Are all domains of life satisfaction equal? Differential associations with health and well-being in older adults

Julia S. Nakamura[1] · Scott W. Delaney[2,7] · Ed Diener[3] · Tyler J. VanderWeele[4,5,6] · Eric S. Kim[1,2,4,7]

Abstract

Purpose Growing evidence documents strong associations between overall life satisfaction and favorable health and well-being outcomes. However, because most previous studies have assessed satisfaction with one's life *as a whole*, we know little about whether *specific domains* of life satisfaction (e.g., satisfaction with family life, income) might be responsible for longitudinally driving better health and well-being.

Methods Data were from 13,752 participants in the Health and Retirement Study—a prospective and nationally representative cohort of US adults aged > 50. We evaluated if positive *changes* in seven individual domains of life satisfaction (between t_0; 2008/2010 and t_1; 2012/2014) were associated with 35 indicators of physical, behavioral, and psychosocial health and well-being (at t_2; 2016/2018).

Results Most domains of life satisfaction were associated with psychological outcomes: satisfaction with family and non-work activities showed the largest associations (sometimes double in magnitude) with subsequent psychological factors, followed by satisfaction with financial situation and income. Further, some domains showed associations with specific physical health outcomes (e.g., mortality, number of chronic conditions, physical functioning limitations), health behaviors (e.g., sleep problems), and social factors (e.g., loneliness).

Conclusions As countries seek innovative and cost-effective methods of enhancing the health and well-being of our rapidly aging populations, findings from our study suggest that some domains of life satisfaction have a substantially larger influence on health and well-being outcomes than others. Individual domains of life satisfaction might be novel targets for interventions and policies seeking to enhance specific facets of health and well-being.

Keywords Outcome-wide epidemiology · Domains of life satisfaction · Older adults · Public health

Tyler J. VanderWeele and Eric S. Kim share senior authorship.

✉ Julia S. Nakamura
jnakamura@psych.ubc.ca

1 Department of Psychology, University of British Columbia, 2136 West Mall, Vancouver, BC V6T 1Z4, Canada

2 Department of Social & Behavioral Sciences, Harvard T.H. Chan School of Public Health, Boston, MA, USA

3 Department of Psychology, University of Virginia, Charlottesville, VA, USA

4 Human Flourishing Program, Institute for Quantitative Social Science, Harvard University, Cambridge, MA, USA

5 Department of Biostatistics, Harvard T.H. Chan School of Public Health, Boston, MA, USA

6 Department of Epidemiology, Harvard T.H. Chan School of Public Health, Boston, MA, USA

7 Lee Kum Sheung Center for Health and Happiness, Harvard T.H. Chan School of Public Health, Boston, MA, USA

Plain English summary

Intergovernmental organizations (e.g., OECD, UN, WHO) are urging countries to use well-being indicators (e.g., life satisfaction) when making important policy decisions. However, global measures of overall life satisfaction have several shortcomings. Because most previous studies have assessed satisfaction with one's life *as a whole*, we know little about whether *specific domains* of life satisfaction might be responsible for longitudinally driving better health and well-being outcomes. Using data from 13,752 participants in a prospective and nationally representative cohort of US adults aged > 50, we evaluated if positive changes in seven individual domains of life satisfaction (e.g., satisfaction with family life, health, etc.) were associated with 35 physical, behavioral, and psychosocial health and well-being outcomes (four years later). Our findings suggest that

some domains of life satisfaction have a substantially larger influence on health and well-being than others. Individual domains of life satisfaction might be novel targets for interventions and policies seeking to enhance specific facets of health and well-being.

Introduction

Populations are rapidly aging around the world [1]. Fifty six million people were aged ≥ 65 years in 2020, and this number is projected to increase to 73 million by 2030 [2]. To mitigate the growing wave of chronic conditions and mounting healthcare costs (e.g., $873,341,235,533 in annual health care costs among Medicare beneficiaries age 65+ in 2017) [2] that come with a rapidly aging population, it is critical to identify factors that promote health and well-being [3, 4]. While most existing research focuses on identifying *risk factors*, investigators and policymakers are increasingly interested in identifying modifiable *health assets* that enhance a person's ability to maintain health [3, 5].

One promising health asset is life satisfaction—a person's evaluation of his or her own life based on the factors that the person deems most important [6]—and it is promising to evaluate for at least three reasons. First, life satisfaction can be increased through intervention at the individual- [7, 8] and population-level [7, 9]. Second, many prominent intergovernmental organizations (e.g., World Health Organization) are recognizing the importance of assessing well-being (one facet of which is life satisfaction) in addition to traditional economic indicators (e.g., gross domestic product) when making policy decisions [9], and this important paradigm shift ("Beyond GDP Movement") is being adopted by many countries [10]. The Beyond GDP Movement recognizes that well-being cannot be measured as a single number (e.g., how GDP indicates market economic output), which does not indicate well-being in society and its sustainability across social, economic, and environmental dimensions [11]. Third, higher life satisfaction is associated with a range of improved health outcomes, including a reduced risk of physical health conditions (e.g., physical functioning limitations), reduced risk of mortality, and better health behaviors (e.g., decreased risk of sleep problems) [12]. There are at least three biobehavioral pathways that may explain the associations between life satisfaction and improved health [3]: (1) buffering against the effects of stress, (2) indirect effects through health behaviors (e.g., life satisfaction might cause people to seek favorable life outcomes and persist at goals, which could improve health behaviors) [13], and (3) direct effects via biological pathways (e.g., reduced inflammation) [14].

However, global measures of overall life satisfaction have several shortcomings, in part because individuals may have difficulty assessing satisfaction with their entire life (across domains) and thus may subjectively partition their experiences into specific domains [15]. In response to the shortcomings of global measures, Campbell et al. (1976) proposed the investigation of individual domains of life satisfaction that would (1) cover many different aspects of life and (2) be relevant for a maximal proportion of the population [15]. Because most previous studies have assessed satisfaction with one's life *as a whole*, we know little about whether *specific domains* of life satisfaction might be responsible for longitudinally driving better health and well-being outcomes. These specific domains include satisfaction with: living conditions (home), city or town, non-work (e.g., daily life and leisure activities), family life, financial situation, total household income, and health. There is evidence that some domains of life satisfaction (e.g., satisfaction with family life) may contribute more than others (e.g., satisfaction with standard of living) to overall life satisfaction in older adults [16] and that satisfaction in some domains (e.g., satisfaction with health) may change throughout the life course [17]. There is also preliminary evidence of individual domains influencing physical health outcomes [18], health behaviors [18], and psychological outcomes [16, 19–22].

These existing studies have been seminal and contributed substantially to the literature, but various limitations minimize their ability to establish causal relationships. First, many studies are cross-sectional, making it challenging to assess causality [19–23]. Second, some studies use data from very specific subpopulations (e.g., pregnant women, family physicians) [18, 23] and cannot be generalized to broader populations. Finally, many previous studies have focused on life satisfaction domains accumulated over the life course (assessing life satisfaction at one time point), rather than changes in life satisfaction domains (assessing changes in life satisfaction between two time points) [19–23]. Better understanding the individual domains of life satisfaction that influence subsequent health and well-being outcomes could help interventionists and policy-makers better allocate limited resources if they were to target specific domains of life satisfaction to improve health and well-being in our rapidly aging society.

Prior work suggests that public health interventions can increase satisfaction in at least some specific domains. For instance, preliminary evidence suggests interventions can increase relationship satisfaction (e.g., mindfulness) [24] and leisure satisfaction (e.g., leisure education programs) [25]. Thus, we might ask, if satisfaction in individual domains of life were increased, what improvements to health and well-being might we expect to see in a 4-year follow up period? The 4-year follow-up period was implemented for two main reasons: (1) Most of the outcomes in our study were assessed every 4 years by the cohort we are leveraging. (2) Many election cycles

occur every 4-years, representing the timeframe a policy-maker has to implement interventions and policies.

To address this question, we used an *outcome-wide* analytic approach [26]. This allowed us to test if *changes* in seven individual domains of life satisfaction (over a 4-year follow-up between wave 0 and wave 1) were associated with subsequent health and well-being four years later (at wave 2). We tested if increases in seven individual domains of life satisfaction [satisfaction with: (1) living conditions, (2) city/town, (3) daily life and leisure activities, (4) family, (5) financial situation, (6) total household income, and (7) health] were associated with better subsequent health and well-being across 35 separate outcomes, including indicators of physical health, health behaviors, and psychosocial well-being.

Methods

Study population

Participants were from the Health and Retirement Study (HRS), a nationally representative longitudinal panel study of adults aged > 50 in the United States. In 2008, approximately 50% of respondents were randomly selected for an enhanced face-to-face (EFTF) interview when most of the life satisfaction domain questions used in this study were first assessed (remaining respondents completed this interview in 2010). Next, participants completed a psychosocial questionnaire, which they mailed to the University of Michigan upon completion (2008 response rate: 84%, 2010 response rate: 73%) [27]. These sub-cohorts alternate reporting psychosocial factors, with each participant reporting psychosocial data every four years. To increase sample size and statistical power, data from 2008 and 2010 were combined. Participants were excluded if they did not report psychosocial data at baseline, since over half of the study outcomes were included in the baseline assessment, resulting in a final sample of 13,752 participants.

This study used data from three timepoints spaced four years apart: (1) Covariates were assessed in the pre-baseline wave (t_0; 2008/2010), (2) exposures (individual domains of life satisfaction) were assessed in the baseline wave (t_1; 2012/2014) (3) outcomes were assessed in the outcome wave (t_2; 2016/2018). Further details about this study can be found on the HRS website (http://hrsonline.isr.umich.edu/). This study used publicly available, de-identified data from the HRS, and was thus exempted from additional review by the Institutional Review Board at the University of British Columbia.

Measures

Satisfaction with individual domains of life

We assessed life satisfaction in seven individual domains of life: living conditions, city or town, non-work (e.g., daily life and leisure activities), family life, financial situation, total household income, and health. Participants responded on a 5-point Likert scale from 1 (*Not at all satisfied*) to 5 (*Completely*), with higher values indicating more satisfaction with a given domain. For each domain, we looked at the baseline distribution of scores and created tertile groups that were as evenly sized as possible to examine potential threshold effects (see table footnotes for more details).

Covariates

We adjusted for a comprehensive set of covariates in the pre-baseline wave (t_0). Covariates included: 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, ≥ $100,000), total wealth (quintiles of total wealth in this sample), educational attainment (no degree, GED/high school diploma, ≥ college degree), employment status (yes/no), health insurance (yes/no), geographic region (Northeast, Midwest, South, West), religious service attendance (none, < 1x/week, ≥ 1x/week), personality (openness, conscientiousness, extraversion, agreeableness, neuroticism; continuous), and childhood abuse (yes/no). We also adjusted for individual domains of life satisfaction and all outcome variables (except for overall life satisfaction) in the pre-baseline wave.

Outcomes

We evaluated 35 outcomes in the outcome wave (t_2), including measures of: physical health (all-cause mortality (see Online Text 3), number of chronic conditions, diabetes, hypertension, stroke, cancer, heart disease, lung disease, arthritis, overweight/obesity, physical functioning limitations, cognitive impairment, chronic pain, self-rated health), health behaviors (heavy drinking, smoking, physical activity, sleep problems), psychological well-being (positive affect, life satisfaction, optimism, purpose in life, mastery, health mastery, financial mastery), psychological distress (depression, depressive symptoms, hopelessness, negative affect, perceived constraints), and social factors (loneliness, living with a spouse/partner, frequency of contact with (1) children, (2) other family, and (3) friends). Online Text 1 and

HRS materials provide further details about each of these variables [28–30].

Statistical analysis

The outcome-wide analytic approach we used in this study uses several analytic decisions not widely used outside of biostatistics and causal inference, thus we summarize these decisions here [26]. First, it remains unknown if covariates are confounders or mediators if covariates are assessed at the same timepoint as the exposure (t_1) [26]. Thus, to reduce this concern and allow for a comprehensive set of covariates to address confounding, we adjusted for covariates in the pre-baseline wave (t_0). Second, we adjusted for all outcome variables (except for overall life satisfaction, as it was replaced with each individual domain of life satisfaction) in the pre-baseline wave (t_0) to reduce the likelihood of reverse causality. Third, to evaluate "*changes*" in life satisfaction domains, we adjusted for life satisfaction domains in the pre-baseline wave (t_0). This helps "hold constant" pre-baseline levels of life satisfaction. Participants who start in the highest life satisfaction tertile in the pre-baseline wave (t_0) and remain there in the baseline wave (t_1) contribute to the final estimate. However, this estimate also corresponds to participants who start in the lowest life satisfaction tertile in the pre-baseline wave and move to the highest life satisfaction tertile in the baseline wave. The model effectively assumes that there is no interaction between past and current life satisfaction (i.e., the highest life satisfaction tertile coefficient is constant across past life satisfaction levels). Thus, we can evaluate how *change*s in life satisfaction (between t_0 and t_1) are associated with later health and well-being outcomes in the outcome wave (at t_2: see Online Text 2). Adjusting for pre-baseline life satisfaction (t_0) has several other advantages. First, it reduces risk of reverse causality by "removing" the potential accumulating effects that life satisfaction might have had on health and well-being outcomes in the past (prevalent exposure). Second, it allows us to focus on how *changes* in life satisfaction (incident exposure) affect outcomes. Therefore, there is a focus on how changes in life satisfaction are associated with short-term changes in health and well-being outcomes. This approach was not used for one domain (satisfaction with health), because the current state of life may immediately affect one's satisfaction with their health, and thus, simultaneous covariate adjustment at baseline (rather than pre-baseline covariate adjustment) is more appropriate.

We ran separate models depending on the nature of each outcome: (1) logistic regression for each binary outcome with a prevalence < 10%, (2) generalized linear models (with a log link and Poisson distribution) for each binary outcome with a prevalence ≥ 10%, or (3) linear regression for each continuous outcome. We standardized all continuous outcomes (mean = 0, standard deviation = 1) so their effect sizes can be interpreted as a standard deviation change in the outcome variable. Practices for multiple testing vary widely and are continuously and rapidly evolving; thus, we marked several p-value cutoffs in our tables [31]. Analyses were conducted in STATA 16.1.

Additional analyses

We conducted several additional analyses. (1) We conducted E-value analyses. *E* values allow us to evaluate the robustness of our results to unmeasured confounding by assessing the minimum strength that unmeasured confounding must have on the risk ratio scale (with both the exposure and the outcome) to entirely explain away the association between the exposure and outcome [32]. (2) We re-analyzed all models using a reduced list of conventional covariates (only sociodemographic factors) in the pre-baseline wave. This approach (i.e., not adjusting for prior life satisfaction) assesses the potential cumulative effects that the whole history of life satisfaction has on outcomes. (3) We re-analyzed models after removing people with a history of a given physical condition at baseline. (4) We calculated correlations between individual domains of life satisfaction.

Multiple imputation

Five data sets were created via imputation by chained equations, and all missing exposures, covariates, and outcomes were imputed. This method provides a more flexible approach than other methods of handling missing data [33] and addresses problems that arise from attrition [34, 35].

Results

In the pre-baseline wave (t_0), participants were on average 65 years old (SD = 10), predominantly women (59%) and currently married (63%). Table 1 provides the distribution of covariates by overall life satisfaction. Online Table 1 describes the *changes* in each domain of life satisfaction from the pre-baseline wave (t_0) to the baseline wave (t_1).

Table 2 shows the associations between the highest (versus lowest) tertile of each domain of life satisfaction and all outcome variables. Over the four-year follow-up period, when assessing physical health outcomes, satisfaction with health was the only domain associated with subsequent mortality: those in the highest (versus lowest) tertile of satisfaction with health had a 21% decreased risk of mortality (95% CI 0.66, 0.95). Higher satisfaction with financial situation and health were associated with fewer total physical chronic conditions (*β* for these domains ranged from: -0.05 to -0.06), and higher satisfaction with

Table 1 Characteristics of participants at pre-baseline by categories of satisfaction with overall life (N=10,442)

Participant characteristics	Overall life satisfaction					
	Tertile 1 (n=809)		Tertile 2 (n=3,046)		Tertile 3 (n=6,587)	
	No. (%)	Mean (SD)	No. (%)	Mean (SD)	No. (%)	Mean (SD)
Sociodemographic factors						
Age (year; range: 48–96)		63.7 (9.1)		66.5 (9.6)		67.5 (9.4)
Female (%)	524 (64.8)		1890 (62.1)		3869 (58.7)	
Race/ethnicity (%)						
White	518 (64.0)		2117 (69.5)		5241 (79.6)	
Black	154 (19.0)		525 (17.2)		710 (10.8)	
Hispanic	116 (14.3)		316 (10.4)		485 (7.4)	
Other	21 (2.6)		87 (2.9)		149 (2.3)	
Married (%)	366 (45.2)		1760 (57.8)		4573 (69.4)	
Annual household income (%)						
< $50,000	619 (76.5)		1926 (63.2)		3299 (50.1)	
$50,000–$74,999	97 (12.0)		466 (15.3)		1136 (17.3)	
$75,000–$99,999	52 (6.4)		261 (8.6)		713 (10.8)	
≥ $100,000	41 (5.1)		393 (12.9)		1439 (21.9)	
Total wealth (%)						
1st quintile	353 (43.6)		747 (24.5)		827 (12.6)	
2nd quintile	184 (22.7)		740 (24.3)		1111 (16.9)	
3rd quintile	132 (16.3)		619 (20.3)		1364 (20.7)	
4th quintile	89 (11.0)		546 (17.9)		1530 (23.2)	
5th quintile	51 (6.3)		394 (12.9)		1755 (26.6)	
Education (%)						
< High school	195 (24.2)		555 (18.3)		851 (13.0)	
High school	462 (57.3)		1777 (58.5)		3542 (53.9)	
≥ College	150 (18.6)		707 (23.3)		2175 (33.1)	
Employed (%)	301 (37.2)		1272 (41.8)		2844 (43.2)	
Health insurance (%)	683 (84.5)		2794 (91.8)		6299 (95.7)	
Geographic region (%)						
Northeast	143 (17.7)		437 (14.4)		935 (14.2)	
Midwest	186 (23.1)		790 (26.0)		1775 (27.0)	
South	318 (39.4)		1218 (40.1)		2572 (39.1)	
West	160 (19.8)		596 (19.6)		1300 (19.8)	
Childhood abuse (%)	143 (17.8)		265 (8.8)		389 (6.0)	
Physical health						
Diabetes (%)	230 (28.5)		729 (24.0)		1068 (16.2)	
Hypertension (%)	517 (64.2)		1802 (59.2)		3514 (53.4)	
Stroke (%)	86 (10.6)		197 (6.5)		337 (5.1)	
Cancer (%)	100 (12.4)		427 (14.1)		904 (13.7)	
Heart disease (%)	252 (31.2)		712 (23.4)		1217 (18.5)	
Lung disease (%)	139 (17.2)		308 (10.1)		387 (5.9)	
Arthritis (%)	533 (65.9)		1923 (63.3)		3600 (54.7)	
Overweight/obesity (%)	623 (78.6)		2266 (75.2)		4630 (71.0)	
Physical function limitations (%)	409 (50.6)		864 (28.4)		778 (11.8)	
Cognitive impairment (%)	160 (20.0)		509 (16.9)		812 (12.5)	
Chronic pain (%)	510 (63.1)		1357 (44.6)		1779 (27.0)	
Self-rated health (range: 1–5)		2.3 (1.0)		2.9 (1.0)		3.6 (0.9)
Health behaviors						
Heavy drinking (%)	50 (7.8)		189 (7.8)		434 (8.0)	

Table 1 (continued)

Participant characteristics	Overall life satisfaction					
	Tertile 1 ($n=809$)		Tertile 2 ($n=3{,}046$)		Tertile 3 ($n=6{,}587$)	
	No. (%)	Mean (SD)	No. (%)	Mean (SD)	No. (%)	Mean (SD)
Smoking (%)	191 (23.7)		473 (15.7)		636 (9.7)	
Frequent physical activity (%)	454 (56.3)		2054 (67.5)		5237 (79.6)	
Sleep problems (%)	318 (64.4)		811 (45.7)		1223 (34.4)	
Religious service attendance (%)						
Never	305 (37.7)		836 (27.5)		1436 (21.8)	
< 1x/week	265 (32.8)		1023 (33.6)		2065 (31.4)	
≥ 1x/week	239 (29.5)		1184 (38.9)		3082 (46.8)	
Psychological well-being						
Positive affect (range: 1–5)		2.7 (0.7)		3.2 (0.7)		3.9 (0.7)
Life satisfaction (range: 1–7)		2.8 (1.4)		4.2 (1.3)		5.6 (1.2)
Optimism (range: 1–6)		3.5 (1.0)		4.2 (0.9)		4.8 (0.9)
Purpose in life (range: 1–6)		3.8 (1.0)		4.4 (0.9)		5.0 (0.8)
Mastery (range: 1–6)		3.9 (1.2)		4.5 (1.0)		5.1 (1.0)
Health mastery (range: 1–10)		5.3 (2.9)		6.7 (2.3)		8.0 (1.9)
Financial mastery (range: 1–10)		4.7 (3.3)		6.5 (2.6)		7.9 (2.1)
Psychological distress						
Depression (%)	427 (52.8)		582 (19.1)		335 (5.1)	
Depressive symptoms (range: 0–8)		3.9 (2.6)		1.8 (2.0)		0.7 (1.2)
Hopelessness (range: 1–6)		3.7 (1.3)		2.7 (1.2)		1.9 (1.0)
Negative affect (range: 1–5)		2.6 (0.8)		1.9 (0.6)		1.5 (0.5)
Perceived constraints (range: 1–6)		3.4 (1.3)		2.5 (1.1)		1.8 (1.0)
Social factors						
Loneliness (range: 1–3)		2.1 (0.6)		1.6 (0.5)		1.3 (0.4)
Not living with spouse/partner (%)	388 (51.0)		1123 (38.5)		1713 (26.9)	
Contact children < 1x/week (%)	259 (33.1)		847 (28.6)		1499 (23.2)	
Contact other family < 1x/week (%)	393 (49.2)		1381 (46.1)		2900 (44.6)	
Contact friends < 1x/week (%)	368 (45.9)		1092 (36.4)		2015 (30.9)	
Personality						
Openness (range: 1–4)		2.7 (0.6)		2.8 (0.5)		3.0 (0.5)
Conscientiousness (range: 1–4)		3.2 (0.5)		3.3 (0.5)		3.5 (0.4)
Extraversion (range: 1–4)		2.8 (0.6)		3.0 (0.5)		3.3 (0.5)
Agreeableness (range: 1–4)		3.4 (0.5)		3.4 (0.5)		3.6 (0.4)
Neuroticism (range: 1–4)		2.6 (0.7)		2.2 (0.6)		1.9 (0.5)

This table was created based on non-imputed data

All variables in Table 1 were used as covariates, and assessed in the pre-baseline wave (t_0; 2008/2010)

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

income was associated with a 16% decreased risk of stroke (95% CI 0.71, 1.00). This was the only domain of life satisfaction to be associated with a specific chronic condition. Higher satisfaction with daily life and leisure activities, financial situation, income, and health were associated with decreased risk of physical functioning limitations (14%-21%), and higher satisfaction in all domains, except for satisfaction with city/town, was associated with a decreased risk of chronic pain (8%-14%) All domains were positively associated with self-rated health four years later (β: 0.12 to 0.32). There was less evidence of associations between life satisfaction domains and several other physical health outcomes (e.g., cancer; Table 2).

There was also little evidence of associations between life satisfaction domains and most health behaviors (e.g., smoking and physical activity). However, we observed associations between increased satisfaction with financial situation and an 11% decreased risk of sleep problems (95% CI 0.80,

Table 2 Satisfaction with individual domains of life and subsequent health and well-being (Health and Retirement Study [HRS]: N=13,752)

	Domain of Life Satisfaction							
	Tertile 1 (reference)	Tertile 3 Home (n=5,449) RR/OR/β (95% CI)	Tertile 3 City/town (n=5,129) RR/OR/β (95% CI)	Tertile 3 Daily life and leisure (n=3,540) RR/OR/β (95% CI)	Tertile 3 Family (n=4,656) RR/OR/β (95% CI)	Tertile 3 Financial situation (n=6,162) RR/OR/β (95% CI)	Tertile 3 Income (n=5,870) RR/OR/β (95% CI)	Tertile 3 Health (n=5,876) RR/OR/β (95% CI)
Physical health								
All-cause mortality	1.00	0.97 (0.82, 1.14)	1.05 (0.89, 1.23)	0.87 (0.75, 1.02)	1.05 (0.89, 1.23)	1.01 (0.85, 1.21)	0.95 (0.80, 1.13)	0.79 (0.66, 0.95)*
Number of chronic conditions	0.00	−0.02 (−0.06, 0.01)	0.00 (−0.04, 0.03)	−0.02 (−0.05, 0.02)	−0.01 (−0.04, 0.03)	−0.06 (−0.11, 0.00)*	−0.05 (−0.11, 0.00)	−0.05 (−0.08, −0.02)**
Diabetes	1.00	0.99 (0.90, 1.09)	1.01 (0.92, 1.12)	0.99 (0.89, 1.11)	0.97 (0.88, 1.07)	0.92 (0.83, 1.02)	0.95 (0.85, 1.06)	0.93 (0.84, 1.04)
Hypertension	1.00	0.98 (0.92, 1.04)	0.99 (0.92, 1.05)	1.00 (0.94, 1.06)	0.99 (0.93, 1.06)	0.97 (0.91, 1.04)	0.98 (0.91, 1.05)	0.99 (0.92, 1.07)
Stroke	1.00	0.94 (0.79, 1.10)	1.03 (0.87, 1.22)	0.98 (0.83, 1.17)	1.02 (0.87, 1.21)	0.92 (0.73, 1.15)	0.84 (0.71, 1.00)*	1.00 (0.82, 1.22)
Cancer	1.00	1.04 (0.90, 1.19)	0.94 (0.84, 1.06)	0.96 (0.85, 1.08)	0.99 (0.88, 1.12)	0.98 (0.85, 1.12)	0.97 (0.83, 1.12)	0.96 (0.83, 1.11)
Heart disease	1.00	0.98 (0.88, 1.08)	1.02 (0.92, 1.12)	1.00 (0.91, 1.10)	0.98 (0.90, 1.08)	0.93 (0.83, 1.05)	0.92 (0.82, 1.03)	0.91 (0.82, 1.02)
Lung disease	1.00	1.05 (0.91, 1.22)	1.13 (0.98, 1.31)	1.05 (0.91, 1.21)	1.05 (0.91, 1.21)	0.99 (0.85, 1.15)	1.01 (0.87, 1.18)	0.98 (0.83, 1.16)
Arthritis	1.00	0.97 (0.91, 1.04)	0.99 (0.93, 1.05)	0.98 (0.92, 1.04)	0.98 (0.92, 1.05)	0.98 (0.92, 1.05)	0.99 (0.92, 1.06)	0.98 (0.91, 1.06)
Overweight/obesity	1.00	0.98 (0.92, 1.05)	0.98 (0.92, 1.04)	0.99 (0.93, 1.06)	1.02 (0.95, 1.08)	0.98 (0.91, 1.05)	1.00 (0.94, 1.07)	1.01 (0.94, 1.09)
Physical functioning limitations	1.00	0.93 (0.84, 1.03)	0.95 (0.86, 1.06)	0.86 (0.76, 0.98)*	0.91 (0.82, 1.00)	0.79 (0.70, 0.90)***	0.80 (0.69, 0.92)**	0.82 (0.72, 0.94)**
Cognitive impairment	1.00	1.07 (0.96, 1.20)	1.03 (0.91, 1.16)	0.99 (0.87, 1.12)	1.06 (0.95, 1.17)	0.94 (0.83, 1.06)	0.95 (0.85, 1.06)	1.05 (0.91, 1.23)
Chronic pain	1.00	0.92 (0.85, 1.00)*	0.94 (0.86, 1.03)	0.86 (0.79, 0.94)***	0.91 (0.84, 0.99)*	0.87 (0.78, 0.96)**	0.86 (0.78, 0.96)**	0.87 (0.79, 0.96)**
Self-rated health	0.00	0.14 (0.09, 0.18)***	0.12 (0.08, 0.17)***	0.21 (0.17, 0.25)***	0.13 (0.09, 0.17)***	0.19 (0.14, 0.25)***	0.19 (0.12, 0.26)***	0.32 (0.25, 0.39)***
Health behaviors								
Heavy drinking	1.00	1.40 (0.95, 2.07)	1.29 (0.92, 1.81)	1.15 (0.87, 1.51)	1.16 (0.89, 1.52)	1.49 (1.01, 2.21)*	1.41 (0.83, 2.39)	0.93 (0.67, 1.30)
Smoking	1.00	0.96 (0.82, 1.13)	1.06 (0.89, 1.27)	0.95 (0.80, 1.12)	0.93 (0.79, 1.11)	0.90 (0.72, 1.12)	0.97 (0.79, 1.20)	1.05 (0.85, 1.30)
Frequent physical activity	1.00	1.00 (0.94, 1.07)	1.01 (0.94, 1.08)	1.03 (0.96, 1.10)	0.98 (0.91, 1.05)	1.01 (0.93, 1.09)	1.01 (0.93, 1.09)	1.07 (0.98, 1.17)
Sleep problems	1.00	1.05 (0.95, 1.15)	0.98 (0.90, 1.07)	0.91 (0.81, 1.03)	0.93 (0.85, 1.03)	0.89 (0.80, 0.98)*	0.89 (0.79, 1.01)	0.96 (0.86, 1.06)
Psychological well-being								
Positive affect	0.00	0.20 (0.15, 0.24)***	0.20 (0.14, 0.25)***	0.37 (0.30, 0.43)***	0.33 (0.26, 0.40)***	0.29 (0.20, 0.38)***	0.24 (0.17, 0.31)***	0.04 (−0.01, 0.10)
Life satisfaction	0.00	0.35 (0.28, 0.42)***	0.30 (0.19, 0.40)***	0.49 (0.44, 0.55)***	0.51 (0.46, 0.56)***	0.54 (0.45, 0.62)***	0.50 (0.42, 0.58)***	0.34 (0.28, 0.41)***
Optimism	0.00	0.08 (0.03, 0.13)**	0.08 (0.02, 0.14)*	0.16 (0.12, 0.20)***	0.18 (0.13, 0.23)***	0.18 (0.11, 0.25)***	0.17 (0.11, 0.23)***	−0.05 (−0.13, 0.02)
Purpose in life	0.00	0.09 (0.03, 0.16)*	0.10 (0.03, 0.17)**	0.26 (0.21, 0.31)***	0.22 (0.15, 0.28)***	0.20 (0.14, 0.27)***	0.18 (0.12, 0.24)***	−0.01 (−0.06, 0.04)

Table 2 (continued)

	Domain of Life Satisfaction							
	Tertile 1 (reference)	Tertile 3 Home (n=5,449) RR/OR/β (95% CI)	Tertile 3 City/town (n=5,129) RR/OR/β (95% CI)	Tertile 3 Daily life and leisure (n=3,540) RR/OR/β (95% CI)	Tertile 3 Family (n=4,656) RR/OR/β (95% CI)	Tertile 3 Financial situation (n=6,162) RR/OR/β (95% CI)	Tertile 3 Income (n=5,870) RR/OR/β (95% CI)	Tertile 3 Health (n=5,876) RR/OR/β (95% CI)
Mastery	0.00	0.15 (0.09, 0.22)***	0.15 (0.10, 0.20)***	0.28 (0.22, 0.34)***	0.21 (0.16, 0.26)***	0.24 (0.17, 0.30)***	0.22 (0.15, 0.29)***	0.12 (0.06, 0.19)***
Health mastery	0.00	0.14 (0.08, 0.20)***	0.14 (0.09, 0.18)***	0.19 (0.10, 0.28)***	0.10 (0.04, 0.17)**	0.18 (0.12, 0.25)***	0.23 (0.16, 0.31)***	0.25 (0.17, 0.32)***
Financial mastery	0.00	0.19 (0.09, 0.29)**	0.19 (0.11, 0.27)***	0.26 (0.20, 0.33)***	0.19 (0.11, 0.27)***	0.48 (0.37, 0.58)***	0.45 (0.38, 0.53)***	0.11 (0.04, 0.18)**
Psychological distress								
Depression	1.00	0.73 (0.63, 0.85)***	0.76 (0.65, 0.89)***	0.54 (0.44, 0.66)***	0.56 (0.48, 0.66)***	0.61 (0.51, 0.72)***	0.62 (0.53, 0.73)***	0.78 (0.65, 0.93)**
Depressive symptoms	0.00	−0.15 (−0.19, −0.11)***	−0.13 (−0.19, −0.08)***	−0.27 (−0.33, −0.21)***	−0.27 (−0.34, −0.20)***	−0.26 (−0.31, −0.20)***	−0.23 (−0.28, −0.19)***	−0.06 (−0.11, −0.01)*
Hopelessness	0.00	−0.14 (−0.19, −0.09)***	−0.14 (−0.19, −0.08)***	−0.21 (−0.26, −0.16)***	−0.23 (−0.28, −0.18)***	−0.29 (−0.35, −0.23)***	−0.25 (−0.30, −0.19)***	−0.02 (−0.07, 0.04)
Negative affect	0.00	−0.19 (−0.25, −0.13)***	−0.18 (−0.23, −0.13)***	−0.33 (−0.38, −0.28)***	−0.32 (−0.40, −0.24)***	−0.32 (−0.44, −0.21)***	−0.29 (−0.37, −0.22)***	−0.05 (−0.10, 0.00)
Perceived constraints	0.00	−0.15 (−0.26, −0.05)*	−0.11 (−0.19, −0.03)*	−0.24 (−0.30, −0.19)***	−0.20 (−0.26, −0.15)***	−0.27 (−0.38, −0.16)***	−0.21 (−0.27, −0.14)***	−0.01 (−0.08, 0.06)
Social factors								
Loneliness	0.00	−0.16 (−0.24, −0.08)***	−0.19 (−0.26, −0.11)***	−0.35 (−0.40, −0.30)***	−0.42 (−0.47, −0.37)***	−0.31 (−0.37, −0.24)***	−0.26 (−0.33, −0.19)***	0.01 (−0.04, 0.07)
Not living with a spouse/partner	1.00	0.92 (0.85, 1.00)*	0.96 (0.88, 1.04)	0.85 (0.78, 0.92)***	0.82 (0.76, 0.89)***	0.92 (0.84, 1.01)	0.92 (0.84, 1.01)	0.99 (0.89, 1.09)
Contact children <1x/week	1.00	1.02 (0.87, 1.21)	1.02 (0.86, 1.21)	0.96 (0.83, 1.12)	0.85 (0.74, 0.97)*	1.00 (0.84, 1.18)	1.03 (0.88, 1.20)	1.00 (0.88, 1.13)
Contact other family <1x/week	1.00	1.01 (0.91, 1.12)	1.06 (0.96, 1.17)	1.03 (0.95, 1.12)	0.94 (0.86, 1.02)	1.02 (0.94, 1.11)	1.02 (0.94, 1.11)	0.97 (0.88, 1.08)
Contact friends <1x/week	1.00	1.03 (0.94, 1.12)	0.96 (0.88, 1.05)	0.96 (0.87, 1.06)	1.08 (0.97, 1.21)	0.98 (0.88, 1.09)	0.96 (0.87, 1.05)	1.03 (0.92, 1.16)

CI confidence interval, *OR* odds ratio, *RR* risk ratio

If the reference value is "1," the effect estimate is OR or RR; if the reference value is "0," the effect estimate is β

The analytic sample was restricted to those who had participated in the baseline wave (t_1; 2012 or 2014). Multiple imputation was performed to impute missing data on the exposure, covariates, and outcomes. For the first six domains of life satisfaction (home, city/town, daily life/leisure activities, family, financial situation, and income), all models controlled for pre-baseline sociodemographic characteristics, outcome variables, and the exposure. For the last domain of life satisfaction (satisfaction with health), all models controlled for baseline sociodemographic characteristics and outcome variables

*$p < 0.05$ before Bonferroni correction; **$p < 0.01$ before Bonferroni correction; ***$p < 0.05$ after Bonferroni correction; ***$p < 0.05$ before Bonferroni correction (the p value cutoff for Bonferroni correction is $p = 0.05/35$ outcomes = $p < 0.001$)

0.98) and a 49% increased risk of heavy drinking (95% CI 1.01, 2.21; Table 2).

For psychological factors, participants in the highest (versus lowest) tertile of all satisfaction domains except for health had better outcomes across all psychological well-being (e.g., purpose in life) and psychological distress (e.g., depressive symptoms) indicators. In contrast, satisfaction with health only showed associations with some psychological factors (e.g., mastery, depression), but not others (e.g., optimism, purpose in life, hopelessness). Some domains of life satisfaction were related to psychological factors much more strongly than other domains. Importantly, satisfaction with family life and non-work activities show the largest associations with subsequent psychological factors, followed by satisfaction with financial situation and income. For example, some effect estimates were double in magnitude for certain domains of life satisfaction: the association between satisfaction with family life and purpose in life ($\beta = 0.22$, 95% CI 0.15, 0.28) was more than twice as large as the association between satisfaction with housing and purpose in life ($\beta = 0.09$, 95% CI 0.03, 0.16; Table 2).

Lastly, when assessing social outcomes, all domains except for health were associated with loneliness, such that participants with higher domain-specific life satisfaction were less lonely 4 years later (β: -0.16 to -0.42). Only one domain was associated with increased contact: those with higher satisfaction with family life had a 15% decreased risk of infrequent contact with children (95% CI 0.74, 0.97; Table 2). See Online Tables 2a-g for associations between all tertiles of each domain of life satisfaction and all outcome variables.

Additional analyses

First, E values suggested that many of the observed associations were moderately robust to unmeasured confounding (Table 3). Second, estimates were generally larger when only adjusting for conventional covariates, and estimates were generally larger after removing participants with histories of a given physical condition at baseline (Online Tables 3a-g). Third, individual domains of life satisfaction showed medium to high correlations with other domains of life satisfaction (Online Table 4).

Discussion

In a large, longitudinal, and nationally representative sample of U.S. adults aged > 50, changes in individual domains of life satisfaction were differentially associated with physical, behavioral, and psychosocial health and well-being four years later. These results remained after adjusting for a wide range of covariates, individual domains of life satisfaction,

and the outcomes in the prior wave. To focus analyses as exclusively as possible on the effects of the domains of life satisfaction, we adjusted for many potential confounders to remove variance that is common to subjective well-being indicators (e.g., adjusting for personality factors, like extraversion and neuroticism, as well as positive affect and negative affect).

Intervening on most domains of life satisfaction may improve subsequent psychological well-being and decrease subsequent psychological distress; however, some domains of satisfaction show much larger associations with psychological outcomes than others. If policymakers wish to impact specific physical health outcomes (e.g., stroke), some domains of life satisfaction (e.g., satisfaction with income) may be more important to intervene upon than others (e.g., satisfaction with city/town). Specifically, satisfaction with family life and non-work activities show the largest associations with psychological factors, followed by satisfaction with financial situation and income. These results help us better understand whether and which domains of life satisfaction might be novel targets for interventions and policies seeking to enhance specific aspects of health and well-being.

The results from this study were somewhat consistent with prior studies in both the United States and elsewhere. Similar to most previous studies, we found associations between individual domains of life satisfaction and various indicators of psychological well-being and distress [16, 19–22] as well as null associations between some domains and physical health outcomes (e.g., income satisfaction and mortality) [36]. However, in contrast to previous studies, we did not find associations between some life satisfaction domains and physical health outcomes or health behaviors (e.g., our findings differ from previous studies in which financial satisfaction was associated with higher body-mass index and smoking) [18]. There are several potential reasons for these discrepancies: (1) Most notably, we assessed changes in domains of life satisfaction by adjusting for pre-baseline life satisfaction (rather than absolute levels of satisfaction), and we further adjusted for a robust range of covariates, and all outcome variables. This provides stronger evidence of causality and asks a different question than prior studies which may have accounted for differences in our results. (2) The domains of life satisfaction appear to be fairly stable, with about 48%-76% of people staying within the same tertile between pre-baseline and baseline waves across all domains. (3) We measured life satisfaction domains and outcome variables differently in our study (e.g., we assessed more domains simultaneously than prior studies).

It remains unclear what proportion of effects observed in our results are due to objective reality vs. perception of a domain. For some domains, we had the data to adjust for objective factors that influence specific domains of

Table 3 Robustness to unmeasured confounding (*E* values) for the associations between satisfaction with individual domains of life (3rd tertile vs. 1st tertile) and subsequent health and well-being (*N* = 13,752)

	Domain of life satisfaction						
	Tertile 3 Home (*n* = 5,449) RR/OR/β (95% CI)	Tertile 3 City/town (*n* = 5,129) RR/OR/β (95% CI)	Tertile 3 Daily life and leisure (*n* = 3,540) RR/OR/β (95% CI)	Tertile 3 Family (*n* = 4,656) RR/OR/β (95% CI)	Tertile 3 Financial situation (*n* = 6,162) RR/OR/β (95% CI)	Tertile 3 Income (*n* = 5,870) RR/OR/β (95% CI)	Tertile 3 Health (*n* = 5,876) RR/OR/β (95% CI)
Physical health							
All-cause mortality	1.23 (1.00)	1.26 (1.00)	1.56 (1.00)	1.27 (1.00)	1.12 (1.00)	1.29 (1.00)	1.84 (1.30)
Number of chronic conditions	1.17 (1.00)	1.06 (1.00)	1.13 (1.00)	1.09 (1.00)	1.29 (1.08)	1.27 (1.05)	1.26 (1.15)
Diabetes	1.11 (1.00)	1.12 (1.00)	1.09 (1.00)	1.20 (1.00)	1.39 (1.00)	1.29 (1.00)	1.35 (1.00)
Hypertension	1.17 (1.00)	1.14 (1.00)	1.06 (1.00)	1.12 (1.00)	1.20 (1.00)	1.18 (1.00)	1.09 (1.00)
Stroke	1.34 (1.00)	1.21 (1.00)	1.14 (1.00)	1.18 (1.00)	1.39 (1.00)	1.66 (1.04)	1.06 (1.00)
Cancer	1.23 (1.00)	1.31 (1.00)	1.26 (1.00)	1.10 (1.00)	1.17 (1.00)	1.23 (1.00)	1.25 (1.00)
Heart disease	1.19 (1.00)	1.15 (1.00)	1.03 (1.00)	1.14 (1.00)	1.35 (1.00)	1.39 (1.00)	1.42 (1.00)
Lung disease	1.29 (1.00)	1.52 (1.00)	1.27 (1.00)	1.27 (1.00)	1.10 (1.00)	1.12 (1.00)	1.15 (1.00)
Arthritis	1.20 (1.00)	1.12 (1.00)	1.18 (1.00)	1.17 (1.00)	1.15 (1.00)	1.12 (1.00)	1.14 (1.00)
Overweight/ obesity	1.14 (1.00)	1.17 (1.00)	1.10 (1.00)	1.15 (1.00)	1.16 (1.00)	1.04 (1.00)	1.10 (1.00)
Physical functioning limitations	1.37 (1.00)	1.27 (1.00)	1.59 (1.18)	1.44 (1.00)	1.83 (1.46)	1.82 (1.40)	1.73 (1.34)
Cognitive impairment	1.35 (1.00)	1.19 (1.00)	1.13 (1.00)	1.30 (1.00)	1.33 (1.00)	1.29 (1.00)	1.29 (1.00)
Chronic pain	1.39 (1.04)	1.32 (1.00)	1.59 (1.33)	1.42 (1.08)	1.58 (1.26)	1.59 (1.26)	1.57 (1.26)
Self-rated health	1.52 (1.40)	1.49 (1.35)	1.72 (1.61)	1.50 (1.38)	1.67 (1.53)	1.67 (1.50)	2.01 (1.83)
Health behaviors							
Heavy drinking	2.16 (1.00)	1.90 (1.00)	1.57 (1.00)	1.59 (1.00)	2.35 (1.10)	2.17 (1.00)	1.35 (1.00)
Smoking	1.25 (1.00)	1.31 (1.00)	1.29 (1.00)	1.35 (1.00)	1.48 (1.00)	1.19 (1.00)	1.29 (1.00)
Frequent physical activity	1.07 (1.00)	1.08 (1.00)	1.21 (1.00)	1.19 (1.00)	1.10 (1.00)	1.08 (1.00)	1.34 (1.00)
Sleep problems	1.26 (1.00)	1.14 (1.00)	1.42 (1.00)	1.34 (1.00)	1.50 (1.15)	1.49 (1.00)	1.27 (1.00)
Psychological well-being							
Positive affect	1.68 (1.57)	1.68 (1.54)	2.14 (1.97)	2.04 (1.87)	1.93 (1.73)	1.80 (1.64)	1.24 (1.00)
Life satisfaction	2.09 (1.91)	1.95 (1.71)	2.51 (2.36)	2.55 (2.41)	2.64 (2.41)	2.53 (2.31)	2.08 (1.91)
Optimism	1.36 (1.21)	1.37 (1.18)	1.58 (1.46)	1.63 (1.51)	1.64 (1.47)	1.61 (1.46)	1.00 (1.00)
Purpose in life	1.39 (1.20)	1.42 (1.24)	1.85 (1.73)	1.74 (1.58)	1.70 (1.54)	1.64 (1.49)	1.00 (1.00)
Mastery	1.57 (1.40)	1.56 (1.42)	1.90 (1.75)	1.72 (1.59)	1.78 (1.61)	1.74 (1.56)	1.48 (1.30)
Health mastery	1.53 (1.37)	1.52 (1.39)	1.66 (1.46)	1.43 (1.26)	1.64 (1.47)	1.78 (1.59)	1.81 (1.63)
Financial mastery	1.67 (1.44)	1.66 (1.46)	1.86 (1.70)	1.66 (1.47)	2.45 (2.19)	2.39 (2.19)	1.46 (1.26)
Psychological distress							
Depression	2.08 (1.64)	1.96 (1.50)	3.10 (2.39)	2.95 (2.38)	2.67 (2.11)	2.61 (2.09)	1.89 (1.36)
Depressive symptoms	1.56 (1.44)	1.51 (1.37)	1.87 (1.73)	1.88 (1.71)	1.84 (1.70)	1.78 (1.65)	1.30 (1.10)
Hopelessness	1.52 (1.39)	1.53 (1.38)	1.71 (1.59)	1.76 (1.64)	1.93 (1.77)	1.82 (1.67)	1.14 (1.00)
Negative affect	1.67 (1.52)	1.63 (1.50)	2.04 (1.90)	2.02 (1.83)	2.02 (1.77)	1.94 (1.76)	1.27 (1.01)

Table 3 (continued)

	Domain of life satisfaction						
	Tertile 3 Home (n = 5,449) RR/OR/β (95% CI)	Tertile 3 City/town (n = 5,129) RR/OR/β (95% CI)	Tertile 3 Daily life and leisure (n = 3,540) RR/OR/β (95% CI)	Tertile 3 Family (n = 4,656) RR/OR/β (95% CI)	Tertile 3 Financial situation (n = 6,162) RR/OR/β (95% CI)	Tertile 3 Income (n = 5,870) RR/OR/β (95% CI)	Tertile 3 Health (n = 5,876) RR/OR/β (95% CI)
Perceived constraints	1.57 (1.32)	1.45 (1.22)	1.80 (1.66)	1.69 (1.55)	1.88 (1.63)	1.71 (1.55)	1.09 (1.00)
Social factors							
Loneliness	1.58 (1.39)	1.65 (1.48)	2.09 (1.95)	2.30 (2.16)	1.97 (1.81)	1.84 (1.68)	1.00 (1.00)
Not living with a spouse/partner	1.39 (1.07)	1.26 (1.00)	1.63 (1.39)	1.73 (1.50)	1.40 (1.00)	1.40 (1.00)	1.13 (1.00)
Contact children < 1x/week	1.18 (1.00)	1.15 (1.00)	1.24 (1.00)	1.63 (1.19)	1.06 (1.00)	1.20 (1.00)	1.02 (1.00)
Contact other family < 1x/week	1.12 (1.00)	1.31 (1.00)	1.20 (1.00)	1.34 (1.00)	1.16 (1.00)	1.17 (1.00)	1.20 (1.00)
Contact friends < 1x/week	1.19 (1.00)	1.24 (1.00)	1.25 (1.00)	1.39 (1.00)	1.16 (1.00)	1.25 (1.00)	1.22 (1.00)

See VanderWeele and Ding [32] for the formula for calculating E values

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

The E values for the limit of the 95% confidence interval (CI) 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

satisfaction we evaluated (e.g., adjusting for income and wealth helps us more cleanly evaluate the influence of perceived satisfaction with finances), but the associations between some other domains of satisfaction (e.g., housing) and outcomes may reflect a combination of perceived and objective realities that we were unable to adjust for (e.g., quality of housing). This is a key nuance that future research should evaluate because prior research suggests satisfaction in some of the domains we evaluated can be increased [24, 25], and such interventions could be useful in specific circumstances. For example, prior work shows that regardless of absolute income, a person's *relative* deprivation in income compared to peers plays a role in health and well-being [37]. Thus, among people who are wealthy but displeased with their finances, intervening on perceptions of their financial satisfaction might improve their health and well-being. While for people who are poor, directly intervening on their finances may be a better approach for improving health and well-being.

Our findings have limitations. First, many physical health factors and health behaviors were self-reported, and thus may be susceptible to self-report bias. Future work

should objectively assess these factors. However, participants were blind to this study's hypotheses. Second, there is still the potential for confounding by third variables. We tried to attenuate this concern by adjusting for a robust array of covariates and the exposure and outcomes in the prior wave, conducting E-value analyses, and using a longitudinal design. The current study also featured several strengths, including the use of a large, diverse, prospective, and nationally representative sample of older adults. Further, our study design reduces concerns about simultaneity bias, reverse causation, and the endogenous nature of life satisfaction and potential confounders (e.g., health, socioeconomic status, etc.) by adjusting for pre-baseline values of: (1) all potential confounders, (2) all outcomes, (3) and our exposures (life satisfaction domains). While this does not eliminate the possibility of these biases, it considerably reduces them, and the E-value calculations provide an assessment of how strong remaining residual biases would have to be to alter results.

Stay at home orders may have generally decreased overall life satisfaction during the COVID-19 pandemic around the world [38]. However, the COVID-19 pandemic has likely

had different effects on individual domains of life satisfaction. For example, increased time spent at home may have amplified the effect of one's living conditions [39] (and thus satisfaction with their living conditions) on health and well-being outcomes. Similarly, increased time spent at home may have altered satisfaction in other domains (e.g., with family life and leisure activities), with large individual variability in responses to the changes brought on by the pandemic [40, 41]. In fact, some of the changes brought on by the pandemic may have actually increased satisfaction in some domains (e.g., improved satisfaction with family life) in certain sociodemographic contexts [40, 41]. Future studies should re-assess the associations we examined in this study, using data that were collected during COVID-19.

Nations around the world have historically focused on increasing economic growth. While this approach has provided many societal benefits, we now recognize the limits of economic growth as an indicator of national well-being. Thus, several countries have adopted well-being measures as metrics and decision-making tools to guide policy decisions, and several others are moving in this direction [9, 11, 42]. Emerging evidence indicates that life satisfaction is a key determinant of voting behavior [43]. Thus, considering how life satisfaction can be improved (and the effects of these changes) should be of interest to policy makers' election and re-election campaigns. As countries seek innovative and cost-effective methods of enhancing the health and well-being of rapidly aging populations, findings from our study suggest that some domains of life satisfaction have a substantially larger influence on health and well-being than others. For example, if looking to decrease depressive symptoms, increasing satisfaction with family life could potentially have an effect more than twice as large as the same increase in satisfaction with one's city or town. Further, looking broadly across all psychological well-being and distress outcomes, some domains (e.g., satisfaction with non-work activities, family life, financial situation, and income) have generally larger effect sizes than other domains (e.g., satisfaction with living conditions and city/town), suggesting that some domains may contribute more to subsequent psychological well-being than others. Our findings highlight a range of specific effects that we might expect to observe if interventions on individual domains of life satisfaction were developed and deployed at scale.

Declarations

References

1. United Nations, Department of Economic and Social Affairs, Population Division. (2020). *World Population Ageing 2019*. Retrieved February 25, 2021, from https://www.un.org/en/development/desa/population/publications/pdf/ageing/WorldPopulationAgeing2019-Report.pdf.

2. Federal Interagency Forum on Aging-Related Statistics. (2020). *Older Americans 2020: Key indicators of well-being*. Retrieved February 25, 2021, from https://www.agingstats.gov/docs/LatestReport/OA20_508_10142020.pdf.

3. Kubzansky, L. D., Huffman, J. C., Boehm, J. K., Hernandez, R., Kim, E. S., Koga, H. K., Feig, E. H., Lloyd-Hones, D. M., Seligman, M., & Labarthe, D. R. (2018). Positive psychological well-being and cardiovascular disease: JACC health promotion

series. *Journal of the American College of Cardiololgy, 72*(12), 1382–1396. https://doi.org/10.1016/j.jacc.2018.07.042

4. VanderWeele, T. J., Chen, Y., Long, K., Kim, E. S., Trudel-Fitzgerald, C., & Kubzansky, L. D. (2020). Positive epidemiology? *Epidemiology, 31*(2), 189–193. https://doi.org/10.1097/EDE.0000000000001147

5. VanderWeele, T. J. (2017). On the promotion of human flourishing. *Proceedings of the National Academy of Science of the United States of America, 114*(31), 8148–8156. https://doi.org/10.1073/pnas.1702996114

6. Diener, E., Emmons, R. A., Larsen, R. J., & Griffin, S. (1985). The Satisfaction With Life Scale. *Journal of Personality Assessment, 49*(1), 71–75. https://doi.org/10.1207/s15327752jpa4901_13

7. Bolier, L., Haverman, M., Westerhof, G. J., Riper, H., Smit, F., & Bohlmeijer, E. (2013). Positive psychology interventions: A meta-analysis of randomized controlled studies. *BMC Public Health.* https://doi.org/10.1186/1471-2458-13-119

8. Wiese, C. W., Kuykendall, L., & Tay, L. (2018). Get active? A meta-analysis of leisure-time physical activity and subjective well-being. *The Journal of Positive Psychology, 13*(1), 57–66. https://doi.org/10.1080/17439760.2017.1374436

9. The Global Council for Happiness and Wellbeing. (2019). *Global Happiness and Wellbeing Policy Report*. Sustainable Development Solutions Network. Retrieved February 25, 2021, from https://s3.amazonaws.com/ghwbpr-2019/UAE/GHWPR19.pdf.

10. Durand, M., & Exton, C. (2019). *Adopting a well-being approach in central government: Policy mechanisms and practical tools*. Global Happiness Wellbeing. Retrieved February 25, 2021, from https://s3.amazonaws.com/ghwbpr-2019/UAE/GH19_Ch8.pdf.

11. Stiglitz, J. E., Fitoussi, J.-P., & Durand, M. (2018). *Beyond GDP: Measuring what counts for economic and social performance*. OECD. https://doi.org/10.1787/9789264307292

12. Kim, E. S., Delaney, S. W., Tay, L., Chen, Y., & DienerVanderweele, E. T. J. (2021). Life satisfaction and subsequent physical, behavioral, and psychosocial health in older adults. *The Milbank Quarterly, 99*(1), 209–230. https://doi.org/10.1111/1468-0009.12497

13. van Stralen, M. M., De Vries, H., Mudde, A. N., Bolman, C., & Lechner, L. (2009). Determinants of initiation and maintenance of physical activity among older adults: A literature review. *Health Psychology Review., 3*(2), 147–207. https://doi.org/10.1080/17437190903229462

14. Uchino, B. N., Kent de Grey, R. G., Cronan, S., Smith, T. W., Diener, E., Samantha, J., & Bosch, J. (2018). Life satisfaction and inflammation in couples: An actor-partner analysis. *Journal of Behavioral Medicine, 41*(1), 22–30. https://doi.org/10.1007/s10865-017-9880-9

15. Campbell, A., Converse, P. E., & Rodgers, W. L. (1976). *The quality of American life: Perceptions, evaluations, and satisfactions*. Russell Sage Foundation. https://doi.org/10.7758/9781610441032

16. Medley, M. L. (1976). Satisfaction with life among persons sixty-five years and older: A causal model. *Journal of Gerontology, 31*(4), 448–455. https://doi.org/10.1093/geronj/31.4.448

17. Beutel, M. E., Glaesmer, H., Wiltink, J., Marian, H., & Brähler, E. (2010). Life satisfaction, anxiety, depression and resilience across the life span of men. *The Aging Male, 13*(1), 32–39. https://doi.org/10.3109/13685530903296698

18. Sahrakorpi, N., Koivusalo, S. B., Eriksson, J. G., Kautiainen, H., Stach-Lempinen, B., & Roine, R. P. (2017). Perceived financial satisfaction, health related quality of life and depressive symptoms in early pregnancy. *Maternal and Child Health Journal, 21*(7), 1493–1499.

19. Rautio, N., Kautiainen, H., Koponen, H., Mäntyselkä, P., Timonen, M., Niskanen, L., Saaristo, T., Oksa, H., Peltonen, M., Puolijoki, H., Vanhala, M., & Keinänen-Kiukaanniemi, S. (2013). Financial satisfaction and its relationship to depressive

symptoms in middle-aged and older adults: Results from the FIN-D2D survey. *International Journal of Social Psychiatry, 59*(3), 239–246. https://doi.org/10.1177/0020764011433635

20. Pearson, Q. M. (2008). Role overload, job satisfaction, leisure satisfaction, and psychological health among employed women. *Journal of Counseling and Development, 86*(1), 57–63. https://doi.org/10.1002/j.1556-6678.2008.tb00626.x

21. Kaufman, J. E. (1988). Leisure and anxiety: A study of retirees. *Activities, Adaptation & Aging, 11*(1), 1–10. https://doi.org/10.1300/J016v11n01_01

22. Ngamaba, K. H., Armitage, C., Panagioti, M., & Hodkinson, A. (2020). How closely related are financial satisfaction and subjective well-being? Systematic review and meta-analysis. *Journal of Behavioral and Experimental Economics, 85*, 101522. https://doi.org/10.1016/j.socec.2020.101522

23. Yilmaz, A. (2018). Burnout, job satisfaction, and anxiety-depression among family physicians: A cross-sectional study. *Journal of Family Medicine and Primary Care, 7*(5), 952–956. https://doi.org/10.4103/jfmpc.jfmpc_59_18

24. Kozlowski, A. (2013). Mindful mating: Exploring the connection between mindfulness and relationship satisfaction. *Sexual and Relationship Therapy, 28*(1–2), 92–104. https://doi.org/10.1080/14681994.2012.748889

25. Desrosiers, J., Noreau, L., Rochette, A., Carbonneau, H., Fontaine, L., Viscogliosi, C., & Bravo, G. (2007). Effect of a home leisure education program after stroke: A randomized controlled trial. *Archives of Physical Medicine and Rehabilitation, 88*(9), 1095–1100. https://doi.org/10.1016/j.apmr.2007.06.017

26. VanderWeele, T. J., Mathur, M. B., & Chen, Y. (2019). Outcome-wide longitudinal designs for causal inference: A new template for empirical studies. *Statistical Science.* https://doi.org/10.1214/19-sts728

27. Smith, J., Ryan, L., Fisher, G. G., Sonnega, A., & Weir, D. (2017). *HRS psychosocial and lifestyle questionnaire 2006–2016: Documentation report core section LB*. Health and Retirement Study. Retrieved April 27, 2021, from https://hrs.isr.umich.edu/sites/default/files/biblio/HRS%202006-2016%20SAQ%20Documentation_07.06.17_0.pdf.

28. Smith, J., Fisher, G., Ryan, L., Clarke, P., House, J., & Weir, D. (2013). *Psychosocial and lifestyle questionnaire 2006–2010: Documentation report*. Health and Retirement Study. Retrieved February 25, 2021, from https://hrs.isr.umich.edu/sites/default/files/biblio/HRS2006-2010SAQdoc.pdf.

29. Fisher, G. G., Faul, J. D., Weir, D. R., & Wallace, R. B. (2005). *Documentation of chronic disease measures in the Health and Retirement Study (HRS/AHEAD)*. Health and Retirement Study. Retrieved February 25, 2021, from https://hrs.isr.umich.edu/sites/default/files/biblio/dr-009.pdf.

30. Jenkins, K. R, Ofstedal, M. B., & Weir, D. (2008). *Documentation of health behaviors and risk factors measured in the Health and Retirement Study (HRS/AHEAD)*. Health and Retirement Study. Retrieved February 25, 2021, from https://hrs.isr.umich.edu/sites/default/files/biblio/dr-010.pdf.

31. VanderWeele, T. J., & Mathur, M. B. (2019). Some desirable properties of the Bonferroni correction: Is the Bonferroni correction really so bad? *American Journal of Epidemiology, 188*(3), 617–618. https://doi.org/10.1093/aje/kwy250

32. VanderWeele, T. J., & Ding, P. (2017). Sensitivity analysis in observational research: Introducing the E-Value. *Annals of Internal Medicine, 167*(4), 268–274. https://doi.org/10.7326/M16-2607

33. Groenwold, R. H., Donders, A. R., Roes, K. C., Harrell, F., & Moons, K. G. (2012). Dealing with missing outcome data in randomized trials and observational studies. *American Journal of Epidemiology, 175*(3), 210–217. https://doi.org/10.1093/aje/kwr302

34. Asendorpf, J. B., van de Schoot, R., Denissen, J. J., & Hutteman, R. (2014). Reducing bias due to systematic attrition in longitudinal studies: The benefits of multiple imputation. *International Journal of Behavioral Development, 38*(5), 453–460. https://doi.org/10.1177/0165025414542713

35. Harel, O., Mitchell, E. M., Perkins, N. J., Cole, S. R., Tchetgen, E. J., Sun, B., & Schisterman, E. F. (2018). Multiple imputation for incomplete data in epidemiologic studies. *American Journal of Epidemiology, 187*(3), 576–584. https://doi.org/10.1093/aje/kwx349

36. Miething, A. (2013). A matter of perception: Exploring the role of income satisfaction in the income–mortality relationship in German survey data 1995–2010. *Social Science & Medicine, 99*, 72–79. https://doi.org/10.1016/j.socscimed.2013.10.017

37. Subramanyam, M., Kawachi, I., Berkman, L., & Subramanian, S. V. (2009). Relative deprivation in income and self-rated health in the United States. *Social Science & Medicine, 69*(3), 327–334. https://doi.org/10.1016/j.socscimed.2009.06.008

38. Ammar, A., Chtourou, H., Boukhris, O., Trabelsi, K., Masmoudi, L., Brach, M., Bouaziz, B., Bentlage, E., How, D., Ahmed, M., Mueller, P., Mueller, N., Hsouna, H., Aloui, A., Hammouda, O., Paineiras-Domingos, L. L., Braakman-Jansen, A., Wrede, C., Bastoni, S., et al. (2020). Covid-19 home confinement negatively impacts social participation and life satisfaction: A worldwide multicenter study. *International Journal of Environmental Research and Public Health, 17*(17), 6237. https://doi.org/10.3390/ijerph17176237

39. Amerio, A., Brambilla, A., Morganti, A., Aguglia, A., Bianchi, D., Santi, F., Costantini, L., Odone, A., Costanza, A., Signorelli, C., Serafini, G., Amore, M., & Capolongo, S. (2020). COVID-19 lockdown: Housing built environment's effects on mental health. *International Journal of Environmental Research and Public Health, 17*(16), 5973. https://doi.org/10.3390/ijerph17165973

40. Williams, L., Rollins, L., Young, D., Fleming, L., Grealy, M., Janssen, X., Kirk, A., MacDonald, B., & Flowers, P. (2021). What have we learned about positive changes experienced during COVID-19 lockdown? Evidence of the social patterning of change. *PLoS ONE, 16*(1), e0244873–e0244873. https://doi.org/10.1371/journal.pone.0244873

41. Mikocka-Walus, A., Klas, A., Olive, L., Evans, S., Westrupp, E. M., Karantzas, G., & Sciberras, E. (2020). From "it has stopped our lives" to "spending more time together has strengthened bonds": The varied experiences of Australian families during COVID-19. *Frontiers in Psychology, 11*, 588667–588667. https://doi.org/10.3389/fpsyg.2020.588667

42. World Health Organization. (2013). Joint meeting of experts on targets and indicators for health and well-being in health 2020: Copenhagen, Denmark, 5–7 February 2013. *World Health Organization Regional Office for Europe*. Retrieved April 27, 2021, from https://apps.who.int/iris/bitstream/handle/10665/108621/e96819.pdf?sequence=1&isAllowed=y.

43. Ward, G. (2019). *Happiness and voting behaviour*. World Happiness Report. Retrieved February 25, 2021, from https://s3.amazonaws.com/happiness-report/2019/WHR19_Ch3.pdf.