



What makes life purposeful? Identifying the antecedents of a sense of purpose in life using a lagged exposure-wide approach

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ABSTRACT

Aims: Prior research documents strong associations between an increased sense of *purpose* in life and improved health and well-being outcomes. However, less is known about candidate antecedents that lead to more purpose among older adults.

Methods: We used data from 13,771 participants in the Health and Retirement Study (HRS) — a diverse, national panel study of adults aged >50 in the United States, to evaluate a large number of candidate predictors of purpose. Specifically, using linear regression with a *lagged exposure-wide approach*, we evaluated if *changes* in 61 predictors spanning physical health, health behaviors, and psychosocial well-being (between t_0 ;2006/2008 and t_1 ;2010/2012) were associated with purpose four years later (t_2 ;2014/2016) after adjustment for a rich set of baseline covariates.

Results: Some health behaviors (e.g., physical activity $\geq 1x/week$ [$\beta = 0.14$, 95% CI: 0.09, 0.19]), physical health conditions (e.g., stroke [$\beta = -0.25$, 95% CI: -0.40 , -0.10]), and psychosocial factors (e.g., depression [$\beta = -0.21$, 95% CI: -0.27 , -0.15]) were associated with subsequent purpose four years later. However, there was little evidence that other health behaviors, physical health conditions, and psychosocial factors such as smoking, drinking, or financial strain, were associated with subsequent purpose.

Conclusions: Several of our candidate predictors such as volunteering, time with friends, and physical activity may be important targets for interventions and policies aiming to increase purpose among older adults. However, some effect sizes were modest and contrast with prior work on younger populations, suggesting purpose may be more easily formed earlier in life.

1. Introduction

There are 46.3 million people aged >65 years in the United States and in the next 15 years, this age group is projected to increase by nearly 50% (Colby & Ortman, 2014). While life expectancies have increased, the burden of chronic disease and number of years lost to disability have also increased (Salomon et al., 2012). Further, deaths attributable to suicide, drug overdose, and alcoholism (“deaths of despair”) began reversing life expectancy trends even before COVID-19 began. Thus, identifying factors that contribute to healthy trajectories of mental and physical health, and also counteract despair, is vital for improving the health and well-being of older adults (Oppers et al., 2012). While much

effort has focused on identifying risk factors of disease, investigators are increasingly seeking potentially modifiable health assets that uniquely enhance a person’s ability to foster healthy behaviors and physical health (Kim et al., 2021; Kubzansky et al., 2018; Levine et al., 2021; Ryff, 2014; VanderWeele, 2017; VanderWeele et al., 2020).

A sense of *purpose* in life, a central component of well-being, is one promising candidate; it refers to the extent that people see their lives as having a sense of direction and goals that are anchored in core values (Frankl, 2006; McKnight & Kashdan, 2009; Ryff, 2014). Victor Frankl suggests that higher purpose leads to a greater will to live, which motivates people to endure short-term discomfort in exchange for longer-term rewards. Building on this theory, a recent review paper

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synthesized evidence showing that people with a higher sense of purpose display a heightened ability to curb impulsivity and report higher self-efficacy (Kim et al., 2019). Thus, people with higher purpose might avoid impulsively indulging in unhealthy behaviors (e.g., eating comfort foods) and instead deploy their higher self-efficacy to engage in healthier behaviors even if they are not immediately appealing (e.g., eating healthy foods, going on a run). 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 (Kang et al., 2019). Thus, people with higher purpose might make healthier behavioral decisions with more cognitive ease.

Indeed, having a higher sense of purpose in life is associated with improved health outcomes, including: better health behaviors (e.g., increased physical activity, increased preventive healthcare use, healthier sleep, reduced drug misuse; Kim et al., 2014; Kim et al., 2015; Turner et al., 2017; Hill et al., 2019; Chen et al., 2019; Kim et al., 2020a; Kim et al., 2020b; Yemiscigil & Vlaev, 2021), improved biological functioning (e.g., reduced allostatic load, reduced inflammation; Zilioli et al., 2015; Hafez et al., 2018), and better physical health outcomes (e.g., improved physical functioning and reduced risk of cardiovascular disease, cognitive impairment, and mortality; Yu et al., 2015; Cohen et al., 2016; Lewis et al., 2016; Kim et al., 2017; Chen et al., 2019; Kim et al., 2019; Kim, Tkatch, et al., 2021; Shiba et al., 2021; Willroth et al., 2021). Purpose is, of course, also desired by many for its own sake, giving one's activities and life goals a broader context (Hanson & VanderWeele, 2021; Lee et al., 2021; VanderWeele, 2017).

Early efforts aimed at enhancing purpose have been developed and assessed, but they have generated mixed results (Friedman et al., 2015; Gruenewald et al., 2016; Ryff, 2014). One key factor hindering intervention development is the identification of factors that predict purpose. Many factors have been assessed as candidate antecedents of increased purpose, including: physical activity (Lewis & Hill, 2020; Yemiscigil & Vlaev, 2021; Zhang & Chen, 2021), psychological well-being (e.g., increased positive affect; Chen et al., 2020), psychological distress (e.g., decreased: depressive symptoms, anxiety symptoms, and hopelessness; Chen et al., 2020), social factors (e.g., increased: volunteering, collective connectedness [belonging to a larger social group], perceived social support, orientation to promote good, number of close relatives, decreased loneliness; George & Park, 2013; Chen et al., 2020; Jongenelis et al., 2021; Mei et al., 2021), and others (e.g., spirituality, orientation to promote good; George & Park, 2013; Weziak-Bialowolska et al., 2021). However, these studies are not entirely uniform (e.g., mixed findings with physical activity; Yemiscigil & Vlaev, 2021; Zhang & Chen, 2021), and many potential antecedents of purpose have been understudied or not studied at all in older adults over 50 years of age (many studies on predictors of purpose contain young and middle-aged participants younger than 45 years of age; e.g., Weziak-Bialowolska et al., 2021).

These prior studies have made important contributions to the literature but remain somewhat limited. First, while an increasing number of studies are longitudinal, many older studies are cross-sectional and cannot assess directionality (Hedberg et al., 2010; Hirooka et al., 2021; Stoddard & Pierce, 2015; Sumner, 2017). Second, many studies did not adequately adjust for key potential confounders (e.g., only adjusting for basic demographics). Third, most studies only evaluated a limited number of predictors, so that we cannot directly compare effect sizes, which is helpful when trying to determine intervention targets that might produce the largest effects. Fourth, many studies use data from small samples or specific subpopulations (e.g., cancer survivors), limiting generalizability to broader populations (George & Park, 2013; Hirooka et al., 2021). Fifth, some studies used suboptimal assessments of purpose (e.g., single-item measures). Sixth, longitudinal studies did not adjust for pre-baseline predictors or outcomes, increasing risk of reverse causality. Finally, most studies evaluated predictors of purpose

accumulated across the life-course, rather than changes in predictors.

In our study, we used a *lagged exposure-wide* analytic approach (see section 2.4 *Statistical Analysis*; VanderWeele, Mathur, & Chen, 2020), to evaluate how changes in 61 predictors (i.e., physical health, health behaviors, psychosocial well-being factors) over a 4-year period might lead to changes in purpose another 4 years later. This hypothesis-generating, data-driven approach allowed us to identify promising antecedents of purpose, which can then undergo further investigation in future studies. We chose these 61 predictors because they are frequently included in the conceptualization of key gerontological models that characterize the antecedents, processes, and outcomes that foster people's ability to age well (Aldwin & Igarashi, 2015; Depp & Jeste, 2006; Reich et al., 2010; Rowe & Kahn, 1987; Ryff & Singer, 2009). Further, many of the candidate predictors are modifiable, or likely modifiable with further research.

2. Methods

2.1. Study population

We used data from the Health and Retirement Study (HRS) – a national panel study of adults aged >50 in the United States. Psychosocial data were first collected in 2006. In this year, 50% of respondents were randomly selected to complete an enhanced face-to-face (EFTF) interview. The other 50% were assessed in the next wave (2008). After the interview, participants completed a psychosocial questionnaire which they mailed to the University of Michigan upon completion (response rates: 88% in 2006, 84% in 2008; Smith et al., 2017). These sub-cohorts alternate reporting on psychosocial factors (each participant reports psychosocial data every four years). Data from the 2006 and 2008 sub-cohorts were combined to increase sample size and statistical power. Participants were excluded if they did not report psychosocial data in this pre-baseline wave since over half of the study predictors were psychosocial factors, resulting in a final sample of 13,771 participants.

We used data from three time points spaced 4-years apart: (a) covariates were assessed in the pre-baseline wave (t_0 ;2006/2008), (b) candidate predictors were assessed in the baseline wave (t_1 ;2010/2012), and (c) our outcome (purpose) was assessed in the outcome wave (t_2 ;2014/2016). The HRS is sponsored by the National Institute on Aging (NIA U01AG009740) and conducted by the University of Michigan (<http://hrsonline.isr.umich.edu/>; Sonnega et al., 2014). The ethics board at the University of British Columbia exempted our study from review because it used de-identified and publicly available data. Documentation, code, and other materials are available upon request. This study was not preregistered.

2.2. Measures

2.2.1. Sense of purpose in life

Purpose was assessed with a 7-item purpose subscale from Ryff's Psychological Well-Being Scale (Ryff & Keyes, 1995). The 7-item subscale has been validated in prior work and has shown good psychometric properties (Abbott et al., 2006). Using a 6-point Likert scale, participants were asked the degree to which they agreed with statements such as, "I have a sense of direction and purpose in my life." Negatively worded items were reverse coded, and all items were averaged to create a composite score, with higher scores indicating higher purpose ($\alpha = 0.76$, range 1–6).

2.2.2. Covariates

We adjusted for a substantial number of covariates in the pre-baseline wave (t_0 ;2006/2008), including: sociodemographics (age [continuous], gender [male/female], race/ethnicity [White, African-American, Hispanic, Other], marital status [married/not married], income [$<$ \$50,000, \$50,000-\$74,999, \$75,000-\$99,999, \geq \$100,000],

total wealth [based on quintiles of the score distribution for total wealth in this sample], educational attainment [no degree, GED/high school diploma, \geq college degree], employment status [yes/no], health insurance [yes/no], geographic region [Northeast, Midwest, South, West], religious service attendance [none, $<1x/week$, $\geq 1x/week$], personality [openness, conscientiousness, extraversion, agreeableness, neuroticism; continuous], and childhood abuse [yes/no]. We adjusted for prior values of all predictors to evaluate change in each predictor. To reduce the possibility of reverse causation, we also adjusted for pre-baseline purpose.

2.2.3. Predictors

We evaluated 61 candidate predictors in the baseline wave (t_1 ;2010/2012) including measures of: (a) physical health (number of chronic conditions, diabetes, hypertension, stroke, cancer, heart disease, lung disease, arthritis, overweight, physical functioning limitations, cognitive impairment, chronic pain, self-rated health, hearing, eyesight); (b) health behaviors (heavy drinking, smoking, physical activity, sleep problems); (c) psychological well-being (positive affect, life satisfaction, optimism, mastery, health mastery, financial mastery); (d) psychological distress (depression, depressive symptoms, hopelessness, negative affect, perceived constraints, anxiety, trait anger, state anger, cynical hostility, stressful life events, financial strain, daily discrimination, major discrimination); (e) social factors (loneliness; living with a spouse/partner; frequency of contact in 3 separate relationship categories: (i) children, (ii) other family, and (iii) friends; closeness with spouse; number of close (i) children, (ii) other family, and (iii) friends; positive social support from (i) spouse, (ii) children, (iii) other family, and (iv) friends; negative social strain from (i) spouse, (ii) children, (iii) other family, and (iv) friends; religious service attendance; volunteer activity; helping friends, neighbours, and relatives; social status ladder ranking; and change in social status ladder ranking); and (f) employment (in the labour force). HRS Materials and [Supplementary Text 1](#) provide further details about each variable (Fisher et al., 2005; Jenkins et al., 2008; Smith et al., 2017).

2.3. Multiple imputation

All missing exposures, covariates, and outcome variables were imputed using multiple imputation by chained equations, and five datasets were created. This method may be more flexible than other methods of handling missing data (Groenwold et al., 2012; Moons et al., 2006; Sterne et al., 2009), and helps address problems that arise from attrition (Asendorpf et al., 2014; Cumming & Goldstein, 2016; Harel et al., 2018; Rawlings et al., 2017; van Ginkel et al., 2019; Weuve et al., 2015).

2.4. Statistical Analysis

We used a lagged exposure-wide approach (VanderWeele, Mathur, & Chen, 2020) and ran separate models for each exposure. In our primary analyses, purpose was a continuous outcome (standardized) and we used linear regression to individually regress purpose in the outcome wave (t_2 ;2014/2016) on baseline candidate predictors (at t_1 ;2010/2012, examined one at a time) adjusting for all covariates in the previous wave (t_0 ;2006/2008). Continuous predictors were standardized (mean = 0, standard deviation = 1) so their effect sizes could be interpreted as a standard deviation change in the exposure. For categorical exposures, the effect estimate corresponds to associations between the exposure at baseline (at t_1 ;2010/2012) and purpose at the outcome wave (t_2 ;2014/2016), conditional on the exposure and covariates in the pre-baseline wave (at t_0 ;2006/2008). We marked multiple p -value cutoffs (including Bonferroni-corrected) and provided exact confidence intervals, since multiple testing practices vary widely and are continuously evolving (Dunn, 1961; VanderWeele & Mathur, 2019).

2.5. Additional analyses

We conducted several additional analyses. First, to evaluate the robustness of our results to potential unmeasured confounding, we calculated E -values to assess the minimum strength of unmeasured confounding on the risk ratio scale (with both the exposure and the outcome) needed to explain away the association between the exposure and outcome (VanderWeele & Ding, 2017). Second, to assess the impact of multiple imputation on results, we re-analyzed all models using only complete cases.

3. Results

Participants were on average 69 years old ($SD = 10$), predominantly women (58%), and married (62%) in the pre-baseline wave (t_0 ;2006/2008). [Table 1](#) provides the distribution of covariates in the pre-baseline wave. [Appendix Table 1](#) describes the changes in purpose from the pre-baseline wave (t_0) to the outcome wave (t_2). Purpose declined in the sample overall across the pre-baseline ($M = 4.57$, $SD = 0.94$), baseline ($M = 4.49$, $SD = 0.97$), and outcome ($M = 4.34$, $SD = 1.01$) waves. Purpose also appeared to be lower among the older versus the younger: in the pre-baseline wave, purpose was highest in people aged <65 ($M = 4.68$, $SD = 0.94$), and became subsequently lower as people aged: young-old (aged 65–74 years, $M = 4.64$, $SD = 0.91$), middle-old (aged 75–84 years, $M = 4.43$, $SD = 0.93$), and oldest-old (aged ≥ 85 years, $M = 4.15$, $SD = 0.95$).

[Table 2](#) shows associations between candidate predictors and purpose. Participants engaging in frequent physical activity ($\geq 1x/week$) at baseline (t_1 ; 2010/2012) had increased purpose ($\beta = 0.14$, 95% CI : 0.09, 0.19) four years later. Conversely, participants with sleep problems at baseline had decreased purpose ($\beta = -0.06$, 95% CI : -0.11 , -0.01) 4-years later. However, there was little evidence of associations between two other health behaviors (e.g., heavy drinking and smoking) and subsequent purpose.

For physical health indicators, nine out of 15 candidate predictors were associated with purpose. For example, stroke ($\beta = -0.25$, 95% CI : -0.40 , -0.10), physical functioning limitations ($\beta = -0.20$, 95% CI : -0.27 , -0.14), cognitive impairment ($\beta = -0.14$, 95% CI : -0.21 , -0.07) and heart disease ($\beta = -0.12$, 95% CI : -0.20 , -0.04) had the strongest associations with decreased subsequent purpose. There was little evidence of associations between other physical health conditions (e.g., cancer, diabetes, etc.) and subsequent purpose.

Amongst psychological factors, all six psychological well-being factors and 11 out of 13 psychological distress factors were associated with subsequent purpose. Among psychological well-being factors, positive affect ($\beta = 0.23$, 95% CI : 0.20, 0.25) and optimism ($\beta = 0.15$, 95% CI : 0.11, 0.19) had the strongest associations with increased subsequent purpose. Among psychological distress factors, depression ($\beta = -0.21$, 95% CI : -0.27 , -0.15) and constraints ($\beta = -0.18$, 95% CI : -0.21 , -0.16) were most strongly associated with decreased subsequent purpose. There was little evidence of associations between two psychological distress factors (e.g., financial strain, major discrimination) and subsequent purpose.

Amongst social variables, 15 out of 22 factors were associated with subsequent purpose. For example, frequent contact with friends (1–2x/week ($\beta = 0.09$, 95% CI : 0.02, 0.15) or $\geq 3x/week$ ($\beta = 0.12$, 95% CI : 0.06, 0.17)), religious service attendance ($<1x/week$ ($\beta = 0.06$, 95% CI : 0.01, 0.10), $\geq 1x/week$ ($\beta = 0.08$, 95% CI : 0.03, 0.13)), volunteering (1–49 h/year ($\beta = 0.09$, 95% CI : 0.01, 0.17), 100–199 h/year ($\beta = 0.15$, 95% CI : 0.06, 0.24), or ≥ 200 h/year ($\beta = 0.18$, 95% CI : 0.06, 0.30)), and all categories of helping friends/neighbours/relatives (1–49 h/year ($\beta = 0.09$, 95% CI : 0.05, 0.13), 50–99 h/year ($\beta = 0.10$, 95% CI : 0.06, 0.15), 100–199 h/year ($\beta = 0.14$, 95% CI : 0.08, 0.19), and ≥ 200 h/year ($\beta = 0.17$, 95% CI : 0.10, 0.24)) were associated with higher subsequent purpose. Conversely, loneliness ($\beta = -0.10$, 95% CI : -0.13 , -0.08) was associated with lower subsequent purpose. There was little evidence of

Table 1
Characteristics of participants at pre-baseline (N = 13,389)^{a,b,c}.

Participant Characteristics	No. (%)	Mean (SD)
Sociodemographic factors		
Age (yr.; range: 52–104)		69.2 (9.6)
Female (%)	8041 (58.4)	
Race/ethnicity (%)		
White	10642 (77.3)	
Black	1761 (12.8)	
Hispanic	1088 (7.9)	
Other	279 (2.0)	
Married (%)	8589 (62.4)	
Annual household income (%)		
< \$50,000	8361 (60.7)	
\$50,000–\$74,999	2119 (15.4)	
\$75,000–\$99,999	1152 (8.4)	
≥ \$100,000	2139 (15.5)	
Total wealth (%)		
1st Quintile	2756 (20.0)	
2nd Quintile	2755 (20.0)	
3rd Quintile	2755 (20.0)	
4th Quintile	2751 (20.0)	
5th Quintile	2754 (20.0)	
Education (%)		
< High school	2715 (19.8)	
High school	7513 (54.7)	
≥ College	3515 (25.6)	
Employment		
In labor force	4782 (34.7)	
Health insurance (%)	13183 (95.8)	
Geographic region (%)		
Northeast	2091 (15.2)	
Midwest	3594 (26.1)	
South	5497 (40.0)	
West	2566 (18.7)	
Childhood abuse (%)	849 (6.3)	
Health Behaviors		
Heavy drinking (%)	791 (7.0)	
Smoking (%)	1725 (12.6)	
Frequent physical activity (%)	9869 (71.7)	
Sleep problems (%)	3055 (42.1)	
Physical Health		
Number of physical conditions (range: 0–8)		2.6 (1.5)
Diabetes (%)	2729 (19.8)	
Hypertension (%)	7848 (57.1)	
Stroke (%)	1109 (8.1)	
Cancer (%)	2089 (15.2)	
Heart disease (%)	3357 (24.4)	
Lung disease (%)	1302 (9.5)	
Arthritis (%)	8304 (60.4)	
Overweight (%)	9491 (69.8)	
Physical functioning limitations (%)	3329 (24.2)	
Cognitive impairment (%)	2705 (20.0)	
Chronic pain (%)	4754 (34.5)	
Self-rated health (range: 1–5)		3.2 (1.1)
Hearing (range: 1–5)		3.3 (1.1)
Eyesight (range: 1–6)		4.2 (1.0)
Psychological Well-Being		
Positive affect (range: 1–5)		3.6 (0.7)
Life satisfaction (range: 1–7)		5.0 (1.5)
Optimism (range: 1–6)		4.5 (1.0)
Purpose in life (range: 1–6)		4.6 (0.9)
Mastery (range: 1–6)		4.8 (1.1)
Health mastery (range: 0–10)		7.2 (2.4)
Financial mastery (range: 0–10)		7.3 (2.6)
Psychological Distress		
Depression (%)	1881 (13.9)	
Depressive symptoms (range: 0–8)		1.4 (1.9)
Hopelessness (range: 1–6)		2.4 (1.3)
Negative affect (range: 1–5)		1.7 (0.6)
Perceived constraints (range: 1–6)		2.2 (1.2)
Anxiety (range: 1–4)		1.6 (0.6)
Trait anger (range: 1–4)		2.2 (0.7)
State anger (range: 1–4)		1.5 (0.5)

Table 1 (continued)

Participant Characteristics	No. (%)	Mean (SD)
Cynical hostility (range: 1–6)		3.0 (1.1)
Stressful life events (range: 0–5)		0.2 (0.6)
Financial strain (range: 1–5)		2.0 (1.0)
Daily discrimination (range: 1–6)		1.6 (0.7)
Major discrimination (range: 0–6)		0.5 (0.9)
Social Factors		
Living with spouse/partner (%)	8796 (65.7)	
Contact children (%)		
< Every few months	1845 (13.8)	
1–2x/Month	1510 (11.3)	
1–2x/Week	4134 (30.8)	
≥3x/Week	5919 (44.2)	
Contact other family (%)		
< Every few months	3274 (24.4)	
1–2x/Month	3124 (23.3)	
1–2x/Week	3679 (27.4)	
≥3x/Week	3358 (25.0)	
Contact friends (%)		
< Every few months	2268 (16.8)	
1–2x/Month	2482 (18.4)	
1–2x/Week	4810 (35.6)	
≥3x/Week	3951 (29.2)	
Loneliness (range: 1–3)		1.5 (0.5)
Closeness with spouse (range: 1–4)		3.5 (0.7)
Number of close children		2.8 (3.7)
Number of close other family		3.9 (5.6)
Number of close friends		4.5 (6.0)
Positive social support from spouse (range: 1–4)		3.5 (0.7)
Positive social support from children (range: 1–4)		3.3 (0.7)
Positive social support from other family (range: 1–4)		2.9 (0.9)
Positive social support from friends (range: 1–4)		3.0 (0.7)
Social strain from spouse (range: 1–4)		2.0 (0.7)
Social strain from children (range: 1–4)		1.7 (0.6)
Social strain from other family (range: 1–4)		1.6 (0.6)
Social strain from friends (range: 1–4)		1.8 (0.4)
Religious service attendance (%)		
Not at All	3455 (25.1)	
<1x/Week	4300 (31.3)	
≥1x/Week	6007 (43.7)	
Volunteering (%)		
0 h	8928 (64.9)	
1–49 h	1530 (11.1)	
50–99 h	1085 (7.9)	
100–199 h	1191 (8.7)	
≥200 h	1021 (7.4)	
Helping friends/neighbours/relatives (%)		
0 h	6626 (48.3)	
1–49 h	3218 (23.4)	
50–99 h	1836 (13.4)	
100–199 h	1190 (8.7)	
≥200 h	859 (6.3)	
Social status ladder (range: 1–10)		6.5 (1.8)
Change in social status ladder (%)		
Moved down	1268 (9.6)	
No change	10295 (77.8)	
Moved up	1671 (12.6)	
Personality		
Openness (range: 1–4)		2.9 (0.6)
Conscientiousness (range: 1–4)		3.4 (0.5)
Extraversion (range: 1–4)		3.2 (0.6)
Agreeableness (range: 1–4)		3.5 (0.5)
Neuroticism (range: 1–4)		2.0 (0.6)

^a This table was created based on non-imputed data.

^b All variables in Table 1 were used as covariates and assessed in the pre-baseline wave (t₀:2006/2008).

^c The percentages in some sections may not add up to 100% due to rounding.

associations between other social factors (e.g., frequency of contact with children, social strain from friends, etc.) and subsequent purpose.

Finally, work force participation was not associated with subsequent purpose.

Table 2

Candidate predictors of purpose in life (health and retirement study [HRS]: N = 13,771)^{a,b,c}.

Candidate Predictor	β	95% CI
Health Behaviors		
Frequent physical activity	0.14	0.09, 0.19***
Smoking	-0.03	-0.13, 0.07
Heavy drinking	0.01	-0.07, 0.08
Sleep problems	-0.06	-0.11, -0.01*
Physical Health		
Number of physical conditions	-0.08	-0.12, -0.04***
Diabetes	-0.04	-0.11, 0.03
Hypertension	-0.04	-0.10, 0.03
Stroke	-0.25	-0.40, -0.10**
Cancer	-0.01	-0.08, 0.07
Heart disease	-0.12	-0.20, -0.04**
Lung disease	-0.03	-0.13, 0.07
Arthritis	-0.02	-0.08, 0.05
Overweight	-0.02	-0.09, 0.05
Physical functioning limitations	-0.20	-0.27, -0.14***
Cognitive impairment	-0.14	-0.21, -0.07**
Chronic pain	-0.05	-0.09, -0.01*
Self-rated health	0.10	0.07, 0.13***
Hearing	0.04	0.01, 0.08*
Eyesight	0.04	0.02, 0.06***
Psychological Well-being		
Positive affect	0.23	0.20, 0.25***
Life satisfaction	0.11	0.09, 0.12***
Optimism	0.15	0.11, 0.19***
Mastery	0.13	0.11, 0.15***
Health mastery	0.13	0.10, 0.16***
Financial mastery	0.13	0.09, 0.16***
Psychological Distress		
Depression	-0.21	-0.27, -0.15***
Depressive symptoms	-0.12	-0.14, -0.10***
Hopelessness	-0.17	-0.21, -0.14***
Negative affect	-0.16	-0.18, -0.13***
Constraints	-0.18	-0.21, -0.16***
Anxiety	-0.12	-0.14, -0.10***
Trait anger	-0.05	-0.07, -0.02***
State anger	-0.07	-0.10, -0.03***
Cynical hostility	-0.05	-0.08, -0.03***
Stressful life events	-0.04	-0.06, -0.02**
Financial strain	-0.03	-0.07, 0.00
Daily discrimination	-0.05	-0.08, -0.02**
Major discrimination	-0.01	-0.05, 0.03
Social Factors		
Living with spouse/partner	-0.02	-0.10, 0.06
Contact children		
< Every few months	Reference	Reference
1-2x/Month	0.06	-0.02, 0.14
1-2x/Week	0.06	-0.03, 0.15
≥3x/Week	0.08	-0.01, 0.17
Contact other family		
< Every few months	Reference	Reference
1-2x/Month	0.04	-0.02, 0.11
1-2x/Week	0.06	0.01, 0.11*
≥3x/Week	0.09	0.02, 0.15*
Contact friends		
< Every few months	Reference	Reference
1-2x/Month	0.05	-0.01, 0.11
1-2x/Week	0.09	0.02, 0.15*
≥3x/Week	0.12	0.06, 0.17***
Loneliness	-0.10	-0.13, -0.08***
Closeness with spouse	0.05	0.02, 0.09**
Number of close children	0.00	-0.03, 0.03
Number of close other family	0.00	-0.02, 0.02
Number of close friends	0.01	-0.01, 0.03
Positive social support from spouse	0.10	0.05, 0.15**
Positive social support from children	0.06	0.04, 0.08***
Positive social support from other family	0.04	0.01, 0.06**
Positive social support from friends	0.04	0.01, 0.07*
Social strain from spouse	-0.05	-0.10, -0.01*
Social strain from children	-0.04	-0.06, -0.01**
Social strain from other family	-0.02	-0.04, 0.00
Social strain from friends	0.01	-0.01, 0.03
Religious service attendance		

Table 2 (continued)

Candidate Predictor	β	95% CI
Not at All	Reference	Reference
<1x/Week	0.06	0.01, 0.10*
≥1x/Week	0.08	0.03, 0.13**
Volunteering		
0 h	Reference	Reference
1-49 h	0.09	0.01, 0.17*
50-99 h	0.08	0.00, 0.17
100-199 h	0.15	0.06, 0.24**
≥200 h	0.18	0.06, 0.30**
Helping friends/neighbours/relatives		
0 h	Reference	Reference
1-49 h	0.09	0.05, 0.13***
50-99 h	0.10	0.06, 0.15***
100-199 h	0.14	0.08, 0.19***
≥200 h	0.17	0.10, 0.24***
Social status ladder	0.07	0.04, 0.10**
Change in social status ladder		
Moved down	Reference	Reference
No change	0.09	0.03, 0.16**
Moved up	0.09	0.00, 0.19
Work		
In labour force	0.04	-0.03, 0.11

* $p < .05$ before Bonferroni correction; ** $p < .01$ before Bonferroni correction; *** $p < .05$ after Bonferroni correction (the p value cut off for Bonferroni correction is $p = .05/61$ predictors = $p < .00081967$).

^a The analytic sample was restricted to those who had participated in the pre-baseline wave (2006/2008). Multiple imputation was performed to impute missing data on the exposures, covariates, and outcome. Candidate antecedents were assessed, one at a time, in wave 2 (2010/2012), and the outcome (purpose) was assessed in wave 3 (2014/2016). The following covariates were adjusted for at wave 1 (2006/2008): sociodemographic characteristics (age, sex, race/ethnicity, marital status, income, total wealth, level of education, employment status, health insurance, geographic region), religious service attendance, childhood abuse, personality factors (openness, conscientiousness, extraversion, agreeableness, neuroticism), all of the predictor variables, including: health behaviors (physical activity, smoking, heavy drinking, sleep problems), physical health (heart disease, stroke, cancer, arthritis, hypertension, diabetes, lung disease, overweight, chronic pain, hearing, eyesight, self-rated health, physical functioning limitations, cognitive impairment), social factors (live with spouse, frequency of contact with children, frequency of contact with other family, frequency of contact with friends, loneliness, closeness with spouse, number of close children, number of close other family, number of close friends, positive social support from spouse, positive social support from children, positive social support from friends, positive social support from other family, social strain from spouse, social strain from children, social strain from other family, social strain from friends, religious service attendance, volunteering, helping friends/neighbours/relatives, perceived social status, change in perceived social status), psychological well-being factors (life satisfaction, positive affect, optimism, health mastery, financial mastery, mastery), psychological distress (depressive symptoms, hopelessness, negative affect, constraints, anxiety, trait anger, state anger, daily discrimination, major discrimination, cynical hostility, stressful life events, financial strain), and work (in labour force), and purpose in life.

^b All continuous candidate antecedents were standardized ($M = 0$; $SD = 1$).

^c An exposure-wide analytic approach was used, and a separate model for each exposure was run. Because purpose was a continuous outcome, we ran a linear regression model to estimate a β .

3.1. Additional analyses

First, E -values suggested that many of the observed associations were moderately robust to unmeasured confounding (Table 3). For example, for physical functioning limitations, an unmeasured confounder that was associated with both purpose and physical functioning limitations by risk ratios of 1.69 each (above and beyond the covariates already adjusted for) could explain away the association, but weaker joint confounder associations could not. Further, to shift the confidence interval to include the null, an unmeasured confounder associated with both purpose and physical functioning limitations by risk ratios of 1.54 each could suffice, but weaker joint confounder associations could not.

Table 3
Robustness to unmeasured confounding (*E*-values) for the associations between candidate predictors and subsequent purpose in life (N = 13,771)^a.

	Effect Estimate ^b	Confidence Interval Limit ^c
Health Behaviors		
Frequent physical activity	1.53	1.41
Smoking	1.19	1.00
Heavy drinking	1.07	1.00
Sleep problems	1.29	1.13
Physical Health		
Number of physical conditions	1.36	1.25
Diabetes	1.23	1.00
Hypertension	1.22	1.00
Stroke	1.82	1.49
Cancer	1.08	1.00
Heart disease	1.48	1.26
Lung disease	1.19	1.00
Arthritis	1.14	1.00
Overweight	1.17	1.00
Physical functioning limitations	1.69	1.54
Cognitive impairment	1.53	1.37
Chronic pain	1.28	1.12
Self-rated health	1.42	1.35
Hearing	1.24	1.12
Eyesight	1.24	1.17
Psychological Well-being		
Positive affect	1.76	1.70
Life satisfaction	1.43	1.39
Optimism	1.55	1.46
Mastery	1.51	1.46
Health mastery	1.51	1.44
Financial mastery	1.49	1.41
Psychological Distress		
Depression	1.72	1.57
Depressive symptoms	1.47	1.42
Hopelessness	1.62	1.54
Negative affect	1.58	1.51
Constraints	1.64	1.58
Anxiety	1.47	1.42
Trait Anger	1.26	1.18
State Anger	1.32	1.22
Cynical hostility	1.28	1.19
Stressful life events	1.22	1.14
Financial strain	1.21	1.05
Daily discrimination	1.26	1.16
Major discrimination	1.10	1.00
Social Factors		
Living with spouse/partner	1.15	1.00
Contact children		
< Every few months	Reference	Reference
1–2x/Month	1.29	1.00
1–2x/Week	1.30	1.00
≥3x/Week	1.35	1.00
Contact other family		
< Every few months	Reference	Reference
1–2x/Month	1.24	1.00
1–2x/Week	1.30	1.13
≥3x/Week	1.38	1.18
Contact friends		
< Every few months	Reference	Reference
1–2x/Month	1.28	1.00
1–2x/Week	1.38	1.19
≥3x/Week	1.47	1.32
Loneliness	1.42	1.36
Closeness with spouse	1.28	1.17
Number of close children	1.04	1.00
Number of close other family	1.03	1.00
Number of close friends	1.10	1.00
Positive social support from spouse	1.41	1.30
Positive social support from children	1.31	1.24
Positive social support from other family	1.22	1.13
Positive social support from friends	1.24	1.13
Social strain from spouse	1.28	1.14
Social strain from children	1.23	1.13
Social strain from other family	1.15	1.00

Table 3 (continued)

	Effect Estimate ^b	Confidence Interval Limit ^c
Social strain from friends	1.08	1.00
Religious service attendance		
Not at All	Reference	Reference
<1x/Week	1.29	1.12
≥1x/Week	1.36	1.20
Volunteering		
0 h	Reference	Reference
1–49 h	1.39	1.17
50–99 h	1.38	1.09
100–199 h	1.56	1.33
≥200 h	1.64	1.35
Helping friends/neighbours/relatives		
0 h	Reference	Reference
1–49 h	1.39	1.26
50–99 h	1.43	1.29
100–199 h	1.53	1.37
≥200 h	1.61	1.41
Social status ladder	1.34	1.25
Change in social status ladder		
Moved down	Reference	Reference
No change	1.40	1.23
Moved up	1.40	1.09
Work		
In labour force	1.24	1.00

^a See VanderWeele and Ding (2017) for the formula for calculating *E*-values.

^b The *E*-values for effect estimates are the minimum strength of association on the risk ratio scale that an unmeasured confounder would need to have with both the exposure and the outcome to fully explain away the observed association between the exposure and outcome, conditional on the measured covariates.

^c The *E*-values for the limit of the 95% confidence interval closest to the null denote the minimum strength of association on the risk ratio scale that an unmeasured confounder would need to have with both the exposure and the outcome to shift the confidence interval to include the null value, conditional on the measured covariates.

Second, complete-case analyses showed similar results to the main imputed analyses (Appendix Table 2).

4. Discussion

In a large, national sample of U.S. adults aged >50, we examined the associations between changes in 61 candidate predictors and subsequent sense of purpose in life. No single factor appeared to exert an outsized influence on purpose, but rather several antecedents exist.

Our findings converge with prior studies that identified predictors of increased purpose (e.g., physical activity (Lewis & Hill, 2020; Yemiscigil & Vlaev, 2021) and prosocial behavior/volunteering (Jongenelis et al., 2021)), and decreased purpose (e.g., loneliness (Chen et al., 2020; Mei et al., 2021), depressive symptoms (Chen et al., 2020), anxiety symptoms (Chen et al., 2020), and hopelessness (Chen et al., 2020)). However, our findings diverge from prior studies which observed other factors (e.g., number of close relatives; Chen et al., 2020) that are associated with increased purpose. There are many potential reasons for these discrepancies, including differences in: (a) study design (e.g., we assessed changes in antecedents and changes in purpose and most studies evaluated these factors statically), (b) analytic methods, (c) sample composition (e.g., different age groups (some of our predictors (e.g., some relational factors) may exert influence earlier in life and thus may have already exerted substantial effects by late-life), healthy people vs. patients samples with specific conditions, retired vs. not retired), (d) measurement and categorization of candidate antecedents, (e) number of covariates (e.g., differences in specific questionnaires/items, including fewer vs. a larger range of covariates), and (f) differences in measurement of purpose.

One important way in which our work contrasts with many prior studies is that we evaluated a considerably older population. Certain

factors, such as social relationships (e.g., number of close relatives), which were longitudinally predictive of purpose in prior studies were less predictive in ours (Chen et al., 2020). The effects of some of these other exposures (e.g., close social relationships) might exert a more powerful influence earlier in life, or have effects that accumulate over the life course; thus, evaluating changes in these factors later in life might miss earlier or more cumulative effects and explain smaller effect sizes. Purpose in life might also be more malleable at younger ages and more difficult to change at older ages, potentially because it has already declined from when one is middle-aged to the oldest-old. Indeed, with few exceptions, purpose appears to decline with age (Hill & Weston, 2019; Irving et al., 2017). However, some of the differences may also be explained by the role that a person occupies at different life stages. For example, having children and caring for them earlier in life may provide a sense of purpose, but after the children are grown and have left the home, while those relationships may still be important, they may provide less purpose, since the role of parenting is often less prominent. As such, it's possible that age-related losses (retirement, widowhood), rather than age itself, catalyze declines in purpose (Irving et al., 2017).

It is also important to note that our study focused on purpose - which is more goal, end, or action oriented - rather than on the broader construct of meaning - which is more cognitive and concerns understanding a broader context (Hanson & VanderWeele, 2021). It is possible that later in life, close social relationships still provide meaning but provide less purpose. While the terms "meaning" and "purpose" are sometimes used interchangeably, there are important distinctions which are becoming increasingly recognized and subject to distinct assessments (George & Park, 2016, 2017; Hanson & VanderWeele, 2021; Martela & Steger, 2016). Unfortunately, one limitation of the present data is that the assessments only concerned purpose and not meaning.

Some of our findings, for example concerning physical health or social relationships, might be understood through the lens of role theory and the role accumulation hypothesis (Thoits, 2012), which hypothesizes that our roles in society and transitions between them (e.g., retirement, death of long-term spouse, etc.) exert a powerful influence on our lives as they provide an underlying architecture of societal expectations and reciprocal obligations which elicit new behavioral demands. This in turn informs how we act, think, feel, and relate to others. Thus, our roles in society provide a framework through which to derive purpose. Studies show that a larger number of role-identities is associated with enhanced health and well-being (Thoits, 2012). However, as we age, we face an accumulation of events that decrease our ability to maintain role-identities. For example, we experience social losses (e.g., death of parents, spouses, siblings, and friends) and this might explain why factors like loneliness predicted reduced purpose in our study. We also experience physical losses (e.g., declines in vision, functional abilities, cognitive functioning, and the accumulation of adverse health events such as stroke and heart disease, as well as chronic pain), and these markers of physical loss were all predictors of decreased purpose. These physical losses in turn decrease our ability to re-engage in new roles. Because physical health typically declines with age, this may have notable implications for older adults' ability to maintain and increase their purpose. Further, we experience role-related losses (e.g., job-loss) attributable to outdated social norms (e.g., artificially low retirement ages) which further contribute to role-identity loss.

Our results also identify modifiable antecedents that appear to enhance purpose. For example, more frequent physical activity was associated with increased purpose. Physical activity helps stave off adverse physical health events and declines in physical functioning, which in turn allows older adults to remain in roles as productive and involved contributors to society. Further, frequent contact with friends was associated with increased purpose. In the face of social losses (e.g., death of family members), maintaining, rekindling, and making new friendships might offer a way to maintain a sense of mattering to others. Further, volunteering had one of the strongest associations with increased purpose, and volunteering provides a role and framework for

daily life infused with ways to contribute and participate in society (Greenfield & Marks, 2004). With further research, volunteering may be an important intervention target to increase purpose in later life.

Our study had several limitations. First, there is potentially unmeasured confounding. However, we mitigated concerns of unmeasured confounding with: (a) robust covariate adjustment, (b) a longitudinal design, and (c) *E*-value analyses. Second, there are many other factors that might predict purpose that were not assessed in HRS (e.g., orientation to promote good (Weziak-Bialowolska et al., 2021), multigenerational relationships (e.g., beyond parent-child relationships, relationships between older adults and their grandchildren)). Third, many physical health outcomes and health behaviors were self-reported and thus are vulnerable to self-report bias. However, study participants were unaware of our hypothesis at the time of the study. Fourth, many of the effect sizes of any given predictor were modest (corresponding only up to a 0.17 standard deviation change in purpose) with *E*-values indicating that associations may be explainable by moderate unmeasured confounding. Notably, there were a wide range of exposures associated with modest changes in purpose, which suggests a multi-faceted approach may be most effective in trying to alter purpose. Moreover, small effects: (a) can have important consequences when accumulated over time and considered at the population-level (Götz et al., 2021), and (b) are perhaps especially important given that purpose later in life may be less malleable than earlier in life (Chen et al., 2019). Fifth, our study did not address how predictors of purpose differ by key factors (e.g., age, gender, etc.), and future studies should consider important social structural moderators and other factors (e.g., personality) that might alter associations between health and well-being antecedents and purpose. Prior research has shown that associations between purpose and health differ across key social structural moderators (e.g., socioeconomic status may moderate associations between purpose in life and mortality; Shiba et al., 2021), and this type of work would be valuable for predictors of purpose. Our study also had several strengths, including the use of a large, diverse, prospective, and national sample of U.S. adults aged >50 years. Further, we investigated many novel predictors that are understudied or not previously studied, and also evaluated all predictors within the same study, allowing us to compare effect sizes.

5. Conclusion

In the last ~100 years, our average life expectancies have increased by almost thirty years. However, due to structural lag, our society's core institutions (e.g., families, education system, workplaces, healthcare system, housing, design of neighbourhoods, etc.) have not been adequately updated to serve the increasingly older age distribution (Rowe & Kahn, 2015). This structural lag means that our institutions, laws, and norms have failed to adapt to the reality of older adults, undermining our rapidly aging population's ability to maintain purpose. Our results highlight potential building blocks that can be targeted as we continue developing and refining purpose interventions. As researchers develop purpose interventions, we urge them to consider how purpose can be achieved via multiple routes, and to consider incorporating people's own values, heterogeneous life course experiences (e.g., historical, cultural, and social contexts), and current circumstances (e.g., access to various assets, including: financial (savings, income, pensions), physical (e.g., infrastructure, shelter, transportation, sanitation), human (e.g., knowledge, skills, health, physical ability), and social assets (e.g., networks, affiliation, reciprocity, trust)) as they develop their own unique purpose. Researchers and policy makers should additionally address structural lag and explore new policy targets that maximize people's ability to pursue purposeful aims in older adulthood. Developing and implementing purpose enhancing interventions and policies may be a promising way of alleviating "deaths of despair," as well as enhancing a range of health and well-being outcomes among our rapidly aging population.

Ethical statement

The ethics board of the University of British Columbia exempted our study from review because it used de-identified and publicly available data.

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Author statement

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Availability of data and materials

Data is publicly available through the Health and Retirement Study (<http://hrsonline.isr.umich.edu/>). Documentation, code, and other materials are available upon request.

Declaration of competing interest

Tyler J. VanderWeele reports receiving personal fees from Flerish Inc. and Flourishing Metrics. Julia S. Nakamura, Ying Chen and Eric S. Kim have no conflicts of interest to report.

Data availability

The authors do not have permission to share data.

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Appendix A. Supplementary data

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