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# Sense of Purpose in Life and Five Health Behaviors in Older Adults

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## Abstract

Accumulating evidence shows that a higher sense of purpose in life is associated with lower risk of chronic conditions and premature mortality. Health behaviors might partially explain these findings, however, the prospective association between sense of purpose and health behaviors is understudied. We tested whether a higher sense of purpose at baseline was associated with lower likelihood of developing unhealthy behaviors over time. Prospective data were from the Health

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and Retirement Study, a national sample of U.S. older adults. Our sample included 13,770 adults assessed up to five times across eight years. Among people who met recommended guidelines for a given health behavior outcome at baseline, those in the top versus lowest quartile of purpose in life had 24% lower likelihood of becoming physically inactive (95% CI:0.68–0.85), 33% lower likelihood of developing sleep problems (95% CI:0.58–0.79), and 22% lower likelihood of developing unhealthy body mass index (BMI) (95% CI:0.69–0.87) in sociodemographic-adjusted models. Further there was a marginal reduction in smoking relapse (HR=0.65, 95% CI:0.41–1.03) and no association with heavy alcohol use (HR=1.02, 95% CI:0.81–1.29). Findings for physical inactivity, sleep problems, and unhealthy BMI remained evident after further adjusting for baseline health status and depression. Our results, suggest that a sense of purpose in life might emerge (with further research) as a valuable target to consider for interventions aimed at helping older adults maintain some health behaviors.

## Keywords

epidemiology; health psychology; purpose in life; psychological well-being; health behaviors; physical activity; smoking; body weight; sleep; alcohol consumption

The number of older adults is growing rapidly throughout the world and meeting the unique needs of this growing demographic is considered a next global public health challenge.[1] Although average life expectancy has increased, so has the number of years lost to disability.[2,3] A key contributor to staving off chronic disease and years lost to disability is engaging in healthy behaviors. However, less work has focused on factors that influence health behaviors themselves, and among this relatively small body of research, the majority of effort has focused on identifying *risk factors* for unhealthy behaviors. Investigators are now increasingly seeking *"health assets,"* resources that enhance a person's ability and willingness to maintain healthy behaviors.[4,5] As populations age, identifying factors that foster the maintenance of healthy behaviors is a public health priority for improving the health and well-being of older adults.

Emerging work suggests that a sense of purpose in life is one promising asset. While it is shaped by social structural factors and changing life circumstances,[5] preliminary studies suggest that it can potentially be modified through deliberate intervention.[6–10] A sense of purpose is viewed as a central component of well-being and refers to the extent that people see their lives as having meaning, a sense of direction, and goals.[6,11–13] Accumulating evidence has observed that having a higher sense of purpose is associated with better biologic functioning (e.g., lower allostatic load, less inflammation, better glucose regulation),[14–16] and lower risk of chronic disease (e.g., cardiovascular disease, Alzheimer's disease)[15,17–22] and mortality.[18,23] Investigators speculate that one biobehavioral pathway underlying these associations is health behaviors.[6,12,21] Viktor Frankl proposed a key theory that addresses why a sense of purpose helps individuals live longer: higher purpose provides individuals with a greater will to live, and this enables people to bear more short-term discomfort since they can appreciate why discomfort is worth enduring.[13] Applying this theory to health behaviors, people with a higher sense of purpose might have more incentive to engage in behaviors that are time-consuming, difficult, costly, fear-inducing,

uncomfortable, or even painful (e.g., colonoscopies), because sustaining better health might enhance people's ability to strive toward their purpose. However, whether purpose temporally precedes or is causally related to better health behaviors remains unclear.

Several studies have observed that a higher sense of purpose is associated with more physical activity, healthier sleep, higher consumption of fruits and vegetables, increased use of preventive healthcare services, enhanced sleep quality, and possibly less smoking.[15,20,24–30] However, the direction of effects is difficult to determine due to various methodological limitations. First, many are cross-sectional, making it challenging to assess the direction of the relationship. Second, most studies use data from small and specific subpopulations (e.g., college students and patient groups) and thus it is unknown whether results generalize to older adults or healthy populations. Third, many studies have not adequately accounted for potential confounders (e.g., psychological distress, baseline health). Fourth, among the few existing longitudinal studies, most have short follow-up times (<1 year) and it cannot be determined whether the associations between purpose and health behaviors persist over longer durations of time. Fifth, some studies used suboptimal purpose assessments (e.g., measures that were 1-item or had subpar psychometric properties).

We tested if higher baseline purpose in life was associated with a lower likelihood of engaging in unhealthy behaviors over time, among people who reported meeting guidelines for that given behavior at baseline. We selected five health behaviors (smoking, physical activity, alcohol use, sleep, and body mass index (BMI))[1] because they reduce risk of developing age-related chronic diseases.[31] We identified relevant covariates based on past research (e.g., demographics, baseline health), and also adjusted for depression because it has been linked with lower purpose and unhealthy behaviors.

## Methods

### Study Population

We used data from the Health and Retirement Study (HRS). It began in 1992 and is an ongoing nationally representative panel study of non-institutionalized U.S. adults aged >50 years (no upper age limit for inclusion), which surveys participants by phone every two years. Starting in the 2006 wave, HRS staff visited a randomly-selected 50% of HRS participants for an enhanced face-to-face (EFTF) interview. Further details about the HRS (e.g., how the cohort was created) can be found elsewhere.[32] The remaining 50% of participants were assessed in the same way in 2008. After the EFTF interview, respondents were given a self-administered psychosocial questionnaire that assessed sense of purpose;[33] the response rate for this psychosocial questionnaire was 88% in 2006 and 84% in 2008.[33] All respondents who completed the questionnaire were included in the analytic sample. To increase our sample size and statistical power, we combined data from 2006/2008 and considered those years as baseline for the current study, resulting in a final analytic sample of 13,770 participants. Respondents who did not complete the psychosocial questionnaire,

[1]We recognize that *health-behavior related outcomes* is the phrase that would more precisely capture these five factors. However, we call these five factors *health behaviors* throughout the manuscript to enhance our study's readability.

versus those who did, were more likely to be younger, female, non-White, and less educated. However, absolute differences were small.

For our study outcomes, we considered five health behaviors. Up to five repeated assessments of each health behavior were used over the eight-year follow-up period. Four behaviors were assessed in the full sample every two years ($t_1$;2006/2008; $t_2$;2008/2010; $t_3$;2010/2012; $t_4$;2012/2014; $t_5$;2014/2016), while sleep was assessed every four years and only in half the sample ($t_1$;2006/2008; $t_3$;2010/2012; $t_5$;2014/2016). For each health behavior, the analytic sample varied depending on how many people met recommended guidelines for each health behavior at baseline. We summarized the number of people who met recommended guidelines for each outcome at baseline in Table 2 and Table S1.

Because the study used de-identified, publicly available data, the Harvard T.H. Chan School of Public Health Institutional Review Board considered it exempt from review.

## Measures

**Purpose in life.—**Purpose was assessed at baseline ($t_1$;2006/2008) and then at 4 year intervals after baseline ($t_3$;2010/2012 and $t_5$;2014/2016), using the validated 7-item purpose subscale of Ryff''s Psychological Well-Being Scales.[34] On a 6-point Likert scale, respondents rated the degree to which they endorsed items like "I have a sense of direction and purpose in my life." Following HRS protocol, if respondents completed at least 5 of 7 items (96.9%), a purpose score was derived by calculating the mean of all items (Cronbach $\alpha$=0.74). Purpose scores were relatively stable over time with intraclass correlation coefficients ranging from 0.55–0.61. We considered purpose as a standardized continuous variable (mean=0, standard deviation=1). We also created quartiles based on the baseline distribution of purpose scores in the analytic sample to examine possible non-linear threshold effects.

**Health behaviors.—**All five health behaviors were self-reported. HRS assesses these factors using measures similar to those used in other large-scale epidemiological cohorts. When comparing the prevalence of each health behavior, by age group, in HRS with two other nationally representative surveys of health (the National Health and Nutrition Examination Survey [NHANES] and the National Health Interview Survey [NHIS]), there is high concordance across all three cohorts for all behaviors.[35] Additionally, some measures have validated self-report assessments against objective assessments (e.g., self-reported smoking vs. urinary cotinine—a biomarker of exposure to tobacco smoke) and shown high concordance.[36]

Participants were considered unhealthy for each of the health behaviors if they met previously established criteria. The supplementary text provides further details about each assessment. *1) Smoking Relapse*: Smoking relapse (yes/no) was assessed by asking participants, "Do you smoke cigarettes now?" We use the term *smoking relapse* because all participants who began smoking over our study follow-up period were all prior smokers. *2) Physical inactivity*: Following prior research in HRS,[37] participants were considered physically inactive if they did not engage in vigorous physical activity (e.g., running, swimming) ≥1x/week over the past 12 months. *3) Heavy alcohol use*: Following National

Institute on Alcohol Abuse and Alcoholism guidelines,[38] non-heavy alcohol use was defined as <14 drinks/week for men and <7 drinks/week for women. Participants not in this alcohol consumption range were classified as heavy alcohol users. *4) Sleep Problems*: Participants completed the 4-item Jenkins Sleep Questionnaire, a validated screening instrument that assesses sleep complaints and insomnia symptoms.[39] Participants were considered unhealthy if they reported ≥1 sleep problem. *5) Unhealthy BMI*: Individuals self-reported weight and height, and BMI was calculated as weight/height$^2$ (kg/m$^2$). Based on growing evidence demonstrating that having a moderately higher BMI is health protective for older adults,[40] anyone with a BMI of either <23 or >28 kg/m$^2$ was considered as having unhealthy BMI.

**Covariates.—**All covariates were self-reported at baseline and included sociodemographics, health status, and depression. *Sociodemographics* were age (continuous), sex, race/ethnicity (white, black, Hispanic, other), marital status (married, not married), educational attainment (<high school, GED/high school diploma, ≥college degree), total wealth (based on quintiles of the distribution), and health insurance (covered, not covered). *Health status* was assessed by evaluating self-reported presence/absence of having a doctor's diagnosis for seven medical conditions: heart problems, stroke, cancer, hypertension, diabetes, lung disease, and arthritis or rheumatism.[41] *Depression* was assessed using the modified (i.e., 8-item) and validated Center for Epidemiological Studies Depression Scale (Cronbach $\alpha$=0.80; ≥4 categorized as depressed).[42]

## Statistical analysis

We used Cox proportional hazards models to evaluate associations between baseline purpose in life with likelihood of subsequently engaging in unhealthy behaviors, among people who reported meeting guidelines for that given behavior at baseline. We tested the proportional hazards assumption by assessing the scaled Schoenfeld residuals and found the assumption was valid (Table S2). For each health behavior, we considered three models. Model 1 included only age. Model 2 additionally added sex, race, marital status, health insurance, and socioeconomic status (total wealth, education). Model 3 additionally added baseline health status and depression. All analyses were conducted in R 3.4.1 (R Core Team (2017). R Foundation for Statistical Computing, Vienna, Austria).

**Additional Analyses—**We conducted additional analyses. 1) To address concerns that major chronic conditions might act as a confounder (i.e., leading to both lower sense of purpose and higher likelihood of engaging in or developing unhealthy behaviors) we re-ran the main models after removing anyone with cancer, heart disease, or stroke at baseline, an even more conservative method of evaluating this potential concern, than our initial strategy of adjusting for chronic conditions at baseline. 2) We evaluated alternate BMI and physical inactivity cutpoints 3) To address concerns that healthy behaviors at baseline precede lower levels of purpose, we used generalized estimating equations (GEE) and included each baseline health behavior as the independent variable in separate models with 3 repeated assessments of purpose ($t_1$;2006/2008, $t_2$;2010/2012, $t_3$;2014/2016) as the dependent variable. If initial levels of a health behavior influence subsequent levels of purpose, we would expect to observe that meeting (versus not meeting) recommended levels of that

factor is associated with either a more rapid increase in purpose or a slower rate of decline in purpose over time.

**Missing Data—**Among respondents in the final analytic sample, the overall item response rate was 94.1%. Because missing data were distributed across variables, complete-case analyses resulted in a loss of 52.8%−68.5% respondents depending on the outcome under examination. Hence, we imputed all missing exposure, covariate, and outcome data using multiple imputation by chained equations. We created 20 imputed datasets and combined estimates from each using Rubin's formula.[43] We chose the multiple imputation approach because it provides valid estimates under weaker assumptions than other methods of handling missing data (such as complete-case analysis) and also helps address potential bias that is generated by attrition.[44–46]

## Results

At baseline, the distribution of sociodemographic and health characteristics was generally similar across levels of purpose with some notable differences (Table 1). For example, those in the highest versus lowest purpose quartile were more educated (34.9% versus 16.7% with a ≥college degree) and less likely to have depression (4.31% versus 27.1%). At baseline, the overall prevalence of unhealthy behaviors in the HRS sample (n = 13,770) was 12.6% for current smoking, 68.9% for physical inactivity, 8.85% for heavy alcohol use, 69.6% for sleep problems, and 62.1% for unhealthy BMI (Table S1). Figure 1 displays the prevalence of individuals who failed to meet the guidelines for each health behavior, at each wave, by quartile of purpose.

In sociodemographic-adjusted Cox models (Table 2; Model 2) participants in the top versus bottom quartile of purpose displayed 24% lower hazard of becoming physically inactive (95% CI for HR:0.68–0.85), 33% lower hazard of developing sleep problems (95% CI:0.58–0.79), and 22% lower hazard of developing unhealthy BMI (95% CI:0.69–0.87). Further there was a marginal reduction in smoking relapse (HR=0.65, 95% CI:0.41–1.03) and no association with heavy alcohol use (HR=1.02, 95% CI:0.81–1.29). Findings for physical inactivity, sleep problems, and unhealthy BMI were maintained after further adjusting for baseline health status and depression (Model 3).

### Additional Analyses

When re-running the main models after excluding anyone with baseline cancer, heart disease, or stroke, we observed the same pattern of findings, but associations were slightly attenuated (Table S3). Models evaluating the alternate BMI cutpoint showed associations with purpose only in age-adjusted models (Table S4). Models evaluating the alternate physical inactivity cutpoint showed stronger associations (Table S4). We also used GEE models and considered each baseline behavior separately in relation to subsequent levels of purpose. We observed a main effect for each health behavior, except non-healthy alcohol use, whereby engaging in healthy behaviors at baseline were associated with higher levels of purpose (Table S5). However, results examining the interaction term between time and each behavior suggested that rate of change in purpose over time did not depend on initial behavior levels (i.e., we observed no evidence that engaging in healthy behaviors at baseline

(versus not) demonstrated a faster increase (or slower decline) in levels of purpose over time (Table S5)).

## Discussion

In a prospective and national sample of U.S. adults aged >50 initially engaging in healthy behaviors, a higher baseline sense of purpose was associated with a lower likelihood of developing physical inactivity, sleep problems, and unhealthy BMI over the eight-year follow-up period. These associations persisted in models adjusting for sociodemographics, baseline health status, and depression. Associations were not evident for smoking relapse or heavy alcohol use. The baseline association between purpose and health behaviors incorporates the lifelong forward association between purpose and health behaviors; by removing anyone with suboptimal health behaviors at baseline, we essentially focused on changes that occurred relatively later in life. We chose this analytically conservative approach to reduce concerns about reverse causality. To further address such concerns, in secondary analyses we removed anyone with major chronic conditions at baseline and associations persisted. Moreover, we did not find evidence that rate of change in purpose depended on health behaviors at baseline. These findings, along with cross-sectional associations between purpose and each health behavior at baseline (where we observe that progressively higher levels of purpose are associated with progressively healthier behaviors; Table 1), suggests we are underestimating the effect of purpose on these health behaviors. It is unclear why purpose showed associations with only certain behaviors. Some behaviors might be less likely to change in older adults, thus we were unable to detect potential associations. Further, if the true effect of purpose on smoking is small, it may be difficult to detect associations without more cases.

We built upon past studies in this area by: 1) using a prospective design, 2) harnessing a large, diverse, and national sample that is more generalizable to older adults, 3) adjusting for key confounders, 4) and evaluating a longer follow-up time. In spite of methodological differences, our results generally align with results from prior research considering purpose in relation to physical activity,[15,24,28,29] and sleep quality.[15,20,26,27] Studies evaluating purpose in relation to smoking have been mixed.[15,20,47] Similar to our findings, past prospective studies with larger samples generally observed no association, while past cross-sectional studies observed the opposite. Our longitudinal results provide additional weight to the growing evidence that no association exists between purpose and smoking relapse over time. Interestingly, conceptually-related studies have observed that among users of illicit substances, people with higher purpose display increased likelihood of recovering from addiction.[48] Little research has evaluated associations between purpose and alcohol consumption or BMI.

Although mechanisms by which purpose influences physical inactivity, sleep problems, or unhealthy BMI are not yet identified, mounting research shows that people with higher (versus lower purpose) differ on numerous processes. For example, stress has been linked with higher likelihood of sedentary behavior and worse sleep, and individuals experiencing high stress sometimes cope by engaging in comfort eating. People with a higher (versus lower purpose) generally perceive stressors as less stressful and emotionally recover from

negative stimuli more rapidly.[49–51] Thus, high purpose might disrupt the stress-unhealthy behavior pathway. People with a higher sense of purpose also display a heightened ability to curb impulsivity[52] and report higher self-efficacy.[29] Thus, people with higher purpose might avoid impulsively indulging in unhealthy behaviors (e.g., comfort eating) and instead deploy their higher self-efficacy to engage in healthier behaviors even if they are not immediately appealing (e.g., eating spinach, going to the gym). Further, adhering to healthy behaviors requires the ability to make healthy choices consistently in the midst of competing options. One recent study suggests that when confronted with competing decisions (e.g., should I take the stairs or elevator?), people with higher purpose experience less neural conflict and also increased receptivity to health advice.[53] Thus, people with higher purpose might make healthier behavioral decisions with more cognitive ease. These explanations are based on theory and preliminary evidence, but future empirical work is needed to directly test these mechanisms.

## Limitations and Strengths

Our study has some limitations. Self-report bias is a possibility as both purpose and health behaviors were self-reported. However, study participants were unaware of this study's hypotheses when completing the HRS survey and purpose was reported prior to each health behavior measure. Prior work, however, has observed cross-sectional associations between purpose with objectively measured sleep and physical activity in smaller samples.[27,28] Additionally, studies comparing self-reported physical activity against doubly-labeled water and accelerometers have shown that self-reported physical activity questionnaires are unable to precisely indicate levels of physical activity, but are able to rank order participants by level of physical activity—which provides crucial information.[54] Another limitation was that the sleep assessment did not specify a time frame; thus, we were unable to determine if sleep problems were chronic or acute. Confounding by unmeasured third variables and reverse causality are also possibilities. However, findings were maintained after taking a number of strategies to reduce this concern, including: 1) careful control for sociodemographics, baseline health status, and depression; 2) removing anyone with suboptimal health behaviors at baseline; 3) removing anyone with major chronic conditions at baseline. We did not find that engaging in any health behavior at baseline predicted changes in purpose over time.

Additional limitations include lack of diet assessment in our sample. Also, a complete history of participants' engagement in each health behavior was not available; thus, it remains unclear whether people were relapsing into a given behavior or initiating the unhealthy behavior for the first time. Future research should examine the potential differences in the relationship between purpose and the initiation, cessation, and maintenance of specific health behaviors over time, as each of these behavioral processes might be influenced by different dynamics. The study was conducted among older adults who tend to experience more social- (e.g., death of parents and spouses) physical- (e.g., declines functioning), and role-related losses (e.g., job loss) relative to younger adults. Because these events might impact levels of purpose future research may want to consider whether and how *changes* in purpose influence health behaviors. Because we restricted our sample at baseline to people who met recommended guidelines for a given behavior, our

results likely generalize to only adults who are able to maintain healthy behaviors into older adulthood.

Our study has considerable strengths including the use of a large, diverse, prospective, and national sample of U.S. adults aged >50. The exposure was assessed using a well-validated measure. The prospective nature of the data mitigates concerns about retrospective reporting bias or reverse causality, and several analyses were conducted to further reduce these concerns.

### Conclusion

As the number of older adults in our society rapidly increases, a comprehensive and multidisciplinary effort is needed to meet the unique demands of an older population. We need both policy and intervention targets that can alter well-being and behavioral health at the population- and individual-levels. Early randomized controlled trials, ranging from volunteering to cognitive behavioral therapy in groups, preliminarily suggest that a sense of purpose can be enhanced.[6–10] Results from this study suggest that a higher sense of purpose is associated with maintenance of some health behaviors; future experimental research might provide even stronger tests of this hypothesis. With additional work, policies and interventions aiming to enhance purpose might be a novel way of simultaneously enhancing the psychological, behavioral, and physical health of our rapidly aging population.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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## Highlights

- Pathways underlying the purpose-physical health association remain unclear
- We evaluated associations between purpose in life and several health behaviors
- We tested this hypothesis in a large and prospective cohort of adults aged >50
- Higher purpose was associated with lower risk of becoming physically inactive
- And also lower risk of developing sleep problems and unhealthy BMI

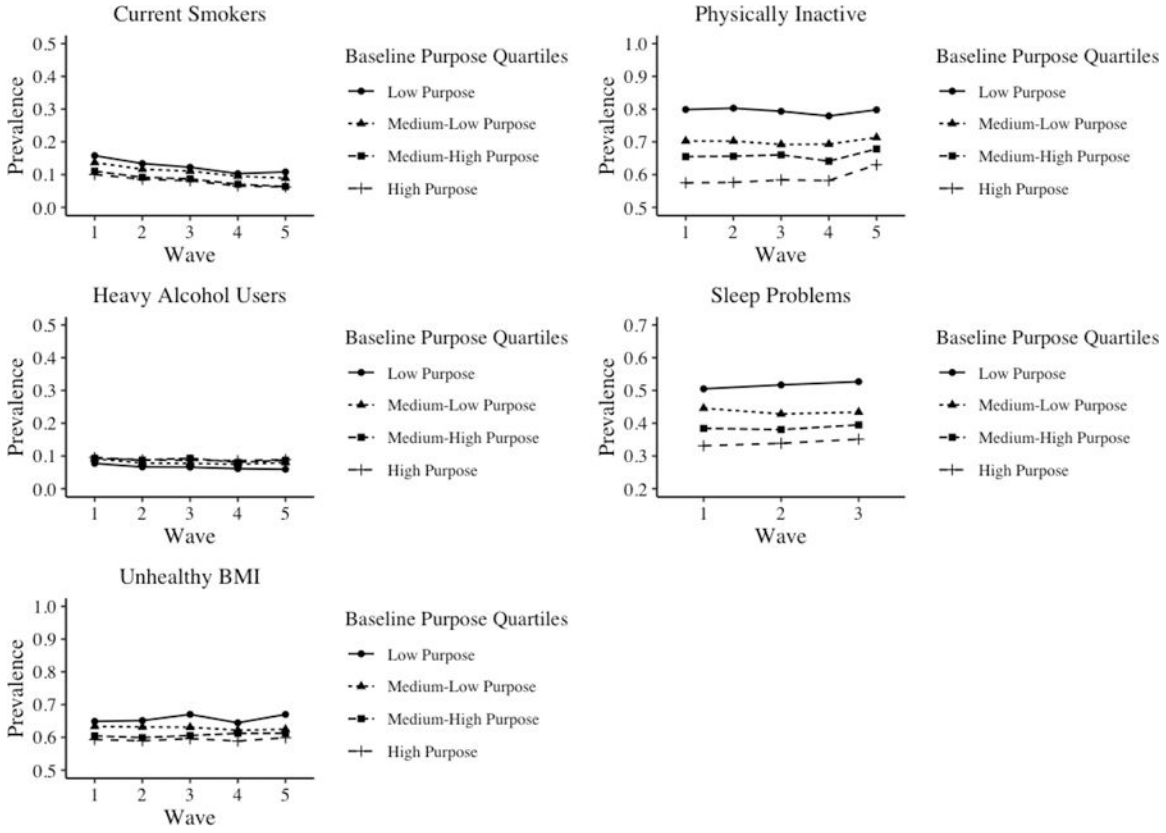


**Figure 1.**
Prevalence of unhealthy behaviors over an eight-year period, by quartile of purpose in life.

**Table 1.**

Baseline characteristics of study participants by level of purpose in life (N=13,770)

| | Sense of Purpose in Life | | | | | |
|---|---|---|---|---|---|---|
| **Characteristic** | **Total n=13,770** | **1st Quartile[a] n=3,485** | **2nd Quartile[b] n=3,216** | **3rd Quartile[c] n=3,511** | **4th Quartile[d] n=3,132** | **Missing n=426** |
| **Sociodemographic Factors** | | | | | | |
| Mean Age (SD) | 69.8 (9.6) | 71.6 (10.3) | 70 (9.7) | 68.9 (9.1) | 67.8 (8.6) | 75.2 (10.1) |
| Gender | | | | | | |
| Male (%) | 5,730 (41.6) | 1,439 (41.3) | 1,357 (42.2) | 1,494 (42.6) | 1,293 (41.3) | 147 (34.5) |
| Female (%) | 8,040 (58.4) | 2,046 (58.7) | 1,859 (57.8) | 2,017 (57.4) | 1,839 (58.7) | 279 (65.5) |
| Marital Status | | | | | | |
| Not Married (%) | 5,181 (37.6) | 1,580 (45.3) | 1,249 (38.8) | 1,154 (32.9) | 963 (30.7) | 235 (55.2) |
| Married (%) | 8,589 (62.4) | 1,905 (54.7) | 1,967 (61.2) | 2,357 (67.1) | 2,169 (69.3) | 191 (44.8) |
| Race/Ethnicity | | | | | | |
| White (%) | 10,659 (77.4) | 2,653 (76.1) | 2,555 (78.5) | 2,796 (79.7) | 2,398 (76.6) | 247 (60.3) |
| Black(%) | 1,765 (12.8) | 377 (10.8) | 371 (11.5) | 429 (12.2) | 483 (15.4) | 105 (24.7) |
| Hispanic (%) | 1,061 (7.71) | 372 (10.7) | 222 (6.9) | 219 (6.24) | 194 (6.19) | 54 (12.7) |
| Other (%) | 284 (2.06) | 83 (2.38) | 68 (2.1) | 66 (1.9) | 57 (2.35) | 10 (2.4) |
| Education | | | | | | |
| < High school (%) | 2,715 (19.8) | 1,018 (29.2) | 628 (19.6) | 511 (14.6) | 385 (12.3) | 173 (40.6) |
| High school (%) | 7,513 (54.7) | 1,883 (54.1) | 1,835 (57.1) | 1,949 (55.7) | 1,648 (52.8) | 198 (46.5) |
| ≥ College (%) | 3,515 (25.6) | 581 (16.7) | 749 (23.3) | 1,040 (29.7) | 1,090 (34.9) | 55 (12.9) |
| Insurance | | | | | | |
| Covered (%) | 12,198 (89.1) | 3,118 (90.3) | 2,869 (89.7) | 3,098 (88.8) | 2,724 (87.2) | 389 (92.8) |
| Not Covered (%) | 1,488 (10.9) | 337 (9.8) | 330 (10.3) | 392 (11.2) | 399 (12.8) | 30 (7.2) |
| Mean Total Wealth (per $1,000; SD) | 510 (124) | 350 (844) | 484 (128) | 551 (1060) | 690 (1689) | 349 (941) |
| **Health behaviors** | | | | | | |
| Currently Smoking (%) | 1,725 (12.6) | 548 (15.8) | 437 (13.7) | 385 (11.0) | 312 (10.0) | 43 (10.2) |
| Physically Inactive (%) | 9,484 (68.9) | 2,780 (79.9) | 2257 (70.3) | 2298 (65.5) | 1801 (57.5) | 348 (81.7) |
| Heavy Alcohol Use (%) | 1,216 (8.85) | 269 (7.73) | 294 (9.16) | 326 (9.30) | 298 (9.53) | 29 (6.81) |
| Sleep problems (%) | 5,571 (41.2) | 1,751 (51.1) | 1,369 (43.5) | 1,307 (37.9) | 961 (31.3) | 183 (44.2) |
| Unhealthy BMI (%) | 8,436 (62.0) | 2,228 (64.9) | 2,014 (63.3) | 2,101 (60.4) | 1,840 (59.3) | 253 (60.7) |

| Characteristic | Total n=13,770 | Sense of Purpose in Life | | | | |
|---|---|---|---|---|---|---|
| | | 1st Quartile[a] n=3,485 | 2nd Quartile[b] n=3,216 | 3rd Quartile[c] n=3,511 | 4th Quartile[d] n=3,132 | Missing n=426 |
| **Health Factors** | | | | | | |
| Heart Disease (%) | 3,362 (24.4) | 1,077 (30.9) | 742 (23.1) | 827 (23.6) | 582 (18.6) | 134 (31.5) |
| Stroke (%) | 1,116 (8.11) | 407 (11.7) | 252 (7.85) | 237 (6.75) | 161 (5.1) | 59 (13.8) |
| Cancer (%) | 2,103 (15.3) | 599 (17.2) | 484 (15.1) | 524 (14.9) | 433 (13.8) | 63 (14.9) |
| Diabetes (%) | 2,729 (19.8) | 901 (25.9) | 633 (19.7) | 631 (18.0) | 451 (14.4) | 113 (26.8) |
| Hypertension (%) | 7,844 (57.0) | 2,172 (62.4) | 1,853 (57.7) | 1,928 (55.0) | 1,625 (51.9) | 266 (62.4) |
| Lung Disease (%) | 1,303 (9.5) | 458 (13.2) | 336 (10.5) | 291 (8.3) | 183 (5.85) | 35 (8.25) |
| Arthritis (%) | 8,318 (60.5) | 2,347 (67.4) | 1,949 (60.7) | 2,039 (58.1) | 1,7107 (54.9) | 266 (60.5) |
| **Depression** | | | | | | |
| Depressed | 1,881 (13.9) | 926 (27.1) | 430 (13.6) | 303 (8.7) | 133 (4.3) | 89 (21.8) |
| Not Depressed | 11,666 (86.1) | 2,485 (72.9) | 2,739 (86.4) | 3,166 (91.3) | 2,956 (95.7) | 320 (78.2) |

[a] Quartile 1 (mean: 3.36; range: 1, 3.86)

[b] Quartile 2 (mean: 4.29; range: 4, 4.57)

[c] Quartile 3 (mean: 5.01; range: 4.6, 5.29)

[d] Quartile 4 (mean: 5.75; range: 5.33, 6.00)

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**Table 2.**

Evaluating the association between baseline purpose ($t_1$;2006/2008) and unhealthy behaviors (over an eight-year follow-up period ($t_1$;2006/2008 to t5;2014/2016)) in Cox time-to-event analysis.[a]

| **Outcomes** | **Purpose in Life: HR (95% CI)** | | | | |
|---|---|---|---|---|---|
| **Smoking Relapse[b] (n=12,039; cases=220)** | **Standardized Purpose** | **Quartile 1 (n=3,073)** | **Quartile 2 (n=3,452)** | **Quartile 3 (n=2,624)** | **Quartile 4 (n=2,890)** |
| Model 1[c] | 0.80 (0.68 – 0.93) | Reference | 0.70 (0.48 – 1.02) | 0.60 (0.40 – 0.91) | 0.53 (0.34 – 0.84) |
| Model 2[d] | 0.86 (0.73 – 1.01) | Reference | 0.77 (0.53 – 1.13) | 0.70 (0.46 – 1.07) | 0.65 (0.41 – 1.03) |
| Model 3[e] | 0.90 (0.76 – 1.07) | Reference | 0.83 (0.57 – 1.20) | 0.76 (0.49 – 1.16) | 0.73 (0.46 – 1.16) |
| **Becoming Physically Inactive (n=4,277; cases=3,038)** | **Standardized Purpose** | **Quartile 1 (n=1,075)** | **Quartile 2 (n=1,273)** | **Quartile 3 (n=1,001)** | **Quartile 4 (n=928)** |
| Model 1[c] | 0.86 (0.83 – 0.90) | Reference | 0.81 (0.74 – 0.90) | 0.70 (0.63 – 0.78) | 0.71 (0.64 – 0.79) |
| Model 2[d] | 0.89 (0.86 – 0.93) | Reference | 0.84 (0.76 – 0.93) | 0.76 (0.68 – 0.85) | 0.76 (0.68 – 0.85) |
| Model 3[e] | 0.91 (0.87 – 0.95) | Reference | 0.86 (0.78 – 0.95) | 0.79 (0.71 – 0.88) | 0.79 (0.71 – 0.89) |
| **Becoming Heavy Alcohol User (n=12,547; cases=823)** | **Standardized Purpose** | **Quartile 1 (n=3,342)** | **Quartile 2 (n=3,015)** | **Quartile 3 (n=3,267)** | **Quartile 4 (n=2,923)** |
| Model 1[c] | 1.07 (0.99 – 1.16) | Reference | 1.00 (0.79 – 1.27) | 1.16 (0.94 – 1.43) | 1.16 (0.92 – 1.45) |
| Model 2[d] | 1.03 (0.94 – 1.12) | Reference | 0.95 (0.74 – 1.21) | 1.05 (0.85 – 1.31) | 1.02 (0.81 – 1.29) |
| Model 3[e] | 1.00 (0.92 – 1.10) | Reference | 0.91 (0.71 – 1.17) | 1.01 (0.81 – 1.26) | 0.96 (0.75 – 1.22) |
| **Onset of Sleep Problems (n=4,185; cases=1,816)** | **Standardized Purpose** | **Quartile 1 (n=1,194)** | **Quartile 2 (n=1043)** | **Quartile 3 (n=933)** | **Quartile 4 (n=1,015)** |
| Model 1[c] | 0.83 (0.78 – 0.88) | Reference | 0.85 (0.75 – 0.98) | 0.74 (0.64 – 0.85) | 0.62 (0.54 – 0.72) |
| Model 2[d] | 0.86 (0.81 – 0.91) | Reference | 0.89 (0.78 – 1.02) | 0.79 (0.68 – 0.92) | 0.67 (0.58 – 0.79) |
| Model 3[e] | 0.88 (0.83 – 0.93) | Reference | 0.92 (0.80 – 1.05) | 0.82 (0.71 – 0.96) | 0.71 (0.60 – 0.83) |

| Outcomes | Purpose in Life: HR (95% CI) | | | | |
|---|---|---|---|---|---|
| **Smoking Relapse[b] (n=12,039; cases=220)** | **Standardized Purpose** | **Quartile 1 (n=3,073)** | **Quartile 2 (n=3,452)** | **Quartile 3 (n=2,624)** | **Quartile 4 (n=2,890)** |
| **Onset of Unhealthy BMI (n=5,219; cases=2,730)** | **Standardized Purpose** | **Quartile 1 (n=1,504)** | **Quartile 2 (n=1,234)** | **Quartile 3 (n=1,184)** | **Quartile 4 (n=1,297)** |
| Model 1[c] | 0.90 (0.86 – 0.94) | Reference | 0.85 (0.76 – 0.95) | 0.81 (0.72 – 0.90) | 0.74 (0.66 – 0.84) |
| Model 2[d] | 0.91 (0.87 – 0.95) | Reference | 0.87 (0.77 – 0.97) | 0.83 (0.74 – 0.94) | 0.78 (0.69 – 0.87) |
| Model 3[e] | 0.92 (0.88 – 0.96) | Reference | 0.87 (0.77 – 0.98) | 0.84 (0.74 – 0.94) | 0.78 (0.69 – 0.89) |

[a] All respondents who were not smoking at baseline, but began smoking over the follow-up period were smokers in prior waves. Thus, we labeled this outcome smoking relapse.

[b] The analytic sample size, the number of cases, and the number of individuals in each purpose quartile were calculated based on the first (out of 20) imputed datasets. Hazard ratio estimates and confidence intervals were obtained by combining results from all of the 20 imputed datasets.

[c] Model 1 is age-adjusted.

[d] Model 2 adds sex, race/ethnicity, marital status, education, total wealth, and health insurance.

[e] Model 3 adds heart disease, stroke, cancer, diabetes, hypertension, lung disease, arthritis, and depression.