

# Widening socioeconomic inequalities in US life expectancy, 1980–2000

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**Background** This study examines changes in the extent of inequalities in life expectancy at birth and other ages in the United States between 1980 and 2000 by gender and socioeconomic deprivation levels.

**Methods** A factor-based deprivation index consisting of 11 education, occupation, wealth, income distribution, unemployment, poverty, and housing quality indicators was used to define deprivation deciles, which were then linked to the US mortality data at the county-level. Life expectancy estimates were developed by age, gender, and deprivation levels for three 3 year time periods: 1980–82, 1989–91, and 1998–2000. Inequalities in life expectancy were measured by the absolute difference between the least-deprived group and each of the other deprivation deciles. Slope indices of inequality for each gender and time period were calculated by regressing life expectancy estimates on deprivation levels using weighted least squares models.

**Results** Those in less-deprived groups experienced a longer life expectancy at each age than their counterparts in more-deprived groups. In 1980–82, the overall life expectancy at birth was 2.8 years longer for the least-deprived group than for the most-deprived group (75.8 vs 73.0 years). By 1998–2000, the absolute difference in life expectancy at birth had increased to 4.5 years (79.2 vs 74.7 years). The inequality indices showed a substantial widening of the deprivation gradient in life expectancy during the study period for both males and females.

**Conclusions** Between 1980 and 2000, those in higher socioeconomic groups experienced larger gains in life expectancy than those in more-deprived groups, contributing to the widening gap.

**Keywords** Life expectancy, deprivation, social inequality, trend, United States.

Ever since the launch of the national health initiative, *Healthy People 2000*, in 1990, one of the two overarching health goals of the US Department of Health and Human Services has been to reduce and ultimately eliminate health inequalities among various segments of the US population, including those among gender, ethnic, socioeconomic, and geographic groups. The other broad health goal for the nation seeks to increase life expectancy and quality of life among Americans of all ages.<sup>1</sup>

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Partly as a result of this initiative, monitoring of health inequalities among ethnic, gender, and geographic groups has become increasingly common in the United States, although studies showing health inequalities over time in relation to socioeconomic position or area-based deprivation are still relatively rare. The declaration of a strong governmental commitment to reducing health inequalities notwithstanding, existing studies have shown persistent and often increasing socioeconomic inequalities in health, particularly in all-cause, cardiovascular, and cancer mortality.<sup>2–6</sup> These efforts to examine health inequalities have involved the analysis of US mortality data, using age-adjusted death rates or relative mortality risks to measure socioeconomic gradients in mortality.<sup>2–6</sup> To our knowledge, no attempt has yet been made to conduct a systematic analysis of how socioeconomic inequalities in US life expectancy have changed in recent decades.

Life expectancy is a more easily understood summary index of mortality than the age-standardized mortality rate and can be easily used to document both absolute and relative inequalities in survival between social class and deprivation groups. The aim of this paper is to examine changes in the extent of inequalities in US life expectancy between 1980 and 2000 by age, sex, and area socioeconomic deprivation.

## Methods

To analyse temporal inequalities in US life expectancy, we used two national data sources, the national mortality database—a component of the National Vital Statistics System—and the decennial census.<sup>7–10</sup> Since the mortality database lacks reliable socioeconomic data, socioeconomic patterns in life expectancy were derived indirectly by linking county-level socioeconomic data from the 1990 decennial census with the national mortality data.<sup>4–6</sup> We used a factor-based deprivation index that consisted of 11 census-based social indicators, which may be viewed to broadly represent educational opportunities, labour force skills, economic, and housing conditions in a given county. Selected indicators of education, occupation, wealth, income distribution, unemployment rate, poverty rate, and housing quality were used to construct the index.<sup>4–6</sup> The factor loadings (correlations of indicators with the index) ranged from 0.90 for median family income to 0.57 for unemployment rate.<sup>6</sup> Substantive and methodological details underlying the construction of the US deprivation index are provided elsewhere.<sup>4–6</sup>

From a theoretical standpoint, the US deprivation index appears to be more comprehensive than the widely used Townsend index for the UK, which comprises only such variables as car ownership, housing tenure, household crowding, and unemployment rate.<sup>11</sup> The US index with a more diverse set of indicators, although not as sophisticated as the Breadline Britain index or the UK index of multiple deprivation,<sup>12–14</sup> is more likely than the Townsend index to capture both absolute and distributive aspects of general living conditions and socioeconomic disadvantage in a community. Besides county, the US deprivation index was constructed at the census tract and zip code levels for 1970, 1980, and 1990 censuses.<sup>4–6</sup>

To analyse trends in life expectancy, we used the weighted population decile distribution of the 1990 deprivation index that classified all US counties into 10 groups of approximately equal population size. The groups thus created ranged from being the most-deprived (first decile) to the least-disadvantaged (10th decile) population groups. A majority of the deprived counties were concentrated in the southern region of the US, whereas many of the affluent counties were located in the north-eastern and western regions of the US.<sup>4–6</sup> The 1990 index was used to compute life expectancy estimates for 3-year time periods: 1980–82, 1989–91, and 1998–2000. Age-, sex-, and county-specific deaths for 1980–82, 1989–91, and 1998–2000 were obtained using the national mortality database,<sup>7,8</sup> whereas age-, sex-, and county-specific population estimates for the same time periods, developed by the US Census Bureau, served as denominators for computing age-specific mortality rates.<sup>9,10</sup> Each of the 3097 counties in the mortality

database was assigned one of the 10 deprivation categories. In the case of Alaska and Hawaii, state-level rather than county-level data were used. Life table estimates were calculated by the standard life table methodology by converting observed age-specific mortality rates (for 19 age groups: <1, 1–4, 5–9, . . . , 80–84, and ≥85 years) into life table probabilities of dying.<sup>15</sup> Infant mortality rate was used to approximate the probability of dying in the first year of life.

Inequalities in life expectancy at birth and at other ages were measured by the absolute difference in life expectancy between the least-deprived group and each of the other deprivation groups. Inequalities across sex and time periods were also measured in relative terms by the percentage change in life expectancy. We also calculated summary indices of inequality for each sex and time period by regressing life expectancy estimates on deprivation levels (deprivation deciles treated as a continuous variable) using weighted least squares regression models, where weights were the population sizes in each deprivation category. Since the deprivation deciles were approximately equal in population size, the weighted and unweighted slope indices of inequality were identical.

## Results

Table 1 presents selected socioeconomic, demographic, and health characteristics of 10 area deprivation groups from 1980 to 2000, whereas Table 2 lists the top 20 and bottom 20 counties in terms of socioeconomic deprivation scores for the 1980, 1990, and 2000 census deprivation indices.<sup>10,16</sup> A complete list of counties belonging in each deprivation group is available from the authors. Descriptive data in Table 1 indicate the relative stability and robustness of the county deprivation groups between 1980 and 2000. Although all deprivation groups experienced improved levels of educational attainment, their relative educational standing remained fairly stable during 1980–2000. Compared with the most-deprived group, the proportion of college graduates in the least-deprived group was about 3 times greater in 1980, 1990, and 2000. Median family income was nearly 2 times higher and median home value 3–4 times higher in the least-deprived group than in the most-deprived group during 1980–2000. The poverty rate was at least 3.7 times higher and unemployment rate at least 1.7 times higher in the most-deprived group than in the least-deprived group. More-deprived groups generally had higher proportions of black and rural residents.

Although infant mortality rates declined substantially in all deprivation groups, socioeconomic gradients in infant mortality appeared to have increased since 1980. Compared with the least-deprived group, the infant mortality rate in the most-deprived group was 1.43, 1.49, and 1.63 times greater in 1980, 1990, and 2000, respectively. The more-deprived groups generally had higher homicide and suicide rates, and the differential in suicide rates between the least-deprived and most-deprived groups appeared to have increased during 1980–2000 (Table 1).

Table 3 presents sex-specific and deprivation-specific number of deaths and life expectancy estimates at birth for the US in 1980–82, 1989–91, and 1998–2000. Life expectancy at birth is defined as the number of years a newborn is expected to live

**Table 1** Selected socioeconomic, demographic, and health characteristics of 10 area deprivation groups, US, 1980–2000

Characteristic	Decile									Decile 10 (Least Deprived)
	Decile 1 (Most Deprived)	Decile 2	Decile 3	Decile 4	Decile 5	Decile 6	Decile 7	Decile 8	Decile 9	
Mean index score, 1990 <sup>a</sup>	81.9	100.6	108.4	114.0	118.9	123.6	128.7	135.7	142.8	158.6
Range (1990 index score)	25.7–95.8	95.9–105.5	105.6–111.4	111.5–116.6	116.7–121.5	121.6–126.0	126.1–132.3	132.4–139.1	139.2–148.2	148.3–177.5
<b>County population size, 1990</b>										
Median	14 007	18 670	30 974	44 915	72 725	96 367	105 110	181 276	259 462	376 396
Minimum	107	462	354	467	5318	2295	2526	7619	12 881	6012
Maximum	591 610	1 203 789	2 111 687	2 300 664	2 818 199	5 105 067	2 122 101	8 863 164	2 498 016	2 410 556
Number of counties, 1990	1221	739	349	258	146	91	116	63	65	49
% Minority population, 1990 <sup>b</sup>	28.6	20.1	26.8	21.2	21.2	26.5	21.6	34.2	22.8	24.3
% Black population, 1990	16.2	11.8	14.9	13.6	12.0	16.1	9.6	10.4	8.7	7.0
<b>% High school graduates</b>										
1980	48.6	58.8	63.0	65.0	67.6	69.3	71.9	71.1	75.1	78.1
1990	59.5	69.0	71.6	74.5	76.1	78.0	79.7	76.7	82.6	84.1
2000	67.0	74.9	79.1	76.2	81.0	80.9	84.3	84.8	86.2	88.4
<b>% College graduates</b>										
1980	8.7	10.7	12.6	13.5	16.0	18.3	18.0	18.9	22.4	25.2
1990	10.1	12.8	15.1	16.6	19.6	22.9	21.9	23.5	28.3	32.2
2000	12.5	16.4	17.8	21.7	22.4	24.8	25.7	30.1	31.6	39.9
<b>Median family income (current \$)</b>										
1980	13 940	16 585	18 241	18 963	19 850	20 499	20 563	21 882	23 105	26 513
1990	22 880	27 307	30 115	32 272	34 725	35 822	37 243	41 495	45 283	53 040
2000	33 984	39 318	42 658	45 966	48 026	50 071	52 420	56 724	63 083	74 098
<b>Median home value (current \$)</b>										
1980	25 500	32 300	36 800	39 100	44 613	46 500	48 750	55 894	64 800	74 100
1990	37 850	43 300	49 200	58 100	65 600	71 300	83 400	95 300	130 900	192 200
2000	53 800	67 000	77 000	86 400	92 600	102 400	110 700	129 800	153 100	200 450
<b>% White collar occupation</b>										
1980	38.5	43.1	48.0	49.6	52.6	56.5	56.1	58.0	60.4	64.1
1990	42.7	47.6	52.6	54.4	57.8	61.4	60.7	62.1	65.9	69.2
2000	48.5	53.0	54.3	58.2	58.6	60.5	61.9	64.7	66.7	71.8
<b>% Families below poverty level</b>										
1980	17.5	11.8	10.6	10.2	8.4	8.8	8.1	7.8	7.1	4.7
1990	19.7	13.2	12.2	10.8	9.5	9.2	7.8	8.0	6.3	3.7
2000	17.9	12.7	9.9	11.3	8.9	8.8	7.2	7.1	5.1	3.9
<b>Unemployment rate</b>										
1980	7.2	6.9	7.2	6.9	5.9	5.8	5.6	5.5	5.3	4.2
1990	9.0	7.4	7.5	6.7	6.2	6.1	5.7	5.9	5.1	4.2
2000	8.8	7.3	6.3	6.8	5.8	6.0	5.1	5.2	4.4	3.6
<b>% Urban population, 1990</b>										
1980	36.6	50.6	70.1	71.7	79.5	88.9	81.5	88.8	85.6	91.4
1990	36.2	50.2	70.3	72.7	80.3	89.6	83.3	89.8	87.1	92.1
2000	50.0	62.0	66.8	84.6	80.3	89.3	84.3	89.2	89.1	94.1

Table 1 Continued

Characteristic	Decile 1 (Most Deprived)									Decile 10 (Least Deprived)
	Decile 2	Decile 3	Decile 4	Decile 5	Decile 6	Decile 7	Decile 8	Decile 9		
<b>% Single-parent households</b>										
1990	10.6	9.7	10.3	10.0	9.6	9.8	9.1	9.2	8.2	7.0
2000	11.2	9.9	9.4	10.2	9.5	9.3	8.9	8.3	8.1	6.4
<b>No. of doctors/10 000 population</b>										
1980	8.4	11.5	15.8	15.9	19.0	22.8	20.3	21.3	26.8	23.4
1990	9.8	13.7	18.6	18.5	22.5	26.4	22.2	23.7	29.4	29.4
2000	10.6	19.5	18.4	23.0	26.2	30.9	24.2	31.2	29.6	37.4
<b>No. of nurses/10 000 population</b>										
1980	28.0	42.9	56.6	58.7	63.3	63.4	63.4	65.8	71.3	72.9
1990	44.2	61.7	69.3	77.3	79.8	80.5	80.4	82.8	90.6	91.5
<b>Infant mortality rate<sup>c</sup></b>										
1980–82	13.4	12.1	12.9	12.3	12.3	13.5	12.0	11.5	10.7	9.7
1989–91	10.9	10.0	10.9	10.4	9.8	11.2	9.4	9.0	8.2	7.3
1998–2000	8.8	8.0	8.3	8.1	7.8	8.1	7.3	6.3	6.2	5.4
<b>Age-adjusted homicide rate<sup>d</sup></b>										
1980–82	12.6	9.6	12.8	9.9	10.7	12.1	8.2	11.2	7.5	4.5
1989–91	11.2	9.6	12.4	9.8	9.7	12.2	7.2	11.1	6.8	4.5
1998–2000	8.1	6.5	8.1	6.4	6.4	8.3	5.6	6.2	4.0	2.9
<b>Age-adjusted suicide rate<sup>d</sup></b>										
1980–82	12.5	12.2	12.5	11.9	13.2	12.4	13.3	12.4	12.9	9.9
1989–91	13.7	13.4	13.4	12.2	13.0	12.8	13.1	11.4	11.8	8.9
1998–2000	12.8	12.3	11.5	11.5	11.2	10.6	11.5	8.9	9.6	7.3

<sup>a</sup> Higher index scores denote higher levels of socioeconomic status and lower levels of deprivation.

<sup>b</sup> Includes blacks, American Indians, Hispanics, Asians & Pacific Islanders.

<sup>c</sup> Rate per 1000 live births.

<sup>d</sup> Rate per 100 000 population and age-adjusted by the direct method to the 2000 US population.

Source: Based on data from the 1980–2000 US decennial censuses, 2003 Area Resource File, and 1980–2000 US National Vital Statistics System.

given the current levels of mortality at various ages. Since the number of deaths used to calculate life expectancies for each sex and deprivation group was quite large, the life expectancy estimates in Table 3 are expected to be quite robust and associated variances extremely small. Life expectancy at birth varied substantially by time period, sex, and deprivation levels—from a low of 68.7 years for men in the most-deprived group in 1980–82 to a high of 81.3 years for women in the least-deprived group in 1998–2000.

In 1980–82, those in less-deprived groups experienced a longer life expectancy at each age than their counterparts in more-deprived groups. In 1980–82, the overall life expectancy at birth was 2.8 years longer for the least-deprived group than for the most-deprived group (75.8 vs 73.0 years). By 1998–2000, the absolute difference in life expectancy at birth had increased to 4.5 years (79.2 vs 74.7 years). Relative differences also increased over the study period; those in the least-deprived group experienced a 3.8% higher life expectancy in 1980–82 and a 6.0% higher life expectancy in 1998–2000 than those in the most-deprived group. The gap in life expectancy at birth between the least-deprived group and the 2nd through 7th most-deprived groups also widened over time. For example, compared with their counterparts in the least-deprived group, those in the third most-deprived group

experienced a shorter life expectancy by 2.0 years in 1980–82, 2.3 years in 1989–91, and 2.5 years in 1998–2000. The index of inequality for the total population, as measured by the unstandardized slope, also showed a widening of the deprivation gradient in life expectancy, increasing from 0.25 in 1980–82 to 0.44 in 1998–2000. The standardized slope or correlation coefficient also increased from 0.94 to 0.98, implying an increasingly stronger association between deprivation levels and life expectancy over time.

Inequalities in life expectancy at birth, as measured by both the absolute and relative differences, were larger for males than for females in each period, and the magnitude of the difference increased over time more for males than for females. For males, the absolute difference in life expectancy at birth between the least-deprived and most-deprived groups increased from 3.8 years in 1980–82 to 5.4 years in 1998–2000. For females, the corresponding absolute differences were 1.3 and 3.3 years in the two time periods, respectively. In terms of the relative differences, men in the least-deprived group enjoyed a 5.5% higher life expectancy in 1980–82 and a 7.6% higher life expectancy in 1998–2000 than those in the most-deprived group. Women in the least-deprived group, on the other hand, had a 1.7% higher life expectancy in 1980–82 and a 4.2% higher life expectancy in 1998–2000 than women

**Table 2** Top 20 and bottom 20 counties in terms of socioeconomic deprivation scores<sup>a</sup> for the 1980, 1990, and 2000 US deprivation indices<sup>b</sup>

1980 Deprivation index			1990 Deprivation index			2000 Deprivation index		
County name	FIPSC	Index score	County name	FIPSC	Index score	County name	FIPSC	Index score
<b>Top 20 counties</b>								
Pitkin County, CO	8097	173.75	Marin County, CA	6041	177.49	Marin County, CA	6041	179.83
Marin County, CA	6041	170.48	Fairfax County, VA	51 059	176.45	Nantucket County, MA	25 019	174.83
Montgomery County, MD	24 031	164.93	Pitkin County, CO	8097	175.68	Douglas County, CO	8035	174.72
Fairfax County, VA <sup>d</sup>	51 059	164.07	Falls Church City, VA	51 610	170.70	Falls Church City, VA	51 610	171.64
Douglas County, CO	8035	158.76	Montgomery County, MD	24 031	170.57	San Mateo County, CA	6081	169.35
San Mateo County, CA	6081	157.50	Morris County, NJ	34 027	167.89	Pitkin County, CO	8097	169.22
Los Alamos County, NM	35 028	157.15	Howard County, MD	24 027	167.37	Santa Clara County, CA	6085	167.30
Howard County, MD	24 027	156.55	Los Alamos County, NM	35 028	166.96	Fairfax County, VA	51 059	166.30
Arlington County, VA	51 013	156.34	San Mateo County, CA	6081	166.93	Loudoun County, VA	51 107	165.45
Du Page County, IL	17 043	154.39	Fairfax City, VA	51 600	166.91	Hunterdon County, NJ	34 019	164.25
Johnson County, KS	20 091	153.78	Somerset County, NJ	34 035	166.86	Los Alamos County, NM	35 028	163.98
Morris County, NJ	34 027	153.23	Hunterdon County, NJ	34 019	165.82	Morris County, NJ	34 027	162.75
Orange County, CA	6059	153.21	Nassau County, NY	36 059	164.53	Howard County, MD	24 027	162.71
Santa Clara County, CA	6085	152.07	Putnam County, NY	36 079	163.50	Somerset County, NJ	34 035	161.39
Alexandria City, VA	51 510	151.58	Arlington County, VA	51 013	163.44	Montgomery County, MD	24 031	158.99
Arapahoe County, CO	8005	150.94	Santa Clara County, CA	6085	162.67	Summit County, UT	49 043	158.77
Eagle County, CO	8037	149.71	Loudoun County, VA	51 107	162.29	Fairfax City, VA	51 600	156.38
Somerset County, NJ	34 035	149.58	Nantucket County, MA	25 019	162.11	Putnam County, NY	36 079	156.27
Summit County, CO	8117	149.38	Rockland County, NY	36 087	161.60	Nassau County, NY	36 059	156.13
Jefferson County, CO	8059	149.32	Bergen County, NJ	34 003	160.42	Norfolk County, MA	25 021	155.31
<b>Bottom 20 counties</b>								
Taliaferro County, GA	13 265	43.11	Elliott County, KY	21 063	49.63	Todd County, SD	46 121	45.48
Casey County, KY	21 045	43.03	Presidio County, TX	48 377	49.59	Dimmit County, TX	48 127	45.26
Rockcastle County, KY	21 203	42.78	Clinton County, KY	21 053	48.48	Wilcox County, AL	1131	45.19
Cumberland County, KY	21 057	41.42	Willacy County, TX	48 489	47.85	Sioux County, ND	38 085	45.05
Jefferson County, MS	28 063	41.42	East Carroll Parish, LA	22 035	47.41	Willacy County, TX	48 489	43.82
Apache County, AZ	4001	40.07	Lee County, KY	21 129	46.98	Wolfe County, KY	21 237	43.70
Zavala County, TX	48 507	39.74	Dimmit County, TX	48 127	46.49	San Juan County, UT	49 037	43.09
Clinton County, KY	21 053	38.23	Clay County, KY	21 051	44.99	Brooks County, TX	48 047	41.60
Leslie County, KY	21 131	37.83	Magoffin County, KY	21 153	44.61	McKinley County, NM	35 031	40.98
Wolfe County, KY	21 237	37.44	Hancock County, TN	47 067	44.39	McDowell County, WV	54 047	38.64
Shannon County, SD	46 113	36.62	Jackson County, KY	21 109	43.68	Maverick County, TX	48 323	37.69
Wayne County, KY	21 231	36.03	Tunica County, MS	28 143	42.73	Hudspeth County, TX	48 229	36.46
McCreary County, KY	21 147	35.69	Wolfe County, KY	21 237	41.28	Clay County, KY	21 051	35.13
Starr County, TX	48 427	31.41	Maverick County, TX	48 323	40.85	Presidio County, TX	48 377	34.45
Clay County, KY	21 051	31.26	McCreary County, TX	21 147	40.20	Shannon County, SD	46 113	33.25
Mora County, NM	35 033	30.82	Apache County, AZ	4001	36.77	Owsley County, KY	21 189	32.55
Tunica County, MS	28 143	29.37	Zavala County, TX	48 507	35.23	Buffalo County, SD	46 017	25.88
Jackson County, KY	21 109	24.62	Owsley County, KY	21 189	31.84	Zavala County, TX	48 507	25.49
Hancock County, TN	47 067	20.95	Shannon County, SD	46 113	30.91	Apache County, AZ	4001	21.45
Owsley County, KY	21 189	15.02	Starr County, TX	48 427	25.72	Starr County, TX	48 427	15.09

<sup>a</sup> Higher index scores denote higher levels of socioeconomic position and lower levels of deprivation.<sup>b</sup> The factor-based deprivation index for each of the 1980, 1990, and 2000 censuses consisted of 11 indicators on education, occupation, wealth, income distribution, unemployment, poverty, and housing quality. Each factor index had a mean value of 100 and a standard deviation of 20.<sup>c</sup> FIPS Code = Federal Information Processing Standards Code.<sup>d</sup> This includes Falls Church City and Fairfax City for the 1980 census.

**Table 3** Number of deaths and life expectancy at birth (in years) by sex and socioeconomic deprivation groups, US, 1980–2000

Socioeconomic Deprivation Group	No. deaths			Life expectancy			Absolute difference in life exp. <sup>a</sup>		
	1980–82	1989–91	1998–2000	1980–82	1989–91	1998–2000	1980–82	1989–91	1998–2000
<b>Both sexes combined</b>									
Decile 1 (most deprived)	743 794	791 137	865 399	73.0	73.9	74.7	2.8	3.5	4.5
Decile 2	691 521	736 585	808 829	73.8	74.8	75.8	2.0	2.6	3.4
Decile 3	681 279	729 795	792 819	73.8	74.8	76.1	2.0	2.6	3.1
Decile 4	621 288	676 803	750 329	74.0	75.1	76.4	1.8	2.3	2.8
Decile 5	590 230	638 730	708 729	74.1	75.4	76.7	1.7	2.0	2.5
Decile 6	579 395	623 712	684 184	73.9	75.2	76.7	1.9	2.2	2.5
Decile 7	517 427	597 159	692 751	74.5	75.9	77.4	1.3	1.5	1.8
Decile 8	526 863	581 969	626 989	74.9	76.3	78.3	0.9	1.1	0.9
Decile 9	509 476	566 192	619 989	75.1	76.4	78.3	0.7	1.0	0.9
Decile 10 (least deprived)	479 498	524 320	580 865	75.8	77.4	79.2	0.0	0.0	0.0
Indices of inequality <sup>b</sup>									
Unstandardized slope <sup>c,d</sup>	0.25	0.32	0.44						
Standardized slope <sup>e</sup>	0.94	0.96	0.98						
<b>Males</b>									
Decile 1 (most deprived)	416 784	423 113	438 978	68.7	69.8	71.5	3.8	4.7	5.4
Decile 2	378 939	386 498	402 095	69.8	71.0	72.8	2.7	3.5	4.1
Decile 3	370 246	381 469	392 945	69.8	71.1	73.1	2.7	3.4	3.8
Decile 4	333 410	347 995	367 319	70.1	71.5	73.5	2.4	3.0	3.4
Decile 5	316 027	327 784	346 626	70.3	71.9	73.9	2.2	2.6	3.0
Decile 6	309 023	320 539	335 473	70.1	71.6	73.8	2.4	2.9	3.1
Decile 7	278 966	310 883	343 604	70.8	72.4	74.7	1.7	2.1	2.2
Decile 8	276 591	298 445	305 607	71.3	72.8	75.7	1.2	1.7	1.2
Decile 9	266 847	289 664	299 702	71.5	73.0	75.8	1.0	1.5	1.1
Decile 10 (least deprived)	247 223	261 346	277 059	72.5	74.5	76.9	0.0	0.0	0.0
Indices of inequality <sup>b</sup>									
Unstandardized slope <sup>c,d</sup>	0.34	0.41	0.52						
Standardized slope <sup>e</sup>	0.95	0.95	0.98						
<b>Females</b>									
Decile 1 (most deprived)	327 010	368 024	426 421	77.5	78.0	78.0	1.3	2.1	3.3
Decile 2	312 582	350 087	406 734	77.9	78.6	78.7	0.9	1.5	2.6
Decile 3	311 033	348 326	399 874	77.7	78.5	78.9	1.1	1.6	2.4
Decile 4	287 878	328 808	383 010	77.8	78.6	79.1	1.0	1.5	2.2
Decile 5	274 203	310 946	362 103	77.9	78.8	79.4	0.9	1.3	1.9
Decile 6	270 372	303 173	348 711	77.7	78.7	79.4	1.1	1.4	1.9
Decile 7	238 461	286 276	349 147	78.2	79.2	80.0	0.6	0.9	1.3
Decile 8	250 272	283 524	321 382	78.4	79.6	80.8	0.4	0.5	0.5
Decile 9	242 629	276 528	320 287	78.5	79.7	80.7	0.3	0.4	0.6
Decile 10 (least deprived)	232 275	262 974	303 806	78.8	80.1	81.3	0.0	0.0	0.0
Indices of inequality <sup>b</sup>									
Unstandardized slope <sup>c,d</sup>	0.12	0.20	0.34						
Standardized slope <sup>e</sup>	0.90	0.96	0.98						

<sup>a</sup> Difference in life expectancy at birth in years between the 10th and each of the other socioeconomic deprivation groups or deciles.

<sup>b</sup> The index of inequality is measured for each 3 year period by the slope or regression coefficient derived by regressing life expectancy at birth on socioeconomic deprivation levels defined in deciles.

<sup>c</sup> Each slope is statistically significantly different from 0 at the 0.01 level.

<sup>d</sup> The difference in slopes between any two 3 year time periods is statistically significant at the 0.01 level.

<sup>e</sup> This is equivalent to the correlation coefficient.

Source: Based on data from the US National Vital Statistics System, 1980–2000.

in the most-deprived group. The slope indices of inequality were larger in magnitude for men than for women, but the consistent increases in the estimated slopes and correlation coefficients during the study period represent increasing area socioeconomic inequalities in life expectancy at birth for both men and women.

Between 1980–82 and 1998–2000, those in higher socioeconomic groups posted larger gains in life expectancy at birth than those in more-deprived groups, contributing to the widening gap. This was apparent for both men and women, but the pattern held much more strongly for men. For men in the most-deprived group, life expectancy at birth increased by 0.23% per year from 1980–82 to 1998–2000, whereas it increased by 0.34% per year for men in the least-deprived group over the same time period. For women in the most-deprived and least-deprived groups, the average annual increases were 0.04 and 0.18%, respectively. The sex difference in life expectancy at birth was higher in more-deprived groups in each time period, and the magnitude of the sex differentials decreased over time across all deprivation groups.

Compared with those in the least-deprived group, those in the most-deprived group generally experienced shorter life expectancies throughout the entire life course (Figures 1 and 2). As expected, the absolute difference in life expectancy between the least-deprived group and the other deprivation groups was greatest at birth, with the difference declining consistently with age. The gap between the least-deprived group and the other more-deprived groups in life expectancy at each age increased during the study period. For example, the life expectancy at age 25 for the most-deprived group was 50.2 years in 1980–82 and 51.4 years in 1998–2000; for the least-deprived group, the life expectancy at age 25 was 52.3 years in 1980–82 and 55.2 years in 1998–2000. The difference thus increased from 2.1 years in 1980–82 to 3.8 years in 1998–2000. Although at advanced ages,

such as at ages 70 years and beyond, the absolute difference in life expectancy between the least-deprived and most-deprived groups was small, the patterns in Figures 1 and 2 show increasing inequalities in male and female life expectancies over time.

### Discussion

The long-term trend in US life expectancy indicates dramatic improvements in survival during the first half of the 20th century. Life expectancy at birth increased from 47.3 years in 1900 to 68.2 years in 1950.<sup>7</sup> However, the gains in life expectancy in the last two decades or so have been modest, increasing from 73.7 years in 1980 to 77.0 years in 2000 and to 77.6 years in 2003.<sup>7,8</sup> Against the backdrop of such impressive improvements in life expectancy, the present study reveals substantial and increasing disparities in US life expectancy over time, with the gap between the least-deprived and most-deprived groups widening from 2.8 years in 1980–82 to 4.5 years in 1998–2000. Clearly, gains in longevity would be substantial if people in the more-deprived groups experienced age-specific mortality rates similar to those of the least-deprived group.

Social inequalities in US life expectancy are not expected to diminish at least for the foreseeable future given large, persistent, and sometimes increasing inequalities in infant and post-neonatal mortality and life expectancy during 2001–2003, particularly those observed between blacks and whites.<sup>17</sup> Existence of such marked and growing inequalities in US life expectancy stands in sharp contrast to the goals of *Healthy People 2010*, which calls for elimination of health inequalities by the end of this decade.<sup>1</sup> Similar increasing inequalities in life expectancy have been observed in the UK, where the government in its recent report has acknowledged

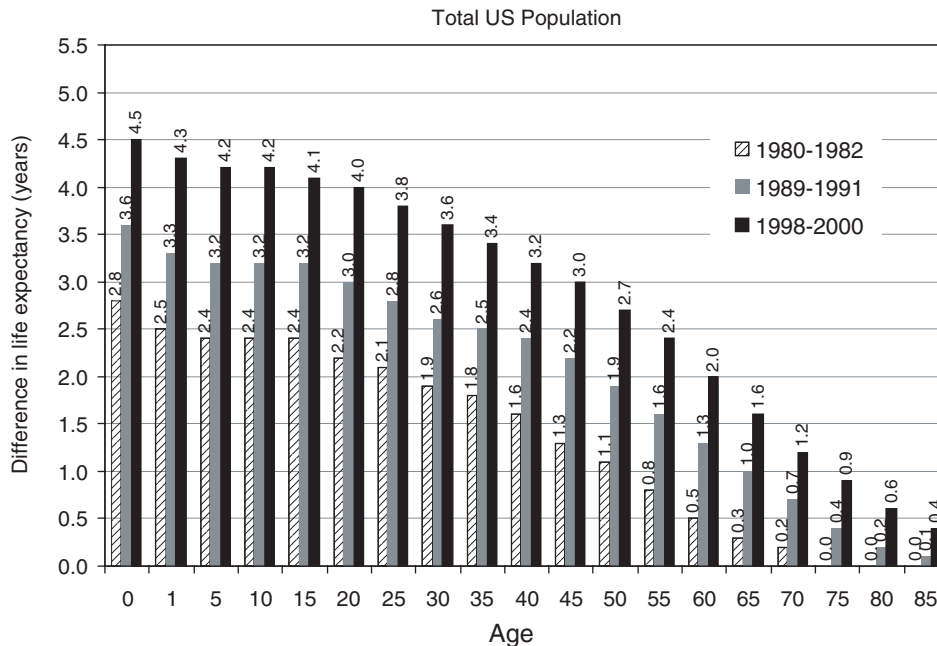
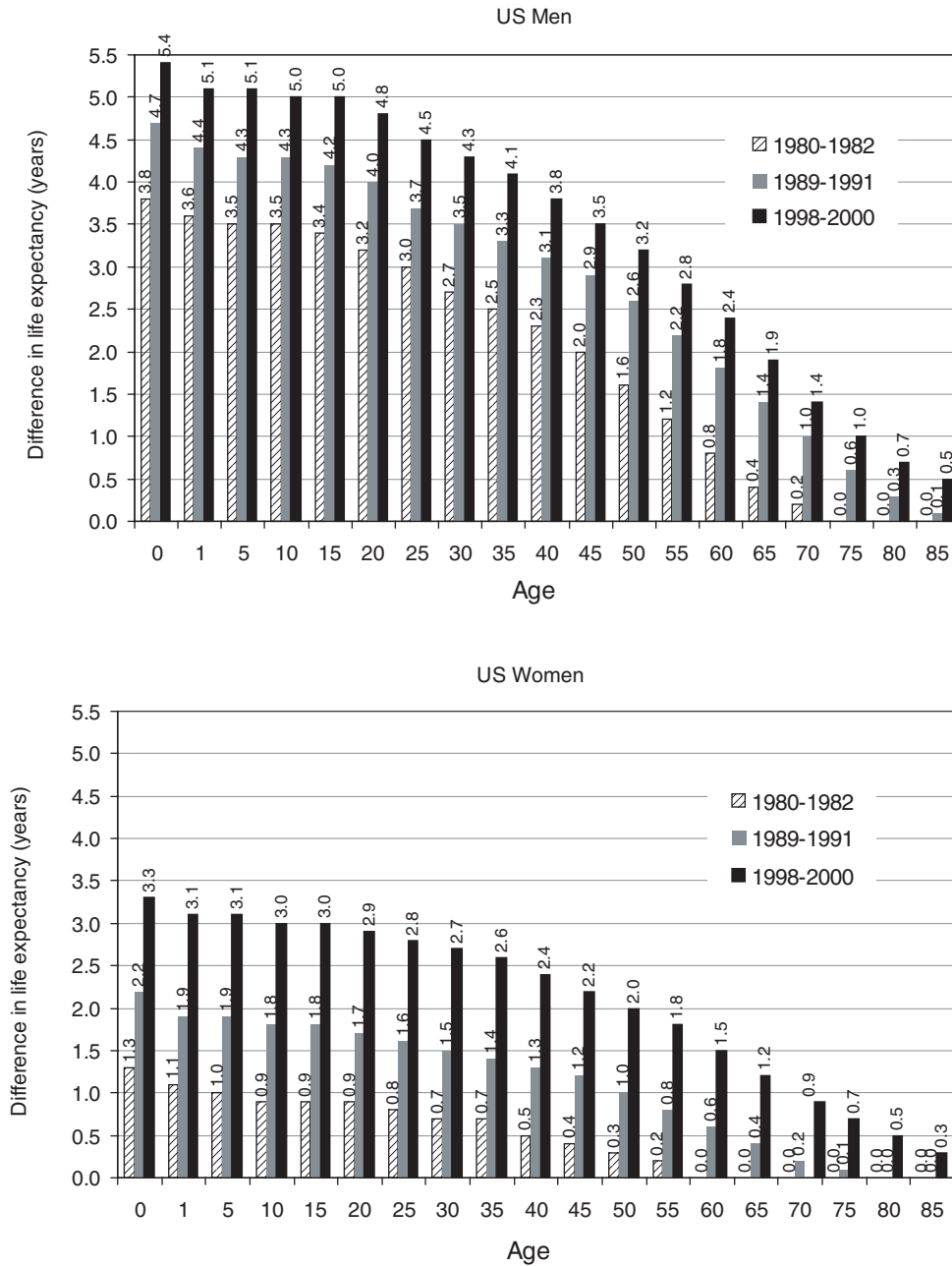


Figure 1 Inequalities in life expectancy between the least-deprived and most-deprived socioeconomic groups, US, 1980–2000



**Figure 2** Inequalities in male and female life expectancies between the least-deprived and most-deprived deprived socioeconomic groups, US, 1980–2000

widening social inequalities in life expectancy and infant mortality despite government efforts to narrow the gap by 2010.<sup>12,18–20</sup>

The pattern of widening inequalities in US life expectancy over the past two decades is consistent with those shown previously for US all-cause, cancer, and cardiovascular mortality trends.<sup>4–6</sup> However, the recent pattern of widening inequalities differed from that observed for the US between 1930 and 1960. The Kitagawa and Hauser study showed substantial gradients in life expectancy at birth by census tract socioeconomic position for the city of Chicago in 1930, 1940, 1950, and 1960. While life expectancy at birth increased with increasing socioeconomic levels in each period, the difference

in life expectancy between the lowest and highest socioeconomic groups diminished between 1930 and 1960.<sup>21</sup> A recent Canadian study also showed a narrowing of the gap.<sup>22</sup> Life expectancy at birth in urban Canada was, respectively, 6.3 and 2.8 years shorter in 1971 for men and women in the poorest quintile compared with their counterparts in the richest quintile. However, by 1996, the inequality in life expectancy between the richest and poorest quintiles had diminished to 5.0 years for men and 1.6 years for women.

Differentials in life expectancy between deprivation groups shown here are probably underestimated because we used counties, rather than smaller and more homogeneous geographic areas such as census tracts, to define deprivation



groups. Many urban counties are large geographic areas or population units with substantial socioeconomic heterogeneity.<sup>4-6</sup> Unfortunately, US mortality data are not available for geographic areas smaller than counties for confidentiality protection of individual information on death certificates. Despite this limitation, use of counties may be preferable to census tracts in temporal analyses because counties, unlike census tracts, maintain fairly stable social, political, administrative, and geographical boundaries over time.<sup>4-6</sup> The 1990 deprivation index has been shown to provide a stable socioeconomic classification of counties over time,<sup>4-6</sup> at least over the study period, and the use of the 1980 index produced life expectancy estimates for 1980–82 similar to those based on the 1990 index. For example, in 1980–82, life expectancy at birth (based on the 1980 index) was 72.9 and 73.3 years for the two most-deprived groups and 76.0 and 75.0 years for the two least-deprived groups, respectively. The 2000 deprivation index was not linked to the age-, sex-, and county-specific mortality data, and hence socioeconomic differentials in life expectancy estimates could not be derived for the 1998–2000 period using the 2000 index. The deprivation indices for the 1980, 1990, and 2000 censuses were highly correlated, however. The correlation of the 1990 index with the 1980 index was 0.94 and with the 2000 index 0.96. The high correlations among indices and the relatively stable socioeconomic standing of county deprivation groups in Table 1 confirm the fact that the broad geographical distribution of deprivation and social disadvantage has changed very little over the past several decades, which is a truly remarkable feature of social stratification in the US.<sup>4-6,23</sup> A similar pattern has also been noted for Britain, where the broad geographical pattern in poverty has changed remarkably little over the past century.<sup>12,24</sup>

Rather than using deprivation deciles based on three different time periods, an advantage of using only the 1990 index was to ensure that the classification of counties into specific deprivation groups remained fixed over time. The small degree of area misclassification that may arise from using the 1990 index for the entire study period is unlikely to significantly affect the general trend of increasing inequalities in life expectancy shown here.

Increasing inequalities in life expectancy by deprivation parallel trends in income inequality, which has risen dramatically in the US over the past three decades.<sup>23,25-27</sup> The Gini coefficient for family income, a summary measure of income inequality that varies between 0 (complete equality) and 1 (extreme inequality), rose consistently from 0.349 in 1969 to 0.436 in 2002. Another income inequality measure, the ratio of household income at the 90th percentile to household income at the 10th percentile, increased from 8.85 in 1969 to 10.63 in 2001. Our analysis of temporal state-level data (not shown) indicates that the relationship of income inequality with life expectancy at birth in the US, even after adjusting for differences in absolute income levels, has become steeper over time, with standardized regression coefficients varying from –0.65 in 1969–71 to –0.71 in 1979–81 to –0.74 in 1989–91.

The widening socioeconomic inequalities in life expectancy shown here may be related to increasing temporal inequalities in the material and social living conditions between area deprivation groups, both in absolute and relative terms.

Absolute differences between deprivation groups in income, wealth and assets (as measured by home ownership and median home value), poverty, unemployment, single-parent households, and health care personnel per capita widened between 1970 and 1990 and between 1980 and 2000, as shown in Table 1. Similarly, the gap in relative income disparity increased markedly.<sup>5</sup>

Besides material deprivation, psychosocial characteristics such as stress, low control at work, home, or over life circumstances, social support, and social integration are important factors in producing health inequalities.<sup>28</sup> Residents of materially deprived areas experience higher levels of social disintegration as they have higher rates of suicide, homicide, violent crime, and migration than those in affluent areas.<sup>5</sup> They are also less likely to participate in civic and political processes, as evidenced by the increasingly lower voting rates observed for those in more-deprived groups in each successive US presidential election from 1980 to 1996 (data not shown).<sup>29</sup> Materialist and psychosocial interpretations are not competing explanations of health inequalities, however. Rather, psychosocial factors as those mentioned above are more likely to act as proximate factors through which social and material deprivation influences health.<sup>28</sup>

Temporal socioeconomic inequalities in life expectancy at birth and at other ages may also be related to geographical inequalities in the distribution of other valued social resources and behavioural and health care factors. County-level deprivation levels are strongly associated with lower local government spending on a variety of infrastructural resources (such as public safety, fire protection, social and welfare services, education, affordable housing, and employment) as well as with higher smoking and obesity rates and rates of non-health-care coverage (data not shown).<sup>29,30</sup> The fact that the area deprivation groups differ significantly in their levels of urbanization and racial composition suggests that racial/ethnic discrimination, social segregation, and labour market discrimination, in addition to the material, social, and medical care factors identified above, may partly account for socioeconomic inequalities in life expectancy shown here.<sup>5,31</sup> Behavioural and social policy interventions (e.g. smoking reduction, tobacco regulation and advertising, cancer screening, prenatal care, and universal health care coverage) have the potential to reduce health inequalities among deprivation groups. However, reducing geographical inequalities in education, income, poverty, unemployment, housing, transportation, and labour market opportunities, the most fundamental determinants of such health inequalities, must be an important public policy goal towards halting the current trend of increasing inequalities and bringing about substantial reductions in the magnitude of existing inequalities in US life expectancy.<sup>5,32</sup>

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**Conflicts of interest:** None.

**KEY MESSAGES**

- Health inequalities in the US, particularly those in all-cause, cardiovascular, and cancer mortality, have continued to widen despite the launch of the national health initiative in 1990 to reduce and ultimately eliminate such inequalities.
- Previous efforts to analyse temporal inequalities have involved national mortality data using age-adjusted death rates or relative mortality risks, but none have utilized life expectancy data by area deprivation to examine changes in the extent of US health inequalities in the past two decades.
- Higher life expectancy at birth and other ages were associated with lower levels of deprivation in each time period, with the deprivation gradient in US life expectancy widening substantially between 1980 and 2000 for both males and females.
- Between 1980 and 2000, those in higher socioeconomic groups experienced larger gains in life expectancy than those in more deprived groups, contributing to the widening gap. Inequalities in US life expectancy were larger for males than for females in each period, and the magnitude of the difference increased over time more for males than for females.
- Increasing inequalities in life expectancy parallel the rising trend in US income inequality and may reflect increasing polarization among deprivation groups with respect to material and social conditions.

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# Commentary: The fading of the dream: widening inequalities in life expectancy in America

Danny Dorling

*'Oh give me a home, where the buffalo roam  
 And the deer and the antelope play  
 Where seldom is heard a discouraging word  
 And the skies are not cloudy all day.'*

[Popular Cowboy Song, undated, verse 1]

Studies of health inequalities in the United States are relatively rare, especially considering the extent of those inequalities in comparison with other countries<sup>1</sup>; the population size of the United States in comparison with far smaller but more studied peoples<sup>2</sup>; the concentration of resources available to academics in that country<sup>3</sup>; and the hegemonic status of the world's 'leader'<sup>4</sup> making it odd that it does not lead in this field. Health and wealth are old acquaintances, but best related where riches are best shared.<sup>5</sup> If riches were to trickle down naturally anywhere, they should have done so in the land where they have been most abundant. That they have not done so can be counted in years of lives lost as well as in dollars. That is not in dispute, even if the precise mechanism is keenly debated.<sup>6</sup> Thus Singh and Siahpush<sup>7</sup> have demonstrated what many long suspected: that health inequalities within the United States have widened considerably in recent decades. At the county level of geographic discrimination there has been a 60% [(4.5–2.8)/2.8] increase in the size of the gap in life expectancy between the poorest and richest tenths of the population from 1980 to 2000. The poorest tenth of the population, by area, can now only expect to live to just under 75 years of age while the people living in the best-off counties live on average to almost 80. Some counties are as populous as Los Angeles city. This is not a fine-grained analysis. That is not possible as much detailed demographic data is concealed in many States of the Union. Thus the 4.5 year life expectancy

difference is a very wide gap considering the degree of averaging involved.

One reason for not being surprised to find widening inequalities in mortality in the United States is that inequalities have been widening in many Western European countries over the same period—albeit assessed more often as measured between socioeconomic groups within countries<sup>8</sup> rather than between areas. However, when geographical comparisons have been made, similar results of increasing inequalities have been found, but usually not as rapid increases as in America.<sup>9</sup> Inequalities within the United States also appear to be much larger than within most countries in Western Europe and to have grown more rapidly. When compared internationally, Western European inequalities are found to be larger again than those prevailing in Japan<sup>10</sup> and are comparable or can be exceeded by those found elsewhere in the rich world.<sup>11</sup> And if poorer countries are included also it becomes increasingly clear that where there is higher inequality, especially income inequality, there is higher inequality in health<sup>12</sup> and that occurs as much between groups of people arranged by occupational social class as it does amongst groups arranged by class as indicated by place of residence.<sup>13</sup> It is worth highlighting that no other rich country with such a large population has such wide inequalities as the United States, a country that can be considered a natural experiment for studying the effects of exposing millions of human beings to relatively high levels of the various insults of inequality.

The detail that Singh and Siahpush give on how the changing trends have differed for men and women, how they have had effects at different points in the life course, and which areas are doing worse, are all worth referring to in their original paper for clues to the processes that may well be occurring outside the United States as well as within. To reiterate, no other rich country has so large a population that such patterns could be as clear when disaggregated by