

Supplementary Material

The role of education and ethnicity on amenable mortality due to five leading non-communicable diseases among blacks and whites in the United States, 1990-2015

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Background General mortality consistently declined in the United States (US) from 1969 to 2013. During the same period, a decrease has been described in the percentage of deaths attributed to main non-communicable diseases (NCD) including heart disease, cancer, chronic obstructive pulmonary disease (COPD), cardiovascular disease (CVD), cerebrovascular diseases and diabetes. Amenable mortality trend and pace has been proposed as a good indicator of health care performance. We aimed to measure the impact of attained education and ethnicity on amenable mortality caused by cancer, CVD, COPD, cerebrovascular disease and diabetes among Non-Hispanic Whites (NHW) and Non-Hispanic Blacks (NHB) in the US from 1990 to 2015.

Methods We analyzed data from death certificates downloaded from the US National Center for Health Statistics using a modified version of the Nolte's list of amenable mortality causes related to appropriate health care. The US Population estimates (1990 to 2015) by age, gender and ethnicity came from the US Census Bureau. We analyzed annual percentage changes in age-standardized mortality rates for cancer, CVD, COPD, cerebrovascular disease and diabetes for the period 1990-2015.

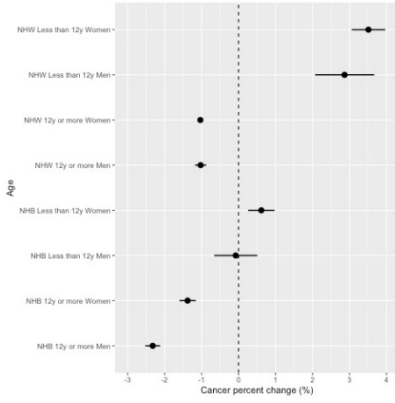
Results Between the time periods of 1990 and 2015, age-adjusted amenable mortality rates due to the five studied causes of death increased among the uneducated, while it decreased among the most educated in both sexes and races. Age-standardized NCD amenable mortality rates were higher among the least educated NHB and NHW males, compared to NHB and NHW females respectively during the entire period. The least educated NHW men and women born in the 1980's presented cancer amenable mortality rates almost 3 times higher than those NHW men and women born in 1955; however, among the most educated NHW individuals, no significant differences were found in amenable mortality across birth cohorts. No notable variation was observed among NHB born before or after 1955, a finding that was consistent for all five studied diseases as well as the combined adjusted-amenable mortality rate. NHW men and women showed the greatest gap between the most and the least educated. Findings also demonstrated that a disparate cohort and year of death effect between the most and the least educated groups widened the gap in cause specific amenable mortality risk and ratio among NHW.

Conclusions Our analysis showed a strong effect of attained education as a key factor for developing and directing health programs aiming to decrease NCD mortality among predominant US races. This reality calls for interventions targeting disadvantaged groups, to remove barriers to quality healthcare, and a healthy longer life. Assertive policy efforts should be made in the US to implement universal healthcare that includes quality curative medicine and innovative preventive services for all, thereby reducing the growing disparities in segments of the population and leading to a more efficient use of available resources.

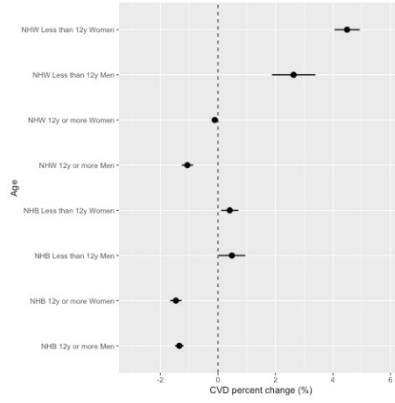
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Figure S5. Percent changes in age-adjusted amenable mortality (X100,000, 95%-CI) due to cancer, CVD, COPD, Cerebrovascular Disease and Diabetes in the United States by gender and ethnicity, 1989-2015.

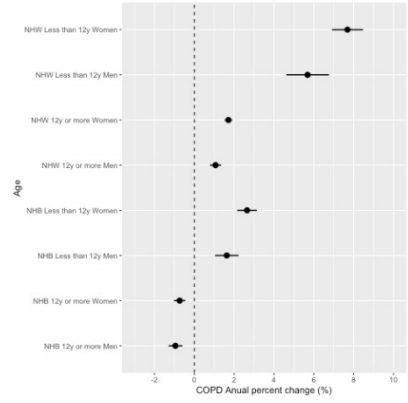
A. Cancer



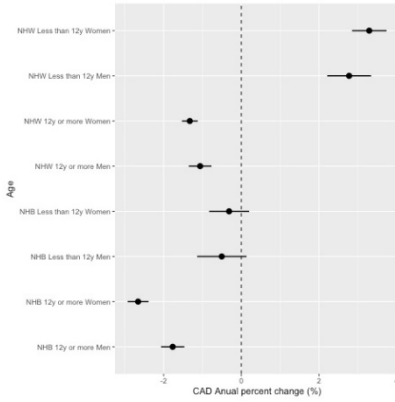
B. CVD



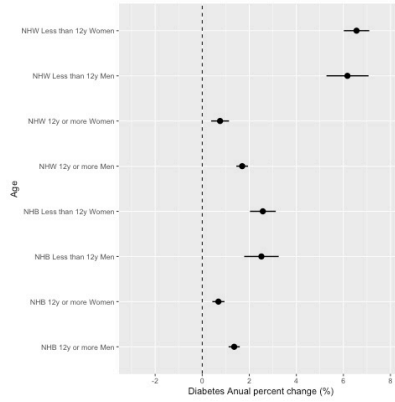
C. COPD



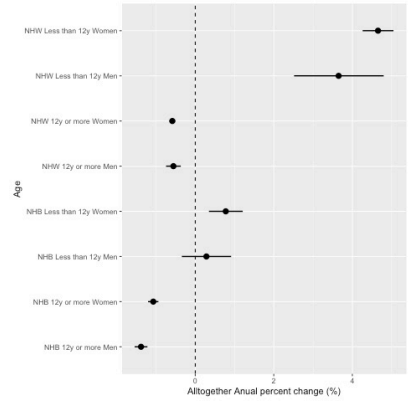
D. Cerebrovascular



E. Diabetes



G. All Five Diseases



Footnote: NHW: Non-Hispanic Whites; NHB: Non-Hispanic Blacks; CVD: Cardiovascular disease; COPD: Chronic obstructive Pulmonary Disease

Table S3. Amenable mortality (number, rate X 1,000,000, 95%-CI) due to Cancer by education and gender, the United States, 1990-2015.

	EDUCATION									
	LESS THAN 12 YEARS					12 YEARS & MORE				
	No. Deaths	Year Average	Rate	95%-CI		No. Deaths	Year Average	Rate	95%-CI	
			Low	High				Low	High	
MEN	NON-HISPANIC WHITES									
1990-1994	178,054	35,611	111.9	98.4	127.3	434,706	86,941	79.5	77.2	82.0
1995-1999	157,655	31,531	130.8	114.4	149.5	473,443	94,689	79.3	76.9	81.7
2000-2004	133,156	26,631	166.5	143.3	193.4	485,465	97,093	76.3	73.8	78.8
2005-2009	114,494	22,899	182.3	153.6	216.4	505,976	101,195	70.2	67.8	72.8
2010-2015	123,955	20,659	192.1	158.1	233.3	675,405	112,568	65.3	62.8	67.9
WOMEN										
1990-1994	117,517	23,503	99.3	92.1	107.0	402,064	80,413	87.5	86.4	88.7
1995-1999	106,024	21,205	117.4	108.5	126.9	435,831	87,166	87.7	86.5	88.9
2000-2004	91,724	18,345	161.4	147.9	176.1	441,893	88,379	83.6	82.4	84.8
2005-2009	78,909	15,782	178.1	161.3	196.6	454,091	90,818	77.1	75.9	78.4
2010-2015	82,412	13,735	191.0	171.1	213.3	588,649	98,108	72.0	70.7	73.2
MEN	NON-HISPANIC BLACKS									
1990-1994	44,456	8,891	177.4	161.1	195.3	44,677	8,935	138.8	133.1	144.8
1995-1999	41,457	8,291	205.1	185.3	227.0	56,077	11,215	134.0	128.5	139.6
2000-2004	35,458	7,092	196.1	174.9	220.0	62,161	12,432	116.9	111.9	122.1
2005-2009	32,387	6,477	183.4	160.9	209.1	69,388	13,878	100.7	96.0	105.6
2010-2015	37,172	6,195	183.9	158.7	213.2	101,504	16,917	89.0	84.6	93.7
WOMEN										
1990-1994	26,168	5,234	117.3	109.5	125.5	43,963	8,793	125.6	119.5	132.0
1995-1999	25,316	5,063	131.0	122.2	140.5	57,686	11,537	133.4	127.2	139.9
2000-2004	22,025	4,405	130.8	121.2	141.2	64,817	12,963	118.4	112.7	124.4
2005-2009	19,817	3,963	129.2	118.9	140.5	72,016	14,403	106.1	100.7	111.8
2010-2015	22,812	3,802	137.6	125.7	150.7	105,060	17,510	99.5	94.3	105.1

Footnote: 95%CI: 95% Confidence Intervals

Table S4. Amenable mortality (number, rate X 1,000,000, 95%-CI) due to cardiovascular disease by education and gender, the United States, 1990-2015.

EDUCATION										
	LESS THAN 12 YEARS					12 YEARS & MORE				
	No. Deaths	Year Average	Rate	95%-CI		No. Deaths	Year Average	Rate	95%-CI	
				Low	High				Low	High
MEN										
NON-HISPANIC WHITES										
1990-1994	198,887	39,777	168.9	148.0	192.7	444,402	88,880	101.3	97.5	105.2
1995-1999	166,758	33,352	201.9	176.1	231.5	455,111	91,022	104.8	100.8	108.8
2000-2004	127,301	25,460	249.4	214.3	290.4	420,654	84,131	98.2	94.1	102.4
2005-2009	101,748	20,350	263.2	222.1	312.0	403,045	80,609	88.0	84.0	92.1
2010-2015	109,364	18,227	283.0	235.0	340.8	533,894	88,982	84.6	80.5	89.0
WOMEN										
1990-1994	104,115	20,823	60.1	55.3	65.3	214,529	42,906	28.7	28.1	29.3
1995-1999	87,770	17,554	80.4	73.9	87.4	223,440	44,688	32.9	32.2	33.6
2000-2004	69,001	13,800	115.7	105.7	126.7	203,265	40,653	32.4	31.7	33.1
2005-2009	53,435	10,687	128.6	116.4	142.1	188,693	37,739	29.7	29.0	30.4
2010-2015	54,888	9,148	142.4	127.8	158.7	250,911	41,819	29.4	28.7	30.1
MEN										
NON-HISPANIC BLACKS										
1990-1994	45,785	9,157	237.9	216.3	261.7	49,079	9,816	197.3	190.4	204.4
1995-1999	42,708	8,542	289.0	262.2	318.5	63,944	12,789	209.4	202.5	216.6
2000-2004	36,170	7,234	289.7	260.7	322.0	71,297	14,259	193.2	186.6	200.0
2005-2009	31,935	6,387	272.2	242.6	305.4	77,738	15,548	170.3	164.2	176.6
2010-2015	35,911	5,985	276.7	245.1	312.5	112,230	18,705	156.0	150.4	161.9
WOMEN										
1990-1994	32,609	6,522	124.7	117.0	132.8	38,294	7,659	95.5	91.1	100.2
1995-1999	29,721	5,944	144.3	135.3	153.8	49,760	9,952	108.4	103.7	113.4
2000-2004	24,560	4,912	149.3	139.4	160.0	54,534	10,907	99.1	94.7	103.8
2005-2009	19,602	3,920	138.3	128.3	149.0	54,594	10,919	82.8	78.9	87.0
2010-2015	20,845	3,474	141.1	130.4	152.7	76,505	12,751	75.6	72.0	79.5

Footnote: 95%CI: 95% Confidence Intervals

Table S5. Amenable mortality (number, rate X 1,000,000, 95%-CI) due to cerebrovascular disease by education and gender, the United States, 1990-2015.

	EDUCATION									
	LESS THAN 12 YEARS					12 YEARS & MORE				
	No. Deaths	Year Average	Rate	95%-CI		No. Deaths	Year Average	Rate	95%-CI	
			Low	High				Low	High	
MEN	NON-HISPANIC WHITES									
1990-1994	22,690	4,538	14.0	12.6	15.6	48,101	9,620	8.5	8.0	9.0
1995-1999	20,640	4,128	17.6	15.8	19.6	52,658	10,532	9.1	8.5	9.6
2000-2004	16,837	3,367	22.5	20.0	25.3	50,964	10,193	8.7	8.2	9.3
2005-2009	12,901	2,580	23.0	20.2	26.2	48,449	9,690	7.6	7.1	8.1
2010-2015	13,822	2,304	24.3	21.1	28.0	64,168	10,695	7.1	6.6	7.6
WOMEN										
1990-1994	19,180	3,836	11.7	10.7	12.7	46,071	9,214	7.6	7.3	7.9
1995-1999	17,441	3,488	15.2	14.0	16.6	50,325	10,065	8.1	7.8	8.5
2000-2004	14,134	2,827	20.8	19.0	22.9	47,399	9,480	7.6	7.3	8.0
2005-2009	10,574	2,115	21.3	19.2	23.6	43,423	8,685	6.6	6.3	6.9
2010-2015	10,625	1,771	22.2	19.9	24.8	54,911	9,152	6.0	5.7	6.3
MEN	NON-HISPANIC BLACKS									
1990-1994	9,232	1,846	47.4	42.2	53.2	8,479	1,696	35.4	33.1	37.8
1995-1999	8,917	1,783	56.1	49.8	63.2	11,042	2,208	36.1	33.9	38.4
2000-2004	7,575	1,515	53.5	46.8	61.0	12,425	2,485	32.8	30.7	35.1
2005-2009	6,468	1,294	46.6	40.2	54.1	13,611	2,722	28.7	26.7	30.8
2010-2015	7,186	1,198	45.8	39.0	53.8	19,193	3,199	25.4	23.6	27.3
WOMEN										
1990-1994	7,559	1,512	31.4	28.4	34.7	9,270	1,854	26.7	25.1	28.4
1995-1999	7,109	1,422	35.9	32.5	39.8	11,736	2,347	27.5	25.9	29.2
2000-2004	5,826	1,165	35.0	31.3	39.1	13,000	2,600	24.1	22.7	25.6
2005-2009	4,783	957	32.0	28.3	36.1	12,843	2,569	19.3	18.1	20.6
2010-2015	4,999	833	30.8	27.0	35.1	16,884	2,814	16.3	15.2	17.4

Footnote: 95%CI: 95% Confidence Intervals

Table S6. Amenable mortality (number, rate X 1,000,000, 95%-CI) due to Chronic Obstructive Pulmonary Disease by education and gender, the United States, 1990-2015.

EDUCATION										
	LESS THAN 12 YEARS					12 YEARS & MORE				
	No. Deaths	Year Average	Rate	95%-CI		No. Deaths	Year Average	Rate	95%-CI	
				Low	High				Low	High
MEN										
NON-HISPANIC WHITES										
1990-1994	37,024	7,405	11.4	9.7	13.4	52,529	10,506	3.4	3.2	3.6
1995-1999	35,747	7,149	15.3	12.9	18.0	59,583	11,917	3.8	3.6	4.0
2000-2004	32,665	6,533	21.7	18.0	26.1	62,281	12,456	4.0	3.8	4.2
2005-2009	31,176	6,235	28.0	22.6	34.7	69,208	13,842	4.1	3.9	4.4
2010-2015	37,530	6,255	33.6	26.2	43.1	102,662	17,110	4.2	4.0	4.6
WOMEN										
1990-1994	24,500	4,900	10.0	8.9	11.2	50,152	10,030	3.3	3.2	3.4
1995-1999	27,459	5,492	15.0	13.3	16.8	59,612	11,922	3.9	3.7	4.0
2000-2004	28,504	5,701	24.7	21.7	28.1	64,773	12,955	4.3	4.1	4.4
2005-2009	28,770	5,754	32.9	28.3	38.2	71,209	14,242	4.4	4.3	4.6
2010-2015	36,519	6,087	43.0	36.1	51.1	104,603	17,434	4.7	4.5	4.9
MEN										
NON-HISPANIC BLACKS										
1990-1994	4,519	904	12.4	10.9	14.2	3,819	764	8.5	7.8	9.3
1995-1999	4,399	880	15.5	13.6	17.7	5,085	1,017	9.0	8.3	9.8
2000-2004	4,058	812	16.1	14.1	18.5	5,739	1,148	8.4	7.7	9.1
2005-2009	3,813	763	15.8	13.7	18.3	6,501	1,300	7.6	6.9	8.3
2010-2015	4,904	817	18.4	15.7	21.5	10,619	1,770	7.3	6.7	8.0
WOMEN										
1990-1994	2,413	483	9.4	8.4	10.4	3,270	654	7.0	6.5	7.5
1995-1999	2,654	531	11.4	10.2	12.7	4,911	982	8.3	7.8	8.9
2000-2004	2,491	498	12.3	11.0	13.7	5,470	1,094	7.1	6.7	7.6
2005-2009	2,556	511	13.5	12.0	15.2	6,273	1,255	6.5	6.0	6.9
2010-2015	3,404	567	16.5	14.6	18.7	10,372	1,729	6.6	6.2	7.1

Footnote: 95%CI: 95% Confidence Intervals

Table S7. Amenable mortality (number, rate X 1,000,000, 95%-CI) due to diabetes by education and gender, the United States, 1990-2015.

	EDUCATION									
	LESS THAN 12 YEARS					12 YEARS & MORE				
	No. Deaths	Year Average	Rate	95%-CI		No. Deaths	Year Average	Rate	95%-CI	
			Low	High				Low	High	
MEN										
NON-HISPANIC WHITES										
1990-1994	5,231	1,046	6.2	5.2	7.3	14,969	2,994	4.0	3.8	4.2
1995-1999	5,684	1,137	8.7	7.5	10.3	19,972	3,994	4.6	4.4	4.8
2000-2004	6,406	1,281	15.6	13.2	18.3	25,764	5,153	5.3	5.1	5.6
2005-2009	6,468	1,294	16.8	14.1	19.9	29,748	5,950	5.4	5.1	5.6
2010-2015	7,716	1,286	19.9	16.7	23.7	40,479	6,747	5.7	5.4	6.0
WOMEN										
1990-1994	4,735	947	4.6	4.1	5.1	11,477	2,295	2.5	2.3	2.7
1995-1999	4,722	944	6.3	5.7	7.0	14,580	2,916	2.9	2.7	3.1
2000-2004	4,717	943	12.6	11.4	14.0	17,114	3,423	3.1	2.9	3.4
2005-2009	4,251	850	13.4	12.0	14.9	18,094	3,619	2.9	2.7	3.2
2010-2015	4,494	749	15.5	13.9	17.3	23,896	3,983	3.0	2.8	3.3
MEN										
NON-HISPANIC BLACKS										
1990-1994	2,385	477	14.5	12.5	16.8	3,470	694	10.3	9.8	10.9
1995-1999	2,671	534	17.7	15.3	20.4	5,554	1,111	13.3	12.7	13.9
2000-2004	2,768	554	20.7	17.8	24.0	7,256	1,451	14.1	13.5	14.8
2005-2009	2,750	550	23.3	20.0	27.2	8,619	1,724	13.8	13.2	14.5
2010-2015	3,316	553	23.5	20.2	27.5	12,831	2,139	14.2	13.5	14.8
WOMEN										
1990-1994	2,715	543	10.8	9.7	12.1	3,939	788	7.2	6.8	7.6
1995-1999	2,818	564	14.0	12.5	15.6	5,994	1,199	9.3	8.8	9.8
2000-2004	2,661	532	16.7	14.9	18.6	6,839	1,368	9.7	9.2	10.2
2005-2009	2,201	440	17.4	15.4	19.6	7,387	1,477	8.7	8.3	9.2
2010-2015	2,535	423	18.3	16.3	20.6	10,312	1,719	8.8	8.4	9.3

Footnote: 95%CI: 95% Confidence Intervals

Table S8. Amenable mortality (number, rate X 1,000,000, 95%-CI) due to NCDs (Cancer, CVD, COPD, Cerebrovascular Disease & Diabetes) by education and gender, the United States, 1990-2015.

	EDUCATION									
	LESS THAN 12 YEARS					12 YEARS & MORE				
	No. Deaths	Year Average	Rate	95%-CI		No. Deaths	Year Average	Rate	95%-CI	
			Low	High				Low	High	
MEN	NON-HISPANIC WHITES									
1990-1994	453,958	90,792	175.6	146.4	210.5	1,026,434	205,287	129.5	125.2	134.0
1995-1999	397,670	79,534	221.1	186.0	262.8	1,096,471	219,294	128.9	124.8	133.1
2000-2004	327,318	65,464	321.0	266.8	386.3	1,085,053	217,011	127.9	123.6	132.3
2005-2009	277,444	55,489	325.1	263.8	400.5	1,102,196	220,439	120.4	116.0	125.0
2010-2015	306,775	51,129	354.9	282.8	445.4	1,487,530	247,922	116.5	112.0	121.2
WOMEN										
1990-1994	275,257	55,051	359.0	321.9	400.3	740,892	148,178	244.7	236.8	252.8
1995-1999	248,264	49,653	376.8	338.9	419.1	801,332	160,266	248.7	241.2	256.4
2000-2004	212,832	42,566	386.1	344.0	433.4	794,309	158,862	227.8	220.7	235.0
2005-2009	180,536	36,107	394.2	347.0	447.8	798,002	159,600	203.5	196.8	210.5
2010-2015	195,107	32,518	376.8	329.5	430.8	1,060,495	176,749	191.1	184.7	197.7
MEN	NON-HISPANIC BLACKS									
1990-1994	109,898	21,980	91.5	86.2	97.2	114,007	22,801	96.3	90.3	102.5
1995-1999	102,972	20,594	93.5	88.5	98.8	146,718	29,344	110.5	104.5	116.8
2000-2004	88,419	17,684	93.2	88.4	98.4	163,786	32,757	93.1	88.2	98.4
2005-2009	79,448	15,890	90.3	85.6	95.4	180,707	36,141	80.2	75.9	84.7
2010-2015	91,086	15,181	88.6	83.9	93.5	263,720	43,953	76.8	72.8	81.1
WOMEN										
1990-1994	73,175	14,635	136.4	128.0	145.4	101,278	20,256	112.5	111.0	113.9
1995-1999	68,981	13,796	163.5	153.8	173.7	132,580	26,516	114.6	113.2	116.0
2000-2004	58,679	11,736	271.0	254.0	289.3	147,236	29,447	111.7	110.3	113.2
2005-2009	49,899	9,980	280.4	260.7	301.5	155,636	31,127	104.9	103.4	106.5
2010-2015	55,875	9,313	324.8	300.5	351.0	223,390	37,232	101.5	100.0	103.1

Footnote: 95%CI: 95% Confidence Intervals; NCD: Non-communicable diseases; CVD: Cardiovascular diseases; COPD: Chronic obstructive pulmonary disease