

Black-White Inequalities in Mortality and Life Expectancy, 1933–1999: Implications for Healthy People 2010

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SYNOPSIS

Objectives. Optimistic predictions for the Healthy People 2010 goals of eliminating racial/ethnic disparities in health have been made based on absolute improvements in life expectancy and mortality. This study sought to determine whether there is evidence of relative improvement (a more valid measure of inequality) in life expectancy and mortality, and whether such improvement, if demonstrated, predicts future success in eliminating disparities.

Methods. Historical data from the National Center for Health Statistics and the Census Bureau were used to predict future trends in relative mortality and life expectancy, employing an Autoregressive Integrated Moving Average (ARIMA) model. Excess mortality and time lags in mortality and life expectancy for blacks relative to whites were also estimated.

Results. Based on data for 1945 to 1999, forecasts for relative black:white age-adjusted, all-cause mortality and white:black life expectancy at birth showed trends toward increasing disparities. From 1979, when the Healthy People initiative began, to 1998, the black:white ratio of age-adjusted, gender-specific mortality increased for all but one of nine causes of death that accounted for 83.4% of all US mortality in 1998. From 1980 to 1998, average numbers of

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excess deaths per day among American blacks relative to whites increased by 20%. American blacks experienced 4.3 to 4.5 million premature deaths relative to whites in 1940–1999.

Conclusions. The rationale that underlies the optimistic Healthy People 2010 forecasts, that future success can be built on a foundation of past success, is not supported when relative measures of inequality are used. There has been no sustained decrease in black-white inequalities in age-adjusted mortality or life expectancy at birth at the national level since 1945. Without fundamental changes, most probably related to the ways medical and public health practitioners are trained, evaluated, and compensated for prevention-related activities, as well as further research on translating the findings of prevention studies into clinical practice, it is likely that simply reducing disparities in access to care and/or medical treatment will be insufficient. Millions of premature deaths will continue to occur among African Americans.

TEXT

Healthy People 2010 has “two overarching goals”: (a) to increase the quality and years of healthy life; and (b) to eliminate health disparities (including disparities between African Americans and other population groups).¹ The Introduction and Foreword to *Healthy People 2010* suggest that its primary architects assumed that these goals are attainable based on absolute improvements in health during the 20th century, particularly during the first two decades of the Healthy People initiative, which began with the publication of the first set of health objectives in 1979.²

The introduction to *Healthy People 2010* notes that “the 20th century brought remarkable and impressive improvements in the lives of the people of the United States. We saw the infant mortality rate plummet and life expectancy increase by 30 years . . . [W]e must ensure that this rate of advancement continues unabated . . . These challenges are substantial, but with the objectives defined by Healthy People 2010, they are achievable.”¹ The Foreword to *Healthy People 2010* continues this theme: “Building on two decades of success in Healthy People initiatives, *Healthy People 2010* is poised to address the concerns of the 21st century.”¹ The present report explores whether there is evidence to support the assertion that past successes are a firm foundation for the Healthy People 2010 goal of eliminating health disparities between African Americans and other population groups. (Note that in this article, we use the terms *black* and *white* to correspond to

the categories used in data from the National Center for Health Statistics [NCHS].)

METHODS

The Healthy People 2010 hypothesis that future success can be built on a foundation of past success is based on observed improvements in absolute mortality and life expectancy.¹ As acknowledged in the final evaluation of Healthy People 2000,³ however, inequality is a relative rather than an absolute concept,⁴ and ratios rather than absolute differences are a more valid measure of inequality. For example, if the mortality rate of the black population was 100 per 1,000 one year and 80 per 1,000 the next, while the mortality rate of the white population was 50 per 1,000 one year and 40 per 1,000 the next, the larger absolute decline among blacks might be taken as an optimistic sign even though the relative disparity between blacks and whites remained the same. By assuming that the observed declines in mortality rates and increases in life expectancy are the basis for future gains in equality, Healthy People 2010 hypothesizes that these absolute improvements can be extrapolated to changes in relative (ratio) measures of mortality and life expectancy.¹ The present study aims to assess the validity of that hypothesis.

We used national data from NCHS and the Census Bureau to describe the time course of relative black:white mortality and life expectancy.^{5–8} We used Autoregressive Integrated Moving Average (ARIMA) time series analysis⁹ because ARIMA is specifically designed to make forecasts based on the values of a time series after giving proper weight to random fluctuations.

Black:white mortality rate ratio. NCHS has published age-adjusted, all-cause mortality rates for 1933 forward using both the 1940 standard population for age-adjustment^{5,6} and the year 2000 standard population for age-adjustment.⁶ We used these data to calculate time series for black:white ratios of age-adjusted, all-cause mortality. We then used ARIMA time series forecasting⁸ to predict the future time course of these ratios based on available data from 1933 forward and 1945 forward. Four forecasts resulted; these included one for 1933–1998 and another for 1945–1998 for all-cause mortality using the 1940 standard population as well as one for 1933–1999 and another for 1945–1999 for all-cause mortality using the year 2000 standard population.

Beginning in 1970, published age-adjusted all-cause mortality rates excluded non-citizens.^{5–7} Also, through 1960, NCHS published age-adjusted overall mortality rates for “non-whites” but not “blacks.”^{5,6} Thereafter,

with the exception of 1963 (when only “non-white” data were available), these rates were published for “blacks” as well as “non-whites.” When there was a choice, we used the rates for “blacks.” Otherwise, we used values for “non-whites” in these analyses.

Life expectancy. Similarly, we used NCHS-published data on estimated life expectancy at birth for 1933–1997⁸ to calculate a time series of white:black ratios, and produced two ARIMA forecasts for life expectancy, one based on ratios for 1933–1997 and one based on ratios for 1945–1997.

We chose the year 1933 as a starting point for these analyses because that was the first year in which mortality data were considered sufficiently valid to include the entire United States. Prior to that time, “national” mortality data included information only from a National Death Registry Area, excluding states whose information did not meet Registry standards.

Additional analyses were done for 1945 onward in order to model a more homogeneous historical period reflecting the post–World War II experience.

Lags. To estimate lags in age-adjusted, all-cause mortality and life expectancy at birth, we began with black mortality in 1998 (as published with calculations that used the 1940 age-adjustment standard), and black life expectancy as of 1997. We then identified the years in which white mortality equaled 1998 black mortality and the years in which white life expectancy equaled 1997 black life expectancy (overall and for males and females). If there was no exact match, the first year in which the two values most closely corresponded was used, unless a lower value for whites was achieved at a date closer to 1998 (for mortality) or 1997 (for life expectancy); this was done to guard against overestimation of the time lag. For comparison purposes, the same sources of data were used to estimate the time lags as of 1965 (the approximate midpoint between 1933 and 1997).

Changes from 1979 to 1998 in black:white mortality ratio. We used age-adjusted, gender- and cause-specific mortality rates as published by NCHS⁵ to compute black:white ratios for the following causes of death for 1979 and for 1998: diseases of the heart; cancer; cerebrovascular disease; all accidents; motor vehicle accidents; chronic obstructive pulmonary disease and allied conditions; diabetes mellitus; all other infectious and parasitic diseases; certain conditions of the perinatal period; asthma; pneumonia and influenza; suicide; homicide and legal intervention; chronic liver disease and cirrhosis; septicemia; nephritis, nephrotic syndrome, and nephrosis; and renal failure, disorders

resulting from impaired renal function, and small kidney of unknown cause.

For each cause, we then calculated (by simple subtraction) net changes from 1979 to 1998 in the black:white ratios for men and women in order to assess progress during the Healthy People years.

Excess deaths. To estimate excess deaths among African Americans, we used population figures for the black population for each decennial year from 1940 to 1990.¹⁰ We then subtracted the age-adjusted all-cause white mortality rate per 1,000 population from the corresponding black rate to get the rate difference. We did this for mortality rates based on the 1940 standard for age-adjustment and for mortality rates based on the year 2000 standard for age-adjustment. Next, we multiplied each rate difference by the total black population for the corresponding year¹⁰ to get an estimate of how many fewer deaths would have occurred among blacks if blacks had had the same mortality rate as whites, rounded to the nearest hundred. To obtain an estimate for each decade, we multiplied this result by 10. Thus, for 1940–1949, we estimated 785,000 excess deaths using the 1940 standard population for age-adjustment and 669,000 excess deaths using the year 2000 standard. We then added these totals to obtain two estimates of excess deaths for the period from 1940 to 1999 (one based on the 1940 standard and one based on the 2000 standard).

End-points of available data. For these analyses, we used data for all available years. This resulted in end-points of 1997 for life expectancy⁸; 1998 for age-adjusted, all-cause mortality using the 1940 population standard^{5,6}; and 1999 for age-adjusted, all-cause mortality using the 2000 population standard.⁷

RESULTS

Black:white mortality rate ratio. Figures 1A–1D show forecasts for the black:white ratio in age-adjusted, all-cause mortality based on (a) data for 1933–1998 and 1945–1998 age-adjusted to the 1940 population standard and (b) data for 1933–1999 and 1945–1999 age-adjusted to the 2000 population standard. In all cases, the slope of the forecast is positive and the 95% confidence interval (CI) does not include 1.0. Because of a more positive slope, projections based on data age-adjusted to the year 2000 standard suggest that disparities will increase more rapidly than those based on data adjusted to the 1940 population standard.

Life expectancy. Forecasts for life expectancy are shown in Figures 2A and 2B. Based on data for 1933–1997,

Figure 1. Black:white ratios for 1933–1998 and 1945–1998, age-adjusted to 1940 and 2000 standard populations, and ARIMA forecasts: all-cause mortality

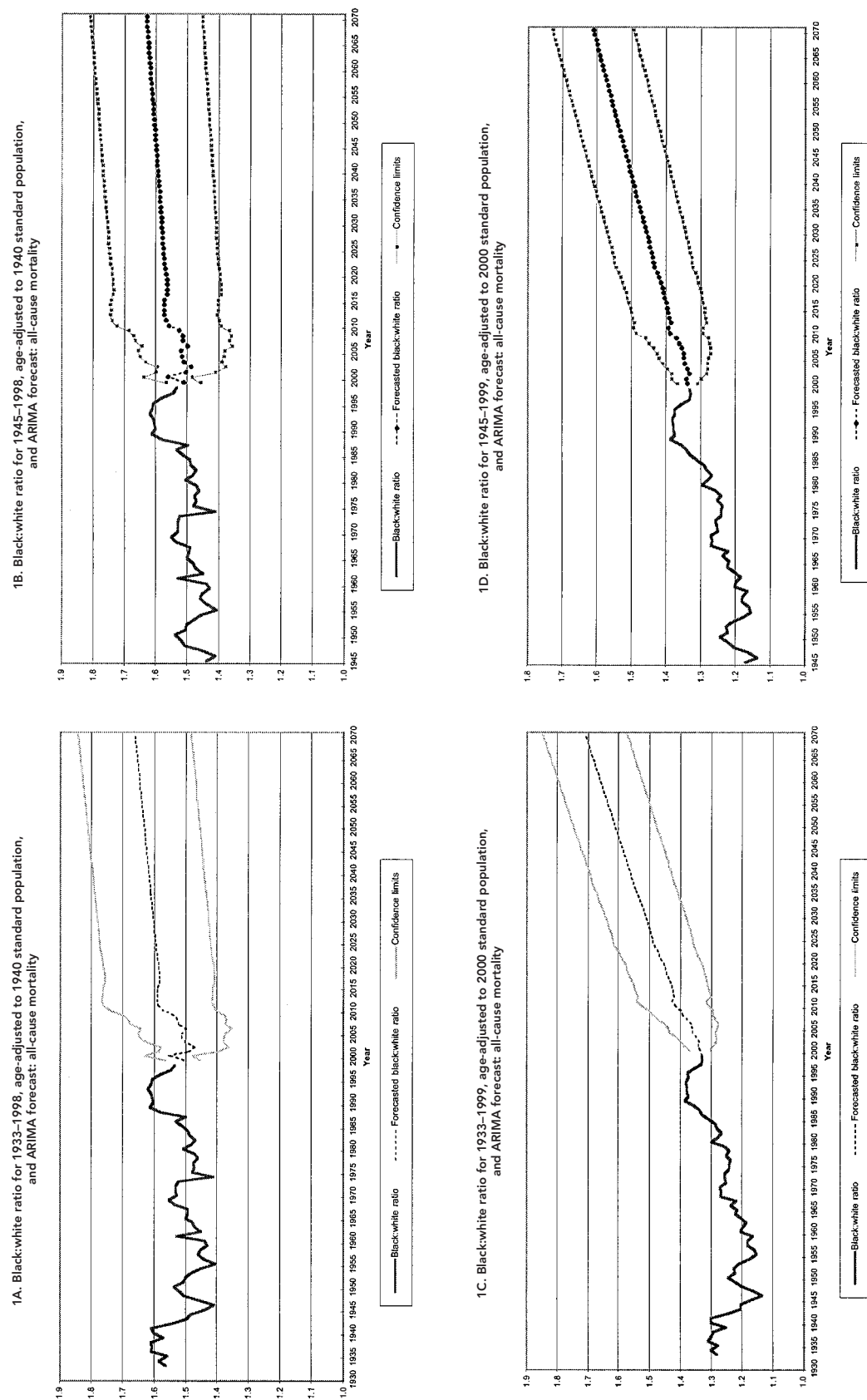
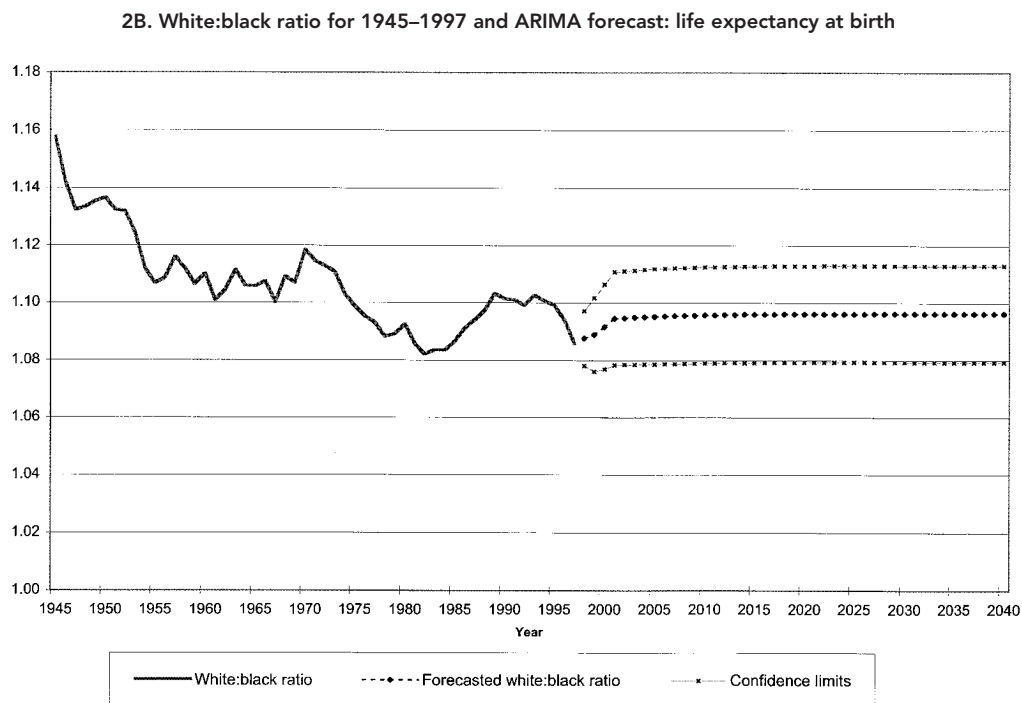
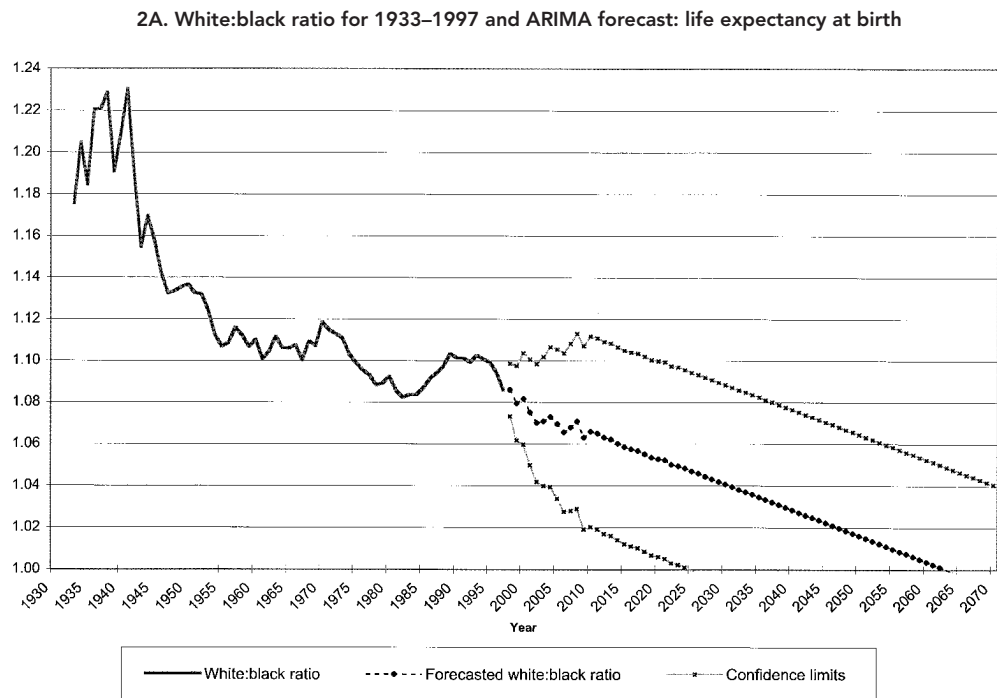


Figure 2. White:black ratios for 1933–1997 and 1945–1997 and ARIMA forecasts: life expectancy at birth

equality is predicted by the year 2063, and the 95% CI includes 1.0 in the year 2025 projection. This prediction, however, is driven by sharp declines during the early part of the observation period. In contrast, ratios for 1954 through 1997 stayed entirely within the range of 1.08 to 1.12. When the forecast is based on post-World War II era data (1945–1997), the slope of the forecast is slightly positive, the 95% CIs are tighter than those based on 1933–1997 data, and the 95% CI does not include 1.0.

Lags. Age-adjusted all-cause mortality for all blacks in 1998 was 6.9 per 100,000, which was equal to the white value for 1969 (a 29-year lag). The age-adjusted all-cause mortality rate for blacks in 1965 showed a lag of 27 years compared with the white rate.

The estimated life expectancy at birth for blacks in 1997 was 71.1 years overall, 67.2 years for males, and

74.7 years for females. The overall value approximated the overall white value for 1966, revealing a 31-year lag for the black population compared with the white population. The 1997 value for black males approximated the 1957 value for white males (a 40-year lag), and the 1997 value for black females approximated the 1970 value for white females (a 27-year lag).

For 1965 (the approximate midpoint between 1933 and 1997), the lag between the black and white populations in life expectancy was 22 years overall, 27 years in males, and 22 years in females.

Changes from 1979 to 1998 in black:white mortality ratio. Table 1 shows net changes in age-adjusted, gender-specific, black:white ratios for leading causes of death for 1979 to 1998. Excluding “motor vehicle accidents” (since this cause is subsumed within “accidents”), these causes were responsible for an overall mortality rate of

Table 1. Age-adjusted, cause-specific mortality rates (per 100,000 population); age-adjusted, cause- and gender-specific black:white mortality ratios; and net changes in ratios for leading causes of death, United States, 1979–1998

Cause of death	Total age-adjusted mortality rate per 100,000 population, 1988	Black:white ratio				Net change in black:white ratio from 1979 to 1998	
		Male		Female		Male	Female
		1979	1998	1979	1998		
Diseases of the heart	126.6	1.13	1.43	1.45	1.66	+0.30	+0.21
Cancer	123.6	1.40	1.45	1.18	1.24	+0.05	+0.06
Cerebrovascular disease	79.5	1.82	1.91	1.70	1.69	+0.09	−0.01
All accidents	30.1	1.28	1.29	1.11	1.11	+0.01	0.00
Motor vehicle accidents	15.6	0.94	1.16	0.71	0.92	+0.22	+0.21
Chronic obstructive pulmonary disease	21.3	0.74	0.80	0.68	0.70	+0.06	+0.02
Diabetes mellitus	13.6	1.83	2.09	2.51	2.70	+0.26	+0.19
All other infectious and parasitic diseases	6.5	1.86	5.80	2.30	2.79	+3.94	+0.49
Certain conditions of the perinatal period	5.5	2.33	3.27	2.52	3.08	+0.94	+0.56
Asthma	1.4	2.38	3.78	2.50	3.17	+1.40	+0.67
Pneumonia and influenza	13.2	1.68	1.52	1.40	1.28	−0.16	−0.12
Suicide	10.4	0.67	0.57	0.46	0.41	−0.10	−0.05
Homicide and legal intervention	7.3	7.08	6.73	4.79	3.80	−0.35	−0.99
Chronic liver disease and cirrhosis	7.2	1.91	1.13	1.90	1.09	−0.78	−0.81
Septicemia	4.4	2.70	2.71	2.79	2.73	+0.01	−0.06
Nephritis, nephrotic syndrome, and nephrosis	4.4	2.92	2.49	3.21	2.69	−0.43	−0.52
Renal failure and other renal diseases	4.1	2.60	2.28	3.25	2.63	−0.32	−0.62
All causes	471.7	1.45	1.59	1.50	1.52	+0.14	+0.02

NOTE: International Classification of Disease (ICD) codes are as follows: diseases of the heart (390–398, 402, 410–429), cancer (140–203), cerebrovascular diseases (430–438), all accidents, (E800–E949), motor vehicle accidents (E810–E825), chronic obstructive pulmonary diseases and allied conditions (490–496), diabetes mellitus (250), all other infectious and parasitic diseases (001–003, 005, 020–032, 037, 039–041, 042–044, 046–054, 056–066, 071–088, and 098–139), asthma (493), pneumonia and influenza (480–487), suicide (E950–E959), homicide and legal intervention (E960–E978), chronic liver disease and cirrhosis (571), septicemia (038), nephritis, nephrotic syndrome, and nephrosis (580–589), renal failure, disorders resulting from impaired renal function, and small kidney of unknown cause (584–586, 588–589).

SOURCE OF DATA: Reference 6

459.1 per 100,000 population, or 97.3% of the total age-adjusted US mortality (471.7 per 100,000 population) published for 1998.⁶

In most instances, net changes were positive, indicating that racial disparities widened. For causes of death that are responsible for 83.4% of the age-adjusted mortality in 1998 (that is, diseases of the heart, cancer, cerebrovascular disease, motor vehicle accidents, chronic obstructive pulmonary disease, diabetes mellitus, certain conditions of the perinatal period, all other infectious and parasitic diseases, and asthma), the only negative net change was -0.01 for cerebrovascular disease among women.⁶ In no instance was the net change indicative of a sudden movement at either end of the time period being described (data not shown). The black:white mortality ratio for HIV/AIDS, age-adjusted based on the year 2000 standard, increased from 3.22 in 1990 (26.7/8.3) to 8.19 (22.1/2.7) in 1998.¹¹

Excess deaths. Table 2 shows the use of risk differences in age-adjusted mortality to estimate excess deaths among the black population in comparison to the white population. The data showed an estimated 4,508,000 premature deaths among blacks in 1940–1999 when the 1940 population standard was used for age-adjustment and 4,272,000 when the year 2000 standard was used. The average number of estimated excess deaths increased from 207 per day for 1980 (75,500 for the year) to 249 per day for 1998 (91,100 for the year) based on data using the 1940 standard and from 221 per day to 265 per day based on data using the year 2000 standard; each represents a 20% increase. Finally, while the estimated number of excess deaths per 1,000 blacks declined during both periods (1940 to 1999 and 1980 to 1998) the accompanying increases in population erased the gains in numbers of excess deaths that might otherwise have been seen.

DISCUSSION

The data do not support the underlying hypothesis of Healthy People 2010 that future success can be built on a foundation of past success. As shown in Figures 1 and 2, disparities in mortality and life expectancy are predicted to increase. We have seen no sustained decrease in black-white disparities in either age-adjusted mortality or overall life expectancy at birth at the national level since the end of World War II, despite decades of funding for social, health-related, and other programs designed to reduce racial disparities—and despite assurances in support of Healthy People objectives in nearly all requests for research applications from federal health agencies over the past two decades. The forecasts are poor regardless of whether inequality is measured by relative overall age-adjusted mortality, relative life expectancy, or lags in either measure, and regardless of whether the 1940 or year 2000 standard population is used for age-adjustment.

Use of the year 2000 standard population produced a poorer prognosis, in part, because it suggests that the US was substantially closer to racial equality in 1945 than it was by the end of the century. In contrast, data based on the 1940 standard suggest that these racial inequalities were much the same in 1945 and 1998 in the US.

At best, it would be illusory to consider national public health programs a success based on other indicators as long as inequalities in mortality and life expectancy fail to improve. To do so would imply that all indicators are equally important or that it is somehow acceptable for black Americans to die at higher rates or live shorter lives, so long as a sufficient number of positive signals can be obtained from other indicators. Unfortunately, this is how the highlights for the final evaluation of Healthy People 2000 are framed: “At the end of the decade, the most recent data indicate that

Table 2. Estimated excess deaths in black population compared to white population, US Census data, 1940–1998

Year	White population (thousands)	Black population (thousands)	Difference between white and black mortality rate		Number of excess deaths (mortality rate difference x black population)	
			1940 standard	2000 standard	1940 standard	2000 standard
1940	118,215	12,866	6.1/1,000	5.2/1,000	78,500	66,900
1950	134,942	15,042	4.3/1,000	3.5/1,000	64,700	52,700
1960	158,832	18,872	3.2/1,000	2.7/1,000	60,400	50,900
1970	178,098	22,581	3.6/1,000	3.2/1,000	81,300	72,200
1980	194,713	26,683	2.831/1,000	3.021/1,000	75,500	80,600
1990	208,727	30,511	2.964/1,000	3.405/1,000	90,400	103,900
1998	223,001	34,431	2.646/1,000	2.810/1,000	91,100	96,800

SOURCE OF DATA: Population data: Reference 9. Mortality rates using 1940 standard: References 5 and 6. Mortality rates using 2000 standard: Reference 7. Conventions as to estimates of “black” race are as described in the Methods section of the present article.

68 objectives (21 percent) met the year 2000 targets and an additional 129 (41 percent) showed movement toward the targets Only 47 objectives (15 percent) showed movement away from the targets.”³ Far from providing a foundation for the future, the millions of premature deaths among African Americans over the course of the 20th century challenge the hegemony of current models designed to improve health (including, but not exclusive to, health care). Both the magnitude of and increases in these “excess” deaths suggest the need for fundamental changes in the ways that medical and public health practitioners are trained, compensated, and evaluated; the need for further research on the translation of prevention studies into practice; and the need for meaningful evaluation of federally funded research in terms of its impact on the inequality trends observed in the present study.

Taken in the context of other research, the data reported here show that the types of changes needed in health care are unlikely to consist of simple assurance of equal access to care or equality in curative and/or palliative care services once access is achieved. Instead, there needs to be fundamental improvement in the way care is given so that comprehensive prevention achieves parity as an integral part of regular care. This is especially true since more than 80% of the US population visits a health care provider in any given year,¹¹ thereby providing an unsurpassed opportunity to initiate solutions. Most of the health issues identified in Table 1 are amenable to primary, secondary, and/or tertiary prevention. The importance of prevention is also reflected in 9 of the 10 “Leading Health Indicators” established for Healthy People 2010 (i.e., physical activity, overweight and obesity, tobacco use, substance abuse, responsible sexual behavior, mental health, injury and violence, environmental quality, and immunization¹¹). Nonetheless, because of the way health care is practiced and providers are trained, health services are almost exclusively devoted to curative and/or palliative treatment. Notwithstanding the observations in both industrialized and developing areas that mortality rates for diseases amenable to medical treatment are falling more rapidly than those for diseases not amenable to medical treatment,¹² the emphasis on curative and/or palliative treatment may be one reason that sociologic analyses often find that health care is less important than social forces when it comes to overall mortality.^{13–15} The focus on treatment of disease rather than on prevention may also play a role in the failure of disease-specific reports¹⁶ (e.g., for heart disease,^{17–19} cancer,^{20–23} and diabetes mellitus^{24,25}) to provide consistent support for the hypothesis that equalization of access to curative and palliative care

will equalize racial disparities in mortality. An exception is a recent Department of Veterans Affairs (VA) study in which blacks were found to have better short-term survival than whites for selected diagnoses.²⁶ While the authors of this study speculated that the results reflected equal access to VA services among blacks and whites, they also acknowledged that problems with short duration of follow-up and assessment of severity of illness may have made these speculations overly optimistic.

The inadequacy of all models of health care delivery that devalue prevention is predictable because of their inability to account for long-recognized relationships between the prevalence and incidence of disease. Specifically, under steady state assumptions, the prevalence of disease in a population is directly proportional to incidence and duration.²⁷ Today, chronic disease predominates, and modern care is mainly palliative and reactive. This works to increase the overall prevalence of disease because it prolongs the duration of illness while having little impact on incidence. No matter how much racial equality in access is introduced into such a system, black people can be expected to continue to have higher mortality rates than white people, because the higher occurrence of preventable risk among blacks²⁸ will continue to produce higher risks of becoming ill or injured in the first place.

The higher cause-specific relative risks for mortality among black Americans than among white Americans in the present data are consistent with this interpretation, as are recent analyses showing that, aside from homicide (which contributed 0.6 years to the six-year difference in years of life expected by blacks relative to whites), the leading causes of death accounting for black-white differences were heart disease (1.7 years), cancer (1.2 years), stroke (0.5 years), and perinatal disease (0.5 years).²⁹ In sum, when other factors appear to be more important determinants of mortality than health care,^{13–15} they do so in the context of a health care system that largely ignores primary, secondary, and tertiary disease prevention. For prevention and health promotion to gain parity with curative approaches, new approaches for training, compensating, and evaluating health care professionals will be needed.

The estimated excess deaths in the present data are comparable to estimates that would be obtained using the methods reported by Geronimus et al.^{30–32} or the 1985 *Secretary's Task Force Report on Black and Minority Health*.²⁸ However, while race-based mortality ratios and absolute risks are important, there are clear limitations to their use as indicators of health. First, evi-

dence from NCHS raises questions about the quality of racial/ethnic data, primarily for racial/ethnic groups other than “black” and “white.”^{33,34} Second, there is no clear agreement on how age-adjustment should be conducted, including which population standard should be used. This is why Kreiger and Williams³⁵ recommended consistent use of one standard or the other, a recommendation that was followed in the present analyses. Third, race itself may be largely a surrogate for other factors, especially differences in environmental exposures.^{36,37} Fourth, presently available summary measures such as age-adjusted mortality and estimated life expectancy are crude. When used for the nation as a whole, they may mask special successes and/or problems for specific age categories/diseases or in specific local populations. A more intense search for populations of success is needed, but regardless of whether these successes are identified, better summary measures are essential to assess global progress toward the goals of Healthy People 2010. Finally, these data raise several interesting issues that are beyond the scope of the present discussion. These include the relative stability of some measures of inequality (e.g. white:black life expectancy since 1954), one question being why the ratios did not become considerably larger given the disadvantages faced by African Americans. Also, there is the issue of benchmarks. Although white values were used as benchmarks for the present analyses, it is apparent from the NCHS data that people classified as neither “white” nor “black” have significantly lower age-adjusted, all-cause mortality rates than either whites or blacks.^{5,6} In the future, the aim of public health should not be simply elimination of disparities, but rather attainment of the best health for all people regardless of race, ethnicity, or social class.

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