RESEARCH REPORT

Marital status and longevity in the United States population

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Purpose: To investigate the relation between marital status and survival.
Data sources: The US 1989 national health interview survey (NHIS) merged with the 1997 US national death index.
Results: Among 1989 NHIS respondents, 5876 (8.77%) died before 1997 and 61 123 (91.23%) were known to be alive. Controlling for demographic and socioeconomic characteristics, the death rate for people who were unmarried was significantly higher than it was for those who were married and living with their spouses. Although the effect was significant for all categories of unmarried, it was strongest for those who had never married. The never married effect was seen for both sexes, and was significantly stronger for men than for women. For the youngest age group (19–44), the predominant causes of early death among adults who had never married were infectious disease (presumably HIV) and external causes. In the middle aged and older men and women, the predominant causes were cardiovascular and other chronic diseases.
Conclusion: Current marriage is associated with longer survival. Among the not married categories, having never been married was the strongest predictor of premature mortality. It is difficult to assess the causal effect of marital status from these observational data.

More than 25 years ago cardiologist James Lynch published *The Broken Heart: The Medical Consequences of Loneliness*.[1] Lynch argued that premature death from heart disease was more common among people who lived alone or were never married. A variety of studies have suggested that supportive social networks promote longer life expectancy.[2–13] The relation between social connectedness and survival has been shown in a variety of different populations including US residents of Alameda County, California,[13] Tecumseh Mighigan,[8] and Evans County Georgia.[14] International studies include Japanese-American men,[9] Japanese men living in Hawaii,[15] Israeli civil service,[10] and adults living alone in Gothenberg, Sweden.[16] In this paper we concentrate on categories of being unmarried. In particular, we focus on those who have never married. Adults with previous marriages are likely to have offspring that stimulate continuing family contact. In contrast, those who have never married might be more socially isolated than those who have been widowed or divorced. Thus, we predict that the health consequences of being unmarried will be strongest for the never married adults.

The studies reported in the literature have several limitations. In most studies, the number of deaths is too few to evaluate the relation between social connectedness and specific causes of death. Furthermore, most studies are too small to evaluate the relation between social connectedness and mortality at different points along the age range. The purpose of this study is to evaluate the relation between marital status and longevity using data from the US national health interview survey and the national death index.

METHOD

Data sources

National health interview survey (NHIS)

Data were from the 1989 NIHS. The survey uses a probability sample of American households to estimate health status for the US civilian non-institutionalised population. The 1989 survey included over 48 0000 households and 115 159 valid person estimates. The questionnaire also asks about acute and chronic conditions that were responsible for disabilities, limitations, or health care visits. The NHIS includes a measure of self perceived health status using the categories, excellent, very good, good, fair, and poor. The full questionnaire, sampling weights, and summary statistics can be obtained at http://www.cdc.gov/nchs/data/series/sr_10/sr10_176.pdf.[17 18]

National death index (NDI)

The NDI captures death records on the basis of state vital statistics reports. Our analysis uses a data file created by NCHS in which NCHS linked the 1989 NHIS to the 1997 NDI using social security numbers. Although the 1989 NHIS included over 115 000 respondents, social security numbers were not collected for respondents 18 years old and younger, and mortality information is not available for respondents 18 and younger, as well as for small numbers of respondents 19 and over with missing social security numbers.

Statistical analysis

Weighted multiple logistic regressions were used to estimate the association between marital status and mortality. We estimated a total of 21 regressions: three variations for each of seven outcome variables, where the outcome variables were all cause mortality as well as mortality from each of the six causes—infectious disease (2.8% of all deaths), cancer (27.2%), cardiovascular disease (41.4%), pulmonary disease (7.8%), external causes (accidents, homicides, and suicides, 5.6%), and all ''other'' causes (15.0%). In the first regression of each set, we included an indicator variable for being ''never married'', to permit straightforward comparison of the effect of being ever married with the effect of being married, divorced/separated, or widowed. In the second regression we included interactions of never married with age and sex, allowing the effect of being never married to vary by age and sex. In the third regression of each set we included interactions of never married with self reported health status. All regressions also include variables

Abbreviations: NHIS, national health interview survey; NDI, national death index

Table 1 Likelihood of death by 1997 based on NHIS responses in 1989 using logit analysis*

Parameter	p Value	Odds ratio estimate	95% CI
Intercept	<0.0001		
Age (19–24)			
25–34	0.1020	1.244	0.958 to 1.615
35–44	<0.0001	3.730	2.727 to 5.100
45–54	<0.0001	7.569	5.553 to 10.318
55–64	<0.0001	15.552	11.457 to 21.109
65–74	<0.0001	31.360	23.086 to 42.599
75–84	<0.0001	76.171	55.795 to 103.988
85+	<0.0001	196.778	139.258 to 278.057
Sex × age (female)			
Male less that 35 years	<0.0001	3.013	2.308 to 3.932
Male 35 years or older	<0.0001	1.709	1.556 to 1.878
Ethnicity (white-non-Hispanic)			
Black	0.0009	1.169	1.066 to 1.281
Latino	0.1761	0.904	0.782 to 1.046
Marital status (married)			
Widowed	<0.0001	1.386	1.264 to 1.520
Divorced-separated	<0.0001	1.267	1.133 to 1.416
Never married	<0.0001	1.575	1.394 to 1.781
Education (college graduate)			
Lt high school	0.0001	1.251	1.115 to 1.404
High school graduate	0.0023	1.188	1.063 to 1.327
Some college	<0.0001	1.300	1.148 to 1.473
Income (>$50K)			
<$20K	<0.0001	1.367	1.211 to 1.543
$20–35K	0.0001	1.267	1.124 to 1.428
$35–50K	0.9513	0.996	0.868 to 1.142
Perceived health (excellent)			
Very good	0.0057	1.155	1.043 to 1.279
Good	<0.0001	1.618	1.469 to 1.783
Fair	<0.0001	2.346	2.103 to 2.618
Poor	<0.0001	4.126	3.611 to 4.715
Miscellaneous			
Personal care	<0.0001	1.795	1.550 to 2.078
Veteran	0.0157	1.120	1.022 to 1.229
Keep house	0.0004	1.207	1.087 to 1.339
Major activity limitation	<0.0001	1.550	1.411 to 1.704

Omitted categories are noted within parentheses in ''Parameter'' column. Source: authors' analysis of 1989 NHIS linked to 1997 NDI.

measuring age, sex, education, race/ethnicity, income, employment status, veteran status, receipt of personal care services (as a proxy for functional status), and self perceived health status. The analyses were completed using the SAS and SPSS programs.

RESULTS

Among the 35 141 cases in the 1989 NHIS that were not useable, 99% were excluded because the respondent's age was less than 19 years, leaving 80 018 cases for analysis. Forty eight per cent of the participants were male and 52% were female. With regard to education at baseline, 6.2% had less than an 8th grade education, 38% were high school graduates, 31.3% had some college, 15.6% had a bachelor's degree, 7.9% had a college graduate degree, and 1% refused. About 34.3% of the participants had family income less than $20 000 per year. The most common race or ethnic identity was white, non-Hispanic (73.6%), followed by black/African American (14.6%), Hispanic (8.5%), Asian-Pacific Islander (2.2%), Native American (0.7%), multiple (0.3%), and ''other'' (0.1%). Thirty nine per cent of the participants rated their health as excellent, 27.8% rated their health as very good, 22.7% as good, 7.2% as fair, and 2.7% as poor.

The main focus of the study is on marital status. Among the participants, 47.7% were married in 1989, 9.9% widowed, 12.5% divorced, 3.5% separated, 5% living with partner, 0.4% unknown marital status, and 21.0% had never been married. Our analyses exclude the small number of unmarried respondents who were living with a partner or had unknown marital status. The divorced and separated groups were combined into a single category. Age was initially aggregated into 10 year intervals, with the exception of a five year block for those 19–24 years. Because of the small numbers in some cells, age was later aggregated into three larger categories: young (19–44 years), middle adult (45–64 years), and older adult (65 years or older).

We investigate the association between marital status and all cause mortality, as well as the association with cause specific mortality. Early in adulthood most of the population was in the never married category (fig 1). By age 35–44, less than 10% of the population remained never married. The separated or divorced category peaked during midlife (ages 35–54) and declined later in life. Widowers increased rapidly with age, beginning about age 45.

In a multivariate logistic regression predicting all cause mortality, age was by far the strongest predictor (table 1). As expected, the risk of dying from all causes increases sharply as the population ages. Using married as the reference group, those who were widowed had a 39% greater risk of mortality and those who were divorced or separated had 27% greater chance of mortality. The strongest risk was seen for the never married people who were 1.58 (CI 1.39 to 1.78) more likely to have died between 1989 and 1997 than were those who were married in 1989. The point estimate for the relation between being never married and mortality was greater than the point estimate for being widowed or divorced/separated, although the 95% confidence intervals overlap. We define the loss of life expectancy associated with having never been married as the ''never married penalty''.

Table 2 Logistic regression comparing likelihood of death for never married with reference to married for subgroups of age and sex (upper section) and with health status (lower section)

Effect	Odds ratio estimate	Lower CI limit	Upper CI limit
Never married/married for			
Male 19–44	2.121	1.684	2.672
Male 45–64	1.618	1.195	2.192
Male 65+	l.097	0.704	1.353
Female 19–44	1.674	1.204	2.328
Female 45–64	1.495	1.064	2.102
Female 65+	1.478	1.153	1.895
Never married/married for perceived health			
Excellent	1.884	1.532	2.318
Very Good	1.733	1.415	2.123
Good	1.356	1.119	1.642
Fair	1.355	1.058	1.736

Logistic regression controls for all variables shown in the logistic regression in table 1. For this analysis n for dead = 7418, n for alive = 72 295. Covariates include ethnicity, education, personal care source, veteran status, head of household, and major activity limitation.

Other variables included in the model were related to mortality in expected directions. In comparison with those who reported themselves to be in excellent health, there was a systematic increase in the probability of death for those with lower self reported health, with an odds ratio over 4.0 for those reporting poor health. Death rates were higher among men than among women (OR = 3.0 for men less than 35, and 1.7 for men greater than 35), among those with less than a college degree (there is no evidence of a dose-response relation at lower levels of education), among those with lower incomes (OR = 1.4 for family income less than $20 000 per year compared with those with incomes above $50 000 per year), and higher among those receiving personal care services, among veterans, among those keeping house (compared with working), and among people whose health prevented them from working. In comparison with white respondents, African-Americans were at a significantly higher risk for early mortality (OR = 1.17, CI 1.06 to 1.28) while Hispanic respondents were not at higher risk (OR = 0.90, CI 0.78 to 1.05). If anything, there is a slight protective effect for being Hispanic. The logistic regression that includes interactions of never married with age and sex suggests that being never married is associated with higher death rates for both men and women (table 2, upper section). Never married men age 19 to 44 were 2.12 (CI 1.68 to 2.67) times more likely to die than married men in this age group. The never married penalty declined with age among men, reaching an odds ratio of 1.62 among men 45–64; men in the 65+ age category were not at significantly greater risk of early death if never married. Among women, there was no evidence of an age gradient in the never married penalty, with odds ratios of 1.64, 1.5, and 1.48 for women in the 19–44, 45–64, and 65 plus age groups, respectively. The never married penalty was greater among men than among women in the youngest age group, about equal in the middle age group, and larger among women than among men among the elderly group.

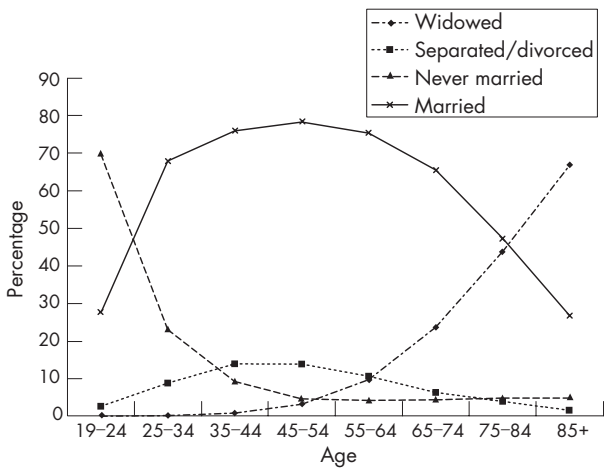

Figure 1 Marital status by age.

One explanation for the never married penalty is that sick people require greater support. Thus we would expect that the never married penalty to be stronger for those with lower health status. We saw a clear monotonic relation between self rated health and probability of death between 1989 and 1996. We examined this issue in more detail by considering the odds ratio of death for the never married compared with currently married status separately for those who rated their own health as excellent, very good, good, or fair. The never married penalty (in odds ratio terms) was larger for those in excellent or very good health and smaller for those in good, fair, or poor health (table 2, lower section).

To investigate the association between being never married and specific causes of death, we estimated logistic regressions with specific causes of death as the dependent variable. Figure 2 summarises the risk of being never married by cause of death. Using married as the reference group, the figure compares odds ratios for the divorced/separated, widowed, and never married for primary cause of death. The figure replicates previous work showing that being divorced or widowed increases the risks of death attributable to cardiovascular disease and cancer, as well as all cause mortality. Although most authors cite the risk of being divorced/separated or widowed, the point estimates suggest that never having been married was a greater risk factor than being divorced or separated for death from all causes, external causes, other causes, and infectious diseases. Furthermore, having never been married was equivalent to being widowed as a risk for death from cardiovascular diseases.

There were only two causes (cancer and pulmonary disease) for which being never married was not a significant risk factor relative to being married.

Table 3 shows odds ratios by cause of death for all never married people, and never married men in the 19–44 and 45–64 age groupings. The table also lists confidence intervals. Embolded cells show that never married people are significantly different from those who were married. For young

Table 3 Odds ratios comparing likelihood of death for never married with married by cause of death and confidence intervals for all never married compared with married (both sexes, all ages), never married men age 19–44, and never married men age 45–64

Cause of death	Both sexes, all ages	Male 19–44	Male 45–64
Cardiovascular (n = 2438)	**1.38 (1.14 to 1.67)**	1.14 (0.61 to 2.10)	**2.35 (1.57 to 3.53)**
Cancer (n = 1603)	0.97 (0.77 to 1.23)	0.66 (0.31 to 1.43)	0.77 (0.42 to 1.44)
Pulmonary (n = 463)	1.09 (0.71 to 1.67)	**2.38 (1.66 to 8.49)**	0.98 (0.30 to 3.16)
Infectious (n = 167)	**4.99 (3.32 to 7.52)**	**9.08 (4.86 to 17.34)**	**6.26 (2.32 to 16.86)**
Accidents, homicides, suicide (n = 332)	**2.03 (1.47 to 2.80)**	**2.35 (1.55 to 3.56)**	1.08 (0.26 to 4.46)
Other (n = 883)	**1.75 (1.37 to 2.25)**	**2.67 (1.54 to 4.61)**	1.71 (0.88 to 3.32)
All causes (n = 5876)	**1.58 (1.39 to 1.78)**	**2.12 (1.68 to 2.67)**	**1.61 (1.19 to 2.19)**

Logistic regression controls for all variables shown in the logistic regression in table 1. Other includes all deaths not in any other category. Embolded cells show statistically significant effects. N reports on the number of deaths among both sexes, all ages. Covariates include ethnicity, education, personal care source, veteran status, head of household, and major activity limitation.

men aged 19 to 44, the association between being never married and increased mortality is particularly notable for infectious disease (presumably a result of increased risk of death from AIDS), external causes, and ''other'' causes. For middle aged men, increased risk associated with being never married was greatest for cardiovascular and infectious diseases. For infectious disease and all cause mortality, there was no differentiation by age for men. For cardiovascular disease, the relative risk of being never married was greater for older men than younger men. For pulmonary disease, accidents, homicides and suicides, and other causes, the point estimates suggest that being never married was a greater relative risk factor for younger than for older men.

DISCUSSION

A variety of studies have shown that unmarried adults have a higher probability of early death than those that are married.[19 20] However, most of these studies do not differentiate those who are separated and divorced from those that were never married. A recent detailed review of the literature[21] does not treat never married as a separate category. Our results suggest that those who are never married are at greater risk than those who are separated and divorced. To observe the impact of never married status upon different causes of death and at different ages, a large sample is required. We are not aware that the NHIS with linkage to the NDI has previously been used for this purpose. Among the published studies, only Johnson and colleagues have reported on a large cohort. Using a cohort of 281 460 participants in the national longitudinal mortality study (NLMS), Johnson *et al* reported findings similar to ours for cardiovascular disease mortality and for cancer. However, they did not include the younger age groups, so were unable to identify the increased risk of early infectious disease deaths in younger never married men.[22]

We have shown, as have several other authors,[3 5 22–28] that there is an association between being never married and increased risk of death. Hu and Goldman have shown that the effects of being married upon mortality occurs in a wide variety of cultures.[25] Reports of similar effects have emerged from the USA,[22] Great Britain,[23] Sweden,[27] Denmark,[26] and the Netherlands.[28] None of the studies has established a causal relation.

Accumulated evidence suggests that social isolation increases the risk of premature death. Marriage is a rough proxy for social connectedness. Among categories on being unmarried, we suggest that having never married may be associated with more severe isolation because it is associated

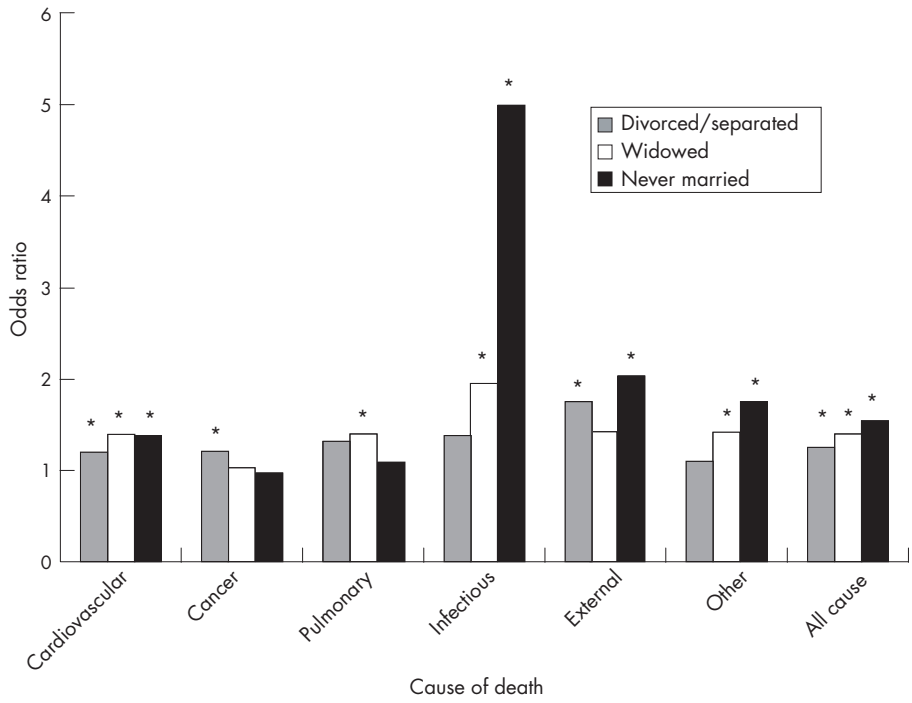

Figure 2 Odds ratios by marital status and cause of death. *Shows confidence limit excludes 1.0.

with greater isolation from children and other family. The data seem to support the hypothesis that the greater level of social isolation associated with having never married is associated with larger health consequences. We consider several rival explanations for the association between social relationships and mortality.

Illness causes disruption in social relationships

One explanation for the never married penalty is that those who are seriously ill are less suitable as marriage partners. However, half of those never married in the 25–34 age group do marry by age 35 (fig 1) and we saw the consequences of being never married in all age groups. Some of the literature on social support argues that disruption in social ties is stressful and leads to poor health outcomes.[1 5 15] However, our data suggest that the effect of never having been married is stronger than being divorced or becoming widowed. It might also be argued that the duration of social isolation has a cumulative effect. For example, Lund and colleagues followed up 10 891 younger men in Denmark. They found a cumulative effect of marriage upon life expectancy. The effects of divorce may be attenuated by remarriage while duration without a female spouse may predict early mortality for younger men.[26] Data from our analyses argue the opposite. With increasing age, the marriage penalty among men decreases rather than increases. The analysis adjusting for self rated health status did not confirm the hypotheses that the marriage penalty results from low health status in the never married.[29] In fact, the marriage penalty is strongest among those who report themselves to be in excellent health (table 2). We acknowledge that this result is difficult to interpret because the absolute risk is higher for participants with the lowest self rated health while the relative risk is higher for the well portion of the population. In addition to a true causal relation, there are several other explanations. The greater relative risk among the well portion of the population might be explained by a selection effect (people in poor health are less attractive as marriage partners), or by an omitted variable.

High risk behaviours

Another explanation for the marriage penalty is that those who have never been married engage in higher risk behaviours than those who are married.[6 30] Our findings show that the never married penalty is greatest for younger adults and that the relation is strongest for infectious disease—presumably deaths related to HIV infection. It is probable that the increase in infectious disease deaths in younger men may be attributable to the prevalence of HIV in gay unmarried men. NHIS does not ask about sexual preference, so we cannot formally evaluate this hypothesis.

The decrease in the never married penalty with age may suggest that as the population ages, risky health behaviours decline. Despite the attractiveness of the risky behaviour hypothesis, there is some evidence to contradict it. It is unlikely that the never married penalty is associated with poor health habits**.** For example, we analysed data from the US NHIS and found that those who were never married were only slightly more likely than those currently married to be current every day smokers (18.6% compared with 15.7%). Furthermore, those never married were less likely to be smokers than those who were divorced (27.9%) or separated (31.4%), or living with a partner (35.1%). Never married adults were more likely to have been lifetime abstainers from alcohol and were slightly less likely than currently married people to be regular alcohol consumers. The never married group exercise slightly more than those that were married and were less likely to be overweight. Overall, those who have never married have slightly better health habits and risk factors than married peers and never married adults have notably better health habits than those who are divorced or separated.

Usual source of care

This study was conducted in the USA where a significant proportion of the population does not have a usual source of health care. One potential explanation for our results is that never married people are less likely to have a usual source of medical care. Although this factor did not clearly emerge in our analysis of the NHIS data, evidence reported in *Vital and Health Statistics* suggested that the never married were more likely to lack a usual source of care (17%) in comparison with those who are married (10.5%), widowed (11%) or divorced or separated (16%). Only those ''living with a partner'' are less likely to have a usual source of medical care (20.7%). The most common reason for not having a usual source of care is being uninsured. As many people gain insurance through a spouse or a former spouse, never married status may be associated with a greater degree of separation from usual health care.

Unfortunately, the NHIS data do not permit much exploration of sub-groupings within the never married category. For example, lesbian/gay status cannot be determined from the information available to us. We encourage evaluation of these factors using other datasets.

Practical implications

Our study may have some practical implications. In particular, it suggests that those who have never married may be in need of particular attention. The risks of being never married, in terms of odds ratios, rival the risks of having increased blood pressure or high cholesterol. There are also some important research implications. In many epidemiological studies, the never married category is merged with widowed and divorced/separated. Our data suggest that being never married deserves a separate category and more research attention.

Limitations

Our study has significant limitations. The data were limited to baseline information obtained from a wide ranging

What the paper adds

Our study raises a series of new questions. Firstly, we found that having never been married is a better predictor of poor health outcomes than either divorce or widowhood. Secondly, the impact of social isolation is not constrained to the elderly. In fact, it is comparatively stronger early in life. This phenomenon may have been overlooked in previous studies because early death is uncommon. The early effects of having never been married are only detectable in studies with very large sample sizes. Finally, our findings challenge the belief that the effect of social isolation is upon diseases of the heart. Our findings underscore the impact on all cause mortality. Furthermore, the predominant cause of death associated with social isolation differs at different stages of the life cycle.

Policy implications

The paper suggests that having never been married may be a risk factor for mortality in all age groups.

interview and mortality follow up. As a result we are limited to associations between broadly defined variables. Because we had only baseline data, we are unable to assess the impact of changes in health status or changes in marital status over the course of time. Comparison of age groups in a cross sectional study cannot substitute for longitudinal analysis. Secular changes and cohort effects could serve as alternative explanations for some of our findings. On the other hand, we are encouraged by the concordance of our findings and those reported by other authors who used very different populations and different methodologies.

CONCLUSIONS

Lynch argued that social isolation is a significant factor in death from heart disease. A variety of studies in the literature underscore the impact of social isolation upon diseases of the heart.[1–5 9 11 13 15 31] Furthermore, a growing literature shows that widowhood may also be an important predictor of mortality in the elderly population.[2 5 13 31]

Our study raises a series of new questions. Firstly, we found that having never been married is a better predictor of poor health outcomes than either divorce or widowhood. Secondly, the impact of social isolation is not constrained to the elderly. In fact, it is comparatively stronger early in life. This phenomenon may have been overlooked in previous studies because early death is uncommon. The early effects of having never been married are only detectable in studies with very large sample sizes. Finally, our findings challenge the belief that the effect of social isolation is upon diseases of the heart. Our findings underscore the impact on all cause mortality. Furthermore, the predominant cause of death associated with social isolation differs at different stages of the life cycle.

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