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Loneliness, bad health, and the moderating role of friends: Differences between younger and older individuals in Germany

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Abstract

This study investigates the moderating role of friends on the relationship between poor health and loneliness, distinguishing young and old individuals. Utilizing data from the German Socio-Economic Panel (SOEP), we find that loneliness is significantly associated with poor health and negatively related to the number of close friends. While these associations are observed across all age groups, a robust moderating role of friends on the health-loneliness link exists only among older adults. Our results are consistent with the buffering hypothesis and the socioemotional selectivity theory.

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1. Introduction

People feel lonely when they perceive a discrepancy between desired and actual social connections (e.g., Barjaková et al. 2023). Loneliness increasingly poses a significant threat to individual well-being and social outcomes (e.g., An et al. 2025, Bryan et al. 2024, Casal et al. 2024). Health problems can affect social interaction, exacerbate feelings of isolation, and intensify the experience of loneliness (e.g., Holt-Lunstad et al. 2015, Lewis et al. 2024). Therefore, understanding which factors can mitigate poor health's impact on loneliness is crucial for developing effective interventions and promoting well-being.

Social relationships have long been recognized as a vital resource for psychological and physical health (e.g., Fiorillo and Sabatini 2015, Tabassum and Lalji 2025). Strong social networks provide individuals with emotional support, a sense of belonging, and opportunities for social engagement, all of which can buffer adverse effects (e.g., Cohen and Wills 1985). Social relationships can mitigate the negative impact of deteriorating health indirectly. They do this by providing support that is often psychological (e.g., by offering empathy), informational (e.g., information regarding possible treatments or doctors), or practical (e.g., by preparing meals or transportation to treatments). This support reduces stress and improves a person's coping mechanisms. The buffering hypothesis proposes that social support can limit the detrimental effects of stressful life events such as health problems.

The buffering effect of a social network may be age-dependent. On average, older individuals will tend to have a smaller and less diverse social network. However, the remaining links within the network may be more rewarding (e.g., Carstensen 2021).

This paper investigates whether having more friends reduces the link between poor health and loneliness, distinguishing younger and older individuals. We hypothesize that individuals with more friends will experience a weaker association between poor health and loneliness than those with fewer or no friends. This hypothesis is grounded in the buffering hypothesis of social support, which suggests that a more extensive social network provides a greater capacity for support mobilization during times of need, such as periods of health decline. We expect that the positive buffering effect will be more pronounced for older people because – based on, for example, the socioemotional selectivity theory – we expect that these relationships are more likely to have been purposefully selected.

Previous literature has shown that the simple intuition that friends can buffer adverse outcomes is not always borne out in the data. For example, Anusic and Lucas (2014) find that social relationships cannot buffer the effect of widowhood on well-being. According to Kuhn and Brulé (2019), the number of friends can even harm life satisfaction when considering adverse life events such as the death of a closely related person, unemployment, and disability. These results align with earlier ones regarding the possibility that friends can even increase loneliness after other adverse life events (Van Baarsen 2002) or more generally (Thompson et al. 2024).

We examine the relationship between health, the number of friends, and loneliness while controlling for potential confounding factors such as gender, socioeconomic status, personality, and other relevant demographic variables. We distinguish between younger and older individuals in our analysis. Loneliness is significantly associated with poor health and negatively related to the number of close friends. The number of friends weakens the association between poor health and loneliness only for older adults. Our results are thus consistent with the buffering hypothesis and the socioemotional selectivity theory.

Other contributions are also interested in indirect effects. For example, Compernolle et al. (2021) consider gender and race as *moderators* of contextual effects on momentary loneliness. Lim and Burr (2023) report findings about how gender *moderates* the link between loneliness and the number of friends. Van den Broek and Tosi (2020) study the association between the number of children and late-life loneliness and whether this differs for fathers and mothers. Christiansen et al. (2016) are interested in *mediators* of the empirical relationship between loneliness and health outcomes. They test whether high perceived stress, health-compromising behavior, and poor sleep mediate the association between loneliness and health outcomes.

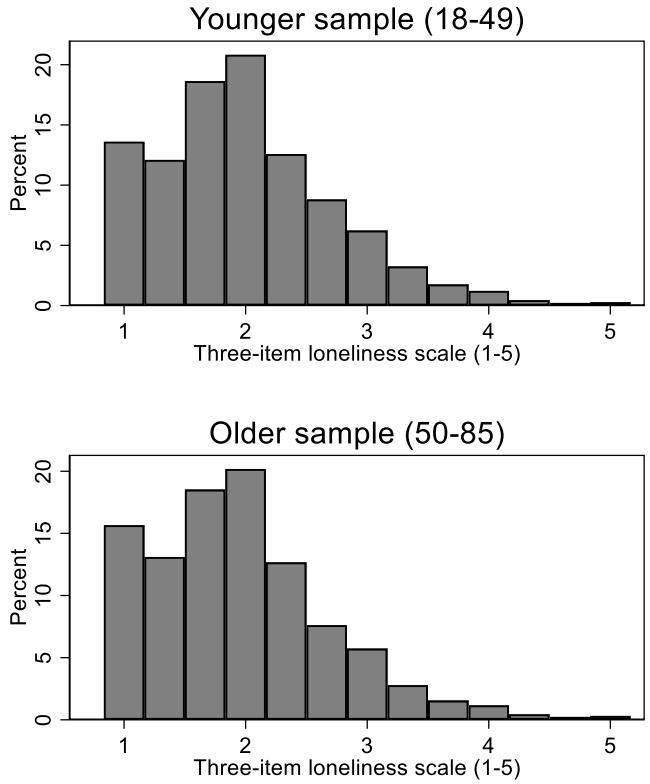
2. Methods

2.1 Sample and Variables

We use data from the German Socio-Economic Panel (SOEP), a large-scale annual survey tracking over 20,000 individuals across more than 10,000 German households (Goebel et al. 2019). In this study, we focus on data from 2013 and 2017 to avoid the potential confounding effects of the COVID-19 pandemic on our key variables: loneliness, health, and social networks. We divide the sample into younger (18-49 years old) and older (50-85 years old) individuals based on the mean and median age of approximately 50 years in the entire sample. This yields 19,200 observations for younger respondents and 19,987 for older respondents in pooled cross-section regressions for the determinants of loneliness.

Loneliness: Our dependent variable is based on the well-established three-item version of the UCLA loneliness scale developed by Hughes et al. (2004). It uses answers to the following questions: "How often do you feel…", followed by "that you lack/miss the company of others?", "left out?" and "isolated from others?". Participants answer on a five-point Likert scale: 1 "Very often," 2 "Often," 3 "Sometimes," 4 "Seldom," and 5 "Never." These questions suffice for constructing a reliable loneliness score (Hughes et al. 2004). Luhmann and Schupp (2015) provide a series of tests supporting the internal validity and construct validity of the SOEP loneliness score based on these three five-point Likert scale items. We reverse the coding to align with the original literature and create a multi-item loneliness scale averaging these three items, with scores ranging from 1 (never) to 5 (very often). We use the mean over the three loneliness items, implying that this new variable is quasi-continuous. Figure 1 illustrates the distribution of our loneliness scores.

Figure 1: Distribution of the three-item loneliness score



Health: We incorporate five distinct variables. First, we utilize a binary variable derived from a five-point self-reported health status question, where "poor" or "bad" health equals one and all other options (very good, good, satisfactory) equal zero. Approximately 11.3% (younger) and 23.2% (older) report poor or bad health. Second, we include a question regarding health limitations in daily activities. Here, 15.8% of younger individuals report some limitations, with 3.7% experiencing severe limitations. In the older sample, these figures rise to 32.5% and 13.7% for some and severe limitations. Third, we construct a disability dummy variable based on official assessments of "severe disability" or "partial work incapacity" for medical reasons. This *objective* measure offers an advantage over subjective ratings. Around 4.5% of younger and 20.3% of older adults have an official disability status. Fourth, we incorporate measures of health concerns. In the younger sample, 47.5% reported some health worries, while 13.8% reported many health worries. In the older sample, these figures increased to 55.2% and 21.7%, respectively. Fifth, we assessed health satisfaction using an eleven-point Likert scale. To align with our conceptual framework, we reverse-coded this measure to obtain dissatisfaction with health (0 = completely satisfied, 10 = completely dissatisfied). Mean dissatisfaction with health was 2.81 (SD = 2.03) for the younger sample and 3.82 (SD = 2.21) for the older sample. It is important to note that these two health measures, worries about health and satisfaction with health, are subjective and may be correlated with worries and satisfaction in other life domains.

Social Connection: We categorized respondents based on their reported number of close friends. The average number of close friends in the younger sample is 4.16 (SD = 3.50) and 4.10 (SD = 3.62) in the older sample. In the younger sample, 3.5% reported having no close friends (reference group), 61.8% reported having 1 to 4 close friends, and 34.7% reported having at least 5. In the older sample, these figures were 8.8%, 57.7%, and 33.4%, respectively.

Note that using the categories instead of the continuous number of friends also helps in identifying potential non-linear relationships.

2.2 Empirical Approach

In our baseline regression models that we use separately for older and younger individuals (see equation (1)), we examine the determinants of loneliness, explicitly focusing on the impact of poor health as a risk factor and the number of close friends. Next, we add interaction terms between poor health and the number of close friends to investigate the moderating role of social support in mitigating the negative impact of poor health on loneliness (see equation (2)).

$$Loneliness_{it} = \alpha + \beta PoorHealth_{it} + \gamma Friends_{it} + \omega\, Controls_{it} + \varepsilon_{it} \quad (1)$$

$$Loneliness_{it} = \alpha + \beta PoorHealth_{it} + \gamma Friends_{it} + \delta PoorHealth_{it} \times Friends_{it} + \omega\, Controls_{it} + \varepsilon_{it} \quad (2)$$

Please note again that our multi-item loneliness scale takes the mean over three items so that our dependent variable is not ordinal. Given the quasi-continuous nature of the multi-item loneliness scale, we employ ordinary least squares (OLS) regression as our primary method and compute robust standard errors to account for potential heteroscedasticity. Our models incorporate a comprehensive set of control variables, including gender, migration background, age, education, household income, household characteristics, labor force status, sports participation, political party activity, religious activity, volunteering activities, risk preferences, Big Five personality traits, survey year, and federal state, to address observed heterogeneity. A detailed list of variables and their descriptive statistics is provided in Appendix Tables V and VI for the younger and older samples, respectively.

In addition to pooled OLS regressions (POLS), we estimate fixed-effects OLS regressions (FEOLS) to control for unobserved time-invariant individual heterogeneity, which might be of special importance when analyzing subjective variables. Standard errors for these models are clustered at the individual level. For fixed-effects panel regressions, we restrict the analysis to individuals observed in both survey years and who remain within their respective age categories. This results in a balanced panel of 3,379 younger individuals with 6,758 observations and 6,039 older individuals with 12,078 observations. Due to the limited number of observations in the younger balanced panel and the relatively low within-person variation in poor health among younger individuals, we anticipate less efficient estimates from the fixed-effects models in the younger sample.

3. Results

3.1. Baseline Regressions: Having Poor Health and No Friends as Risk Factors

Tables I and II present the findings from our baseline regressions using pooled OLS (POLS) and fixed-effects OLS (FEOLS) for the three-item loneliness scale as the outcome variable. We present the findings for the different health variables in different panels. Table VII in the Appendix provides *detailed* results regarding all coefficients for the specification incorporating poor/bad health status.

Table I: Baseline loneliness regressions with poor health status, health constraints, and official disability status

	Younger sample		Older sample	
	POLS	FEOLS	POLS	FEOLS
Poor/bad health status (dummy)				
1	0.240 ***	0.104 **	0.231 ***	0.100 ***
	(0.019)	(0.042)	(0.013)	(0.021)
Number of close friends (ref. none)				
1-4 friends	-0.159 ***	-0.080	-0.052 **	-0.105 ***
	(0.035)	(0.092)	(0.021)	(0.037)
>=5 friends	-0.210 ***	-0.103	-0.136 ***	-0.148 ***
	(0.035)	(0.095)	(0.022)	(0.040)
Number of observations	19200	6758	19987	12078
Number of individuals		3379		6039
R^2 (within for FEOLS)	0.186	0.057	0.202	0.050
Some health constraints (dummy)				
1	0.116 ***	0.075 **	0.110 ***	0.049 ***
	(0.015)	(0.033)	(0.011)	(0.018)
Severe health constraints (dummy)				
1	0.313 ***	0.380 ***	0.301 ***	0.190 ***
	(0.034)	(0.099)	(0.018)	(0.034)
Number of close friends (ref. none)				
1-4 friends	-0.164 ***	-0.076	-0.051 **	-0.103 ***
	(0.035)	(0.091)	(0.021)	(0.037)
>=5 friends	-0.215 ***	-0.100	-0.138 ***	-0.146 ***
	(0.035)	(0.093)	(0.022)	(0.040)
Number of observations	19200	6758	19987	12078
Number of individuals		3379		6039
R^2 (within for FEOLS)	0.185	0.063	0.203	0.052
Disability official (dummy)				
1	0.153 ***	-0.005	0.157 ***	0.028
	(0.027)	(0.093)	(0.013)	(0.033)
Number of close friends (ref. none)				
1-4 friends	-0.172 ***	-0.085	-0.059 ***	-0.104 ***
	(0.035)	(0.092)	(0.021)	(0.037)
>=5 friends	-0.223 ***	-0.107	-0.147 ***	-0.147 ***
	(0.035)	(0.095)	(0.022)	(0.040)
Number of observations	19200	6758	19987	12078
Number of individuals		3379		6039
R^2 (within for FEOLS)	0.178	0.055	0.194	0.045

Notes: Sample age 18-49 (younger) vs. 50-85 (older). The dependent variable is a quasi-continuous three-item loneliness scale ranging from 1 (never) to 5 (very often), with a mean of about 2.0 and SD of 0.74 in both samples. Specifications include all control variables as in Appendix Table VII. Robust (clustered at the individual level for FEOLS) standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

Our analyses consistently demonstrate a negative association between the number of close friends and loneliness across all baseline regressions for younger and older individuals. Focusing on the older sample and the specification including poor/bad health status as a dummy variable (top panel in Table I), the POLS and FEOLS models indicate that individuals with 1

to 4 close friends report loneliness scores that are, on average, 0.052 and 0.105 points lower, respectively, compared to those without close friends. Similarly, individuals with at least five close friends report loneliness scores that are 0.136 and 0.148 points lower, respectively. Notably, the estimated coefficients for the number of close friends remain relatively consistent across different specifications of health status.

Poor/bad health status is significantly and positively associated with higher levels of loneliness in both POLS and FEOLS models for both samples (top panel in Table I). The magnitude of the coefficients is independent of the age group. Specifically, younger individuals with poor/bad health report loneliness scores that are 0.240 points higher in POLS models and 0.104 points higher in FEOLS models compared to their healthier counterparts. These figures for the older sample are 0.231 and 0.100 points, respectively.

Health constraints in everyday life also significantly predict higher levels of loneliness across all four baseline regressions. The most conservative estimates are obtained from the FEOLS model for the older sample, which reveals that individuals with some health constraints experience loneliness scores that are 0.049 points higher, while those with severe health constraints experience scores that are 0.190 points higher.

While the official disability status offers an objective measure of health limitations, the low within-person variation in disability status limits the interpretability of the FEOLS estimates. However, the POLS models demonstrate that individuals with an official disability rating report loneliness scores that are 0.153 points (younger) and 0.157 points (older) higher compared to those without a disability.

Table II presents the results for the two more subjective health indicators that support the previous findings. Having (more) worries and being more dissatisfied with own health significantly increase the feeling of loneliness among younger and older people. All baseline regressions in Table I and Table II indicate that poor health increases loneliness, and having close friends reduces loneliness for younger and older people. In the next section, the interrelation between poor health and having friends will be explored in terms of potential moderation.

Even though we have controlled for many time-variant and time-invariant characteristics as well as for individual fixed-effects, endogeneity might still be an issue due to unobserved characteristics and reverse causality between loneliness and health. To address these problems in a further sensitivity check, we have estimated linear regressions with endogenous binary treatment and use regional variation in health care supply (number of hospital beds and doctors) at the federal state level (e.g., Eibich and Ziebarth 2014) as instruments for bad health status and disability status. These regional instruments are significantly correlated with bad health status and official disability in our first stage regressions. In the second stages, the estimated coefficients are larger than in the OLS estimates indicating a downward bias in OLS. Overall, our results seem to be robust.

Table II: Baseline loneliness regressions with worries about health and satisfaction with health

	Younger sample		Older sample	
	POLS	FEOLS	POLS	FEOLS
Worries about health (ref. none)				
some worries (2)	0.152 ***	0.060 **	0.124 ***	0.060 ***
	(0.010)	(0.024)	(0.011)	(0.019)
many worries (3)	0.330 ***	0.147 ***	0.321 ***	0.112 ***
	(0.018)	(0.045)	(0.016)	(0.029)
Number of close friends (ref. none)				
1-4 friends	-0.154 ***	-0.079	-0.062 ***	-0.105 ***
	(0.034)	(0.092)	(0.021)	(0.037)
>=5 friends	-0.207 ***	-0.104	-0.146 ***	-0.146 ***
	(0.035)	(0.095)	(0.022)	(0.040)
Number of observations	19200	6758	19987	12078
Number of individuals		3379		6039
R^2 (within for FEOLS)	0.196	0.059	0.205	0.048
Dissatisfaction with health (0-10)	0.058 ***	0.037 ***	0.060 ***	0.035 ***
	(0.003)	(0.007)	(0.003)	(0.005)
Number of close friends (ref. none)				
1-4 friends	-0.158 ***	-0.084	-0.055 ***	-0.100 ***
	(0.035)	(0.092)	(0.021)	(0.037)
>=5 friends	-0.209 ***	-0.109	-0.137 ***	-0.141 ***
	(0.035)	(0.095)	(0.022)	(0.039)
Number of observations	19200	6758	19987	12078
Number of individuals		3379		6039
R^2 (within for FEOLS)	0.198	0.065	0.214	0.056

Notes: Sample age 18-49 (younger) vs. 50-85 (older). The dependent variable is a quasi-continuous three-item loneliness scale ranging from 1 (never) to 5 (very often), with a mean of about 2.0 and SD of 0.74 in both samples. Specifications include all control variables as in Appendix Table VII. Robust (clustered at the individual level for FEOLS) standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

3.2. The Number of Friends as Moderator

Tables III and IV present the results of our moderation analyses, examining the moderating role of the number of close friends on the link between health indicators and loneliness by adding an interaction term. Consistent across all regression models and health measures, we find significant evidence of moderation in the older sample, but not in the younger sample (with the exception of the POLS regression for health worries in the younger sample). These findings suggest that the buffering effects of social support are more pronounced in older adulthood. Consequently, the subsequent discussion focuses exclusively on the results for the older sample.

Table III: Moderation in regressions with poor health status, health constraints, and official disability status

	Younger sample		Older sample	
	POLS	FEOLS	POLS	FEOLS
Poor/bad health status (dummy)				
1	0.214 **	-0.157	0.325 ***	0.238 ***
	(0.093)	(0.252)	(0.045)	(0.068)
Number of close friends (ref. none)				
1-4 friends	-0.167 ***	-0.136	-0.030	-0.066 *
	(0.037)	(0.088)	(0.024)	(0.040)
>=5 friends	-0.213 ***	-0.148	-0.080 ***	-0.094 **
	(0.037)	(0.090)	(0.025)	(0.042)
Poor/bad health status # friends				
1 # 1-4 friends	0.045	0.313	-0.050	-0.127 *
	(0.095)	(0.254)	(0.048)	(0.070)
1 # >=5 friends	-0.010	0.202	-0.218 ***	-0.204 ***
	(0.098)	(0.261)	(0.049)	(0.073)
Number of observations	19200	6758	19987	12078
Number of individuals		3379		6039
R^2 (within for FEOLS)	0.187	0.059	0.205	0.052
Some health constraints (dummy)				
1	0.164 *	0.174	0.185 ***	0.122 **
	(0.090)	(0.208)	(0.043)	(0.060)
Severe health constraints (dummy)				
1	0.489 ***	0.125	0.459 ***	0.371 ***
	(0.139)	(0.356)	(0.058)	(0.094)
Number of close friends (ref. none)				
1-4 friends	-0.141 ***	-0.091	<0.001	-0.048
	(0.039)	(0.095)	(0.029)	(0.048)
>=5 friends	-0.181 ***	-0.107	-0.042	-0.055
	(0.039)	(0.097)	(0.029)	(0.050)
Some health constraints # friends				
1 # 1-4 friends	-0.025	-0.088	-0.059	-0.062
	(0.092)	(0.213)	(0.045)	(0.061)
1 # >=5 friends	-0.101	-0.126	-0.120 ***	-0.110 *
	(0.093)	(0.213)	(0.045)	(0.063)
Severe health constraints # friends				
1 # 1-4 friends	-0.190	0.316	-0.110 *	-0.141
	(0.145)	(0.348)	(0.062)	(0.096)
1 # >=5 friends	-0.193	0.194	-0.318 ***	-0.319 ***
	(0.151)	(0.396)	(0.064)	(0.102)
Number of observations	19200	6758	19987	12078
Number of individuals		3379		6039
R^2 (within for FEOLS)	0.185	0.064	0.205	0.056
Disability official (dummy)				
1	0.192	-0.487	0.244 ***	0.080
	(0.138)	(0.357)	(0.049)	(0.079)
Number of close friends (ref. none)				
1-4 friends	-0.169 ***	-0.128	-0.043 *	-0.104 **
	(0.036)	(0.093)	(0.024)	(0.041)
>=5 friends	-0.219 ***	-0.154	-0.106 ***	-0.115 ***
	(0.037)	(0.094)	(0.024)	(0.044)

Disability official # friends				
1 # 1-4 friends	-0.031	0.487	-0.052	0.002
	(0.142)	(0.342)	(0.052)	(0.077)
1 # >=5 friends	-0.065	0.565	-0.177 ***	-0.163 **
	(0.146)	(0.375)	(0.053)	(0.082)
Number of observations	19200	6758	19987	12078
Number of individuals		3379		6039
R^2 (within for FEOLS)	0.178	0.057	0.195	0.048

Notes: Sample age 18-49 (younger) vs. 50-85 (older). The dependent variable is a quasi-continuous three-item loneliness scale ranging from 1 (never) to 5 (very often), with a mean of about 2.0 and SD of 0.74 in both samples. Specifications include all control variables as in Appendix Table VII. Robust (clustered at the individual level for FEOLS) standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

For older individuals, having poor/bad health significantly increases loneliness by 0.325 (0.238) points in the POLS (FEOLS) model when having no close friends (top panel in Table III). However, this increase is attenuated substantially to 0.325-0.218=0.107 (0.238-0.204=0.034) points when having at least five close friends. Similar patterns are observed for other health indicators.

The positive correlation between health constraints in everyday life and loneliness is significantly reduced when having more close friends. Having some health constraints increases loneliness by 0.185 (0.122) points for older individuals with no close friends; but only by 0.185-0.120=0.065 (0.122-0.110=0.012) points for those with at least five close friends. Having severe health constraints increases loneliness by 0.459 (0.371) points for older individuals with no close friends; but only by 0.459-0.318=0.141 (0.371-0.319=0.052) points for those with at least five close friends.

For older individuals with an official disability status, loneliness is 0.244 points higher when having no close friends; but only 0.244-0.177=0.067 points higher when having at least five close friends. Note, again, that the low within-person variation in the disability status limits the interpretability of the FEOLS estimate for the disability status itself. But the interaction term can still be interpreted due to the within-variation of friends, which is significant in FEOLS (-0.163) and comparable to the POLS estimate.

The results for the more subjective health measures – many health worries and dissatisfaction with health – presented in Table IV further corroborate these findings. In all models, the significant negative coefficients of the interaction terms consistently demonstrate that having more close friends significantly moderates the negative impact of these health concerns on loneliness in the older sample. As a further sensitivity check, we conducted separate analyses for men and women within the older sample. The overall findings remained robust, with significant moderating effects of close friendships observed for both older men and older women.

Our findings provide strong evidence that social support, specifically the number of close friends, plays a crucial role in buffering the adverse effects of poor health on loneliness, particularly in older adulthood. Importantly, these results highlight that the presence of social connections and the extent of social networks is crucial in mitigating the adverse impacts of health challenges on well-being.

Table IV: Moderation in regressions with worries about health and satisfaction with health

	Younger sample		Older sample	
	POLS	FEOLS	POLS	FEOLS
Worries about health (ref. none)				
some worries (2)	0.247 ***	-0.003	0.124 ***	0.078
	(0.075)	(0.183)	(0.047)	(0.072)
many worries (3)	0.460 ***	-0.040	0.433 ***	0.391 ***
	(0.091)	(0.232)	(0.058)	(0.091)
Number of close friends (ref. none)				
1-4 friends	-0.083	-0.177	-0.051	-0.002
	(0.058)	(0.137)	(0.041)	(0.065)
>=5 friends	-0.104 *	-0.172	-0.068 *	-0.048
	(0.059)	(0.138)	(0.041)	(0.067)
Worries about health # friends				
some worries (2) # 1-4 friends	-0.078	0.072	0.024	-0.028
	(0.076)	(0.184)	(0.049)	(0.074)
some worries (2) # >=5 friends	-0.128 *	0.050	-0.033	-0.008
	(0.077)	(0.185)	(0.050)	(0.075)
many worries (3) # 1-4 friends	-0.113	0.259	-0.062	-0.299 ***
	(0.093)	(0.233)	(0.061)	(0.095)
many worries (3) # >=5 friends	-0.178 *	0.087	-0.246 ***	-0.335 ***
	(0.095)	(0.240)	(0.063)	(0.099)
Number of observations	19200	6758	19987	12078
Number of individuals		3379		6039
R^2 (within for FEOLS)	0.196	0.061	0.207	0.053
Dissatisfaction with health (0-10)	0.052 ***	-0.016	0.090 ***	0.073 ***
	(0.016)	(0.035)	(0.009)	(0.016)
Number of close friends (ref. none)				
1-4 friends	-0.191 ***	-0.297 **	0.056	0.074
	(0.061)	(0.129)	(0.043)	(0.069)
>=5 friends	-0.208 ***	-0.284 **	0.076 *	0.061
	(0.062)	(0.134)	(0.043)	(0.073)
Dissatisfaction with health # friends				
1-4 friends	0.010	0.061 *	-0.024 **	-0.040 **
	(0.016)	(0.035)	(0.010)	(0.016)
>=5 friends	-0.003	0.047	-0.052 ***	-0.048 ***
	(0.016)	(0.037)	(0.010)	(0.017)
Number of observations	19200	6758	19987	12078
Number of individuals		3379		6039
R^2 (within for FEOLS)	0.198	0.067	0.216	0.058

Notes: Sample age 18-49 (younger) vs. 50-85 (older). The dependent variable is a quasi-continuous three-item loneliness scale ranging from 1 (never) to 5 (very often), with a mean of about 2.0 and SD of 0.74 in both samples. Specifications include all control variables as in Appendix Table VII. Robust (clustered at the individual level for FEOLS) standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

3.3. Discussing the Contingency of The Number of Friends as Moderator

The asymmetric effect regarding the moderating role of friendships is interesting and may be attributable to different mechanisms. For example, older people may experience a greater decline in their physical and cognitive health, meaning that they benefit more from social

support than younger people. Adding to this, it seems reasonable that the role of social support changes as people age from focusing on personal and career development to emotional support, practical assistance (e.g., help with errands, transportation), and companionship, which are particularly important when facing health challenges. In addition, older individuals become more aware of their mortality and the fragility of health, which can intensify feelings of loneliness and isolation, particularly when faced with health problems. A strong social network can mitigate these feelings. Moreover, when we consider older people, it is also more likely that their friends experience worse health as well which may hinder their ability to provide support. This implies that more friends are required to maintain the same level of social support. Finally, the sample of older people includes retirees who lack social interaction at work and thus are more reliant on their network of friends.

4. Conclusion

People who suffer from poor health may also suffer from loneliness. This paper explored whether the association between poor health and loneliness depends on the number of friends. Previous literature has argued that strong social support can buffer the effects of adverse outcomes, but some papers have shown that this does not hold in all scenarios.

We find that loneliness is positively correlated with poor health and negatively correlated with close friends for younger and older people. But the number of friends reduces (as moderator) the association between poor health and loneliness only for older people aged 50 and above. Our results are thus consistent with the buffering hypothesis and the socioemotional selectivity theory.

We find robust evidence using different health-related variables and individual fixed-effects regressions, but we do not claim that our conditional correlations are causal effects. Thus, our study has its limitations. We could not include dynamic aspects in our two-year panel data, which might be important since poor health can negatively affect the number of friends and vice versa – leading to a kind of vicious cycle (self-reinforcing downward spiral) that can increase loneliness further. These limitations need to be tackled in future research using longer panel data.

Our results have policy implications. It seems advisable to prioritize establishing social connection programs for older people using community and senior centers, for example. Such programs would also enable intergenerational interaction. It may be necessary to consider these aspects as essential elements of any treatment regime for older people with poor health. In addition, improving their access to means of transportation to ease their participation in social activities and maintaining social connections seems essential. This is critical because poor health often makes transportation more burdensome.

Data Availability Statement

This paper uses data from the German Socio-Economic Panel (doi: 10.5684/soep.core.v36eu). Details of the data set are provided here:

https://www.diw.de/en/diw_01.c.814095.en/edition/soep-core_v36eu__data_1984-2019__eu_edition.html.

SOEP data are available to researchers only after they have signed a data distribution contract.

Instructions for accessing the data can be found here:

https://www.diw.de/en/diw_01.c.601584.en/data_access.html.

Conflict of Interest

The authors declare that they have no conflict of interest.

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APPENDIX TABLES

Table V: Definitions and descriptive statistics for younger sample

	Mean	SD	Min	Max
Three-item loneliness scale (1-5)	2.006	0.740	1	5
Poor/bad health status (dummy)	0.113	0.317	0	1
Some health constraints (dummy)	0.158	0.364	0	1
Severe health constraints (dummy)	0.037	0.189	0	1
Disability official (dummy)	0.045	0.208	0	1
Worries about health (3 cats)=no worries (1)	0.387	0.487	0	1
Worries about health (3 cats)=some worries (2)	0.475	0.499	0	1
Worries about health (3 cats)=many worries (3)	0.138	0.345	0	1
Dissatisfaction with health (0-10)	2.809	2.027	0	10
Number of close friends (3 cats)=No friends	0.035	0.184	0	1
Number of close friends (3 cats)=1-4 friends	0.618	0.486	0	1
Number of close friends (3 cats)=>=5 friends	0.347	0.476	0	1
Age in years	35.870	9.309	18	49
Female (dummy)	0.549	0.498	0	1
Direct or indirect migration background (dummy)	0.277	0.448	0	1
Secondary schooling degree low (dummy)	0.160	0.367	0	1
Secondary schooling degree mid (dummy)	0.310	0.462	0	1
Secondary schooling degree high (dummy)	0.370	0.483	0	1
Apprenticeship degree (dummy)	0.576	0.494	0	1
College degree (dummy)	0.241	0.428	0	1
Household income per capita (in 1000 real Euros 2015)	1.222	5.046	0	490
Number of persons in the household	3.252	1.444	1	13
Children <16 years in the household (dummy)	0.548	0.498	0	1
Divorced (dummy)	0.066	0.248	0	1
Widowed (dummy)	0.004	0.066	0	1
Unemployed (dummy)	0.053	0.223	0	1
Employed part-time (dummy)	0.188	0.391	0	1
Employed full-time (dummy)	0.491	0.500	0	1
Retired (dummy)	0.000	0.000	0	0
Participation in sports at least monthly (dummy)	0.559	0.497	0	1
Participation in volunteering at least monthly (dummy)	0.198	0.399	0	1
Participation policy at least monthly (dummy)	0.022	0.147	0	1
Participation in religion at least monthly (dummy)	0.143	0.350	0	1
Risk-taking preference (Likert 0-10)	4.935	2.375	0	10
Big 5: Openness (1-7)	4.676	1.158	1	7
Big 5: Conscientiousness (1-7)	5.701	0.943	1	7
Big 5: Extraversion (1-7)	4.990	1.154	1	7
Big 5: Agreeableness (1-7)	5.360	0.947	1	7
Big 5: Neuroticism (1-7)	3.802	1.229	1	7
Survey years=2013	0.363	0.481	0	1
Survey years=2017	0.637	0.481	0	1
Federal states (16)=Schleswig-Holstein	0.036	0.186	0	1
Federal states (16)=Hamburg	0.018	0.133	0	1
Federal states (16)=Lower Saxony	0.102	0.303	0	1
Federal states (16)=Bremen	0.008	0.089	0	1
Federal states (16)=North Rhine-Westphalia	0.209	0.406	0	1

Federal states (16)=Hesse	0.070	0.255	0	1
Federal states (16)=Rhineland-Palatinate	0.045	0.208	0	1
Federal states (16)=Baden-Wuerttemberg	0.119	0.324	0	1
Federal states (16)=Bavaria	0.160	0.367	0	1
Federal states (16)=Saarland	0.008	0.092	0	1
Federal states (16)=Berlin	0.039	0.194	0	1
Federal states (16)=Brandenburg	0.031	0.173	0	1
Federal states (16)=Mecklenburg-Western Pomerania	0.021	0.142	0	1
Federal states (16)=Saxony	0.065	0.246	0	1
Federal states (16)=Saxony-Anhalt	0.033	0.178	0	1
Federal states (16)=Thuringia	0.036	0.186	0	1

Notes: Pooled cross-sections 2013 and 2017 for younger sample (18-49 years). N=19200.

Table VI: Definitions and descriptive statistics for older sample

	Mean	SD	Min	Max
Three-item loneliness scale (1-5)	1.957	0.741	1	5
Poor/bad health status (dummy)	0.232	0.422	0	1
Some health constraints (dummy)	0.325	0.468	0	1
Severe health constraints (dummy)	0.137	0.344	0	1
Disability official (dummy)	0.203	0.403	0	1
Worries about health (3 cats)=no worries (1)	0.231	0.421	0	1
Worries about health (3 cats)=some worries (2)	0.552	0.497	0	1
Worries about health (3 cats)=many worries (3)	0.217	0.412	0	1
Dissatisfaction with health (0-10)	3.820	2.206	0	10
Number of close friends (3 cats)=No friends	0.088	0.284	0	1
Number of close friends (3 cats)=1-4 friends	0.577	0.494	0	1
Number of close friends (3 cats)=>=5 friends	0.334	0.472	0	1
Age in years	63.638	9.442	50	85
Female (dummy)	0.520	0.500	0	1
Direct or indirect migration background (dummy)	0.114	0.318	0	1
Secondary schooling degree low (dummy)	0.358	0.479	0	1
Secondary schooling degree mid (dummy)	0.302	0.459	0	1
Secondary schooling degree high (dummy)	0.250	0.433	0	1
Apprenticeship degree (dummy)	0.726	0.446	0	1
College degree (dummy)	0.262	0.440	0	1
Household income per capita (in 1000 real Euros 2015)	1.495	1.015	0	41
Number of persons in the household	2.174	0.986	1	12
Children <16 years in the household (dummy)	0.080	0.271	0	1
Divorced (dummy)	0.123	0.328	0	1
Widowed (dummy)	0.101	0.302	0	1
Unemployed (dummy)	0.029	0.168	0	1
Employed part-time (dummy)	0.113	0.317	0	1
Employed full-time (dummy)	0.303	0.459	0	1
Retired (dummy)	0.364	0.481	0	1
Participation in sports at least monthly (dummy)	0.490	0.500	0	1
Participation in volunteering at least monthly (dummy)	0.228	0.420	0	1
Participation policy at least monthly (dummy)	0.037	0.190	0	1
Participation in religion at least monthly (dummy)	0.192	0.394	0	1
Risk-taking preference (Likert 0-10)	4.470	2.354	0	10

Big 5: Openness (1-7)	4.617	1.189	1	7
Big 5: Conscientiousness (1-7)	5.867	0.899	1	7
Big 5: Extraversion (1-7)	4.799	1.090	1	7
Big 5: Agreeableness (1-7)	5.417	0.966	1	7
Big 5: Neuroticism (1-7)	3.773	1.227	1	7
Survey years=2013	0.450	0.497	0	1
Survey years=2017	0.550	0.497	0	1
Federal states (16)=Schleswig-Holstein	0.030	0.170	0	1
Federal states (16)=Hamburg	0.016	0.127	0	1
Federal states (16)=Lower Saxony	0.096	0.295	0	1
Federal states (16)=Bremen	0.007	0.083	0	1
Federal states (16)=North Rhine-Westphalia	0.193	0.394	0	1
Federal states (16)=Hesse	0.067	0.250	0	1
Federal states (16)=Rhineland-Palatinate	0.050	0.217	0	1
Federal states (16)=Baden-Wuerttemberg	0.107	0.310	0	1
Federal states (16)=Bavaria	0.153	0.360	0	1
Federal states (16)=Saarland	0.010	0.097	0	1
Federal states (16)=Berlin	0.039	0.194	0	1
Federal states (16)=Brandenburg	0.050	0.217	0	1
Federal states (16)=Mecklenburg-Western Pomerania	0.027	0.161	0	1
Federal states (16)=Saxony	0.070	0.256	0	1
Federal states (16)=Saxony-Anhalt	0.041	0.198	0	1
Federal states (16)=Thuringia	0.044	0.206	0	1

Notes: Pooled cross-sections 2013 and 2017 for older sample (50-85 years). N=19987.

Table VII: Complete results for baseline loneliness regression with poor health status

	Younger sample		Older sample	
	POLS	FEOLS	POLS	FEOLS
Poor/bad health status (dummy)				
1	0.240 ***	0.104 **	0.231 ***	0.100 ***
	(0.019)	(0.042)	(0.013)	(0.021)
Number of close friends (ref. none)				
1-4 friends	-0.159 ***	-0.080	-0.052 **	-0.105 ***
	(0.035)	(0.092)	(0.021)	(0.037)
≥ 5 friends	-0.210 ***	-0.103	-0.136 ***	-0.148 ***
	(0.035)	(0.095)	(0.022)	(0.040)
Age in years	-0.001	-0.016 ***	-0.007 ***	-0.013 ***
	(0.001)	(0.003)	(0.001)	(0.002)
Female (dummy)	0.043 ***		<0.001	
	(0.012)		(0.011)	
Direct or indirect migration background (dummy)	0.031 **		0.066 ***	
	(0.013)		(0.024)	
Secondary schooling degree low (dummy)	-0.052 **		-0.096 ***	
	(0.021)		(0.029)	
Secondary schooling degree mid (dummy)	-0.080 ***		-0.081 ***	
	(0.019)		(0.029)	
Secondary schooling degree high (dummy)	-0.127 ***		-0.100 ***	
	(0.018)		(0.030)	
Apprenticeship degree (dummy)	0.011		0.013	
	(0.013)		(0.013)	
College degree (dummy)	-0.003		0.012	

	(0.014)		(0.016)	
Household income per capita (in 1000 real Euros 2015)	-0.002 ***	-0.021	-0.034 ***	-0.006
	(0.001)	(0.025)	(0.008)	(0.012)
Number of persons in household	-0.038 ***	-0.015	-0.053 ***	-0.040 **
	(0.005)	(0.016)	(0.007)	(0.019)
Children <16 years in household (dummy)	0.026 *	0.009	0.120 ***	0.001
	(0.013)	(0.037)	(0.023)	(0.045)
Divorced (dummy)	0.093 ***	0.064	0.155 ***	0.032
	(0.023)	(0.088)	(0.017)	(0.073)
Widowed (dummy)	0.123	0.061	0.148 ***	0.027
	(0.083)	(0.182)	(0.019)	(0.061)
Unemployed (dummy)	0.177 ***	0.130 *	0.214 ***	0.239 ***
	(0.029)	(0.068)	(0.040)	(0.061)
Employed parttime (dummy)	-0.095 ***	0.003	-0.081 ***	-0.002
	(0.017)	(0.036)	(0.018)	(0.034)
Employed fulltime (dummy)	-0.070 ***	-0.015	-0.089 ***	-0.008
	(0.015)	(0.034)	(0.016)	(0.029)
Retired (dummy)			-0.053 ***	0.010
			(0.017)	(0.025)
Participation sports at least monthly (dummy)	-0.049 ***	-0.038	-0.007	-0.007
	(0.011)	(0.026)	(0.010)	(0.018)
Participation volunteering at least monthly (dummy)	0.006	-0.033	-0.022 **	-0.017
	(0.012)	(0.028)	(0.011)	(0.020)
Participation policy at least monthly (dummy)	0.081 ***	0.062	-0.050 **	-0.038
	(0.031)	(0.063)	(0.023)	(0.038)
Participation religion at least monthly (dummy)	0.022	0.028	0.021 *	-0.038
	(0.014)	(0.044)	(0.012)	(0.031)
Risk taking preference (Likert 0-10)	0.004 *	-0.002	0.007 ***	-0.003
	(0.002)	(0.007)	(0.002)	(0.004)
Big 5: Openness (1-7)	0.029 ***	0.010	0.014 ***	-0.009
	(0.005)	(0.016)	(0.005)	(0.010)
Big 5: Conscientiousness (1-7)	-0.060 ***	-0.057 ***	-0.074 ***	-0.033 ***
	(0.006)	(0.019)	(0.006)	(0.012)
Big 5: Extraversion (1-7)	-0.100 ***	-0.034 **	-0.085 ***	-0.064 ***
	(0.005)	(0.017)	(0.005)	(0.011)
Big 5: Agreeableness (1-7)	-0.036 ***	-0.055 ***	-0.043 ***	-0.023 **
	(0.006)	(0.016)	(0.006)	(0.011)
Big 5: Neuroticism (1-7)	0.147 ***	0.099 ***	0.145 ***	0.066 ***
	(0.005)	(0.014)	(0.004)	(0.010)
Survey year and federal states	Yes	Yes	Yes	Yes
Individual fixed-effects	No	Yes	No	Yes
Constant	2.757 ***	3.191 ***	3.107 ***	3.158 ***
	(0.071)	(0.361)	(0.094)	(0.296)
Number of observations	19200	6758	19987	12078
Number of individuals		3379		6039
R^2 (within for FEOLS)	0.186	0.057	0.202	0.050

*Notes: Sample age 18-49 (younger) vs. 50-85 (older). The dependent variable is a quasi-continuous three-item loneliness scale ranging from 1 (never) to 5 (very often), with a mean of about 2.0 and SD of 0.74 in both samples. Robust (clustered at the individual level for FEOLS) standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.10.*