

Supplementary material

Lifespan inequalities and mortality risk across social determinants of health

A. Causes of death

Table A1. Causes of death analyzed, ICD-10 codes and short name, ordered by importance.

Short name	Cause	ICD-10 codes
Heart	Diseases of heart	I00-I09,I11,I13,I20-I51
Cancer	Malignant Neoplasms	C00-C97
Lung cancer	Malignant neoplasms of the trachea, bronchus and lung	C33-C34
Breast cancer	Malignant neoplasm of breast	C50
Prostate cancer	Malignant neoplasm of prostate	C61
Other cancer	Other malignant neoplasms	C00-C32,C35-C49,C51-C60,C62-C97
U. injuries	Unintentional injuries	V01-X59, Y40-Y86,Y88
CLRD	Chronic lower respiratory diseases	J40-J47
Cerebrovascular	Cerebrovascular diseases	I60-I69
Alzheimer	Alzheimer disease	G30
Diabetes	Diabetes mellitus	E10-E14
Kidney	Nephritis, nephrotic syndrome and nephrosis	N00-N07,N17-N19,N25-N27
Influenza	Influenza and pneumonia	J09-J18
Suicide	Intentional self-harm	U03,X60-X84,Y87.0
Liver	Chronic liver disease and cirrhosis	K70,K73-K74
Homicide	Assault (homicide)	U01-U02,X85-Y09,Y87.1

B. Alternative scoring system

Table B1. Mortality scoring system across social determinants of health with interaction, US 2015-2019.

	-4	-3	-2	-1	0	1	2	3
Sex					M		F	
Marital		Nm		Pm	Ma			
Education	Hd				Sa			Ud
Race					B		H	W
Female:Marital					Ma, Nm	Pm		
Female:Education					Sa, Ud	Hd		
Female:Race					B, W	H		
Never married:Education				Hd,Ud	Sa			
Never married:Race			W	H	B			
Previously Married:Education				Ud	Sa, Hd			
Previously Married:Race	W			H	B			
HighSchool:Race				W	B, H			
University:Race					B, H	W		

Source: MCDD [1], ACS [2] and authors' own calculation.

Table B2. Comparison of scoring system based on death rates (Cox proportional hazard model) and partial life expectancy between age 30 and 90 (linear regression), US 2015-2019

	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5
Death rates												
Sex							M					F
Marital		Nm		Pm			Ma					
Education		Hd					Sa			Ud		
Race							B	W	H			
Partial life expectancy												
Sex							M					F
Marital		Nm		Pm			Ma					
Education	Hd						Sa			Ud		
Race							B	W	H			

Note: The scoring systems use the same reference population for comparative purposes, being the population with the closest age-specific death rates to the average. However, the population with the PLE value closest to the average is Black previously married men with a university degree.

Source: MCDD [1], ACS [2] and authors' own calculation.

C. Population size, sample size and death counts

Table C1. Population size, sample size, and total deaths pooled over five years (2015-2019) for the 54 US subpopulations, ordered by population size.

Sex	Marital status	Education	Race	Population size	Sample size	Deaths
Male	Married	University Degree	White	83350042	962782	691715
Female	Married	University Degree	White	79082164	913672	248528
Male	Married	High School Degree	White	64865377	786793	1382735
Female	Married	Some college	White	60892331	722272	309191
Female	Married	High School Degree	White	59726801	726948	767472
Male	Married	Some college	White	59000662	694764	585891
Female	Previously Married	High School Degree	White	45514035	516225	2392221
Female	Previously Married	Some college	White	32902883	359337	635974
Male	Previously Married	High School Degree	White	27797327	302451	1249403
Female	Previously Married	University Degree	White	24120868	264316	447216
Male	Never married	High School Degree	White	20565524	211906	362274
Male	Previously Married	Some college	White	17811212	190300	335057
Male	Married	High School Degree	Hispanic	17226338	137738	175816
Male	Never married	University Degree	White	14920739	149388	97199
Female	Never married	University Degree	White	14812759	151326	82532
Female	Married	High School Degree	Hispanic	14708957	125130	86831
Male	Previously Married	University Degree	White	14182191	151741	356890
Male	Never married	Some college	White	13843696	135227	99148
Female	Never married	High School Degree	White	10999200	112534	184608
Male	Never married	High School Degree	Black	10333675	88445	160929
Female	Never married	Some college	White	10215404	98908	60853
Female	Previously Married	High School Degree	Black	10203879	94565	311471

Male	Married	High School Degree	Black	10156340	90521	200843
Female	Never married	High School Degree	Black	9065577	68938	104936
Female	Previously Married	High School Degree	Hispanic	8063237	66729	188782
Female	Married	High School Degree	Black	7435557	66157	84602
Male	Married	Some college	Black	7425467	62515	65375
Female	Previously Married	Some college	Black	7322770	63415	88442
Female	Married	Some college	Black	6998572	59546	38102
Female	Never married	Some college	Black	6983633	50327	32578
Male	Never married	High School Degree	Hispanic	6690618	47355	69994
Female	Married	Some college	Hispanic	6527005	60788	18111
Male	Previously Married	High School Degree	Black	6477429	57716	192928
Female	Married	University Degree	Black	6459747	54589	23196
Male	Married	Some college	Hispanic	6279462	55832	34032
Male	Married	University Degree	Black	5908213	49060	40057
Female	Married	University Degree	Hispanic	5633224	54995	10453
Male	Married	University Degree	Hispanic	5233965	48507	23944
Male	Never married	Some college	Black	4811639	35928	29410
Female	Never married	High School Degree	Hispanic	4773001	34738	39504
Male	Previously Married	High School Degree	Hispanic	4690290	36834	110650
Female	Never married	University Degree	Black	4354679	33785	17247
Female	Previously Married	University Degree	Black	4234812	37264	51922
Male	Previously Married	Some college	Black	3655608	30464	42210
Female	Previously Married	Some college	Hispanic	3354669	29023	25469
Male	Never married	University Degree	Black	2370937	16641	11770
Male	Never married	Some college	Hispanic	2311178	17277	10096
Female	Never married	Some college	Hispanic	2106611	16385	6442

Female	Previously Married	University Degree	Hispanic	1909787	17160	15708
Male	Previously Married	Some college	Hispanic	1813411	14974	17806
Male	Previously Married	University Degree	Black	1709291	13848	22913
Female	Never married	University Degree	Hispanic	1528738	13253	4152
Male	Never married	University Degree	Hispanic	1450233	11650	4753
Male	Previously Married	University Degree	Hispanic	1017193	8634	11014

Source: MCDD [1] for total deaths and ACS [2] for population and sample sizes.

D. Lifespan variation

In Figure D1, we show the relation between lifespan variation, measured with e-dagger [3], and the outsurvival statistic, measuring the probability that someone from a subpopulation outlives a random individual in the U.S. (based on the total U.S. lifespan distribution) [4]. E-dagger measures the average number of years of life lost between age 30 and 90. For all U.S. subpopulations, lifespan variation remains. In addition, there is overlap between lifespan distributions from all subpopulations. The probability for someone in each subpopulation to outlive someone at random in the U.S. varies between 29% and 65%. The probability for someone in each subpopulation to outlive someone from the subpopulations with the highest partial life expectancy varies between 19% and 52%. This means that dividing the U.S. population into 54 groups does not fully explain the total lifespan variation.

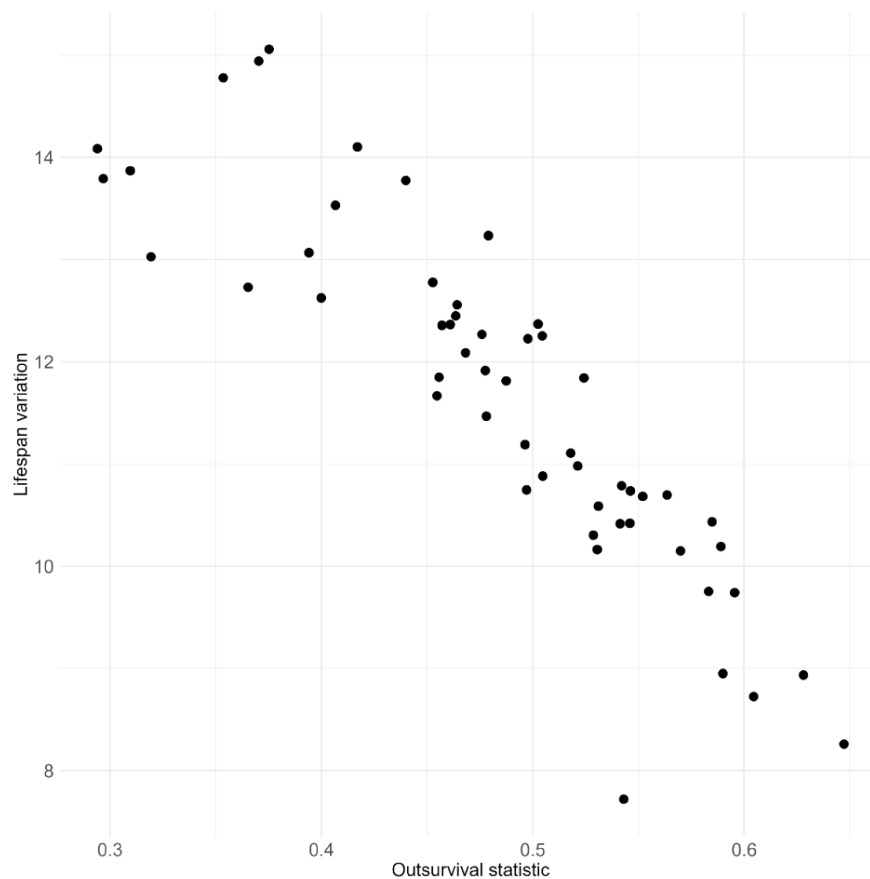


Figure D1. Lifespan variation and outsurvival statistic for 54 U.S. subpopulations
Source: MCDD [1], ACS [2] and authors' own calculation.

E. Correlation between the standard deviation of the death rates and the range of the scores

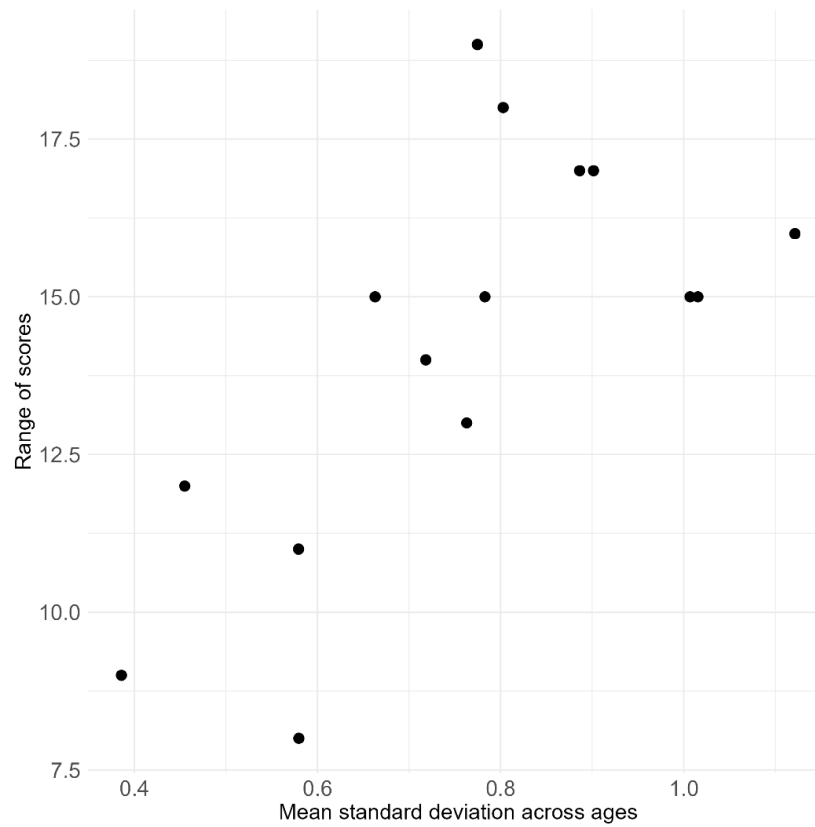


Figure E1. Relation between the range of the scores for each cause of death and the mean age-specific standard deviation of the death rates.
Source: MCDD [1], ACS [2] and authors' own calculation.

F. Causes of death scores for selected subpopulations

Table F. Score for specific subpopulations with an all-cause score of -3, their cumulated mortality risks, the total cumulated risk in the U.S. and the coefficient of determination of the scoring model (R^2).

	F,Pm,Hd,W		M,Ma,Hd,H		M,Pm,Sa,B		M,Nm,Sa,H		M,Nm,Ud,B		Tot. Risk	R^2
	Score	Risk	Score	Risk	Score	Risk	Score	Risk	Score	Risk		
Heart	0	37.6	-1	37.6	-3	37.1	-1	46.1	-3	52.1	32.6	0.72
Lung C.	-1	11.3	2	6.5	2	6.5	5	5.3	4	6.0	7.2	0.49
Breast C.	0	4.1	-	-	-	-	-	-	-	-	3.3	0.30
Prostate C.	-	-	-2	4.8	-5	6.5	0	3.8	-5	7.7	4.4	0.50
Other C.	-3	8.4	-2	8.0	3	5.9	1	3.8	1	6.8	6.5	0.43
Accidents	0	8.1	0	5.8	0	4.9	-1	7.2	2	5.0	5.5	0.70
CLRD	-4	16.8	1	6.2	0	5.6	1	6.9	2	4.5	8.9	0.54
Cerebrovasc.	0	9.9	-1	10.0	-2	8.3	0	11.6	-1	10.8	7.9	0.57
Alzheimer	-4	9.3	-2	7.0	2	4.4	0	8.6	0	5.6	7.1	0.18
Diabetes	0	4.6	-2	8.0	-4	6.8	-4	7.4	-3	7.9	4.0	0.67
Kidney	-1	3.1	-2	3.9	-5	4.6	-2	2.7	-4	4.3	2.7	0.61
Influenza	-1	3.5	0	3.5	1	2.9	0	5.7	0	4.2	2.8	0.58
Suicide	3	1.2	2	1.0	2	0.6	0	1.3	2	0.8	1.2	0.73
Liver	1	2.2	-1	3.7	4	0.9	-1	3.0	6	0.9	1.4	0.65
Homicide	0	0.3	-2	0.4	-5	0.7	-2	0.4	-4	0.6	0.3	0.55

Source: MCDD [1], ACS [2] and authors' own calculation.

Note: Sex: female (F), male (M); Marital status: married (Ma), previously married (Pm), never-married (Nm); Education: high school diploma or less (Hd), some college or associate degree (Sa), and university degree (Ud); Race: Black (B), Hispanic-White (H), and non-Hispanic White (W).

References

- 1 National Vital Statistics System. Multiple Cause of Death File 2015-2019. National Center for Health Statistics. 2022.
- 2 U.S. Census Bureau. 2015-2019 American Community Survey 5-year estimates. Public Use Microdata Sample. 2022. <https://data.census.gov/mdat/#/search?ds=ACSPUMS5Y2019>
- 3 Vaupel JW, Romo VC. Decomposing change in life expectancy: A bouquet of formulas in honor of Nathan Keyfitz's 90th birthday. *Demography*. 2003;40:201–16.
- 4 Vaupel JW, Bergeron-Boucher M-P, Kashnitsky I. Outsurvival as a measure of the inequality of lifespans between two populations. *DemRes*. 2021;44:853–64.