels of stress (57.5% vs. 30.2%), sadness (54.4% vs. 17.6%), worry (64.2% vs. 33.3%), and anger (37.3% vs. 15.1%). Moreover, lonely individuals were 14.3% less likely to report having friends or relatives to count on (69.1% vs. 83.4%) and were 11.3% less likely to be satisfied with opportunities to meet people than those who reported not to feel lonely (71.9% vs. 83.2%).

People who reported pain were more likely to be older, widowed or divorced, have a lower level of education, be out of the workforce, and have lower personal income. They were also 29.6% more likely to have health problems, 24.9% more likely to experience distress, constituted by higher levels of stress (24.7%), sadness (26.5%), worry (31.7%), and anger (16.8%). In addition, those who reported pain were 11% less likely to have friends to count on and 6.2% less likely to be satisfied with opportunities to meet people than those who reported not to feel pain (see Table S.2 in the SM).

Females experienced more loneliness, pain, distress, and negative emotions than men. Regarding age, older people were more likely to experience loneliness, pain, and health problems whereas middle-aged individuals (vs. younger and older) were more likely to experience distress and other negative emotions (see Table S.3 in the SM).

Tables 2, 3, 4, 5, 6 and 7 show binary logistic regressions with either physical pain or health problems as dependent variables and Ordinary Least Squares (OLS) regressions with distress as the dependent variable. All models included loneliness and satisfaction with social support as independent variables. These tables show the main coefficients. Models showing the coefficients for all the covariates can be found in Tables S.4 to S.9 in the SM. All results also held using OLS regressions which can be found in Tables S.10 to S.16 in the SM and multilevel models which can be found in Tables S.17 to S.23 in the SM.

Loneliness and its association with physical pain, health, and distress

We used binary logistic regressions to explore the association of loneliness with pain and health problems and OLS regressions to analyse the associations between loneliness, and distress.

Table 2 shows regressions that used physical pain as the dependent variable and loneliness as the main independent variable. People who reported to feel lonely a lot the previous day were more likely to report

Variable	Loneliness – yes (N=58,397)		Loneliness – no (N=198,363)		
	%	Std. Dev.	%	Std. Dev.	% difference
Physical pain	52.2	0.5	29.4	0.455	22.8
Health problems	40.2	0.49	22.4	0.417	17.8
Distress	53.4	0.35	24	0.291	29.4
Stress	57.5	0.494	30.2	0.459	27.3
Sadness	54.4	0.498	17.6	0.38	36.8
Worry	64.2	0.479	33.3	0.471	30.9
Anger	37.3	0.484	15.1	0.358	22.2
Having friends or relatives count on					
Yes	69.1	0.462	83.4	0.372	-14.3
Opportunities to meet people					
Satisfied	71.9	0.449	83.2	0.374	-11.3
Sex					
Female	54.2	0.498	52.5	0.499	1.7
Age group (years old)					
15–24	17	0.375	18.1	0.385	-1.1
25–34	20.7	0.405	20.9	0.406	-0.2
35–49	24.7	0.431	26.3	0.44	-1.6
50–64	19.8	0.399	20.1	0.401	-0.3
65–100	17.8	0.382	14.7	0.354	3.1
Marital status					
Single	32.4	0.468	29.8	0.458	2.6
Domestic partner	5.2	0.221	7.3	0.26	-2.1
Married	37.1	0.483	51	0.5	-13.9
Separated	4.4	0.206	2.4	0.153	2
Divorced	6.7	0.251	4.2	0.2	2.5
Widowed	14.2	0.349	5.3	0.224	8.9
Level of education					
Elementary	36.7	0.482	23.7	0.425	13
Secondary	49	0.5	53	0.499	-4
Tertiary	14.3	0.35	23.3	0.423	-9
Employment status					
Employed full time for an employer	22.6	0.418	31.9	0.466	-9.3
Employed full time for self	14.1	0.348	13.7	0.344	0.4
Employed part time want full time	11.1	0.314	7.7	0.266	3.4
Employed part time do not want full time	7.3	0.261	7.5	0.263	-0.2
Unemployed	8.4	0.277	5.3	0.225	3.1
Out of workforce	36.5	0.482	33.9	0.473	2.6
Personal income in US dollars	8392.179	113663.14	11723.619	59393.083	-3331.44
Children under 15 in the household	1.4	2.116	1.2	1.8	0.2

Table 1. % Yes by loneliness group, 139 countries, 2023 and 2024, $N=256,760$. All variables represent % of people except for income and number of children in the household which represent mean of number of US dollars and mean of number of children, respectively. Descriptive statistics for each variable in the full sample can be found in Table S.1.

physical pain than those who did not ($OR=2.404$, $\log OR=0.877$, $p<0.001$, $95\%CI[2.314, 2.497]$, column 1). This association held after individually controlling for demographic characteristics ($OR=2.217$, $p<0.001$, $95\%CI[2.143, 2.293]$, column 2), having friends or relatives to count on ($OR=2.166$, $p<0.001$, $95\%CI[2.093, 2.240]$, column 3), satisfaction with opportunities to meet people ($OR=2.168$, $p<0.001$, $95\%CI[2.096, 2.241]$, column 4), as well as all covariates together in the same regression ($OR=2.128$, $\log OR=0.755$, $p<0.001$, $95\%CI[2.057, 2.201]$, column 5). The controls reduced the log odds ratio of the main effect by 0.122. This suggests that demographic characteristics and satisfaction with social support and opportunity statistically account for 14% of the association between loneliness and pain.

Table 3 shows regressions that used health problems as the dependent variable and loneliness as the main independent variable. People who reported to feel lonely a lot the previous day were more likely to report health problems than those who did not ($OR=2.249$, $\log OR=0.810$, $p<0.001$, $95\%CI[2.153, 2.347]$, column 1). This

	Dependent variable: Physical pain (0–1)				
	(1)	(2)	(3)	(4)	(5)
Loneliness – Yes	2.404*** (0.047)	2.217*** (0.038)	2.166*** (0.037)	2.168*** (0.037)	2.128*** (0.037)
Having friends or relatives count on – Yes	-	-	0.748*** (0.011)	-	0.766*** (0.011)
Satisfied with opportunities to meet people – Yes	-	-	-	0.781*** (0.011)	0.804*** (0.011)
Country fixed effects	Yes	Yes	Yes	Yes	Yes
Personal characteristics	No	Yes	Yes	Yes	Yes
<i>N</i>	256,760	256,760	256,760	256,760	256,760
<i>Pseudo R</i> ²	0.063	0.093	0.095	0.094	0.096

Table 2. Physical pain and loneliness in 139 countries, 2023 and 2024. Binary logistic regressions. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Models show Odd Ratios (OR) from binary logistic regressions with standard errors clustered by country in parentheses. OR greater than 1 represent a positive relationship. OR smaller than 1 represent negative relationships. Mean physical pain = 0.35. Personal characteristics: Sex, age, age squared, marital status, level of education, employment status, log of personal income, and number of children under 15 in the household. Models 1, 2, 3, 4, and 5 represent different regression models to be read vertically. Full models can be found in Table S.4.

	Dependent variable: Health problems (0–1)				
	(1)	(2)	(3)	(4)	(5)
Loneliness – yes	2.249*** (0.049)	1.925*** (0.033)	1.883*** (0.032)	1.881*** (0.031)	1.849*** (0.031)
Having friends or relatives count on – Yes	-	-	0.769*** (0.015)	-	0.790*** (0.016)
Satisfied with opportunities to meet people – Yes	-	-	-	0.773*** (0.014)	0.793*** (0.014)
Country fixed effects	Yes	Yes	Yes	Yes	Yes
Personal characteristics	No	Yes	Yes	Yes	Yes
<i>N</i>	256,760	256,760	256,760	256,760	256,760
<i>Pseudo R</i> ²	0.051	0.152	0.153	0.153	0.154

Table 3. Health problems and loneliness in 139 countries, 2023 and 2024. Binary logistic regressions. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Models show Odd Ratios (OR) from binary logistic regressions with standard errors clustered by country in parentheses. OR greater than 1 represent a positive relationship. OR smaller than 1 represent negative relationships. Mean health problems = 0.26. Personal characteristics: Sex, age, age squared, marital status, level of education, employment status, log of personal income, and number of children under 15 in the household. Models 1, 2, 3, 4, and 5 represent different regression models to be read vertically. Full models can be found in Table S.5.

	Dependent variable: Distress (0–1)				
	(1)	(2)	(3)	(4)	(5)
Loneliness – Yes	0.275*** (0.005)	0.271*** (0.005)	0.264*** (0.005)	0.264*** (0.005)	0.258*** (0.005)
Having friends or relatives count on – Yes	-	-	-0.076*** (0.003)	-	-0.069*** (0.003)
Satisfied with opportunities to meet people – Yes	-	-	-	-0.073*** (0.002)	-0.066*** (0.002)
Country fixed effects	Yes	Yes	Yes	Yes	Yes
Personal characteristics	No	Yes	Yes	Yes	Yes
Constant	0.389*** (0.002)	0.304*** (0.008)	0.343*** (0.008)	0.346*** (0.008)	0.376*** (0.009)
<i>N</i>	256,760	256,760	256,760	256,760	256,760
<i>Adj. R</i> ²	0.182	0.202	0.209	0.209	0.215

Table 4. Distress and loneliness in 139 countries, 2023 and 2024. Linear probability models. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Models show unstandardized OLS coefficients with standard errors clustered by country in parentheses. Mean distress = 0.31. Personal characteristics: Sex, age, age squared, marital status, level of education, employment status, log of personal income, and number of children under 15 in the household. Models 1, 2, 3, 4, and 5 represent different regression models to be read vertically. Full models can be found in Table S.12.

	Dependent variable: Physical pain (0–1)					
	(1)	(2)	(3)	(4)	(5)	(6)
Loneliness – Yes	2.404*** (0.047)	2.037*** (0.035)	1.996*** (0.034)	1.958*** (0.033)	1.961*** (0.033)	1.931*** (0.033)
Health problems – Yes	-	4.049*** (0.109)	3.441*** (0.090)	3.415*** (0.089)	3.418*** (0.089)	3.398*** (0.089)
Having friends or relatives count on – Yes	-	-	-	0.782*** (0.011)	-	0.798*** (0.011)
Satisfied with opportunities to meet people – Yes	-	-	-	-	0.816*** (0.011)	0.836*** (0.012)
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Personal characteristics	No	No	Yes	Yes	Yes	Yes
N	256,760	256,760	256,760	256,760	256,760	256,760
Pseudo R ²	0.063	0.124	0.135	0.136	0.136	0.137

Table 5. Physical pain and loneliness adjusting for health problems in 139 countries, 2023 and 2024. Binary logistic regressions. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Models show Odd Ratios (OR) from binary logistic regressions with standard errors clustered by country in parentheses. OR greater than 1 represent a positive relationship. OR smaller than 1 represent negative relationships. Mean physical pain = 0.35. Personal characteristics: Sex, age, age squared, marital status, level of education, employment status, log of personal income, and number of children under 15 in the household. Models 1, 2, 3, 4, 5, and 6 represent different regression models to be read vertically. Full models can be found in Table S.6.

	Dependent variable: Physical pain (0–1)					
	(1)	(2)	(3)	(4)	(5)	(6)
Loneliness – Yes	2.404*** (0.047)	1.418*** (0.022)	1.296*** (0.017)	1.286*** (0.017)	1.288*** (0.016)	1.280*** (0.016)
Distress	-	8.503*** (0.289)	8.774*** (0.277)	8.633*** (0.273)	8.671*** (0.275)	8.554*** (0.272)
Having friends or relatives count on – Yes	-	-	-	0.868*** (0.012)	-	0.876*** (0.013)
Satisfied with opportunities to meet people – Yes	-	-	-	-	0.905*** (0.013)	0.917*** (0.013)
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
	No	No	Yes	Yes	Yes	Yes
N	256,760	256,760	256,760	256,760	256,760	256,760
Pseudo R ²	0.063	0.129	0.156	0.157	0.157	0.157

Table 6. Physical pain and loneliness adjusting for distress problems in 139 countries, 2023 and 2024. Binary logistic regressions. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Models show Odd Ratios (OR) from binary logistic regressions with standard errors clustered by country in parentheses. OR greater than 1 represent a positive relationship. OR smaller than 1 represent negative relationships. Mean physical pain = 0.35. Personal characteristics: Sex, age, age squared, marital status, level of education, employment status, log of personal income, and number of children under 15 in the household. Models 1, 2, 3, 4, 5, and 6 represent different regression models to be read vertically. Full models can be found in Table S.7.

association held after controlling for demographic characteristics ($OR = 1.925$, $p < 0.001$, 95%CI[1.862, 1.991], column 2), having friends and relatives to count on ($OR = 1.883$, $p < 0.001$, 95%CI[1.821, 1.946], column 3), satisfaction with opportunities to meet people ($OR = 1.881$, $p < 0.001$, 95%CI[1.821, 1.942], column 4), and all covariates together in the same regression ($OR = 1.849$, log OR = 0.615, $p < 0.001$, 95%CI[1.789, 1.909], column 5). The controls reduced the log odds ratio of the main effect by 0.196. That is, demographic characteristics, satisfaction with social support, and perceived opportunities statistically account for 24.2% of the association between loneliness and health problems.

Table 4 shows regressions that used distress as the dependent variable and loneliness as the main independent variable. Lonely people were also more likely to experience distress ($b = 0.275$, $p < 0.001$, 95%CI[0.266, 0.284], column 1) which held after controlling for demographic characteristics ($b = 0.271$, $p < 0.001$, 95%CI[0.261, 0.280], column 2), having friends or relatives to count on ($b = 0.264$, $p < 0.001$, 95%CI[0.254, 0.273], column 3), satisfaction with opportunities to meet people ($b = 0.264$, $p < 0.001$, 95%CI[0.254, 0.273], column 4), and all covariates together in the same regression ($b = 0.258$, $p < 0.001$, 95%CI[0.249, 0.267], column 5). Demographic factors and satisfaction with social support and opportunity statistically accounted for a comparatively small percentage (6.18%) of the association between loneliness and distress, reducing the coefficient by 0.017 in the fully adjusted regression (column 5).

It is worth noting that satisfaction with opportunities to meet people consistently did not statistically account for any variation in the main association across the models for reported physical pain, health problems, and distress. This can be seen by the unchanged loneliness coefficient between columns 3 and 4 across Tables 2, 3, 4.

	Dependent variable: physical pain (0–1)					
	(1)	(2)	(3)	(4)	(5)	(6)
Loneliness – yes	2.020*** (0.041)	1.845*** (0.037)	1.239*** (0.022)	2.003*** (0.074)	1.900*** (0.068)	1.107** (0.036)
Female	1.216*** (0.020)	1.214*** (0.020)	1.144*** (0.018)	1.246*** (0.020)	1.240*** (0.020)	1.162*** (0.017)
Loneliness – yes x female	1.101*** (0.025)	1.088*** (0.025)	1.062* (0.025)	-	-	-
Age	1.032*** (0.002)	1.021*** (0.002)	1.023*** (0.002)	1.031*** (0.002)	1.021*** (0.002)	1.022*** (0.002)
Loneliness – yes x age	-	-	-	1.001* (0.001)	1.000 (0.001)	1.003*** (0.001)
Health problems – yes	-	3.397*** (0.089)	-	-	3.397*** (0.089)	-
Distress	-	-	8.550*** (0.272)	-	-	8.574*** (0.274)
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
N	256,760	256,760	256,760	256,760	256,760	256,760
Pseudo R ²	0.096	0.137	0.157	0.096	0.137	0.157

Table 7. Physical pain and loneliness across sexes and age groups in 139 countries, 2023 and 2024. Binary logistic regressions. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Models show Odd Ratios (OR) from binary logistic regressions with standard errors clustered by country in parentheses. OR greater than 1 represent a positive relationship. OR smaller than 1 represent negative relationships. Mean physical pain = 0.35. Personal characteristics: Sex, age, age squared, marital status, level of education, employment status, log of personal income, and number of children under 15 in the household. Models 1, 2, 3, 4, 5, and 6 represent different regression models to be read vertically. All models account for having friends and relatives to count on and satisfaction with opportunities to meet people. Full models can be found in Table S.8.

Loneliness and its association with physical pain after accounting for other health problems

Table 5 shows the association between loneliness and physical pain after controlling for health problems. The main effect of loneliness without covariates reflects a significantly positive association ($OR = 2.404$, $\log OR = 0.877$, $p < 0.001$, 95%CI[2.314, 2.497], column 1) which held after controlling for health problems ($OR = 2.037$, $\log OR = 0.711$, $p < 0.001$, 95%CI[1.969, 2.106], column 2), demographic factors ($OR = 1.996$, $p < 0.001$, 95%CI[1.931, 2.063], column 3), having friends or relatives to count on ($OR = 1.958$, $p < 0.001$, 95%CI[1.894, 2.024], column 4), satisfaction with opportunities to meet people ($OR = 1.961$, $p < 0.001$, 95%CI[1.897, 2.026], column 5) and all covariates in the same model ($OR = 1.931$, $p < 0.001$, 95%CI[1.867, 1.995], column 6). Health problems statistically accounted for 18.9% of the association between loneliness and pain as the log odds ratio decreased from 0.877 in the model without covariates (column 1) to 0.711 in the model that controlled for health problems (column 2), showing a reduction of 0.166.

Table 6 shows the association between loneliness and physical pain after controlling for distress. Similarly, Column 1 shows the main effect of loneliness without covariates ($OR = 2.404$, $\log OR = 0.877$, $p < 0.001$, 95%CI[2.314, 2.497]) which held after controlling for distress ($OR = 1.418$, $\log OR = 0.349$, $p < 0.001$, 95%CI[1.374, 1.461], column 2), demographic factors ($OR = 1.296$, $p < 0.001$, 95%CI[1.264, 1.329], column 3), having friends or relatives to count on ($OR = 1.286$, $p < 0.001$, 95%CI[1.254, 1.319], column 4), satisfaction with opportunities to meet people ($OR = 1.288$, $p < 0.001$, 95%CI[1.256, 1.321], column 5) and all covariates in the same model ($OR = 1.280$, $p < 0.001$, 95%CI[1.248, 1.312], column 6). Distress statistically accounted for 60.2% of the association between loneliness and pain as the log odds ratio decreased from 0.877 in the model without covariates (column 1) to 0.349 in the model that controlled for distress (column 2), showing a reduction of 0.528.

Table 7 shows interaction terms between sex and loneliness and age and loneliness as predictors with physical pain as the dependent variable. Column 1 shows a positive interaction term between loneliness and being female ($OR = 1.101$, $p < 0.001$, 95%CI[1.053, 1.151]) which held after controlling for health problems ($OR = 1.088$, $p < 0.001$, 95%CI[1.041, 1.137], column 2) and distress ($OR = 1.062$, $p < 0.001$, 95%CI[1.014, 1.113], column 3). These results suggest that females who experience loneliness report greater pain than men who experience loneliness. Table 7 also shows interaction terms between loneliness and age which were significant after controlling for demographic and social support factors ($OR = 1.001$, $p = 0.045$, 95%CI[1.00, 1.002], column 4), insignificant after controlling for health problems ($OR = 1$, $p = 0.599$, 95%CI[0.998, 1.001], column 5), and significant after controlling for distress ($OR = 1.003$, $p < 0.001$, 95%CI[1.002, 1.004], column 6). However, the interaction coefficient between loneliness and age was almost negligible in all cases. Interactions between loneliness and age and loneliness and sex using health problems and distress as dependent variables provided similar conclusions and can be found in Tables S.9 and S.16 in the SM, respectively.

To shed light on the country-specific relationships between loneliness and each of the dependent variables, namely physical pain, health problems, and distress, we conducted fully adjusted regressions by country which are reported in the supplement (Table S.24–S.26 in SM).

Discussion

This study used a large sample of 256,760 individuals from 139 countries to investigate the relationship between loneliness and pain across sexes and the adult life span, considering the role of health problems, and psychological distress, as outlined by the biopsychosocial model of pain^{25,46}. The experience of loneliness was relatively common, with 22.7% of people reporting feeling lonely a lot the previous day. Lonely individuals were

more likely to report pain, health problems, and distress, including worry, sadness, stress, and anger, than those who did not feel lonely. In addition, lonely individuals were less likely to perceive that they had social support in form of friends or relatives to count on, or that they had sufficient opportunities to meet people. They were also more likely to be separated, divorced, or widowed, suggesting the impact of lost or lacking relationships and unmet social needs. Being lonely was associated with lower level of education, less employment than desired, and lower personal income. The association between loneliness and pain was largely accounted for by the experience of distress, whereas physical health and social characteristics seemed to play a smaller role. The patterns were more pronounced in females than males, but similar across ages, showing similar biopsychosocial influences on pain across the adult lifespan. The current findings highlight the importance of distress and psychological factors. While they cannot speak to causality, they show that loneliness, pain, and distress are statistically strongly interconnected phenomena that negatively affect a large proportion of the global population, even after consideration of self-reported physical health.

Loneliness and its characteristics

Loneliness was relatively stable across ages from 15 to 64 years, with on average 22.7% reporting feeling lonely a lot. Slightly more individuals in the oldest group aged 65 to 100 reported feeling lonely a lot, supporting that loneliness is a somewhat bigger concern in old age⁴⁷. Across all ages, similar levels of males and females reported that they felt lonely a lot (see Table S.3 in the SM for means of key variables across ages and sexes), which is aligned with findings from previous meta-analyses^{29,30,48}.

We found loneliness to be associated with factors that indicate subjective and objective social isolation on an individual level and social exclusion at the societal level. Lonely individuals were more likely to be single, separated, divorced, or widowed than non-lonely individuals. However, the differences were most pronounced for being married and widowed, suggesting a particular importance of the lack or loss of a life-partner or spouse. The number of children under 15 in the household was comparable, suggesting that a similar caregiving load is more likely faced alone by those who are lonely.

A relatively high percentage of 69.1% of lonely individuals reported having friends or relatives to count on. While this rate was lower than for non-lonely individuals, it shows that loneliness can occur even when social networks are generally perceived as supportive. Similar findings emerged regarding opportunities to meet people, where 71.9% of lonely individuals indicated that they were satisfied. Although again, this figure was substantially lower than in non-lonely individuals.

In terms of demographic and socio-economic characteristics, lonely individuals were more likely to have only elementary education. They were less often in full time employment, more likely to work part time wanting to work full time, to be unemployed or out of the workforce, and to have a lower average personal income than non-lonely individuals. This shows that the experience of loneliness is not only associated with lack or loss of individual social connections, but also with broader socio-economic factors that indicate social exclusion⁴⁹ as previously suggested by others^{47,50–54}. This highlights the importance of employment and socio-economic disadvantage for improving loneliness in the population.

In addition, loneliness co-occurred with different negative psychological and physical states. Slightly more than half of the lonely individuals compared to about a third of those who did not feel lonely reported physical pain. Health problems that interfered with functioning were less common than pain, however still affected 41% of lonely people, which was about double the rate observed in non-lonely individuals. Like pain, distress was reported by about half of the lonely individuals, while it was only the case for about a quarter of non-lonely individuals. Specifically, lonely individuals were much more likely to experience sadness, worry and stress, which is in line with findings from other large surveys⁵⁵. While anger was a less prevalent negative emotion among lonely individuals, it was still more than twice as often reported by those who felt lonely a lot compared to those who did not. Our findings are in line with numerous studies associating loneliness with poorer mental and physical health and pain^{4,5,56}.

Loneliness, physical pain, health problems, and distress

Individuals who felt lonely a lot were 22.8% more likely to experience physical pain, 17.8% more likely to report health problems and 29.4% more likely to experience distress compared to those who did not feel lonely a lot.

These findings align with previous studies that related loneliness to the presence and outcomes of multiple health conditions⁵⁷ including cardio-vascular and pulmonary disease and diabetes^{56,58} which may impact participation and connection^{59–61}. This interpretation is supported by our finding that the association between health problems and loneliness was most reduced when satisfaction with social support (i.e., friends and family to count on) and opportunity for social connection were accounted for, as also shown by e.g. Burholt et al.⁶². However, our cross-sectional data cannot address causality and also fits with the idea that poor health may lead to declining social status and loneliness with effects on workforce participation, downward social drift, experience of health-related stigma and stereotypes⁶². Prior work has found that the association between loneliness and pain could be explained by poor physical health interfering with the desire or ability to connect, to partake socially or to work^{23,30,59–61,63}. In support of such mechanisms, the association between loneliness and pain was reduced after controlling for health problems in the statistical models. However, health problems only accounted for about a quarter of variance in the association between loneliness and pain, suggesting a vital role of other mechanisms.

Importantly, distress statistically accounted for the largest amount of the variation in the association between loneliness and pain (60.2%). This finding is in line with the idea that loneliness and pain may be related through their bi-directional connections to negative affective states or other distress-related symptoms, such as disturbed sleep^{23,52}. Loneliness has also been related to aberrant HPA axis activation, immune-metabolic mechanisms³, as well as behavioural changes such as decreased physical activity⁶⁴ and health behaviours⁶⁵ which may affect

distress and physical pain individually and/or synergistically. It has been suggested that physical pain and the psychological pain of loneliness are subserved by shared neurobiological systems⁶⁶. Consequently, it is possible that the distressing pain experiences may become conflated⁶⁷ although this idea remains debated⁶⁸. Furthermore, it is also possible that the experience of physical pain relates to somatization of the psychological pain, serving as social signal to others that one needs support^{69,70}. Physical pain as a signal to others may be socially more acceptable and less stigmatised than expressing loneliness or lacking social connectedness⁷¹.

Perceived social support by relatives and friends and satisfaction with opportunities to meet people only accounted for 14% of the association between loneliness and pain. Prior research showed modest correlations between loneliness and actual social connections⁷² underscoring that one can feel lonely when having strong social connections or people to count on. In line with this work, our findings suggest that loneliness can be associated with pain above and beyond satisfaction with social connection. This is a key consideration when designing loneliness interventions: simply increasing social connections or making friends may not be enough to counteract the pain of loneliness.

Levels of loneliness, pain, and health problems were higher in older individuals, whereas levels of distress were slightly lower. However, age differences were overall small. Age interactions with respect to the associations between loneliness and pain, as well as other health problems and distress were almost zero, suggesting that the relationships between loneliness and mental and physical wellbeing exists across all age groups. Associations with pain were more prevalent in lonely females than lonely males. Research has reported higher pain levels in females^{23,41,73,74} which were amplified during economic recessions⁴² suggesting that socio-economic inequalities that females face might play a role in explaining the stronger association⁴³. However, the effect in the current study was found when socio-economic and social characteristics, as well as health problems and distress were controlled for, suggesting that the sex differences may be related to differences in the expression of loneliness or other factors.

Cross-cultural findings

We conducted exploratory analyses to examine cross-cultural variations in loneliness, and their relation to physical pain, health problems, and distress (Tables S.24 to S.26 and Fig. S.1). The data show that these issues affect individuals globally above and beyond age, sex, and other personal characteristics. While some of the poorest countries in the world showed the highest rates across all measures, there was substantial global variation that did not correspond to patterns according to which the world is commonly classified like wealth or economic development⁷⁵. Across countries, the associations between loneliness, physical pain, health problems, and distress also varied, ranging from zero to medium effect sizes. This suggests that these associations are not due to a universal mechanism, but that they are heavily influenced by cultural factors. For example, prior work has shown that the link between loneliness and health is stronger in less individualistic (or more collectivistic) cultures⁷⁶. Thus, to fully understand how these experiences vary across regions, we would need to consider other country-specific aspects like social welfare, social and cultural norms, values (e.g., social expectations of being married/cohabiting), and the likelihood of individuals expressing their feelings⁷⁷. For example, further research is needed to advance our understanding of what loneliness means and how it is experienced, expressed, and reported in different cultural contexts (see⁷⁸). The current findings highlight that a one size fits all approach to tackling loneliness cannot be feasible or effective and that solutions need to be sought at different levels.

Strengths and limitations

Our study contributes novel insights into associations between loneliness and pain, considering health problems, and distress. A strength of this study is that it provides data coverage of a global sample including regions of the world that are under researched (e.g. for loneliness see¹⁴). However, the findings of our study need to be interpreted in the light of several limitations. First, the data are cross-sectional and therefore do not allow for conclusions about causality. Second, the GWP uses self-report assessments of health problems rather than clinician ascertained diagnoses. It is possible that lonely individuals report more negatively on their health⁷⁹. Third, the GWP survey asks participants to indicate “... *any health problems that prevent you from doing any of the things people your age normally can do*”. Respondents might perceive some of their health problems and their impact as normal at a certain age. Thus, reported health problems may be an underestimate of actual health problems in this sample. Furthermore, the question regarding health problems is phrased in such a way that participants may also think of mental health problems when they answer. This may account for some of the overlap with reported distress. Fourth, we used single-item measures which can contribute to common-method bias which occurs when both the dependent and independent variable are measured with the same technique. Yet single-item measures are highly used in this type of large, global surveys due to the time and cost advantages they have. Fifth, participants were asked to indicate whether they “*felt lonely a lot the previous day*”. This wording did not allow us to disentangle the levels of loneliness. Future research should explore these research questions with loneliness scales that allow for further investigation of degrees of loneliness.

Conclusion

This study shows that loneliness is associated with pain, even after accounting for a myriad of negative psychological, physiological, and socio-economic experiences. Our findings underscore that loneliness is potentially painful and multi-faceted, encompassing individual psychological, but also social, and cultural aspects. Consequently, loneliness and the related pain need to be addressed in multi-faceted ways focusing on individual social connections and belonging, as well as support structures and socio-economic inequalities.

Method

Data

The Gallup World Poll (GWP) is a nationally representative, cross-sectional dataset including data from 168 countries and territories from 2005 to 2024. Every year, GWP interviews around 1,000 people in each country and collects information about people's health and wellbeing, attitudes, behaviours, beliefs, socioeconomic status, and labour market circumstances⁸⁰. In countries and territories where telephone coverage represents at least 80% of the population (Northern America, Western Europe, Confucian Asia and Pacific countries or territories including Japan, Australia, New Zealand and Taiwan, and Gulf Cooperation Council (GCC) countries) Gallup uses random-digit-dialling of a nationally representative list of telephone numbers. In regions with less extensive telephone coverage (Africa, Latin America, and some Middle east countries, Eastern Europe, and Southern Africa) surveys are conducted face-to-face, and households are still randomly selected⁸¹. Gallup weights the World Poll final samples to account for unequal selection probability, nonresponse, double coverage of landline and cell phone users, and to match the national demographics of each country⁸⁰. While the health and wellbeing variables are available through the full GWP time span, the loneliness variable, our main independent variable is only available in 2023 and 2024. Thus, based on availability of relevant variables, the sample for our study consists of 256,760 individuals from 139 countries (53% female, s.d. = 49.9; Age: Mean = 42.9, s.d. = 18.071, Range = 15–100).

Measures

Dependent variables

Our study explored the following dependent variables available in the GWP:

Physical pain Participants were asked to "...please think about yesterday, from the morning until the end of the day. Think about where you were, what you were doing, who you were with, and how you felt." They were then asked "Did you experience the following during a lot of the day yesterday? How about ... Physical Pain?" and could answer yes (1) or no (0). In our sample, 34.5% of people experienced physical pain the day before (s.d.= 47.6). We used this measure as binary with 'no' as the reference category in binary logistic regressions.

Health problems Participants were asked "do you have any health problems that prevent you from doing any of the things people your age normally can do?" and could answer yes (1) or no (0). In our sample, 26.4% of people reported to have health problems (s.d.= 44.1). We used this measure as binary with 'no' as the reference category in binary logistic regressions.

Distress The measure of distress was composed of four variables of negative psychological states available in the GWP. Participants were asked "Did you experience the following during a lot of the day yesterday? How about ... Sadness/anger/stress/worry" and could answer yes (1) or no (0). We averaged the scores in these four variables to get a continuous general index of distress which also ranged between 0 and 1. In our sample, 30.7% of people experienced distress (s.d.= 32.9) the day before.

Independent variables

We used the following main independent variables available in the GWP

Loneliness Participants were asked "Did you experience the following feelings during A LOT OF THE DAY yesterday? How about ... Loneliness?" and could answer yes (1) or no (0). This variable was used as binary with 'no' as the reference category. Feeling a lot of loneliness was reported by 22.7% (s.d.= 41.9). For simplicity, we refer to lonely and non-lonely people.

Having relatives or friends to count on Individuals were asked "If you were in trouble, do you have relatives or friends you can count on to help you whenever you need them, or not?" and could answer yes (1) or no (0). This variable was used as binary with 'no' as the reference category. In our sample, 80.1% of people reported that had friends or relatives to count on (s.d.= 39.9).

Satisfaction with opportunities to meet people People were asked "In the city or area where you live, are you satisfied or dissatisfied with _____? The opportunities to meet people and make friends" and could answer satisfied (1) or dissatisfied (0). This variable was used as binary with 'dissatisfied' as the reference category. In our sample 80.6% reported that were satisfied with the opportunities to meet people (s.d.= 39.5).

Demographic characteristics

Our regression models included the following covariates available in the GWP: Participant's age (15 to 100), sex (male, female), level of education (elementary, secondary, tertiary), marital status (single/never married, domestic partner, married, separated, divorced, widowed), employment status (employed full-time for an employer, employed full-time for self, employed part-time want full-time, employed part-time do not want full-time, unemployed, out of labour force), personal income in US dollars, and number of children in the household.

Descriptive statistics for the variables included in the analyses can be found in Table S.1 in the Supplementary Materials.

Statistical analyses

To examine the association of loneliness with physical pain, and health problems we conducted binary logistic regressions using binary versions of the pain and health problem variables. Since distress was a continuous

variable, we used Ordinary Least Squares (OLS) regressions to examine the association between loneliness and distress. In these models, distress was the dependent variable and loneliness the main independent variable. All models controlled for objective indicators of social connection—such as having relatives or friends to count on and satisfaction with opportunities to meet people—as well as key demographic characteristics.

As a robustness check, we conducted Ordinary Least Squares (OLS) regressions using continuous versions of the pain and health problem variables (see Supplementary Materials). Consistent with prior work⁷⁸, both methods produced similar conclusions.

All models—both OLS and logistic regressions—included country and year fixed effects, implemented by adding a set of country indicator (dummy) variables and year indicator (dummy) variables. This approach controls for unobserved heterogeneity across countries and years by allowing each country and year to have its own intercept, accounting for factors such as political climate, cultural norms, or environmental conditions that may influence the relationship between loneliness and pain.

We also clustered standard errors at the country-year level to account for intra-country-year correlation, recognizing that individuals within the same country and year may provide more similar responses than individuals from different countries and years. This clustering helps correct for potential downward bias in standard errors due to within-country-year dependence.

An alternative approach for analysing these data is multilevel (hierarchical) modelling, which accounts for the nested structure of participants (Level 1) within countries (Level 2). While fixed effects and clustered standard errors already address much of this structure, we further validated our findings by estimating multilevel models with random intercepts for countries, as reported in the Supplementary Materials. These models produced results consistent with those presented in the main text, highlighting the robustness of the findings.

Data availability

The Gallup World Poll data belong to Gallup, Inc. For more information, see: <https://www.gallup.com/analyti/cs/318875/global-research.aspx>. Scripts for analyses are available through the Open Science Framework (OSF) https://osf.io/bw9kx/?view_only=3974b75eb70f4e18865547e5b3ba6084. All methods were carried out in accordance with relevant guidelines and regulations. Data collection was approved by the Gallup internal Institutional Review Board (IRB) that is responsible for the oversight of international research.

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References

1. Veazie, S., Gilbert, J., Winchell, K., Paynter, R. & Guise, J. M. *Addressing Social Isolation To Improve the Health of Older Adults: A Rapid Review* (Agency for Healthcare Research and Quality (US), 2019).
2. Perlman, D. & Peplau, L. A. Toward a social psychology of loneliness. *Personal Relationships*. **3**, 31–56 (1981).
3. Cacioppo, J. T. & Cacioppo, S. *Advances in Experimental Social Psychology* **58**, 127–197 (eds Olson, J. M.) (Academic Press, 2018).
4. Lim, M., Holt-Lunstad, J. & Badcock, J. *55* 789–791 (Springer, 2020).
5. Hawkey, L. & Cacioppo, J. Loneliness matters: A theoretical and empirical review of consequences and mechanisms. *Ann. Behav. Med.* **40**, 218–227 (2010).
6. Mushtaq, R., Shoib, S., Shah, T. & Mushtaq, S. Relationship between loneliness, psychiatric disorders and physical health? A review on the psychological aspects of loneliness. *J. Clin. Diagn. Res.* **8**, We01–04. <https://doi.org/10.7860/jcdr/2014/10077.4828> (2014).
7. Christiansen, J. et al. Social isolation, and chronic disease outcomes. *Ann. Behav. Med.* <https://doi.org/10.1093/abm/kaa044> (2020). Loneliness.
8. Hawkey, L. C., Burlison, M. H., Berntson, G. G. & Cacioppo, J. T. Loneliness in everyday life: cardiovascular activity, psychosocial context, and health behaviors. *J. Personal. Soc. Psychol.* **85**, 105 (2003).
9. Beutel, M. E. et al. Loneliness in the general population: prevalence, determinants and relations to mental health. *BMC Psychiatry*. **17**, 97. <https://doi.org/10.1186/s12888-017-1262-x> (2017).
10. Bell, V. et al. Do loneliness and social exclusion breed paranoia? An experience sampling investigation across the psychosis continuum. *Schizophr Res. Cogn.* **33**, 100282. <https://doi.org/10.1016/j.scog.2023.100282> (2023).
11. Holt-Lunstad, J., Smith, T. B., Baker, M., Harris, T. & Stephenson, D. Loneliness and social isolation as risk factors for mortality: a meta-analytic review. *Perspect. Psychol. Sci.* **10**, 227–237. <https://doi.org/10.1177/1745691614568352> (2015).
12. Velthorst, E. et al. The impact of loneliness and social relationship dissatisfaction on clinical and functional outcomes in Dutch mental health service users. *Psychiatry Res.* **342**, 116242. <https://doi.org/10.1016/j.psychres.2024.116242> (2024).
13. Meisters, R. et al. Does loneliness have a cost?? A Population-Wide study of the association between loneliness and healthcare expenditure. *Int. J. Public. Health.* **66**, 581286. <https://doi.org/10.3389/ijph.2021.581286> (2021).
14. Surkalim, D. L. et al. The prevalence of loneliness across 113 countries: systematic review and meta-analysis. *Bmj* **376** (2022).
15. Luhmann, M., Buecker, S. & Rüsberg, M. Loneliness across time and space. *Nat. Rev. Psychol.* **2**, 9–23. <https://doi.org/10.1038/s44220-024-00221-5> (2024).
16. The hurt of loneliness and social isolation. *Nat. Mental Health* **2**, 255–256 <https://doi.org/10.1038/s44220-024-00221-5> (2024).
17. Maese, E. Almost a Quarter of the World Feels Lonely. *Gallup Blog* (2023).
18. Qualter, P. et al. Tackling loneliness evidence review: main report. *London: Department Digit. Cult. Media & Sport* (2022).
19. WHO Commission on Social Connection <https://www.who.int/groups/commission-on-social-connection> (2023).
20. HMGov. (ed Culture Digital, Media & Sport). (2018).
21. Blyth, F. M., Macfarlane, G. J. & Nicholas, M. K. The contribution of psychosocial factors to the development of chronic pain: The key to better outcomes for patients? *Pain* **129** (2007).
22. Fortuna, K. L. et al. Loneliness and its association with physical health conditions and psychiatric hospitalizations in people with serious mental illness. *Soc. Work Ment Health.* **18**, 571–585. <https://doi.org/10.1080/15332985.2020.1810197> (2020).
23. Smith, T. O., Dainty, J. R., Williamson, E. & Martin, K. R. Association between musculoskeletal pain with social isolation and loneliness: analysis of the english longitudinal study of ageing. *Br. J. Pain.* **13**, 82–90. <https://doi.org/10.1177/2049463718802868> (2018).
24. Loeffler, A. & Steptoe, A. Bidirectional longitudinal associations between loneliness and pain, and the role of inflammation. *Pain* **162**, 930–937. <https://doi.org/10.1097/j.pain.0000000000002082> (2021).
25. Turk, D. C. & Okifuji, A. Psychological factors in chronic pain: evolution and revolution. *J. Consult Clin. Psychol.* **70**, 678–690. <https://doi.org/10.1037//0022-006x.70.3.678> (2002).

26. Poscia, A. et al. Interventions targeting loneliness and social isolation among the older people: an update systematic review. *Exp. Gerontol.* **102**, 133–144. <https://doi.org/10.1016/j.exger.2017.11.017> (2018).
27. Powell, V. D. et al. Unwelcome companions: Loneliness associates with the cluster of pain, fatigue, and depression in older adults. *Gerontol. Geriatric Med.* **7**, 2333721421997620. <https://doi.org/10.1177/2333721421997620> (2021).
28. Jaremka, L. M. et al. Pain, depression, and fatigue: loneliness as a longitudinal risk factor. *Health Psychol.* **33**, 948 (2014).
29. Mund, M., Freuding, M. M., Möbius, K., Horn, N. & Neyer, F. J. The stability and change of loneliness across the life span: A Meta-Analysis of longitudinal studies. *Personality Social Psychol. Rev.* **24**, 24–52. <https://doi.org/10.1177/1088868319850738> (2019).
30. Barjaková, M., Garneró, A. & d'Hombres, B. Risk factors for loneliness: A literature review. *Soc. Sci. Med.* **334**, 116163. <https://doi.org/10.1016/j.socscimed.2023.116163> (2023).
31. Luhmann, M. & Hawkley, L. C. Age differences in loneliness from late adolescence to oldest old age. *Dev. Psychol.* **52**, 943–959. <https://doi.org/10.1037/dev0000117> (2016).
32. Qualter, P. et al. Loneliness across the life span. *Perspect. Psychol. Sci.* **10**, 250–264 (2015).
33. Manoli, A., McCarthy, J. & Ramsey, R. Estimating the prevalence of social and emotional loneliness across the adult lifespan. *Sci. Rep.* **12**, 21045. <https://doi.org/10.1038/s41598-022-24084-x> (2022).
34. Hutten, E. et al. Risk factors of loneliness across the life span. *J. Social Personal Relationships.* **39**, 1482–1507. <https://doi.org/10.1177/02654075211059193> (2021).
35. Chang, A. Y., Skirbekk, V. F., Tyrovolas, S., Kassebaum, N. J. & Dieleman, J. L. Measuring population ageing: an analysis of the global burden of disease study 2017. *Lancet Public Health.* **4**, e159–e167 (2019).
36. Vos, T. 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* **396**, 1204–1222. [https://doi.org/10.1016/S0140-6736\(20\)30925-9](https://doi.org/10.1016/S0140-6736(20)30925-9) (2020).
37. Lautenbacher, S., Peters, J. H., Heesen, M., Scheel, J. & Kunz, M. Age changes in pain perception: A systematic-review and meta-analysis of age effects on pain and tolerance thresholds. *Neurosci. Biobehavioral Reviews.* **75**, 104–113. <https://doi.org/10.1016/j.neubiorev.2017.01.039> (2017).
38. Fardghassemi, S. & Joffe, H. The causes of loneliness: the perspective of young adults in london's most deprived areas. *PLoS One.* **17**, e0264638. <https://doi.org/10.1371/journal.pone.0264638> (2022).
39. Zhang, D. Pain and the risk of social isolation and loneliness in older Chinese adults: do gender, age, and education make a difference? *Soc. Sci. Med.* **363**, 117486. <https://doi.org/10.1016/j.socscimed.2024.117486> (2024).
40. Forgeron, P. A. et al. The influence of loneliness on pain outcomes for adolescents: A Cross-Sectional survey. *Can. J. Pain.* **8**, 2404615. <https://doi.org/10.1080/24740527.2024.2404615> (2024).
41. Casale, R. et al. Pain in women: A perspective review on a relevant clinical issue that deserves prioritization. *Pain Ther.* **10**, 287–314. <https://doi.org/10.1007/s40122-021-00244-1> (2021).
42. Macchia, L. & Oswald, A. J. Physical pain, gender, and the state of the economy in 146 nations. *Soc. Sci. Med.* **287**, 114332. <https://doi.org/10.1016/j.socscimed.2021.114332> (2021).
43. Oliveira, A. M. B. et al. Socioeconomic and sex inequalities in chronic pain: A population-based cross-sectional study. *PLOS ONE.* **18**, e0285975. <https://doi.org/10.1371/journal.pone.0285975> (2023).
44. Macchia, L. Understanding despair: the role of physical pain. *Am. J. Health Promotion.* **37**, 763–765. <https://doi.org/10.1177/08901171231177849> (2023).
45. Bevers, K., Watts, L., Kishino, N. D. & Gatchel, R. J. The biopsychosocial model of the assessment, prevention, and treatment of chronic pain. *US Neurol.* **12**, 98–104 (2016).
46. Gatchel, R. J., Peng, Y. B., Peters, M. L., Fuchs, P. N. & Turk, D. C. The biopsychosocial approach to chronic pain: scientific advances and future directions. *Psychol. Bull.* **133**, 581 (2007).
47. Niedzwiedz, C. L. et al. The relationship between wealth and loneliness among older people across europe: is social participation protective? *Prev. Med.* **91**, 24–31. <https://doi.org/10.1016/j.ypmed.2016.07.016> (2016). <https://doi.org/https://doi>.
48. Maes, M., Qualter, P., Vanhalst, J., Van den Noortgate, W. & Goossens, L. Gender differences in loneliness across the lifespan: A Meta-Analysis. *Eur. J. Pers.* **33**, 642–654. <https://doi.org/10.1002/per.2220> (2019).
49. Morgan, C., Burns, T., Fitzpatrick, R., Pinfold, V. & Priebe, S. Social exclusion and mental health: conceptual and methodological review. *Br. J. Psychiatry.* **191**, 477–483. <https://doi.org/10.1192/bjp.bp.106.034942> (2007).
50. Kung, C. S., Pudney, S. E. & Shields, M. A. Economic gradients in loneliness, social isolation and social support: evidence from the UK biobank. *Soc. Sci. Med.* **306**, 115122 (2022).
51. Macdonald, S. J., Nixon, J. & Deacon, L. Loneliness in the city: examining socio-economics, loneliness and poor health in the North East of England. *Public Health.* **165**, 88–94. <https://doi.org/10.1016/j.puhe.2018.09.003> (2018).
52. Allen, S. F., Gilbody, S., Atkin, K. & van der Feltz-Cornelis, C. The associations between loneliness, social exclusion and pain in the general population: A N = 502,528 cross-sectional UK biobank study. *J. Psychiatr Res.* **130**, 68–74. <https://doi.org/10.1016/j.jpsychires.2020.06.028> (2020).
53. Emerson, E. et al. Disability and loneliness in the united kingdom: cross-sectional and longitudinal analyses of trends and transitions. *BMC Public Health.* **23**, 2537. <https://doi.org/10.1186/s12889-023-17481-y> (2023).
54. Amendola, S., Cerutti, R. & von Wyl, A. Estimating the prevalence and characteristics of people in severe social isolation in 29 European countries: A secondary analysis of data from the European social survey round 9 (2018–2020). *PLOS ONE.* **18**, e0291341. <https://doi.org/10.1371/journal.pone.0291341> (2023).
55. Amendola, S. & von Wyl, A. Trends in loneliness in 17 European countries between 2006 and 2015: A secondary analysis of data from the European Social Survey. *J. Health Psychol.* 13591053241278473 (2024).
56. Petite, T. et al. A systematic review of loneliness and common chronic physical conditions in adults. *Open. Psychol. J.* **8**, 113–132. <https://doi.org/10.2174/1874350101508010113> (2015).
57. Sundström, G., Fransson, E., Malmberg, B. & Davey, A. Loneliness among older Europeans. *Eur. J. Ageing.* **6**, 267. <https://doi.org/10.1007/s10433-009-0134-8> (2009).
58. Wang, F. et al. A systematic review and meta-analysis of 90 cohort studies of social isolation, loneliness and mortality. *Nat. Hum. Behav.* **7**, 1307–1319 (2023).
59. Lewis, S. et al. There but not really involved: the meanings of loneliness for people with chronic illness. *Soc. Sci. Med.* **343**, 116596 (2024).
60. Van Wilder, L. et al. Living with a chronic disease: insights from patients with a low socioeconomic status. *BMC Fam. Pract.* **22**, 233. <https://doi.org/10.1186/s12875-021-01578-7> (2021).
61. Iovino, P., Vellone, E., Cedrone, N. & Riegel, B. A. Middle-Range Theory of Social Isolation in Chronic Illness. *Int. J. Environ. Res. Public Health* <https://doi.org/10.3390/ijerph20064940> (2023).
62. Burholt, V., Windle, G. & Morgan, D. J. Tam, O. B. O. t. C. W. A social model O. loneliness: the roles O. disability, social resources, and cognitive impairment. *Gerontologist* **57**, 1020–1030. <https://doi.org/10.1093/geront/gnw125> (2016).
63. Khatooni, M., Dehghankar, L., Bahrani, M., Panahi, R. & Hajnasiri, H. Perceived social isolation among patients with multiple sclerosis suffering from Disease-Induced pain and disability. *J. Nurs. Res.* **10**, 1097 (2024).
64. Pels, F. & Kleinert, J. Loneliness and physical activity: A systematic review. *Int. Rev. Sport Exerc. Psychol.* **9**, 231–260 (2016).
65. Lauder, W., Mummary, K., Jones, M. & Caperchione, C. A comparison of health behaviours in lonely and non-lonely populations. *Psychol. Health Med.* **11**, 233–245. <https://doi.org/10.1080/13548500500266607> (2006).
66. Eisenberger, N. I. The neural bases of social pain: evidence for shared representations with physical pain. *Psychosom. Med.* **74**, 126–135. <https://doi.org/10.1097/PSY.0b013e3182464dd1> (2012).

67. Sharvit, G. & Schweinhardt, P. The influence of social signals on the self-experience of pain: A neuroimaging review. *Front. Neurol.* **13**, 856874. <https://doi.org/10.3389/fneur.2022.856874> (2022).
68. Ferris, L. J., Jetten, J., Hornsey, M. J. & Bastian, B. Feeling hurt: revisiting the relationship between social and physical pain. *Rev. Gen. Psychol.* **23**, 320–335. <https://doi.org/10.1177/1089268019857936> (2019).
69. Vigil, J. M. & Strenth, C. No pain, no social gains: A social-signaling perspective of human pain behaviors. *World J. Anesthesiology.* **3**, 18–30 (2014).
70. Tiokhin, L. Do symptoms of illness serve signaling functions?(Hint: yes). *Q. Rev. Biol.* **91**, 177–195 (2016).
71. Barreto, M. et al. Exploring the nature and variation of the stigma associated with loneliness. *J. Soc. Pers. Relat.* **39**, 2658–2679. <https://doi.org/10.1177/02654075221087190> (2022).
72. Matthews, T. et al. Social isolation, loneliness and depression in young adulthood: a behavioural genetic analysis. *Soc. Psychiatry Psychiatr Epidemiol.* **51**, 339–348. <https://doi.org/10.1007/s00127-016-1178-7> (2016).
73. Fillingim, R. B., King, C. D., Ribeiro-Dasilva, M. C., Rahim-Williams, B. & Riley, J. L. III Sex, gender, and pain: a review of recent clinical and experimental findings. *J. Pain.* **10**, 447–485 (2009).
74. Bimpong, K. et al. The gender pain gap: gender inequalities in pain across 19 European countries. *Scand. J. Public Health.* **50**, 287–294. <https://doi.org/10.1177/1403494820987466> (2021).
75. *World Bank Country and Lending Groups.* <https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups> (2024).
76. Beller, J. & Wagner, A. Loneliness and health: the moderating effect of Cross-Cultural individualism/collectivism. *J. Aging Health.* **32**, 1516–1527. <https://doi.org/10.1177/0898264320943336> (2020).
77. Dykstra, P. A. Older adult loneliness: Myths and realities. *Eur. J. Ageing.* **6**, 91–100. <https://doi.org/10.1007/s10433-009-0110-3> (2009).
78. Ozawa-de Silva, C. & Parsons, M. Toward an anthropology of loneliness. *Transcult. Psychiatry.* **57**, 613–622. <https://doi.org/10.1177/1363461520961627> (2020).
79. Spithoven, A. W. M., Bijttebier, P. & Goossens, L. It is all in their mind: A review on information processing bias in lonely individuals. *Clin. Psychol. Rev.* **58**, 97–114. <https://doi.org/10.1016/j.cpr.2017.10.003> (2017).
80. Gallup (ed Gallup Inc.) (Gallup Inc., 2024).
81. Gallup. (Gallup Inc., 2021).

Author contributions

Both authors participated in the study design. L.M conducted the analyses and wrote sections of the paper. A.K.F wrote sections of the paper.

Declarations

Competing interests

The authors declare no competing interests.

Informed consent

Informed consent was obtained from all participants and/or their legal guardians.

Additional information

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