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Purpose in life and 8-year mortality by gender and race/ethnicity among older adults in the U.S

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Abstract

We examined the associations between a sense of *purpose* and all-cause mortality by gender and race/ethnicity groups. Data were from the Health and Retirement Study, a nationally representative cohort study of U.S. adults aged >50 (n = 13,159). Sense of *purpose* was self-reported at baseline (2006/2008), and risk of all-cause mortality was assessed over an 8-year follow-up period. We also formally tested for potential effect modification by gender and race/ethnicity. We observed the associations between higher purpose and lower all-cause mortality risk across all gender and race/ethnicity groups. There was modest evidence that the highest level of purpose (versus

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Koichiro Shiba: Conceptualization, Methodology, Software, Formal analysis, Writing – original draft, Writing – review & editing, Visualization, Project administration. **Laura D. Kubzansky:** Writing – review & editing, Supervision. **David R. Williams:** Writing – review & editing. **Tyler J. VanderWeele:** Writing – review & editing, Methodology. **EricS. Kim:** Conceptualization, Writing – original draft, Writing – review & editing, Funding acquisition.

Appendix A. Supplementary data
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lowest quartile) was associated with even lower risk of all-cause mortality among women (risk ratio = 0.66, 95% confidence interval: 0.56, 0.77) compared to men (risk ratio = 0.80, 95% confidence interval: 0.69, 0.93; *p*-value for multiplicative effect modification =0.07). However, we observed no evidence of effect modification by race/ethnicity. Having a higher sense of *purpose* appears protective against all-cause mortality regardless of gender and race/ethnicity. *Purpose*, a potentially modifiable factor, might be a health asset across diverse populations.

Keywords

Purpose in life; Race/ethnicity; Gender; Effect modification; Interaction; Older adults; Health and retirement study

1. Introduction

The biomedical sciences and public health have focused on *reducing risk factors as a way to improve health outcomes*. This deficit-based approach has generated important scientific insights and interventions. Emerging research, however, has shed light on the health benefits of a strengths-based approach, which focuses on identifying and *fostering resilience factors and health-promoting assets. (*VanderWeele et al., 2020*) Purpose* in life—the extent to which people perceive their lives as having a sense of direction and goals—has emerged as a promising candidate health asset. (Ryff, 2014; McKnight and Kashdan, 2009; Ryff and Kim, 2020) Growing evidence suggests that a higher sense of *purpose* is associated with healthier lifestyle behaviors (e.g., increased physical activity and preventive healthcare use, as well as reduced illicit drug use and likelihood of sleep problems), (Kim et al., 2020a; Kim et al., 2020b; Kim et al., 2014; Kim et al., 2022; Kang et al., 2021) healthier biological function (e.g., reduced inflammation and allostatic load), (Zilioli et al., 2015; Steptoe and Fancourt, 2019; Hafez et al., 2018) physical function, (Kim et al., 2017) and also reduced risk of chronic disease (e.g., lower risk of cardiovascular disease and cognitive impairment), (Steptoe and Fancourt, 2019; Kim et al., 2019; Cohen et al., 2016; Sutin et al., 2021) and mortality. (Kim et al., 2022; Cohen et al., 2016; Hill and Turiano, 2014; Alimujiang et al., 2019)

It is theoretically possible that the health impacts of *purpose* differ by key demographic characteristics because socio-environmental factors that block the intermediate pathways linking *purpose* and enhanced health might be differentially distributed across the demographic groups. For example, higher *purpose* may lower mortality risk via promoting health behaviors (e.g., physical activity). (Kim et al., 2020a) However, without access to necessary socioenvironmental factors (e.g., adequate infrastructure that enables physical activity such as green space, a safe neighborhood, etc), one may not fully benefit from having higher *purpose*. A recent study in older adults evaluated three indicators of socioeconomic status (i.e., income, total wealth, educational attainment) as potential effect modifiers of the *purpose*-mortality association. Results showed that the highest levels of *purpose* appeared protective against all-cause mortality regardless of SES, while more modest levels of *purpose* appeared less beneficial health-wise among people with lower SES. (Shiba et al., 2021)

Similarly, gender and race/ethnicity may moderate the impacts of *purpose* on health because people may have differential access to risks, opportunities, and resources due to gendered and racialized social structures. Thus, people in marginalized identity groups might receive more health benefits from purpose because they have limited access to other health-promoting resources, but purpose is an alternate resource that is more accessible than others. It is important to examine potentially heterogeneous effects of *purpose*; finding that *purpose* is associated with favorable health across gender and race/ethnicity groups suggests that the health benefits of *purpose* are realizable in multiple demographic contexts. Alternatively, finding that *purpose* is associated with smaller beneficial health effects in specific subgroups would prompt further investigation into the underlying reasons for heterogeneous effects; this additional work could help identify whether and how the health benefits of *purpose* might become realizable for all. However, research evaluating gender and race/ethnicity as potential effect modifiers is limited.

Only two studies to date have evaluated if the *purpose*-mortality association is moderated by gender or race/ethnicity, and they reported mixed results. One US-based study of 1238 older adults observed that the *purpose*-mortality association was not moderated by either gender or race. (Boyle et al., 2009) A second study, conducted in 73,272 middle-aged and older adults in Japan evaluated *Ikigai* ("what makes life worth living"), which is a distinct but close conceptual cousin to *purpose*. This study reported that the Ikigai-mortality association was stronger in men than in women. (Tanno et al., 2009) These studies contribute substantially to the literature, but some limitations remain unaddressed. First, the only study to evaluate effect modification by race/ethnicity was conducted in a sample with a small number of case counts in the different race/ethnicity groups; thus, it might have been underpowered. Second, the study of Ikigai and mortality was conducted with a culturally and racially homogenous population, and some evidence suggests that associations between psychological factors and health outcomes are not universally observed across different cultures. (Kitayama and Park, 2021)

To fill these knowledge gaps, we analyzed a large, diverse, and nationwide longitudinal sample of U.S. older adults and examined the associations between purpose in life and all-cause mortality by gender and race/ethnicity.

2. Methods

Data are from the Health and Retirement Study (HRS)—an ongoing nationwide panel study of U.S. adults aged >50 years. HRS was initiated in 1992 with biennial follow-up surveys ongoing. In 2006, the HRS began visiting a randomly-selected 50% of study participants for an enhanced face-to-face interview. The remaining 50% of participants were assessed with the same protocol in 2008. At each time point, after the interview, respondents were given a self-administered psychosocial questionnaire to return by mail to study staff, which included items assessing sense of *purpose* (response rate was 88% in 2006 and 84% in 2008).

We combined respondents from both time points and considered 2006/2008 as the baseline for our current study (N = 13,770). Individuals with missing information on either *purpose* (n = 426) or death (n = 185) were excluded, resulting in a final analytic sample of 13,159 participants. Because the study used de-identified, publicly available data, the Harvard T.H. Chan School of Public Health IRB exempted it from review. In addition, all HRS respondents provided written informed consent to the HRS study.

2.1. Measures

Mortality.—To keep follow-up length constant across all participants, information about death was obtained up to 2014 (for the 2006 subsample) and up to 2016 (for the 2008 subsample). Thus, our study assessed death over an 8-year follow-up period. Information about death was obtained first via an exit interview conducted with next-of-kin. When subsequently confirming the exit interview deaths reported with those reported by the National Death Index, there was a 95.5% match.

Purpose in Life.—*Purpose* in life was assessed at baseline (2006/2008) using the validated 7-item *purpose* in life subscale of the Ryff Psychological Well-being Scales. (Ryff and Keyes, 1995) Each item was rated on a 6-point Likert scale, and overall scores were derived using the mean of item responses (range: 1–6), with higher scores reflecting higher sense of *purpose* (Cronbach $\alpha = 0.74$ among those with complete purpose data). The mean purpose score was derived if respondents completed at least 5 of the 7 *purpose* items (96.9%). Of the study population ($n = 13,159$), 199 participants had one and 30 participants had two missing items. Mean purpose scores were 4.25 (SD = 0.95) among the 199 participants with one missing item and 4.24 (SD = 1.05) among the 30 participants with two missing items, which were relatively lower compared to those with complete data ($n = 12,690$; mean = 4.59 and SD = 0.93). To evaluate potential non-linearities in the *purpose*-mortality association, we created quartiles based on the baseline distribution of *purpose* scores in the analytic sample (Low: 1.00–3.86; Medium-low: 3.87–4.57; Medium-high: 4.58–5.29; High: 5.30–6.00).

Gender and Race/Ethnicity.—We considered gender and race/ethnicity as potential effect modifiers using self-reported data in the baseline survey (2006/2008). Gender was coded as: men or women and race/ethnicity was coded as: White, Black, Hispanic, or Other.

Covariates.—We considered a range of covariates assessed at baseline, including socioeconomic status, other demographic characteristics, baseline physical health, and depression. Depression has been identified as a risk factor for mortality and is also related to lower *purpose* (Kim et al., 2022; Cuijpers and Smit, 2002); thus, we adjusted for depression to reduce concerns that *purpose* simply reflects the absence of depression. Socioeconomic status included educational attainment (highest degree attained: <high school, high school of GED, and ≥ college), annual total household income following conventional HRS coding (1st Quartile: ≤$20,024; 2nd Quartile: $20,025–$38,321; 3rd Quartile: $38,322–$71,895; 4th Quartile: ≥$71,896), and total wealth (1st Quintile: ≤$35,000; 2nd Quintile: $35,001–$140,000; 3rd Quintile: $140,001–$311,000; 4th Quintile: $311,001–$652,500; 5th Quintile: ≥$652,501). Other demographic characteristics included: age (years, continuous), marital status (married, not married), health insurance status (covered, not covered). Baseline physical health status was assessed according to self-reported presence/absence of a doctor's diagnosis for each of the following major diseases: heart disease, cancer, stroke, diabetes,

hypertension, lung disease, and arthritis. Depression was assessed using the validated 8-item Center for Epidemiological Studies Depression Scale (Cronbach $\alpha = 0.80$; a score of ≥4 was categorized as depressed). (Radloff, 1977)

2.2. Statistical analysis

Because our outcome (death) was not rare (24.7% among the total sample), odds ratios from logistic regression can overestimate risk ratios (RRs). Thus, we used Poisson regression models to estimate RRs for the *purpose*-mortality association over the 8-year follow-up period. To evaluate potential effect modification by gender and race/ethnicity, we fit two separate models. In each model, we introduced product terms between baseline *purpose* in life (three dummy variables for quartiles) and the categories (dummy variables) of gender or race/ethnicity. In each model, we also adjusted for all covariates and the other effect modifier (e.g., we adjusted for race/ethnicity as a covariate in the model assessing effect modification by gender).

Following the framework proposed by Knol and VanderWeele (2012), (Knol and VanderWeele, 2012) we computed a series of effect estimates and measures of effect modification. First, using Poisson models, we estimated RRs to evaluate the *purpose*-mortality association within each stratum of gender (or race/ethnicity) category. Second, we estimated RRs for the association of a joint exposure of *purpose* and gender (or race/ethnicity) with mortality over the 8-year follow-up period. The reference groups in these analyses were people with the lowest *purpose* levels and: 1) men (for gender analyses), 2) white (for race/ethnicity analyses)). Third, using the RRs from the joint *purpose* and gender (or race/ethnicity) estimates from the second analysis, we estimated measures of effect modification on both the additive (relative excess risk due to interaction: RERI) and multiplicative (Ratio of RRs: RRR) scales. Additive effect modification, which captures change in absolute risk difference estimates across levels of effect modifiers, is rarely reported in epidemiology despite its public health relevance. (Knol and VanderWeele, 2012) The additive effect modification measure provides insight into whether the absolute number of deaths that could be prevented via potential purpose interventions might differ across social groups. Multiplicative effect modification can be large even when the baseline prevalence of the outcome is low, and the population impact of such effect heterogeneity is minimal. See Supplementary Text for a detailed description of how to estimate and interpret both measures of effect modification. Supplementary Table 1 provides an example of how we combined the regression coefficients from the Poisson model that assesses effect modification by gender. As we performed many statistical tests for effect modification by each gender (or race/ethnicity) category, low power and multiple testing are both concerns. Thus, we conducted a sensitivity analysis where we coded *purpose* as a continuous variable. We then created product terms between continuous *purpose* and the effect modifier of interest (gender or race/ethnicity categories) and conducted an omnibus test for effect modification on the multiplicative scale.

Among the analytic sample of 13,159 individuals, 2.9% ($n = 377$) had missing data in at least one of the variables. We imputed missing data using multiple imputation by chained equation. (van Buuren and Groothuis-Oudshoorn, 2010) Specifically, we created 20 imputed datasets using the R package "mice" (R Foundation for Statistical Computing, Vienna, Austria), performed the analyses described above in each imputed dataset, and combined estimates across the imputed datasets based on the Rubin's rule. (Rubin, 2004) All analyses were performed using R, version 3.6.0. The data supporting the findings of this study are publicly available upon request to the Health and Retirement Study. R code to replicate the findings will be made available upon request to the corresponding author.

3. Results

3.1. Descriptive statistics

Table 1 shows the descriptive statistics of the analytic sample. Among the 13,159 people in our study sample, 3253 people (24.7%) died during the 8-year follow-up period. Overall, people with the highest baseline *purpose* in life showed lower mortality risk compared to those with the lowest *purpose* (e.g., mortality risk was 15.2% in the highest baseline *purpose* group and 36.5% in the lowest baseline *purpose* group). In a dose-response fashion, increasingly higher baseline *purpose* was associated with increasingly: higher socioeconomic status, better physical health, lower depression prevalence, and younger age at baseline. While mean baseline *purpose* scores were comparable across gender groups (4.59 in men and 4.58 in women), it was higher among Blacks (4.73), and lower among Hispanics (4.38) and people in the "Other" group (4.50), compared to the average among Whites (4.58).

3.2. Purpose and mortality within strata of gender or race/ethnicity

Supplementary Fig. 1 shows associations between *purpose* quartiles and 8-year mortality risk for each stratum of gender or race/ethnicity (see Supplementary Table 2 for exact estimates). Overall, there was a dose-response trend so that people with increasingly higher levels of *purpose* displayed decreasingly lower mortality risk across gender and race/ethnicity groups. However, the *purpose*-mortality point-estimates were stronger in women, than men. For example, RRs comparing the highest (versus lowest) baseline *purpose* group was 0.66 for women and 0.80 for men. When comparing people with the highest (versus lowest) levels of *purpose*, the *purpose*-mortality association was stronger in Blacks (RR = 0.59; 95% Confidence Interval [CI]: 0.43, 0.80), Hispanics (RR = 0.52; 95% CI: 0.32, 0.86), than in Whites (RR = 0.76; 95% CI: 0.67, 0.86). Further, in Blacks, we did not observe strong evidence of a *purpose*-mortality association among people with mid-range levels of *purpose* (i.e., "Medium-high" and "Medium-low" *purpose*). People in the "Other" group displayed increased mortality risk with increasing *purpose* but confidence intervals were wide (e.g., people with high *purpose* had RR = 1.31; 95% CI: 0.57, 3.05).

3.3. Evaluating potential effect modification

Tables 2 and 3 show associations for the joint exposure of *purpose* in life and gender (Table 2) or race/ethnicity (Table 3) with mortality, as well as corresponding measures of effect modification. Although point estimates suggested that the combination of having the highest *purpose* and being a woman (versus being a man) had a stronger association with lower mortality risk than the simple sum of the two factors alone, confidence intervals were wide, and evidence of effect modification was only modest (e.g., having the highest *purpose* and being a woman combined: RERI = 0.06, $p = 0.45$; RRR = 0.82, $p = 0.07$). However, in sensitivity analyses where we conducted an omnibus test using continuous *purpose* scores (Supplementary Table 3), we observed confirmatory evidence for multiplicative effect modification by gender (RRR = 0.93, $p = 0.05$). Point estimates for the combination of having the highest *purpose* levels and being Hispanic or Black (versus White) hinted at possible effect modification, but formal tests of additive and multiplicative effect modification provided little evidence for this trend. People in the "Other" group showed relatively similar estimates as Whites.

4. Discussion

In a national sample of U.S. adults aged >50, we examined the longitudinal association between *purpose* and mortality risk over the 8-year follow-up period and considered if associations differed depending on gender or race/ethnicity. We had three main findings. First, we observed an overall trend across all groups: as *purpose* levels increased, risk of all-cause mortality decreased. Second, although *distributions* of baseline *purpose* were similar between men and women, the *purpose*-mortality *association* was somewhat stronger among women (versus men). When formally testing measures of effect modification, there was slight evidence suggesting that the highest level of *purpose* may be more protective against mortality among women (versus men). The omnibus test demonstrated additional evidence for potential multiplicative effect modification by gender. Third, there was little evidence of effect modification by race/ethnicity. Point estimates from the stratum-specific *purpose*-mortality associations hinted that Blacks and Hispanics (versus Whites) may benefit more from protective effects of *purpose* concerning all-cause mortality. However, when formally testing potential effect modification by race/ethnicity, we did not observe strong statistical support for either observation. The overarching pattern of findings suggests that increasingly higher levels of *purpose* are beneficial for health regardless of gender or race/ethnicity.

Our findings somewhat diverged from previous evidence. One longitudinal study of older adults in the U.S. reported that the *purpose*-mortality association was not moderated by gender or race. (Boyle et al., 2009) We likewise observed no moderation by race; however, we also observed slight evidence that the *purpose*-mortality association was stronger in women than men despite the comparable mean baseline *purpose* scores across women (4.58) and men (4.59). The diverging results for effect modification by gender might be attributable to differences in sample size as our mortality case count was >20× larger than that of the previous study; hence we had increased power to detect potential effect modification. Further, another study of middle-aged and older adults in Japan observed that the Ikigai-mortality association was stronger in men than in women, (Tanno et al., 2009) whereas our results suggested the opposite. These diverging results might be explained by emerging evidence that associations between psychological factors and health outcomes do not consistently generalize across cultures. Although many, but not all, studies across cultures might maintain main effects (e.g., higher *purpose*/ikigai is associated with better health), the size of effect modification by gender was different when comparing results from our U.S.-based participants and Japanese participants from prior studies. (Kitayama and Park, 2021)

A potential reason for the weaker association between higher *purpose* and lower mortality among men (versus women) is that some of the pathways through which *purpose* provides its health benefits (e.g., promoting healthy behaviors) might be disrupted in men due to gendered social norms, expectations, responsibilities, and barriers that all cumulatively decrease men's willingness to seek health services. (Rieker and Bird, 2005; Williams, 2008; Griffith, 2016) For example, a higher sense of *purpose* is associated with increased use of preventive health services. (Kim et al., 2014) However, men are less likely to seek high-priority, appropriate preventive services as illustrated in a recent report showing that men were more likely than women to obtain only 0–25% of core preventive healthcare services (21.9% of men versus 11.3% of women). (Borsky et al., 2018) Future research should identify mechanisms that might be blocked among men.

Our study had several limitations. First, the HRS did not assess race/ethnicities beyond Whites, Blacks, and Hispanics. Although there was an "Other" category, the aggregated racial category is not a meaningful demographic because it masks nuanced trends across all other racial groups in the category (e.g., Asians of various backgrounds, Native Americans). Moreover, the category was a small subgroup (n = 271; 2.1% of the total sample) and corresponding confidence intervals were much wider than ones for other racial groups. However, we retained people in this group to spur future research in even more diverse race/ethnicity groups and highlight that larger numbers of people from diverse backgrounds are needed in our large epidemiologic studies. Second, we used a self-identified binary item (i.e., men versus women) to identify a person's gender. This binary measure of gender is crude as it does not capture the non-binary nature of gender. There are also other ways of assessing gender, but HRS does not assess this information. Future work should measure one's gender identity and expression more thoroughly and evaluate how it might influence the *purpose*-mortality association. Third, our primary analysis assessed the interaction between the categorical purpose variable and categorical effect modifiers, resulting in many statistical tests. Thus, some of the observed associations might be due to chance. However, we conducted omnibus tests using the continuous purpose term to mitigate this concern. Fourth, there may be cultural biases in answering the items in the purpose in life scale, which may explain some of the observed differences in the mean purpose scores across social groups. Our study also had several strengths, including: use of a large, prospective, and national sample of older U.S. adults, adjustment for a range of sociodemographic factors and health conditions which helps reduce bias from confounding, use of a widely used and validated measure of *purpose* in life, and use of formal interaction analyses on both the additive and multiplicative scale.

In conclusion, with some small caveats, we observed that people with increasingly higher levels of *purpose* displayed decreasingly lower risk of all-cause mortality, and this association persisted across gender and race/ethnicity. Although further work is needed, there was also some evidence that women might benefit more from the salubrious effects of *purpose*. Early randomized controlled trials, ranging from group cognitive behavioral therapy to volunteering, have explored whether a sense of *purpose* (and its conceptual cousin, meaning) can potentially be altered. (Breitbart et al., 2015; Friedman et al., 2019) However, further work is needed to further document the effectiveness of these interventions. Thus, with much needed additional research, *purpose* could emerge as an important upstream target for interventions and policies aimed at enhancing health across an increasingly diverse population and also a potential target that could improve the health of women and racial/ethnic minorities.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Conflicts of interest and source of funding

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Data availability

The authors do not have permission to share data.

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Table 1

Characteristics of Study Participants at Baseline, by Levels of Purpose in Life (*n* = 13,159).

	Total (*n* = 13,159)	Sense of purpose in life[a]			
		Low (*n* = 3445)	Medium-low (*n* = 3167)	Medium-high (*n* = 3465)	High (*n* = 3082)
Death by the end of follow-up	3253 (24.7)	1259 (36.5)	801 (25.3)	724 (20.9)	469 (15.2)
Gender					
Men (%)	5495 (41.8)	1420 (41.2)	1337 (42.2)	1466 (42.3)	1272 (41.3)
Women (%)	7664 (58.2)	2025 (58.8)	1830 (57.8)	1999 (57.7)	1810 (58.7)
Race/ethnicity					
White (%)	10,240 (77.8)	2615 (75.9)	2515 (79.4)	2758 (79.6)	2352 (76.3)
Black (%)	1645 (12.5)	376 (10.9)	365 (115)	423 (12.2)	481 (15.6)
Hispanic (%)	1002 (7.6)	371 (10.8)	220 (6.9)	219 (6.3)	192 (6.2)
Other (%)	271 (2.1)	83 (2.4)	67 (2.1)	64 (1.8)	57 (1.8)
Socioeconomic status					
Education					
<high school (%)	2515 (19.1)	1012 (29.4)	616 (19.5)	504 (14.5)	383 (12.4)
High school (%)	7223 (54.9)	1863 (54.1)	1806 (57.0)	1928 (55.6)	1626 (52.8)
≥college (%)	3395 (25.8)	568 (16.5)	741 (23.4)	1022 (29.5)	1064 (34.5)
Household income quartiles[b,c]					
Q1 (%)	3221 (24.5%)	1257 (36.5%)	766 (24.2%)	680 (19.6%)	518 (16.8%)
Q2 (%)	3303 (25.1%)	944 (27.4%)	879 (27.8%)	814 (23.5%)	666 (21.6%)
Q3 (%)	3312 (25.2%)	753 (21.9%)	813 (25.7%)	957 (27.6%)	789 (25.6%)
Q4 (%)	3323 (25.3%)	491 (14.3%)	709 (22.4%)	1014 (29.3%)	1109 (36.0%)
Wealth quintiles[b,d]					
Q1 (%)	2598 (19.7)	969 (28.1)	651 (20.6)	569 (16.4)	409 (13.3)
Q2 (%)	2616 (19.9)	810 (23.5)	659 (20.8)	630 (18.2)	517 (16.8)
Q3 (%)	2642 (20.1)	673 (19.5)	623 (19.7)	705 (20.3)	641 (20.8)
Q4 (%)	2656 (20.2)	524 (15.3)	651 (20.6)	768 (22.2)	713 (23.1)
Q5 (%)	2657 (20.1)	469 (13.6)	583 (18.4)	793 (22.9)	802 (26.0)
Other demographic characteristics					
Mean age (SD)	69.6 (9.58)	71.6 (10.3)	70.0 (9.74)	68.9 (9.11)	67.9 (8.60)
Marital status					
Not married (%)	4885 (37.1)	1566 (45.5)	1232 (38.9)	1135 (32.8)	952 (30.9)
Married (%)	8274 (62.9)	1879 (54.5)	1935 (61.1)	2330 (67.2)	2130 (69.1)
Health insurance					
Not covered (%)	1432 (10.9)	332 (9.6)	324 (10.2)	389 (112)	387 (12.6)
Covered (%)	11,651 (88.5)	3083 (89.5)	2826 (89.2)	3055 (88.2)	2687 (87.2)
Health Factors [e]					
Heart disease					
No (%)	9905 (75.3)	2362 (68.6)	2416 (76.3)	2630 (75.9)	2497 (81.0)

	Total (*n* = 13,159)	Sense of purpose in life[a]			
		Low (*n* = 3445)	Medium-low (*n* = 3167)	Medium-high (*n* = 3465)	High (*n* = 3082)
Yes (%)	3240 (24.6)	1081 (31.4)	746 (23.6)	832 (24.0)	581 (18.9)
Stroke					
No (%)	12,102 (92.0)	3035 (88.1)	2913 (92.0)	3229 (93.2)	2925 (94.9)
Yes (%)	1048 (8.0)	406 (11.8)	251 (7.9)	235 (6.8)	156 (5.1)
Cancer					
No (%)	11,098 (84.3)	2838 (82.4)	2673 (84.4)	2942 (84.9)	2645 (85.8)
Yes (%)	2037 (15.5)	597 (17.3)	486 (15.3)	520 (15.0)	434 (14.1)
Diabetes					
No (%)	10,537 (80.1)	2539 (73.7)	2534 (80.0)	2834 (81.8)	2630 (85.3)
Yes (%)	2609 (19.8)	903 (26.2)	626 (19.8)	630 (18.2)	450 (14.6)
Hypertension					
No (%)	5580 (42.4)	1267 (36.8)	1310 (41.4)	1542 (44.5)	1461 (47.4)
Yes (%)	7565 (57.5)	2172 (63.0)	1853 (58.5)	1919 (55.4)	1621 (52.6)
Lung diseases					
No (%)	11,851 (90.1)	2976 (86.4)	2817 (88.9)	3166 (91.4)	2892 (93.8)
Yes (%)	1291 (9.8)	463 (13.4)	343 (10.8)	296 (8.5)	189 (6.1)
Arthritis					
No (%)	5119 (38.9)	1105 (32.1)	1230 (38.8)	1425 (41.1)	1359 (44.1)
Yes (%)	8027 (61.0)	2338 (67.9)	1934 (61.1)	2036 (58.8)	1719 (55.8)
Depression [f]					
No (%)	11,180 (85.0)	2455 (71.3)	2694 (85.1)	3123 (90.1)	2908 (94.4)
Yes (%)	1780 (13.5)	921 (26.7)	426 (13.5)	302 (8.7)	131 (4.3)

[a] Purpose in life was assessed using the purpose in life subscale of the Ryff psychological well-being scales. Purpose in life quartiles: Low: 1–3.86; medium–low: 4–4.57; medium–high: 4.6–5.29; high: 5.33–6.00.

[b] Income and wealth were imputed by health and retirement study and, thus, there was no missing in these variables in the data used.

[c] Household income quartiles: 1st quartile: ≤$20,024; 2nd quartile: $20,025–$38,321; 3rd quartile: $38,322–$71,895; 4th quartile: ≥$71,896.

[d] Wealth quintiles: 1st quartile: ≤$35,000; 2nd quartile: $35,001–$140,000; 3rd quartile: $140,001–$311,000; 4th quartile: $311,001–$652,500; 5th quartile: ≥$652,501.

[e] Health factors were defined as self-reported presence/absence of having a doctor's diagnosis.

[f] Depression was assessed using the 8-item Center for Epidemiological Studies Depression Scale with a cut-off point of ≥4.

Table 2

Relative risks of 8-year all-cause mortality for the joint exposure of purpose in life and gender ($N = 13{,}159$).[a,b,c,d]

Gender	Sense of purpose in Life[b]							
	Low		**Medium-low**		**Medium-high**		**High**	
	N Died/alive	**RR (95% CI)**	**N Died/alive**	**RR (95% CI)**	**N Died/alive**	**RR (95% CI)**	**N Died/alive**	**RR (95% CI)**
Men	586/834	1.0	392/945	0.92 (0.80, 1.04) $p = 0.18$	368/1098	0.88 (0.77, 1.01) $p = 0.06$	246/1026	0.80 (0.69, 0.93) $p < 0.01$
Women	673/1352	0.76 (0.68, 0.86) p < 0.01	409/1421	0.65 (0.57, 0.74) p < 0.01	356/1643	0.61 (0.53, 0.70) p < 0.01	223/1587	0.50 (0.43, 0.59) p < 0.01
	Additive and multiplicative effect modification							
	Low		**Medium-low Additive** [c]	**Multiplicative** [d]	**Medium-high Additive**	**Multiplicative**	**High Additive**	**Multiplicative**
Men	Reference		Reference	Reference	Reference	Reference	Reference	Reference
Women	Reference		−0.03 (−0.18, 0.12) $p = 0.73$	0.93 (0.78, 1.11) $p = 0.45$	−0.04 (−0.19, 0.11) $p = 0.62$	0.90 (0.75, 1.08) $p = 0.27$	−0.06 (−0.22, 0.10) $p = 0.45$	0.82 (0.66, 1.02) p = 0.07

[a] Risk ratios were adjusted for: Age, race/ethnicity, marital status, education, household income, wealth, health insurance, heart disease, stroke, cancer, diabetes, hypertension, lung disease, arthritis, and depression using Poisson regression.

[b] Purpose in life was assessed using the purpose in life subscale of the Ryff psychological well-being scales. Purpose in life quartiles: Low: 1.00–3.86; medium-low: 3.87–4.57; medium-high: 4.58–5.29; high: 5.30–6.00.

[c] Effect modification on additive scale: Relative excess risk due to interaction (RERI; standard errors were calculated by using the delta method).

[d] Effect modification on multiplicative scale: Ratio of risk ratio (RRR).

Table 3

Relative risks of 8-year all-cause mortality for the joint exposure of purpose in life and race/ethnicity ($N = 13{,}159$).[a,b,c,d]

	Sense of purpose in life[b]							
Race/ethnicity	**Low**		**Medium-low**		**Medium-high**		**High**	
	N Died/alive	**RR (95% CI)**	**N Died/alive**	**RR (95% CI)**	**N Died/alive**	**RR (95% CI)**	**N Died/alive**	**RR (95% CI)**
White	1008/1607	1.0	645/1870	0.89 (0.81, 0.99) $p = 0.03$	572/2186	0.83 (0.75, 0.93) $p < 0.01$	381/1971	0.76 (0.67, 0.86) p < 0.01
Black	131/245	1.01 (0.84, 1.22) $p = 0.91$	101/264	0.88 (0.71, 1.08) $p = 0.21$	110/313	0.93 (0.77, 1.14) p = 0.50	62/419	0.60 (0.46, 0.77) p < 0.01
Hispanic	103/268	0.92 (0.74, 1.13) $p = 0.41$	43/177	0.72 (0.53, 0.99) $p = 0.04$	32/187	0.59 (0.42, 0.85) p < 0.01	18/174	0.48 (0.30, 0.76) p < 0.01
Others	17/66	0.63 (0.39, 1.02) p = 0.06	12/55	0.69 (0.39, 1.21) $p = 0.20$	9/55	0.72 (0.37, 1.38) $p = 0.32$	8/49	0.83 (0.41, 1.67) $p = 0.60$
	Additive and multiplicative effect modification							
	Low		**Medium-low Additive**[c]	**Multiplicative**[d]	**Medium-high Additive**	**Multiplicative**	**High Additive**	**Multiplicative**
White	Reference		Reference	Reference	Reference	Reference	Reference	Reference
Black	Reference		−0.03 (−0.29, 0.23) $p = 0.84$	0.97 (0.74, 1.28) p = 0.84	0.99 (−0.17, 0.35) $p = 0.50$	1.11 (0.84, 1.46) $p = 0.46$	−0.18 (−0.43, 0.07) $p = 0.17$	0.77 (0.56, 1.07) $p = 0.12$
Hispanic	Reference		−0.08 (−0.38, 0.21) $p = 0.59$	0.89 (0.61, 1.29) $p = 0.53$	−0.16 (−0.44, 0.13) $p = 0.29$	0.78 (0.52, 1.17) $p = 0.23$	−0.20 (−0.50, 0.10) $p = 0.20$	0.68 (0.41, 1.14) $p = 0.15$
Others	Reference		0.16 (−0.34, 0.66) $p = 0.52$	1.22 (0.58, 2.57) $p = 0.61$	0.25 (−0.31, 0.81) $p = 0.38$	1.36 (0.60, 3.08) p = 0.46	0.44 (−0.22, 1.09) $p = 0.19$	1.72 (0.74, 4.03) p = 0.21

[a]Risk ratios were adjusted for: Age, gender, marital status, education, household income, wealth, health insurance, heart disease, stroke, cancer, diabetes, hypertension, lung disease, arthritis, and depression using Poisson regression.

[b]Purpose in life was assessed using the purpose in life subscale of the Ryff psychological well-being scales. Purpose in life quartiles: Low: 1.00–3.86; medium-low: 3.87–4.57; medium-high: 4.58–5.29; high: 5.30–6.00.

[c]Effect modification on additive scale: Relative excess risk due to interaction (RERI; standard errors were calculated by using the delta method).

[d]Effect modification on multiplicative scale: Ratio of risk ratio (RRR).