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Original Scholarship

Life Satisfaction and Subsequent Physical, Behavioral, and Psychosocial Health in Older Adults

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Policy Points:

- Several intergovernmental organizations (Organisation for Economic Co-operation and Development, World Health Organization, United Nations) are urging countries to use well-being indicators (e.g., life satisfaction) in addition to traditional economic indicators when making important policy decisions.
- As the number of governments implementing this new approach grows, so does the need to continue evaluating the health and well-being outcomes we might observe from policies aimed at improving life satisfaction.
- The results of this study suggest that life satisfaction is a valuable target for policies aiming to enhance several indicators of psychosocial well-being, health behaviors, and physical health outcomes.

Context: Several intergovernmental organizations (Organisation for Economic Co-operation and Development, World Health Organization, United Nations) are urging countries to use well-being indicators (e.g., life satisfaction) in addition to traditional economic indicators when making important policy decisions. As the number of governments implementing this new approach grows, so does the need to continue evaluating the health and

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well-being outcomes we might observe from policies aimed at improving life satisfaction.

Methods: We evaluated whether positive change in life satisfaction (between t_0;2006/2008 and t_1;2010/2012) was associated with better outcomes on 35 indicators of physical, behavioral, and psychosocial health and well-being (in t_2;2014/2016). Data were from 12,998 participants in the University of Michigan's Health and Retirement Study—a prospective and nationally representative cohort of US adults over age 50.

Findings: Participants with the highest (versus lowest) life satisfaction had better subsequent outcomes on some physical health indicators (lower risk of pain, physical functioning limitations, and mortality; lower number of chronic conditions; and higher self-rated health) and health behaviors (lower risk of sleep problems and more frequent physical activity), and nearly all psychosocial indicators (higher positive affect, optimism, purpose in life, mastery, health mastery, financial mastery, and likelihood of living with spouse/partner; and lower depression, depressive symptoms, hopelessness, negative affect, perceived constraints, and loneliness) over the 4-year follow-up period. However, life satisfaction was not subsequently associated with many specific health conditions (i.e., diabetes, hypertension, stroke, cancer, heart disease, lung disease, arthritis, overweight/obesity, or cognitive impairment), other health behaviors (i.e., binge drinking or smoking), or frequency of contact with children, family, or friends.

Conclusions: These results suggest that life satisfaction is a valuable target for policies aiming to enhance several indicators of psychosocial well-being, health behaviors, and physical health outcomes.

Keywords: life satisfaction, psychological well-being, outcome-wide epidemiology, public health.

THREE FACTORS CONVERGE TO UNDERSCORE THE HEIGHTENED importance of evaluating the potential health and well-being effects of intervening on life satisfaction—a topic of growing interest among policymakers. First, several prominent intergovernmental organizations, including the Organisation for Economic Co-operation and Development, the World Health Organization, and the United Nations, are urging countries to use well-being indicators such as life satisfaction in addition to traditional economic indicators (e.g., gross domestic product) when making important policy decisions.[1–3] Many

countries are adopting this paradigm shift.[4,5] As the number of governments implementing this new approach grows, so does the need to continue evaluating the health and well-being outcomes we might observe from policies that aim to improve life satisfaction. Second, emerging evidence indicates that changing levels of life satisfaction is an important determinant of voting behavior.[6,7] Thus, it is in the interest of policymakers' election and reelection campaigns to consider how life satisfaction can be improved, as well as understanding the downstream effects of doing so. And third, populations are rapidly aging in many countries throughout the world.[8] For example, in the United States, the number of people aged 65 years or older is projected to increase nearly 50% in the next 15 years.[9] As populations age, identifying factors that foster health and well-being is critical for stemming the growing wave of chronic conditions and mounting health care costs.[10,11] Although traditional biomedical efforts have focused on identifying *risk factors* of disease, researchers and policymakers are increasingly seeking potentially modifiable *health assets* that uniquely enhance a person's ability to foster health and well-being.[10,12]

Life satisfaction, a person's evaluation of his or her own life based on factors that the person deems most relevant,[13] is one promising health asset. It is shaped by genetics, social structural factors, and changing life circumstances[3,14,15]; however, it is modifiable through a range of interventions that can be applied among individuals (e.g., therapy, online exercises, expressing gratitude, physical activity)[19,20] and across nations (e.g., policies targeting social determinants of health).[3,19,21,22]

Mounting research also observes that high life satisfaction is associated with better health outcomes, such as reduced risk of chronic disease (e.g., heart disease, diabetes)[23–25] and reduced mortality.[26] When considering the potential biobehavioral pathways through which life satisfaction might influence health outcomes, there are at least three to consider: (1) enhancement of other psychological and social resources that buffer against the toxic effects of overwhelming stress; (2) indirect effects through health behaviors, and (3) direct effects through biological pathways. Researchers have begun documenting these potential pathways, and growing work indicates that life satisfaction is associated with better health behaviors (e.g., increased physical activity, healthier diets, and higher use of preventive health services; lower levels of smoking and

alcohol misuse)[27–32] and healthier biologic function (e.g., more favorable inflammation levels [fibrinogen, c-reactive protein, interleukin-6] and less hypertension).[31,33–35]

These existing studies have been seminal and contributed substantially to the literature, but they remain limited from a causal inference point of view. First, many studies are cross-sectional, making it challenging to assess causality. Second, some studies use data from small and specific subpopulations (e.g., college students and patient groups), thus we do not know whether results generalize to older adults or healthy populations. Third, many studies do not account for important potential confounders such as depressive symptoms or baseline health. Fourth, most longitudinal studies have not controlled for life satisfaction in the pre-baseline wave (nor pre-baseline outcomes, and a range of other covariates), which allows researchers to ask a slightly different question—one that is particularly important in this era of translational research. What health and well-being outcomes might we observe within a relatively short time horizon (four-year follow-up) if life satisfaction were increased?

We evaluated a four-year follow-up period for several reasons. First is a very practical reason: most of our outcomes were assessed every four years. Second, many election cycles in the United States as well as in other nations occur approximately every four years; thus, it represents a reasonable window of time that a policymaker has to make positive change in order to be reelected. Our study illuminates what health and well-being outcomes we might expect to observe four years later if effective life satisfaction interventions and policies were implemented. Third, a four-year window is a reasonable amount of time in which life satisfaction could impact a variety of health and well-being outcomes.

In our research, we used a new *outcome-wide* analytic approach, which is described further in the statistical analysis section.[36] Using this approach, we tested whether changes in life satisfaction were associated with better subsequent health and well-being across 35 separate outcomes, including indicators of physical health, health behaviors, and psychosocial well-being. These outcomes were chosen because they are frequently included in the conceptualization of seminal gerontological models that characterize the antecedents, processes, and outcomes that foster people's ability to age well.[37–40]

Methods

Study Population

We used data from the University of Michigan Health and Retirement Study (HRS), a nationally representative panel study of adults over age 50. Starting in 2006, the HRS provided mail-in questionnaires to study participants and began assessing a range of psychosocial factors in a randomly selected 50% of HRS participants. The other 50% of HRS participants completed the questionnaire in the next wave, in 2008. Each subcohort alternates reporting so that each participant reports psychosocial data every four years. In 2006, the psychosocial questionnaire response rate was 88%, and in 2008 it was 84%.[41] To increase sample size and power, we combined data from both subcohorts.

Our study used data from three time points (t_0, t_1, t_2). All covariates were assessed in the pre-baseline wave (t_0;2006/2008). The exposure, life satisfaction, was assessed four years later in the baseline wave (t_1;2010/2012). Finally, all outcomes were assessed another four years later in the outcome wave (t_2;2014/2016). We restricted the sample to individuals who completed the psychosocial questionnaire at baseline because nearly half of our study outcomes were included in this psychosocial assessment, resulting in a final analytic sample size of 12,998.

The University of Michigan's Institute of Social Research is responsible for the study and provides extensive documentation about the protocol, instrumentation, sampling strategy, and statistical weighting procedures.[41–44] This study used de-identified and publicly available data; therefore, the Harvard T.H. Chan School of Public Health's Institutional Review Board exempted it from human subjects review.

Measures

Life Satisfaction. Life satisfaction was assessed using the Satisfaction with Life Scale, a measure with good discriminant and convergent validity, as well as good reliability.[13] On a seven-point Likert scale, respondents rated the degree to which they endorsed five items, such as, "In most ways my life is close to ideal." The mean of all items was taken to create a scale, with higher scores indicating higher life satisfaction (Cronbach $\alpha = 0.88$). To examine threshold effects, we created tertiles based on the baseline distribution of life satisfaction scores in the sample.

Covariates. All covariates were assessed in the pre-baseline wave (t_0;2006/2008) by self-report. Covariates included (1) demographics (age, sex, race/ethnicity [White, Black, Hispanic, Other]), (2) marital status (married/not married), (3) annual household income (<$50,000, $50,000-$74,999, $75,000-$99,999, ≥$100,000), (4) total wealth (quintiles of the score distribution in this sample), (5) educational attainment (no degree, GED/high school diploma, college degree or higher), (6) employment (yes/no), (7) health insurance (yes/no), (8) geographic region (Northeast, Midwest, South, West), (9) religious service attendance (none, less than once a week, one or more times per week), (10) personality (openness, conscientiousness, extraversion, agreeableness, neuroticism), and (11) childhood abuse (yes/no).

Outcomes. We considered 35 outcomes in 2014/2016 (t_2), including dimensions of physical health factors, health behaviors, psychological well-being, psychological distress, and social factors. Physical health factors included all-cause mortality, number of chronic conditions, diabetes, hypertension, stroke, cancer, lung disease, arthritis, overweight/obesity, physical functioning limitations, cognitive impairment, chronic pain, and self-rated health. Health behaviors encompassed binge drinking, smoking, physical activity, and sleep problems, while psychological well-being included positive affect, life satisfaction, optimism, purpose in life, mastery, health mastery, and financial mastery. Psychological distress comprised depression, depressive symptoms, hopelessness, negative affect, and perceived constraints; and social factors included loneliness, living with spouse/partner, and frequency of contact with children, other family, or friends—each assessed separately. The HRS guides and eText 1 provide further details about each assessment (see online Appendix).[41–44]

Statistical Analysis

We took an outcome-wide analytic approach,[36] which features several analytic decisions not widely used in disciplines outside of biostatistics and causal inference. Thus, we summarize these analytic decisions here. First, if covariates are assessed at the same time point as the exposure (t_1), it remains unclear if the covariates are confounders or mediators;[36] thus, we adjust for covariates in the pre-baseline wave (t_0), which helps reduce this worry and also allows for a very rich set of control variables to

address confounding. Second, we adjust for all outcome variables in the pre-baseline wave (t_0) in each model to reduce potential reverse causality. We also further adjust for a wide range of other covariates in order to adjust for potential confounding variables.[45] Third, to evaluate change in life satisfaction we adjust for life satisfaction in the pre-baseline wave (t_0). This helps us hold constant the pre-baseline levels of life satisfaction. Those who are in the highest life satisfaction tertile in the pre-baseline wave (t_0) and continue being in that group in the baseline wave (t_1) contribute to the final estimate. However, the estimate produced from this analysis also corresponds to people in our sample who were in the lowest life satisfaction tertile in t_0 and move to the highest life satisfaction tertile in t_1. The model effectively assumes that the coefficient for the highest life satisfaction tertile is constant across past life satisfaction levels (i.e., no interaction between past and current life satisfaction). Thus, based on the model, we are able to evaluate how change in life satisfaction (between t_0 and t_1) is associated with subsequent health and well-being outcomes (at t_2; see eText 2 in the online Appendix for further details). Controlling for pre-baseline life satisfaction levels (t_0) also has several other advantages, including helping reduce risk of reverse causality by removing the potential accumulating effects that life satisfaction might have already had on health and well-being outcomes in the past ("prevalent exposure"), and allowing us to instead focus on the effects of change in life satisfaction ("incident exposure") on outcomes. Further discussion and methodological detail are given elsewhere.[36]

We ran separate models for each outcome. Depending on the nature of the outcome, we ran (1) logistic regression models for binary outcomes with $<10\%$ prevalence; (2) generalized linear models (with a log link and Poisson distribution) for binary outcomes with $\geq 10\%$ prevalence; or (3) linear regression models for continuous outcomes. We standardized all continuous outcomes (mean = 0, standard deviation = 1) so their effect size can be interpreted as a standard deviation change in the outcome. In our tables, we marked multiple *p*-value cutoffs because practices for multiple testing vary widely and this is an active and evolving area of research.[46]

Additional Analyses. We ran several additional analyses. First, to evaluate the robustness of our results to unmeasured confounding, we conducted E-value analyses to assess the minimum strength of association (on the risk ratio scale) that an unmeasured confounder must have with both the exposure and the outcome to explain away the observed

association.[47] Second, to evaluate if any item of the Satisfaction with Life Scale was more strongly associated with outcomes, we sequentially evaluated each of the 5 items in relation to each of the 35 outcomes. If any item emerged as more strongly associated with outcomes, the content within that item might be a more important intervention target than other dimensions. Third, some research suggests that declining levels of life satisfaction exert a stronger effect on outcomes than increasing levels of life satisfaction.[48] Thus, we first reran analyses among only those study participants displaying increasing life satisfaction between t_0 and t_1. In a subsequent analysis, we reran analyses among only participants displaying decreasing life satisfaction between t_0 and t_1. In these analyses, the exposure was a difference score between t_0 and t_1. Fourth, while our primary analyses used multiple imputation to handle missing data, we reanalyzed all models using only complete cases. Fifth, to evaluate how our findings might compare to past research, we reanalyzed all models using a more conventional set of covariates (e.g., sociodemographics and depression, but no control for life satisfaction or outcomes, in the pre-baseline wave). This analytic approach asks a different question: What are the potential long-term cumulative effects that the whole history of life satisfaction (approximated by its current measure but not controlling for the past) has on outcomes? Sixth, we reanalyzed the main models but removed people who had any history of a given physical condition at baseline. Seventh, we reanalyzed the main models but treated life satisfaction as a continuous variable. To facilitate comparison of effect size across studies, we standardized the life satisfaction score (mean = 0, standard deviation = 1).

Multiple Imputation. We imputed all missing exposures, covariates, and outcomes using an imputation by chained equations approach and generated five data sets because it provides a potentially more accurate approach than other methods of handling missing data and helps address problems that arise due to attrition.[49–51]

Results

In the covariate wave (t_0;2006/2008), the average age of participants was 66 years old (standard deviation [SD] = 10) and they were predominantly women (59%), married (67%), and high school educated (55%). Table 1 provides the distribution of covariates by categories of

Table 1. Characteristics of Participants at Baseline by Tertiles of Life Satisfaction ($N = 12,432$)

Participant Characteristics	Life Satisfaction					
	Tertile 1 ($n = 4,424$)		Tertile 2 ($n = 4,131$)		Tertile 3 ($n = 3,877$)	
	%	Mean (SD)	%	Mean (SD)	%	Mean (SD)
Sociodemographic Factors						
Age (yr; range: 46-99)		65.3 (10.0)		66.8 (9.8)		67.2 (9.7)
Female	59.3		57.7		59.7	
Race/Ethnicity						
White	70.9		77.8		80.9	
Black	19.7		13.7		9.5	
Hispanic	6.5		6.1		6.9	
Other	2.9		2.4		2.6	
Married	58.8		67.3		74.7	
Annual household income						
<$50,000	62.1		55.6		47.0	
$50,000-$74,999	16.2		15.8		17.5	
$75,000-$99,999	8.9		10.8		11.3	
≥$100,000	12.9		17.8		24.2	

Continued

Table 1. *Continued*

Participant Characteristics	Life Satisfaction					
	Tertile 1 (n = 4,424)		Tertile 2 (n = 4,131)		Tertile 3 (n = 3,877)	
	%	Mean (SD)	%	Mean (SD)	%	Mean (SD)
Total wealth						
1st quintile	27.0		18.6		11.4	
2nd quintile	23.4		20.6		15.3	
3rd quintile	19.1		21.2		20.4	
4th quintile	17.7		20.2		23.3	
5th quintile	12.9		19.4		29.7	
Education						
Less than high school diploma	17.7		13.9		13.3	
High school diploma	58.6		56.1		51.0	
College degree or higher	23.8		30.0		35.7	
Employed	42.0		43.4		41.3	
Health insurance	93.7		96.2		96.6	
Geographic region						
Northeast	15.1		14.7		15.3	
Midwest	26.4		27.6		28.4	

Continued

Table 1. *Continued*

Participant Characteristics	Life Satisfaction					
	Tertile 1 (n = 4,424)		Tertile 2 (n = 4,131)		Tertile 3 (n = 3,877)	
	%	Mean (SD)	%	Mean (SD)	%	Mean (SD)
South	39.5		39.6		37.1	
West	19.0		18.2		19.2	
Childhood abuse	9.6		6.3		4.7	
Physical Health						
Diabetes	21.4		17.2		13.0	
Hypertension	56.6		54.1		49.3	
Stroke	7.5		5.8		4.1	
Cancer	13.5		14.0		13.4	
Heart disease	23.0		21.2		16.4	
Lung disease	11.0		7.3		4.7	
Arthritis	62.4		58.8		51.5	
Overweight/obesity	74.4		73.4		67.9	
Physical function limitations	28.5		17.1		10.5	
Cognitive impairment	16.4		13.0		11.1	
Chronic pain	43.3		31.3		23.5	
Self-rated health (range: 1-5)		2.9 (1.1)		3.3 (1.0)		3.7 (1.0)

Continued

Table 1. *Continued*

Participant Characteristics	Life Satisfaction					
	Tertile 1 (n = 4,424)		Tertile 2 (n = 4,131)		Tertile 3 (n = 3,877)	
	%	Mean (SD)	%	Mean (SD)	%	Mean (SD)
Health Behaviors						
Binge drinking	12.5		14.2		14.0	
Smoking	17.8		11.7		8.4	
Frequent physical activity	69.5		78.1		82.9	
Sleep problems	48.6		39.3		34.5	
Religious Service Attendance						
Never	27.0		24.2		20.7	
Less than once per week	34.0		32.6		30.6	
One or more times per week	39.0		43.2		48	
Psychological Well-being						
Positive affect (range: 1-5)		3.3 (0.8)		3.6 (0.6)		4.0 (0.6)

Continued

Table 1. *Continued*

Participant Characteristics	Life Satisfaction					
	Tertile 1 (n = 4,424)		Tertile 2 (n = 4,131)		Tertile 3 (n = 3,877)	
	%	Mean (SD)	%	Mean (SD)	%	Mean (SD)
Life satisfaction (range: 1-7)		4.2 (1.5)		5.2 (1.2)		6.0 (1.1)
Optimism (range: 1-6)		4.1 (1.0)		4.5 (0.9)		4.9 (0.9)
Purpose in life (range: 1-6)		4.4 (0.9)		4.7 (0.9)		5.0 (0.8)
Mastery (range: 1-6)		4.5 (1.1)		4.8 (1.0)		5.2 (1.0)
Health mastery (range: 1-10)		6.8 (2.5)		7.4 (2.1)		8.1 (1.9)
Financial mastery (range: 1-10)		6.6 (2.8)		7.5 (2.4)		8.2 (2.0)
Psychological Distress						
Depression	21.1		9.8		4.5	
Depressive symptoms (range: 0-8)		1.9 (2.2)		1.1 (1.7)		0.7 (1.3)
Hopelessness (range: 1-6)		2.7 (1.3)		2.2 (1.2)		1.8 (1.0)
Negative affect (range: 1-5)		1.9 (0.7)		1.6 (0.5)		1.4 (0.5)
Perceived constraints (range: 1-6)		2.5 (1.2)		2.1 (1.1)		1.7 (1.0)

Continued

Table 1. *Continued*

Participant Characteristics	Life Satisfaction					
	Tertile 1 (n = 4,424)		Tertile 2 (n = 4,131)		Tertile 3 (n = 3,877)	
	%	Mean (SD)	%	Mean (SD)	%	Mean (SD)
Social Factors						
Loneliness (range: 1-3)		1.7 (0.6)		1.4 (0.5)		1.3 (0.4)
Living with spouse/partner	62.6		71.0		78.2	
Contact with children <1x/week	28.5		24.7		21.0	
Contact with other family <1x/week	48.9		47.2		47.8	
Contact with friends <1x/week	36.7		34.5		30.0	
Personality						
Openness (range: 1-4)		2.9 (0.6)		3.0 (0.5)		3.1 (0.5)
Conscientiousness (range: 1-4)		3.3 (0.5)		3.4 (0.4)		3.5 (0.4)
Extraversion (range: 1-4)		3.1 (0.6)		3.2 (0.5)		3.4 (0.5)
Agreeableness (range: 1-4)		3.5 (0.5)		3.5 (0.5)		3.6 (0.4)
Neuroticism (range: 1-4)		2.2 (0.6)		2.0 (0.6)		1.9 (0.6)

This table was created based on nonimputed data and means are unadjusted for any covariates.
All variables in Table 1were used as covariates and assessed in the pre-baseline wave (t_0;2006/2008).

life satisfaction. ETable 1 describes the change in life satisfaction from the pre-baseline wave (t_0) to the baseline wave (t_1) (see online Appendix).

When evaluating physical health outcomes over the four-year follow-up period, respondents in the highest (versus lowest) tertile of life satisfaction, conditional on prior life satisfaction, subsequently had 26% reduced risk of mortality (95% confidence interval [CI]: 0.63, 0.88), 25% reduced risk of physical functioning limitations (95% CI: 0.67, 0.83), 12% reduced risk of chronic pain (95% CI: 0.81, 0.95), higher self-rated health ($\beta = -0.23$, 95% CI: 0.19, 0.28), and a slightly smaller number of chronic conditions ($\beta = -0.06$, 95% CI: -0.09, -0.03; see Table 2). However, there was no evidence of such an association with a range of other physical health outcomes, including diabetes, hypertension, stroke, cancer, heart disease, lung disease, arthritis, overweight/obesity, or cognitive impairment. When evaluating health behaviors, respondents in the highest (versus lowest) tertile of life satisfaction, conditional on prior life satisfaction, subsequently had 8% higher likelihood of frequent physical activity (95% CI: 1.01, 1.16) and 14% reduced risk of sleep problem onset (95% CI: 0.79, 0.93), but there was no evidence of associations with other health behaviors, including binge drinking or smoking.

Finally, when evaluating psychological and social outcomes, those in the highest (versus lowest) tertile of life satisfaction, conditional on prior life satisfaction, subsequently had better indicators across nearly all psychological well-being, psychological distress, and social well-being factors. For example, respondents in the highest (versus lowest) tertile of life satisfaction subsequently reported a higher sense of purpose ($\beta = 0.20$, 95% CI: 0.16, 0.25) and optimism ($\beta = 0.28$, 95% CI: 0.23, 0.33), as well as lower hopelessness ($\beta = -0.23$, 95% CI: -0.29, -0.17), negative affect ($\beta = -0.29$, 95% CI: -0.35, -0.23), and loneliness ($\beta = -0.33$, 95% CI: -0.40, -0.26). They also had 46% reduced risk of depression (95%, CI: 0.45, 0.64). There was no association, however, with frequency of contact with children, other family, or friends.

Additional Analyses

We conducted several additional analyses. First, E-values suggested that many of the observed associations were moderately robust to unmeasured confounding (Table 3). For example, an unmeasured confounder that was

Table 2. Life Satisfaction and Subsequent Health and Well-being (Health and Retirement Study [HRS]: N =12,998)[a,b,c]

	Life Satisfaction		
	Tertile 1[d] (n = 4,666) (Reference)	Tertile 2[d] (n = 4,321) RR/OR/β (95% CI)	Tertile 3[d] (n = 4,011) RR/OR/β (95% CI)
Physical Health			
All-cause mortality	1.00	0.84 (0.73, 0.95)**	0.74 (0.63, 0.88)***
Number of chronic conditions	0.00	−0.04 (−0.07, 0.01)*	−0.06 (−0.09, -−0.03)***
Diabetes	1.00	0.97 (0.89, 1.06)	0.94 (0.84, 1.05)
Hypertension	1.00	0.98 (0.93, 1.04)	1.00 (0.94, 1.06)
Stroke	1.00	0.93 (0.81, 1.06)	0.88 (0.75, 1.04)
Cancer	1.00	0.95 (0.86, 1.05)	0.93 (0.83, 1.05)
Heart disease	1.00	0.97 (0.89, 1.05)	0.93 (0.83, 1.01)
Lung disease	1.00	0.90 (0.79, 1.03)	0.90 (0.77, 1.04)
Arthritis	1.00	1.00 (0.94, 1.05)	0.97 (0.91, 1.03)
Overweight/obesity	1.00	1.01 (0.96, 1.07)	1.02 (0.96, 1.08)
Physical functioning limitations	1.00	0.85 (0.78, 0.92)***	0.75 (0.67, 0.83)***
Cognitive impairment	1.00	1.01 (0.92, 1.11)	1.03 (0.93, 1.15)
Chronic pain	1.00	0.92 (0.85, 0.99)*	0.88 (0.81, 0.95)**
Self-rated health	0.00	0.13 (0.09, 0.16)***	0.23 (0.19, 0.28)***
Health Behaviors			
Binge drinking	1.00	1.19 (0.94, 1.50)	1.08 (0.73, 1.60)
Smoking	1.00	1.00 (0.70, 1.42)	0.90 (0.57, 1.42)
Frequent physical activity	1.00	1.06 (1.00, 1.13)	1.08 (1.01, 1.16)*
Sleep problems	1.00	0.93 (0.85, 1.01)	0.86 (0.79, 0.93)***

Continued

Table 2. *Continued*

	Life Satisfaction		
	Tertile 1[d] (n = 4,666) (Reference)	Tertile 2[d] (n = 4,321) RR/OR/β (95% CI)	Tertile 3[d] (n = 4,011) RR/OR/β (95% CI)
Psychological Well-being			
Positive affect	0.00	0.17 (0.12, 0.21)***	0.30 (0.25, 0.35)***
Life satisfaction	0.00	0.48 (0.44, 0.52)***	0.79 (0.73, 0.86)***
Optimism	0.00	0.14 (0.10, 0.18)***	0.28 (0.23, 0.33)***
Purpose in life	0.00	0.08 (0.05, 0.12)***	0.20 (0.16, 0.25)***
Mastery	0.00	0.15 (0.09, 0.21)***	0.28 (0.23, 0.34)***
Health mastery	0.00	0.09 (0.05, 0.14)***	0.19 (0.12, 0.25)***
Financial mastery	0.00	0.13 (0.07, 0.19)**	0.23 (0.16, 0.29)***
Psychological Distress			
Depression	1.00	0.71 (0.62, 0.81)***	0.54 (0.45, 0.64)***
Depressive symptoms	0.00	−0.18 (−0.22, −0.14)***	−0.22 (−0.27, −0.17)***
Hopelessness	0.00	−0.13 (−0.17, −0.09)***	−0.23 (−0.29, −0.17)***
Negative affect	0.00	−0.17 (−0.22, −0.13)***	−0.29 (−0.35, −0.23)***
Perceived constraints	0.00	−0.11 (−0.17, −0.06)**	−0.19 (−0.26, −0.12)***
Social Factors			
Loneliness	0.00	−0.21 (−0.27, −0.15)***	−0.33 (−0.40, −0.26)***
Living with spouse/partner	1.00	1.09 (1.02, 1.17)*	1.17 (1.09, 1.25)***

Continued

Table 2. *Continued*

	Life Satisfaction		
	Tertile 1[d] ($n = 4{,}666$) (Reference)	Tertile 2[d] ($n = 4{,}321$) RR/OR/β (95% CI)	Tertile 3[d] ($n = 4{,}011$) RR/OR/β (95% CI)
Contact with children <1x/week	1.00	1.04 (0.95, 1.14)	1.01 (0.91, 1.12)
Contact with other family <1x/week	1.00	0.97 (0.90, 1.04)	0.97 (0.89, 1.06)
Contact with friends <1x/week	1.00	0.95 (0.88, 1.02)	0.93 (0.86, 1.01)

Abbreviations: CI, confidence interval; OR, odds ratio; RR, risk ratio.

*$p < 0.05$ before Bonferroni correction; **$p < 0.01$ before Bonferroni correction; *** $p < 0.05$ after Bonferroni correction. The p-value cutoff for Bonferroni correction is $p = 0.05/35$ outcomes $= p < 0.001$.

[a]The analytic sample was restricted to those who had participated in the baseline wave (t_1;2010 or 2012). Multiple imputation was performed to impute missing data on the exposure, covariates, and outcomes. All models controlled for sociodemographic characteristics (age, sex, race/ethnicity, marital status, annual household income, total wealth, level of education, employment status, health insurance, geographic region), pre-baseline childhood abuse, pre-baseline religious service attendance, pre-baseline values of the outcome variables (diabetes, hypertension, stroke, cancer, heart disease, lung disease, arthritis, overweight/obesity, physical functioning limitations, cognitive impairment, chronic pain, self-rated health, binge drinking, current smoking status, physical activity, sleep problems, positive affect, life satisfaction, optimism, purpose in life, mastery, health mastery, financial mastery, depressive symptoms, hopelessness, negative affect, perceived constraints, loneliness, living with spouse/partner, contact with children <1x/week, contact with other family <1x/week, contact with friends <1x/week), personality factors (openness, conscientiousness, extraversion, agreeableness, neuroticism), and the pre-baseline value of the exposure. These variables were controlled for in the pre-baseline (t_0;2006 or 2008).

[b]We used an outcome-wide analytic approach and ran a separate model for each outcome. We ran a different type of model depending on the nature of the outcome: (1) for each binary outcome with a prevalence of ≥10%, we used a generalized linear model (with a log link and Poisson distribution) to estimate a RR; (2) for each binary outcome with a prevalence of <10%, we used a logistic regression model to estimate an OR; and (3) for each continuous outcome, we used a linear regression model to estimate a β.

[c]All continuous outcomes were standardized (mean = 0; standard deviation = 1), and β was the standardized effect size.

[d]If the reference value is 1, the effect estimate is OR or RR; if the reference value is 0, the effect estimate is β.

Table 3. Robustness to Unmeasured Confounding (E-Values) for the Associations Between Life Satisfaction (Third Tertile vs. First Tertile) and Subsequent Health and Well-being ($N = 12{,}998$)[a]

	Effect Estimate[b]	Confidence Interval Limit[c]
Physical Health		
All-cause mortality	2.02	1.54
Number of chronic conditions	1.29	1.18
Diabetes	1.32	1.00
Hypertension	1.06	1.00
Stroke	1.52	1.00
Cancer	1.35	1.00
Heart disease	1.41	1.00
Lung disease	1.48	1.00
Arthritis	1.20	1.00
Overweight/obesity	1.17	1.00
Physical functioning limitations	2.00	1.69
Cognitive impairment	1.22	1.00
Chronic pain	1.55	1.28
Self-rated health	1.77	1.66
Health Behaviors		
Binge drinking	1.37	1.00
Smoking	1.47	1.00
Frequent physical activity	1.38	1.11
Sleep problems	1.60	1.35
Psychological Well-being		
Positive affect	1.96	1.66
Life satisfaction	3.54	3.31
Optimism	1.91	1.78
Purpose in life	1.70	1.58
Mastery	1.90	1.76
Health mastery	1.66	1.50
Financial mastery	1.76	1.59
Psychological Distress		
Depression	3.14	2.48
Depressive symptoms	1.74	1.61
Hopelessness	1.77	1.62

Continued

Table 3. *Continued*

	Effect Estimate[b]	Confidence Interval Limit[c]
Negative affect	1.93	1.78
Perceived constraints	1.66	1.50
Social Factors		
Loneliness	2.04	1.87
Living with spouse/partner	1.61	1.40
Contact with children <1x/week	1.12	1.00
Contact with other family <1x/week	1.20	1.00
Contact with friends <1x/week	1.36	1.00

[a] See VanderWeele and Ding (2017)[47] 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 (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.

associated with both life satisfaction and mortality by risk ratios of 2.02, each, above and beyond the large array of covariates already adjusted for, could explain the association, but weaker confounding could not. Further, to shift the CI to include the null, an unmeasured confounder associated with both life satisfaction and mortality by risk ratios of 1.54, each, could suffice, but weaker confounding could not. Second, when comparing associations between each item of the Satisfaction with Life Scale with our outcomes, we observed a similar pattern of estimates in all the items except for "If I could live my life again, I would change almost nothing." This item had the weakest associations with the outcomes (eTables 2-6 in the online Appendix). Third, when evaluating only the subsets of study participants that displayed either increasing or decreasing levels of life satisfaction, the strength of estimates were

generally similar in both subsets except for one difference: the magnitude of association with mortality was stronger among participants displaying declining life satisfaction (eTables 7 and 8). Fourth, complete-case analyses produced similar estimates when compared against estimates from multiple imputed estimates (eTable 9). Fifth, conventionally adjusted covariate models generally showed larger coefficients than fully adjusted models (eTable 10). These analytic differences might emphasize the effect of short-term change in life satisfaction versus accumulating effects over time or might reflect residual confounding in conventional analyses. Sixth, when reevaluating the fully adjusted models after removing anyone with a history of a given physical condition at baseline (t_1), the coefficients were generally larger (eTable 10). Seventh, when evaluating results after treating life satisfaction as a continuous variable, instead of tertiles, the overall trend of results in the study were largely similar (eTable 11).

Discussion

In a large, diverse, prospective, and nationally representative sample of people aged over 50, we observed that people in the highest (versus lowest) tertile of life satisfaction, even conditional on prior life satisfaction, subsequently had better physical health outcomes (reduced risk of mortality, chronic pain, physical functioning limitations, self-rated health, and number of chronic conditions) and health behaviors (reduced risk of sleep problems and higher likelihood of frequent physical activity), as well as better outcomes on a broad range of psychosocial factors (increased positive affect, life satisfaction, optimism, purpose in life, mastery, health mastery, financial mastery, and likelihood of living with spouse/partner; decreased depression, depressive symptoms, hopelessness, negative affect, perceived constraints, and loneliness) over the four-year follow-up period. Notably, we also observed that high current life satisfaction, conditional on past life satisfaction, was not subsequently associated with specific physical health outcomes (e.g., diabetes, hypertension, stroke, cancer, heart disease, lung disease, arthritis, cognitive impairment, overweight/obese), many health behaviors (e.g., binge drinking or smoking), or frequency of contact with children, other family, or friends over the four-year follow-up period.

Our analyses were intended to be conservative. By controlling for a robust array of covariates, pre-baseline levels of life satisfaction, and all the outcomes, we effectively evaluated change in life satisfaction (conditioned on the past)—for example, a change in life satisfaction from the bottom tertile to the top tertile. It is conservative to evaluate change in life satisfaction ("incident exposure") instead of "prevalent exposure" because the latter potentially incorporates the lifelong effects of past life satisfaction on health and well-being outcomes. By evaluating only incidence of life satisfaction, we essentially focused on how short-term changes in the exposure were associated with short-term changes in the outcomes. This method helps remove the potential accumulating effects that past life satisfaction had on health and well-being over the life course. This analysis is likely of greater policy relevance because it helps policymakers estimate what short-term (i.e., over a four-year time horizon) outcomes they might expect to see if policies that improve life satisfaction were enacted.

To evaluate if certain dimensions of the life satisfaction scale might be superior to target via policy, our secondary analyses observed that most of the items in the scale showed a relatively equal magnitude of association with outcomes, except for one, namely "If I could live my life again, I would change almost nothing." This suggests that living with no regrets is not preferable to a more reflective approach to past successes and failures. Analyses that evaluated whether it might be wiser to allocate resources toward increasing life satisfaction or helping stem decreasing life satisfaction both appeared to have roughly equal magnitudes of association with outcomes. Thus, we did not observe evidence of a negativity bias on outcomes, except for mortality.

In our study, people with high (versus low) life satisfaction, even conditional on prior life satisfaction, had a substantially reduced risk of mortality, yet such high life satisfaction was not associated with specific physical health indicators. Several factors might explain this seemingly perplexing observation. First, life satisfaction was associated with several mechanisms that past research has identified as independent risk/protective factors for mortality, including reduced loneliness and elevated purpose in life. Second, although data on incidence of chronic conditions was captured by HRS, causes of death were not captured in our study. A study participant could have been free of stroke their entire life but died suddenly from stroke and such information was not captured. HRS collects information about some causes of death, but the

categories do not map cleanly onto the chronic condition categories that we evaluated; thus, we did not create composite variables simultaneously capturing incidence of disease and death due to disease (see eText 3 in the online Appendix for further details). Third, when considering the top causes of death among older adults (e.g., injury, pneumonia/influenza, or suicide), some are not well captured in the HRS assessments of health conditions. However, in light of the present evidence, it may be that life satisfaction helps less with preventing the incidence of disease than it does with survival from disease.

Results in the Context of Past Research

Our results converge with past research on topics such as enhanced psychosocial outcomes and reduced risk of mortality; yet they diverge in other important areas, such as health behaviors and other physical health outcomes.[23–31,31–35] These differences may stem from methodological differences, including differences in (1) study design, (2) how life satisfaction and/or the outcomes were measured, (3) the number and types of covariates controlled for, (4) sample composition, and (5) adjustment for pre-baseline life satisfaction and all outcomes. When evaluating results from conventionally adjusted models (i.e., a reduced list of covariates and not adjusting for pre-baseline levels of life satisfaction or outcomes), many associations observed in the life-satisfaction health literature were also observed in our results. This suggests that our analyses emphasize short-term change in life satisfaction versus accumulating effects over longer durations of time.

Mechanisms

When considering potential biobehavioral pathways between life satisfaction and health outcomes,[10] there are at least three to consider: (1) enhancement of other psychological and social resources that buffer against the toxic effects of overwhelming stress; (2) indirect effects through health behaviors, and (3) direct effects through biological pathways. When considering psychosocial resources, people with high stress exposure often develop chronic psychological distress, which in turn is associated with elevated risk of mortality. Thus, high life satisfaction might theoretically blunt the deteriorative effects of stress exposure on

the body because it fosters resilience. For example, when people experience stressors throughout the day, high life satisfaction might foster accelerated recovery. Illustrative experimental studies have demonstrated that people with high positive affect, a conceptual cousin of life satisfaction, display accelerated cardiovascular recovery after exposure to stressful stimuli[52]—but more research is needed. When theoretically considering the intersection of psychosocial resources and health behaviors, people with higher life satisfaction expect and seek favorable life outcomes, and therefore they might be more likely to persist at goals, plan for future challenges, and cope more effectively with difficulties. Through these psychological processes and assets, life satisfaction might lead to better health behaviors because they influence key psychological processes (e.g., self-efficacy, motivation, goal setting, self-regulation) that impact whether individuals engage in healthy behaviors.[53] Interestingly, we only observed associations between life satisfaction physical activity and sleep problems, but no associations with binge drinking or physical activity. Thus, there might be other health behaviors through which life satisfaction works to reduce mortality risk that we did not have measures for, such as diet. Or, life satisfaction might work through biological processes, such as reduced inflammation and lower risk of hypertension.[31,33–35]

Limitations and Strengths

Only four years of follow-up data were available, and this is likely not enough follow-up time for a psychological factor to influence chronic diseases, which often take decades to develop. Future research should reevaluate the associations in this study using data with longer follow-up times. Another limitation is that our primary analysis assumes that the effects of change in life satisfaction from the lowest tertile in t_0 to the highest tertile in t_1 is of the same magnitude but opposite sign as the effects of a change from the highest tertile in t_0 to the lowest tertile in t_1. Future research could further evaluate this assumption, but the fact that our analyses evaluating only increases, versus only decreases, in life satisfaction (eTables 7 and 8 in the online Appendix) gave similar results suggests that this assumption may have been reasonable. Another limitation is that the exposure and all of the outcomes (except mortality) were self-reported; thus, self-report bias is a potential concern. Future

research that uses objective health outcome assessments can address this potential bias.

Unmeasured third variables could have confounded our results. However, our study design and several of our analyses aimed to reduce these concerns. These included robust covariate adjustment, the prospective nature of the data, control for prior life satisfaction and prior outcomes, and E-value analyses for robustness to unmeasured confounding. Our study evaluated associations in only one cultural context and important life satisfaction differences between countries exist; such differences might have important implications for health and well-being outcomes.[54,55] Thus, future work should evaluate these associations in different cultural contexts. Our study also featured several strengths, including the use of a large, diverse, prospective, and nationally representative sample of older adults. Further, we were able to attain stronger evidence of causality for our question of interest because we adjusted for pre-baseline values of the exposure, a robust range of covariates and outcomes, and sensitivity analysis for unmeasured confounding.[36,56]

Conclusion

In the past several decades, nations have largely fixated on economic growth as the overarching aim. This focus has provided an array of societal benefits, but we have now long recognized the limits of this approach. As our nations pause and reevaluate our priorities in light of the widespread change that COVID-19 and its downstream effects have caused, our policymakers have a rare opportunity to courageously pursue another overarching aim in our postpandemic world—well-being for *all*.

A growing number of countries have already adopted well-being measures as metrics and decision-making tools to guide policy decisions, and several others are on the horizon.[1–3] In addition to recognizing this as an important goal in and of itself, another partial reason for this change is that emerging evidence indicates that changing levels of life satisfaction is an important determinant of voting behavior.[6,7] Further, countries are seeking innovative and cost-effective methods of enhancing the health and well-being trajectories of our swiftly aging populations. Both randomized controlled trials (aimed at individuals)[19,20] and case studies of successful policies (aimed at populations)[1–3] suggest that life satisfaction

can be enhanced through a variety of intervention programs and policies. Findings from our study suggest that continuously iterating and applying existing assessments,[57–59] interventions,[19,20] and policies[3,19,21,22] that target life satisfaction is a promising method of enhancing several other aspects of health and well-being for our rapidly aging population. If we take effective steps in this direction, our study illuminates some of the short-term health and well-being benefits that might result. Life satisfaction specifically, and well-being more generally, is, and should be, an important policy goal.

References

1. Stiglitz JE, Fitoussi JP, Durand M. *Beyond GDP: Measuring What Counts for Economic and Social Performance*. Paris, France: OECD Publishing; 2018.
2. World Health Organization. *Joint Meeting of Experts on Targets and Indicators for Health and Well-being in Health 2020*. Copenhagen, Denmark: World Health Organization Regional Office of Europe; 2013.
3. The Global Council for Happiness and Wellbeing. *Global Happiness and Wellbeing Policy Report*. New York, NY: Sustainable Development Solutions Network; 2019.
4. Durand M, Exton C. Adopting a well-being approach in central government: policy mechanisms and practical tools. In: *The Global Council for Happiness and Wellbeing. Global Happiness and Wellbeing Policy Report*. New York, NY: Sustainable Development Solutions Network; 2019.
5. Stiglitz JE. *Measuring What Counts: The Global Movement for Well-being*. New York, NY: The New Press; 2019.
6. De Neve J-E, Eichstaedt JC, Ungar LH, Ward G. (Un)Happiness and voting in U.S. presidential elections. *J Pers Soc Psychol*. In press.
7. Ward G. Happiness and voting behaviour. In:*The Global Council for Happiness and Wellbeing. Global Happiness and Wellbeing Policy Report*. New York, NY: Sustainable Development Solutions Network; 2019.
8. United Nations, Department of Economic and Social Affairs, Population Division. *World Population Ageing 2019*. New York, NY: United Nations; 2020.
9. Colby SL, Ortman JM. *Projections of the Size and Composition of the U.S. Population*. Washington, DC: US Census Bureau; 2014:25-1143.

10. Kubzansky LD, Huffman JC, Boehm JK, et al. Positive psychological well-being and cardiovascular health promotion. *J Am Coll Cardiol*. 2018;72(12):1382-1396.
11. VanderWeele TJ, Chen Y, Long K, Kim ES, Trudel-Fitzgerald C, Kubzansky LD. Positive epidemiology? *Epidemiology*. 2020;31(2):189-193.
12. VanderWeele TJ. On the promotion of human flourishing. *Proc Natl Acad Sci*. 2017;114(31):8148-8156.
13. Diener E, Emmons RA, Larsen RJ, Griffen S. Satisfaction with Life Scale. *J Pers Assess*. 1985;49(1):71-75.
14. Barger SD, Donoho CJ, Wayment HA. The relative contributions of race/ethnicity, socioeconomic status, health, and social relationships to life satisfaction in the United States. *Qual Life Res*. 2009;18(2):179-189.
15. Diener E, Oishi S, Tay L. Advances in subjective well-being research. *Nat Hum Behav*. 2018;2(4):253-260.
16. Helliwell JF, Putnam RD. The social context of well-being. *Philos Trans R Soc B Biol Sci*. 2004;359(1449):1435-1446.
17. Bartels M. Genetics of wellbeing and its components satisfaction with life, happiness, and quality of life: a review and meta-analysis of heritability studies. *Behav Genet*. 2015;45(2):137-156.
18. Okbay A, Baselmans BML, De Neve J-E, et al. Genetic variants associated with subjective well-being, depressive symptoms, and neuroticism identified through genome-wide analyses. *Nat Genet*. 2016;48(6):624-633.
19. Bolier L, Haverman M, Westerhof GJ, Riper H, Smit F, Bohlmeijer E. Positive psychology interventions: a meta-analysis of randomized controlled studies. *BMC Public Health*. 2013;13:119.
20. Wiese CW, Kuykendall L, Tay L. Get active? A meta-analysis of leisure-time physical activity and subjective well-being. *J Posit Psychol*. 2018;13(1):57-66.
21. Helliwell JF, Huang H, Grover S, Wang S. Empirical linkages between good governance and national well-being. *J Comp Econ*. 2018;46(4):1332-1346.
22. Heintzelman SJ, Kushlev K, Lutes LD, et al. ENHANCE: evidence for the efficacy of a comprehensive intervention program to promote subjective well-being. *J Exp Psychol Appl*. 2020;26(2):360-383.
23. Boehm JK, Peterson C, Kivimaki M, Kubzansky LD. Heart health when life is satisfying: evidence from the Whitehall II cohort study. *Eur Heart J*. 2011;32(21):2672-2677.

24. Boehm JK, Chen Y, Williams DR, et al. Subjective well-being and cardiometabolic health: an 8–11 year study of midlife adults. *J Psychosom Res*. 2016;85:1-8.
25. Feller S, Teucher B, Kaaks R, Boeing H, Vigl M. Life satisfaction and risk of chronic diseases in the European prospective investigation into cancer and nutrition (EPIC)-Germany study. *PLoS One*. 2013;8(8):e73462.
26. Martín-María N, Miret M, Caballero FF, Rico-Uribe LA, Steptoe A, Chatterji S, Ayuso-Mateos JL. The impact of subjective well-being on mortality: a meta-analysis of longitudinal studies in the general population. *Psychosom Med*. 2017;79(5):565-575.
27. Kim ES, Kubzansky LD, Soo J, Boehm JK. Maintaining healthy behavior: a prospective study of psychological well-being and physical activity. *Ann Behav Med*. 2017;51(3):337-347.
28. Kim ES, Kubzansky LD, Smith J. Life satisfaction and use of preventive health care services. *Health Psychol*. 2015;34(7):779-782.
29. Grant N, Wardle J, Steptoe A. The relationship between life satisfaction and health behavior: a cross-cultural analysis of young adults. *Int J Behav Med*. 2009;16:259-268.
30. Strine TW, Chapman DP, Balluz LS, Moriarty DG, Mokdad AH. The associations between life satisfaction and health-related quality of life, chronic illness, and health behaviors among U.S. community-dwelling adults. *J Community Health*. 2008;33:40-50.
31. Hamer M, Chida Y. Life satisfaction and inflammatory biomarkers: the 2008 Scottish Health Survey. *Japanese Psychol Res*. 2011;53(2):133-139.
32. Boehm JK, Soo J, Zevon ES, Chen Y, Kim ES, Kubzansky LD. Longitudinal associations between psychological well-being and the consumption of fruits and vegetables. *Health Psychol*. 2018;37(10):959-967.
33. Blanchflower DG, Oswald AJ. Hypertension and happiness across nations. *J Health Econ*. 2008;27(2):218-233.
34. Mojon-Azzi S, Sousa-Poza A. Hypertension and life satisfaction: an analysis using data from the Survey of Health, Ageing and Retirement in Europe. *Appl Econ Lett*. 2011;18(2):183-187.
35. Uchino BN, Kent de Grey RG, Cronan S, Smith TW, Diener E, Joel S, Bosch J. Life satisfaction and inflammation in couples: an actor-partner analysis. *J Behav Med*. 2018;41(1):22-30.
36. VanderWeele TJ, Mathur MB, Chen Y. Outcome-wide longitudinal designs for causal inference: a new template for empirical studies. *Stat Sci*. In press.
37. Ryff CD, Singer B. Understanding healthy aging: key components and their integration. *Handb Theor Aging*. 2009;2:117-144.

38. Rowe JW, Kahn RL. Human aging: usual and successful. *Science*. 1987;237(4811):143-149.
39. Reich JW, Zautra AJ, Hall JS.*Handbook of Adult Resilience*. New York, NY: Guilford Press; 2010.
40. Depp CA, Jeste DV. Definitions and predictors of successful aging: a comprehensive review of larger quantitative studies. *Am J Geriatr Psychiatry*. 2006;14(1):6-20.
41. Smith J, Fisher G, Ryan L, Clarke P, House J, Weir D.HRS psychosocial and lifestyle questionnaire. Ann Arbor, MI: Survey Research Center, Institute for Social Research, University of Michigan; 2013.
42. Sonnega A, Faul JD, Ofstedal MB, Langa KM, Phillips JWR, Weir DR. Cohort profile: the Health and Retirement Study (HRS). *Int J Epidemiol*. 2014;43(2):576-585.
43. Fisher GG, Faul JD, Weir DR, Wallace RB.*Documentation of Chronic Disease Measures in the Health and Retirement Study (HRS/AHEAD)*. Ann Arbor, MI: Institute for Social Research, University of Michigan; 2005.
44. Jenkins KR, Ofstedal MB, Weir D.*Documentation of Health Behaviors and Risk Factors Measured in the Health and Retirement Study (HRS/AHEAD)*. Ann Arbor, MI: Institute for Social Research, University of Michigan; 2008.
45. VanderWeele TJ. Principles of confounder selection. *Eur J Epidemiol*. 2019;34(3):211-219.
46. Dunn OJ. Multiple comparisons among means. *J Am Stat Assoc*. 1961;56(293):52-64.
47. VanderWeele TJ, Ding P. Sensitivity analysis in observational research: introducing the E-value. *Ann Intern Med*. 2017;167(4):268-274.
48. Baumeister RF, Bratslavsky E, Finkenauer C, Vohs KD. Bad is stronger than good. *Rev Gen Psychol*. 2001;5(4):323-370.
49. Moons KGM, Donders RART, Stijnen T, Harrell FE Jr. Using the outcome for imputation of missing predictor values was preferred. *J Clin Epidemiol*. 2006;59(10):1092-1101.
50. Asendorpf JB, van de Schoot R, Denissen JJA, Hutteman R. Reducing bias due to systematic attrition in longitudinal studies: the benefits of multiple imputation. *Int J Behav Dev*. 2014;38(5):453-460.
51. Harel O, Mitchell EM, Perkins NJ, Cole SR, Tchetgen EJT, Sun BL, Schisterman EF. Multiple imputation for incomplete data in epidemiologic studies. *Am J Epidemiol*. 2018;187(3):576-584.
52. Tugade MM, Fredrickson BL. Resilient individuals use positive emotions to bounce back from negative emotional experiences. *J Pers Soc Psychol*. 2004;86(2):320-333.

53. vanStralen MM, De Vries H, Mudde AN, Bolman C, Lechner L. Determinants of initiation and maintenance of physical activity among older adults: a literature review. *Health Psychol Rev*. 2009;3(2):147-207.
54. Hong JH, Charles ST, Lee S, Lachman ME. Perceived changes in life satisfaction from the past, present and to the future: a comparison of U.S. and Japan. *Psychol Aging*. 2019;34(3):317-329.
55. Diener E.*Culture and Well-Being: The Collected Works of Ed Diener*. Vol 38. New York, NY: Springer; 2009.
56. VanderWeele TJ, Jackson JW, Li S. Causal inference and longitudinal data: a case study of religion and mental health. *Soc Psychiatry Psychiatr Epidemiol*. 2016;51(11):1457-1466.
57. VanderWeele TJ, Trudel-Fitzgerald C, Allin P, et al. Current recommendations on the selection of measures for well-being. *Prev Med*. 2020;133:106004.
58. Ryff CD, Boylan JM, Kirsch JA. Advancing the science of well-being: a dissenting view on measurement recommendations. In: Lee M, Kubzansky LD, VanderWeele TJ. *Interdisciplinary Perspectives From the Social Sciences and the Humanities*. Vol 1. Oxford, England: Oxford University Press; 2020.
59. VanderWeele TJ, Trudel-Fitzgerald C, Allin P, et al. Brief well-being assessments, or nothing at all? *Prev Med*. 2020:106095.

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Supplementary Material

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