

Appendix Text 1

To obtain a measure of additive effect modification, relative excess risk due to interaction (RERI) was estimated using the following formula:

$$RERI_{a,m} = RR_{am} - RR_{a_{Ref},m} - RR_{a,m_{Ref}} + 1$$

where RR_{am} is the RR of death for the stratum with baseline purpose $A = a$ and SES category $M = m$; further $A = a_{Ref}, M = m_{Ref}$ represents the reference groups for baseline purpose and SES (i.e., the lowest purpose quartile and lowest SES category). SEs for RERIs were computed via the delta method.¹ To obtain a measure of multiplicative effect modification, the ratio of RRs (RRR) was estimated using the following formula.

$$RRR_{am} = RR_{am} / (RR_{a_{Ref},m} * RR_{a,m_{Ref}})$$

RERI and RRR can be interpreted as the extent to which the RR of death for the joint exposure to baseline purpose and SES together exceeds the RR predicted by each considered separately on either the additive (RERI) or multiplicative scale (RRR). Statistical significance for effect modification was assessed by testing the null hypotheses $RERI = 0$ (for the additive scale) and $RRR = 1$ (for the multiplicative scale).

Appendix Text 2

Additional details about covariates and missing data are described below.

Covariates

Although purpose in life and depression are correlated, adjusting for depression is important because from a conceptual point of view it could be a confounder in our main association of interest. Additionally, emerging evidence shows that dimensions of psychological well-being (including a sense of purpose in life) are associated with several physical health outcomes, above and beyond the mere absence of depression – thus purpose is an important factor to evaluate in its own right.

Missing Data

This study conducted a sensitivity analysis where covariates as well as purpose in life were imputed and the results were essentially identical. Also, 185 (1.3%) of the study sample was excluded due to missing data on death. This is a small percentage of the population, thus unlikely to substantially alter the results.

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Appendix Table 1. Modification of the Effect of Sense of Purpose in Life on Mortality (by Level of Education)^a

Level of education	Sense of purpose in life							
	Low		Medium–low		Medium–high		High	
	n, died/alive	RR (95% CI)	n, died/alive	RR (95% CI)	n, died/alive	RR (95% CI)	n, died/alive	RR (95% CI)
<High school		1.0		$\exp(\beta_1)$		$\exp(\beta_2)$		$\exp(\beta_3)$
High school		$\exp(\beta_4)$		$\exp(\beta_1 + \beta_4 + \beta_6)$		$\exp(\beta_2 + \beta_4 + \beta_8)$		$\exp(\beta_3 + \beta_4 + \beta_{10})$
≥College		$\exp(\beta_5)$		$\exp(\beta_1 + \beta_5 + \beta_7)$		$\exp(\beta_2 + \beta_5 + \beta_9)$		$\exp(\beta_3 + \beta_5 + \beta_{11})$
Measures of effect modification								
	Low	Medium–low		Medium–high		High		
		Additive ^b	Multiplicative ^c	Additive	Multiplicative	Additive	Multiplicative	
<High school	ref	ref	ref	ref	ref	ref	ref	
High school	ref	$\exp(\beta_1 + \beta_4 + \beta_6) - \exp(\beta_1) - \exp(\beta_4) + 1$	$\exp(\beta_6)$	$\exp(\beta_2 + \beta_4 + \beta_8) - \exp(\beta_2) - \exp(\beta_4) + 1$	$\exp(\beta_8)$	$\exp(\beta_3 + \beta_4 + \beta_{10}) - \exp(\beta_3) - \exp(\beta_4) + 1$	$\exp(\beta_{10})$	
≥College	ref	$\exp(\beta_1 + \beta_5 + \beta_7) - \exp(\beta_1) - \exp(\beta_5) + 1$	$\exp(\beta_7)$	$\exp(\beta_2 + \beta_5 + \beta_9) - \exp(\beta_2) - \exp(\beta_5) + 1$	$\exp(\beta_9)$	$\exp(\beta_3 + \beta_5 + \beta_{11}) - \exp(\beta_3) - \exp(\beta_5) + 1$	$\exp(\beta_{11})$	

Notes: RRs are adjusted for age, sex, race/ethnicity, marital status, household income, wealth, health insurance, heart disease, stroke, cancer, diabetes, hypertension, lung disease, arthritis, and depression using Poisson regression.

^aPoisson regression model: $\log E[\text{Death} | \text{Purpose}, \text{Education}, C] = \beta_0 + \beta_1 \text{Purpose}_{\text{Medium-low}} + \beta_2 \text{Purpose}_{\text{Medium-high}} + \beta_3 \text{Purpose}_{\text{High}} + \beta_4 \text{Education}_{\text{High School}} + \beta_5 \text{Education}_{\geq \text{College}} + \beta_6 \text{Education}_{\text{High School}} * \text{Purpose}_{\text{Medium-low}} + \beta_7 \text{Education}_{\geq \text{College}} * \text{Purpose}_{\text{Medium-low}} + \beta_8 \text{Education}_{\text{High School}} * \text{Purpose}_{\text{Medium-high}} + \beta_9 \text{Education}_{\geq \text{College}} * \text{Purpose}_{\text{Medium-high}}$

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$Purpose_{Medium-high} + \beta_{10} Education_{High\ School} * Purpose_{High} + \beta_{11} Education_{\geq College} * Purpose_{High} + C\beta'$, where C is a vector of covariates.

^bEffect modification on additive scale: relative excess risk due to interaction (RERI; SEs were calculated by using the delta method).

^cEffect modification on multiplicative scale: ratio of risk ratio (RRR).

RR, risk ratio.

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Appendix Table 2. Characteristics of study participants at baseline, by levels of purpose in life (n=13,159)

Characteristics	Sense of purpose in life ^a				
	Total (n=13159)	Low (n=3,445)	Medium -low (n=3,167)	Medium- high (n=3,465)	High (n=3,082)
Death by the end of follow-up	3,253 (24.7)	1,259 (36.5)	801 (25.3)	724 (20.9)	469 (15.2)
Socioeconomic status					
Education					
<High school (%)	2,515 (19.1)	1,012 (29.4)	616 (19.5)	504 (14.5)	383 (12.4)
High school (%)	7,223 (54.9)	1,863 (54.1)	1,806 (57.0)	1,928 (55.6)	1,626 (52.8)
≥College (%)	3,395 (25.8)	568 (16.5)	741 (23.4)	1,022 (29.5)	1,064 (34.5)
Household income quartiles ^{b,c}					
Q1 (%)	3,221 (24.5%)	1,257 (36.5%)	766 (24.2%)	680 (19.6%)	518 (16.8%)
Q2 (%)	3,303 (25.1%)	944 (27.4%)	879 (27.8%)	814 (23.5%)	666 (21.6%)
Q3 (%)	3,312 (25.2%)	753 (21.9%)	813 (25.7%)	957 (27.6%)	789 (25.6%)
Q4 (%)	3,323 (25.3%)	491 (14.3%)	709 (22.4%)	1,014 (29.3%)	1,109 (36.0%)
Wealth quintiles ^{b,d}					
Q1 (%)	2,598 (19.7)	969 (28.1)	651 (20.6)	569 (16.4)	409 (13.3)
Q2 (%)	2,616 (19.9)	810 (23.5)	659 (20.8)	630 (18.2)	517 (16.8)
Q3 (%)	2,642 (20.1)	673 (19.5)	623 (19.7)	705 (20.3)	641 (20.8)
Q4 (%)	2,656 (20.2)	524 (15.3)	651 (20.6)	768 (22.2)	713 (23.1)
Q5 (%)	2,657 (20.1)	469 (13.6)	583 (18.4)	793 (22.9)	802 (26.0)
Other demographic characteristics					
Mean age (SD)	69.6 (9.58)	71.6 (10.3)	70.0 (9.74)	68.9 (9.11)	67.9 (8.60)
Gender					
Men (%)	5,495 (41.8)	1,420 (41.2)	1,337 (42.2)	1,466 (42.3)	1,272 (41.3)

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Women (%)	7,664 (58.2)	2,025 (58.8)	1,830 (57.8)	1,999 (57.7)	1,810 (58.7)
Race/ethnicity					
White (%)	10,240 (77.8)	2,615 (75.9)	2,515 (79.4)	2,758 (79.6)	2,352 (76.3)
Black (%)	1,645 (12.5)	376 (10.9)	365 (11.5)	423 (12.2)	481 (15.6)
Hispanic (%)	1,002 (7.6)	371 (10.8)	220 (6.9)	219 (6.3)	192 (6.2)
Other (%)	271 (2.1)	83 (2.4)	67 (2.1)	64 (1.8)	57 (1.8)
Marital status					
Not married (%)	4,885 (37.1)	1,566 (45.5)	1,232 (38.9)	1,135 (32.8)	952 (30.9)
Married (%)	8,274 (62.9)	1,879 (54.5)	1,935 (61.1)	2,330 (67.2)	2,130 (69.1)
Health insurance					
Not covered (%)	1,432 (10.9)	332 (9.6)	324 (10.2)	389 (11.2)	387 (12.6)
Covered (%)	11,651 (88.5)	3,083 (89.5)	2,826 (89.2)	3,055 (88.2)	2,687 (87.2)
Health factors					
Heart disease					
No (%)	9,905 (75.3)	2,362 (68.6)	2,416 (76.3)	2,630 (75.9)	2,497 (81.0)
Yes (%)	3,240 (24.6)	1,081 (31.4)	746 (23.6)	832 (24.0)	581 (18.9)
Stroke					
No (%)	12,102 (92.0)	3,035 (88.1)	2,913 (92.0)	3,229 (93.2)	2,925 (94.9)
Yes (%)	1,048 (8.0)	406 (11.8)	251 (7.9)	235 (6.8)	156 (5.1)
Cancer					
No (%)	11,098 (84.3)	2,838 (82.4)	2,673 (84.4)	2,942 (84.9)	2,645 (85.8)
Yes (%)	2,037 (15.5)	597 (17.3)	486 (15.3)	520 (15.0)	434 (14.1)
Diabetes					
No (%)	10,537 (80.1)	2,539 (73.7)	2,534 (80.0)	2,834 (81.8)	2,630 (85.3)
Yes (%)	2,609 (19.8)	903 (26.2)	626 (19.8)	630 (18.2)	450 (14.6)
Hypertension					
No (%)	5,580 (42.4)	1,267 (36.8)	1,310 (41.4)	1,542 (44.5)	1,461 (47.4)
Yes (%)	7,565 (57.5)	2,172 (63.0)	1,853 (58.5)	1,919 (55.4)	1,621 (52.6)
Lung diseases					

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No (%)	11,851 (90.1)	2,976 (86.4)	2,817 (88.9)	3,166 (91.4)	2,892 (93.8)
Yes (%)	1,291 (9.8)	463 (13.4)	343 (10.8)	296 (8.5)	189 (6.1)
Arthritis					
No (%)	5,119 (38.9)	1,105 (32.1)	1,230 (38.8)	1,425 (41.1)	1,359 (44.1)
Yes (%)	8,027 (61.0)	2,338 (67.9)	1,934 (61.1)	2,036 (58.8)	1,719 (55.8)
Depression					
No (%)	11,180 (85.0)	2,455 (71.3)	2,694 (85.1)	3,123 (90.1)	2,908 (94.4)
Yes (%)	1,780 (13.5)	921 (26.7)	426 (13.5)	302 (8.7)	131 (4.3)

Notes: Boldface indicates statistical significance ($p < 0.05$).

^aPurpose in life was assessed using the purpose in life subscale of the Ryff Psychological Well-being Scales. Purpose in life quartiles: low: 1–3.86; medium–low: 4–4.57; medium–high: 4.6–5.29; high: 5.33–6.00.

^bIncome and wealth were imputed by Health and Retirement Study and, thus, there was no missing in these variables in the data used.

^cHousehold income quartiles: 1st quartile: \leq \$20,024; 2nd quartile: \$20,025–\$38,321; 3rd quartile: \$38,322–\$71,895; 4th quartile: \geq \$71,896.

^dWealth quintiles: 1st quartile: \leq \$35,000; 2nd quartile: \$35,001–\$140,000; 3rd quartile: \$140,001–\$311,000; 4th quartile: \$311,001–\$652,500; 5th quartile: \geq \$652,501.

Q, quartile/quintile.

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Appendix Table 3. RRs and CIs for Associations Between Baseline Purpose in Life and 8-Year Mortality Within Strata of Educational Attainment, Income Groups, and Wealth Quintiles^a

SES stratum	Sense of Purpose in Life ^b											
	Low			Medium–low			Medium–high			High		
	RR	95% CI	RR	95% CI	RR	95% CI	RR	95% CI	RR	95% CI	RR	95% CI
Education												
<High school	ref	ref	ref	0.97	0.82	1.14	0.96	0.80	1.15	0.68	0.53	0.87
High school	ref	ref	ref	0.87	0.77	0.98	0.82	0.73	0.94	0.74	0.64	0.86
≥College	ref	ref	ref	0.77	0.62	0.97	0.72	0.58	0.89	0.67	0.53	0.84
Income quartiles ^c												
Q1	ref	ref	ref	0.91	0.79	1.06	0.91	0.78	1.06	0.76	0.62	0.92
Q2	ref	ref	ref	0.93	0.79	1.10	0.87	0.74	1.04	0.84	0.69	1.02
Q3	ref	ref	ref	0.79	0.65	0.96	0.78	0.64	0.95	0.60	0.47	0.75
Q4	ref	ref	ref	0.78	0.59	1.02	0.65	0.50	0.85	0.62	0.47	0.82
Wealth quintiles ^d												
Q1	ref	ref	ref	0.93	0.78	1.10	1.00	0.83	1.20	0.81	0.64	1.03
Q2	ref	ref	ref	0.87	0.72	1.06	0.87	0.71	1.05	0.70	0.56	0.80
Q3	ref	ref	ref	0.91	0.74	1.11	0.86	0.70	1.06	0.71	0.56	0.91
Q4	ref	ref	ref	0.92	0.74	1.14	0.83	0.66	1.04	0.68	0.52	0.88
Q5	ref	ref	ref	0.71	0.56	0.91	0.58	0.45	0.74	0.66	0.52	0.85

^aRRs were adjusted for age, gender, race/ethnicity, marital status, health insurance, heart disease, stroke, cancer, diabetes, hypertension, lung disease, arthritis, and depression using Poisson regression. Each model was further adjusted for the other 2 SES indicators (e.g., income and wealth for the education model).

^bPurpose in life was assessed using the purpose in life subscale of the Ryff Psychological Well-being Scales. Purpose in life quartiles: low: 1.00–3.86; medium–low: 3.87–4.57; medium–high: 4.58–5.29; high: 5.30–6.00.

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

^dWealth quintiles: 1st quartile: ≤\$35,000; 2nd quartile: \$35,001–\$140,000; 3rd quartile: \$140,001–\$311,000; 4th quartile: \$311,001–\$652,500; 5th quartile: ≥\$652,501.

Q, quartile/quintile; RR, risk ratio.

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Appendix Table 4. Measures of Effect Modification for Associations Between Continuous Purpose in Life and 8-Year Mortality by Continuous SES Indicators^a

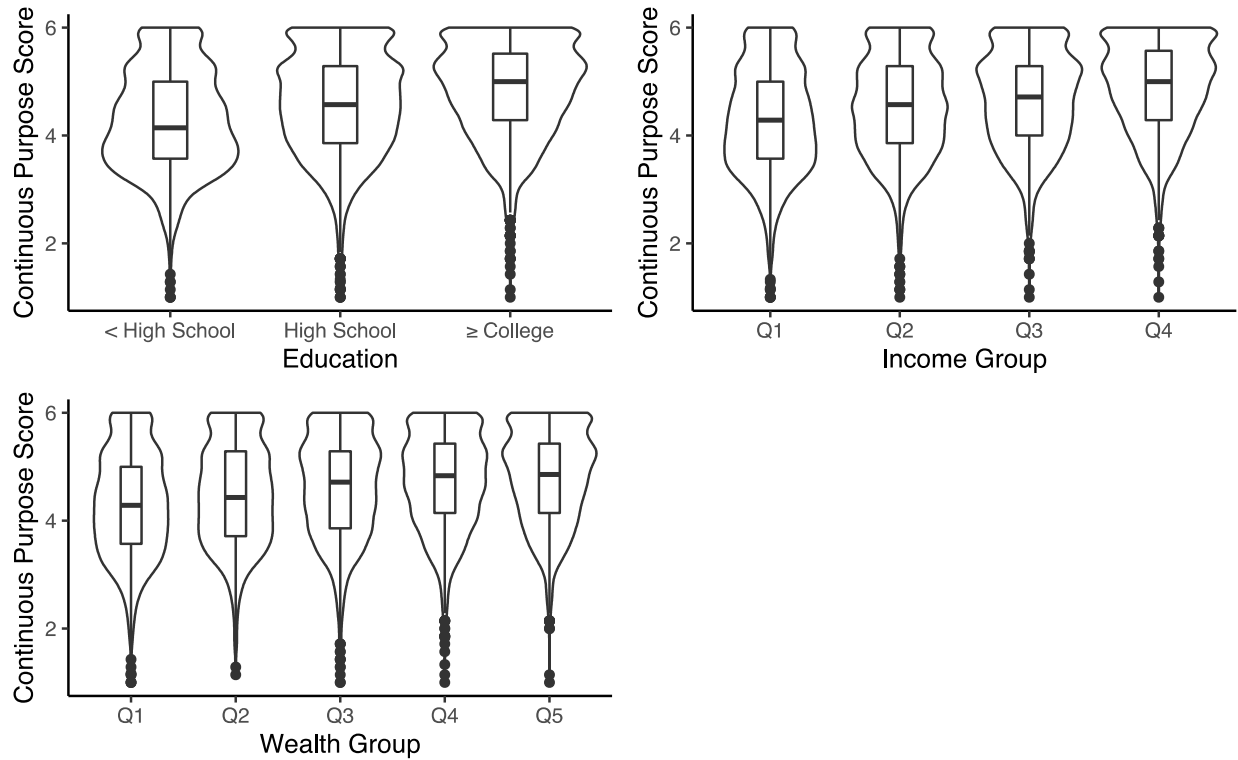
Effect modifier	RRR ^b		
	Estimate	(95% CI)	<i>p</i> -value
Education	0.97	(0.93, 1.02)	0.26
Income	0.96	(0.94, 0.99)	0.02
Wealth	0.98	(0.95, 1.00)	0.04

^aPurpose quartiles and SES indicators (3 levels for education, 4 levels for income, and 5 levels for wealth) were treated as continuous in this analysis. Poisson regression models adjusted for age, gender, race/ethnicity, marital status, health insurance, heart disease, stroke, cancer, diabetes, hypertension, lung disease, arthritis, and depression. Each model was further adjusted for the other two SES indicators (e.g., income and wealth for the education model).

^bRatio of risk ratios (RRR): Effect modification on multiplicative scale.

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Appendix Figure 1. Distribution of continuous purpose in life across levels of educational attainment, income quartiles, and wealth quintiles.^{a,b}



^aHousehold income quartiles: 1st quartile: \leq \$20,024; 2nd quartile: \$20,025–\$38,321; 3rd quartile: \$38,322–\$71,895; 4th quartile: \geq \$71,896.

^bWealth quintiles: 1st quartile: \leq \$35,000; 2nd quartile: \$35,001–\$140,000; 3rd quartile: \$140,001–\$311,000; 4th quartile: \$311,001–\$652,500; 5th quartile: \geq \$652,501.

Appendix References

1. Hosmer DW, Lemeshow S. Confidence interval estimation of interaction. *Epidemiology*. 1992;3(5):452–456. <https://doi.org/10.1097/00001648-199209000-00012>.