

## Recent trends in mortality rates by race

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This paper was motivated in part by a desire to use, in a variety of classroom situations, some of the readily available statistics on mortality and related factors. Most of the data comes from the various Reports issued by the (United States) National Centers for Health Statistics (NCHS), which can be obtained free or at nominal cost. A second aim was to illustrate certain statistical ideas, such as the relative merits of means and medians. However, the subject of racial differentials in mortality rates is of considerable intrinsic interest, which the analysis presented here only begins to address.

My students (juniors, seniors and graduate students in actuarial science) are usually aware that mortality rates among blacks are higher than the corresponding rates among whites. But when asked to quantify the difference they are sometimes surprised by the results. For example, the crude death rate among blacks for the 12 months ending June 1996 was 856.1 deaths per 100,000 population,<sup>1</sup> while among whites during the same period there were 912.5 deaths per 100,000 population. The reason for this seeming anomaly is the very different age distributions in the two populations. As Table 1 shows, the mortality ratio (black rate/white rate) by age group varies from 1.18 for ages 75-84 to 2.46 in infancy and 2.47 for ages 35-44, with a simple average of 1.85. This presents an opportunity to define age-adjusted rates (of several sorts), and possibly to ask students to calculate them.

In addition to giving a more accurate comparison between two populations for a single year, the adjusted rates present a clearer picture of trends. Figure 1 shows the crude mortality rates for the two main racial groups in the recent past, and the age-adjusted rates for the same years. Besides confounding the race differential, the crude rates allow the aging of the population to obscure the general downward trend which the age-adjusted rates reveal.

The race differential is particularly striking in infancy. Death rates among infants have long attracted popular attention, partly for emotional reasons and partly because the infant mortality rate is widely taken as an indicator of the overall health of a population, especially for purposes of comparison. Figure 2 shows that infant mortality rates (the number of deaths under 1 year per 1000 live births) have declined slowly but fairly steadily for both blacks and whites in the US, as indeed has been the case almost world-wide. International comparison is embarrassing for the United States. Table 2 shows data for selected countries in 1993.<sup>2</sup> The NCHS-reported infant mortality rate for whites in 1993 was 6.8, comparable to (though a little larger than) that in Canada and most of the northern-European countries; the rate for blacks was 16.5.<sup>3</sup>

Why is the difference so great? It is easy to suggest reasons, but our goal as actuaries is "to substitute facts for appearances and demonstrations for impressions." So here are some conjectures, and some facts that substantiate or refute them.

*Conjecture #1:* Maybe black mothers are more likely to give birth to male babies; we know that mortality is higher among males.

This is raised mostly as a classroom example; just a moment's reflection indicates it is not very plausible. The sex differential for infant mortality rates is in the range of 20% to 25% excess for males, so it would take a huge sex difference in births to account for any meaningful part of the race differential. In fact, the NCHS annual reports on birth statistics show that while black mothers do have more male babies than female babies, the difference is not as pronounced as among white mothers; in 1995, for example, the ratio was 1.031 among blacks, 1.052 among whites.<sup>4</sup>

*Conjecture #2* is more plausible, and apparently believed by many people: Black mothers are much younger than white mothers, and younger mothers are at greater risk of giving birth to babies with various physical abnormalities, some of which increase the likelihood of infant death.

First the facts concerning age of mothers. For births in 1995, the median age of black mothers was 24.4, of white mothers 27.6.<sup>5</sup> This may or may not seem like a large difference, but it should at least undermine the impression that the "typical" black mother is a teenager, the "typical" white

mother in her 30's. In fact the typical mother of either race is in her 20's: 53% of black mothers, 52% of white mothers. But as with the crude mortality rates, the averages conceal some important features. About 11.5% of white births were to mothers under 20, and about 4.3% to mothers under 18. For blacks the figures were 23.1% and 10.8% respectively. So it is true that there are proportionately more teen mothers among blacks. But does this help to explain the difference in mortality rates?

Death certificates give the age, race, sex of deceased, cause of death and sometimes additional information, but not usually the age of the mother. In order to ascertain directly how the mortality rate for infants is related to the age of their mothers, one would need to match infant death certificates with birth certificates. The NCHS does prepare a Linked Birth/ Infant Death Data Set, but a single year's data costs about \$1300. What can we do "cheap"? We can look for an indirect link.

For black infants, the *leading* cause of death is "Disorders related to short gestation and unspecified low birthweight"; the death rate (per 100,000 live births) for this cause among black infants is more than 4.5 times the rate among white infants.<sup>6</sup> Moreover, low birthweight is related to the age of the mother. Using information on birth certificates, the NCHS calculates and reports births by weight (in 500-gram intervals) and by age and race of mother. (Above the teen years the mother's age is given only in 5-year intervals.) Figure 3 shows (estimated) median weights by age for white and black mothers. Note that the trend is generally upward, but the pattern is not monotonic, and not particularly strong. On the other hand, the curve for black mothers lies below that for white mothers in all age groups except for age 45-49 (accounting for less than .1% of births), where the values are almost equal.

Time for another lesson in basic statistics: why use the median rather than the mean? We could estimate the mean, using the middle of each weight range for all the births reported in that range, but probably that would not be very accurate. Probably there is something like exponential drop-off in the tails, and lack of symmetry. On the other hand, I *know* which interval includes the median, and probably the distribution is approximately uniform near the middle of the distribution.

Actually we aren't so much interested in *average* birthweights as in *low* birthweights. Figure 4 shows, in addition to the medians, estimates of the 10th and 90th percentiles. The 10th percentile curves are particularly instructive. The race differential is greater in the 10th percentile than in the median. There is noticeable improvement through the teen years -- more so in the 10%ile than in the median -- but, for black mothers, the situation deteriorates at the higher ages.

Health professionals define low birthweight as under 2500 grams. The entire 10th percentile curve for black mothers lies below the 2500-gram level, whereas for white mothers it is in that range only for mothers under 15 or over 45. Moreover, the rate for low birthweight to black mothers aged 30-34 is 14.3%, higher than for black mothers aged 16-19; and for black mothers aged 35-39 the rate (16.3%) is even higher than for the under-15 group.<sup>7</sup> For very low birthweight (under 1500 grams), where presumably more of the infant deaths are concentrated, the pattern for white mothers is what one would expect: rates dropping through the teen years, reaching a low (about 1%) in the 20's and early 30's, and beginning to increase again in the 40's. But for black mothers the pattern is strikingly different. VLBW is more prevalent among mothers in their 30's than among teenaged mothers. Of the approximately 18,000 VLBW babies born to black mothers in 1995, 30% were born to women over 30, almost half to women in their 20's, 21% to teenagers. Thus we are led to suspect that reducing teen pregnancy rates,<sup>8</sup> while it may have a number of beneficial effects, should probably *not* be expected to result in a significant reduction in infant mortality rates, or in the race differential.

*Conjecture #3:* Smoking (and abuse of alcohol and other drugs) is a major cause of the differential.

A recent paper in the Archives of Pediatrics and Adolescent Medicine<sup>9</sup> claims that smoking by mothers and other adults is responsible for 6200 pediatric deaths annually, including 2800 caused by low birthweight (essentially all neonatal) and 2000 due to SIDS (by definition during infancy). The authors thus attribute to smoking at least 4800 of 30,000 annual infant deaths. [The remaining 1400 "smoking" deaths are due to asthma and other respiratory problem, burns, etc.; some occur in infancy and some later in childhood.] Although the paper does not mention race, we note that, according to NCHS reports, black infants account for about 30% of SIDS

deaths and about 45% of deaths attributed to low birthweight. If black mothers are more likely to smoke than white mothers, that might help explain the differential in infant mortality rates.

First it must be noted that there are significant differences between the paper just mentioned and NCHS reports on several of the most important statistics, including the number of deaths attributable to low birthweight and the incidence of smoking among new mothers. However, it seems clear that smoking on the part of the mother exacts a heavy price on infants.

Again a more exact analysis would require the matched birth and death records, but indirect evidence via low birthweight is available. The NCHS reports low birthweight incidence by age, race and smoking status of mother (among other factors)<sup>10</sup>. Incidence of smoking among new mothers varies widely by age and race. 21.9% of white teenaged mothers smoke, but only 5.3% of black teenaged mothers. Above age 30 the order is reversed: 11.1% white vs 16% black aged 30-34, 11.5% white vs 18% black aged 35-39, 9.8% white vs 14.6% black aged 40-49. Among black mothers, about one quarter of all births, and about one quarter of all births under 2500 grams, occur under age 20, where the smoking incidence is much lower for blacks than whites. Smoking, at least smoking by teen mothers, does not explain the race differential in infant mortality.

*Conjecture #4:* The race differential in infant mortality rates is due not to any one factor but to a complex of issues, principally involving the economic situation into which infants are born.

We have seen that several of the simple explanations do not stand close scrutiny. The economic hypothesis is difficult to evaluate (at least from an actuarial standpoint), because neither birth nor death records include explicit economic information. We can, however, cite some indirect evidence.

While low birthweight is about twice as prevalent among blacks as among whites, *deaths* due to low birthweight are about 4.5 times as prevalent. This suggests that factors in the infant environment, rather than medical factors at birth, account for a large part of the differential. I plan to examine this question more closely, using the linked birth/death records from the NCHS.

It has also been noted that in countries where infant mortality rates are lower than in the United States, children also tend to do better on other measures, such as tests of academic ability.<sup>11</sup>

Although the evidence is less definitive than one might wish, it seems likely that, until we as a nation are prepared to take responsibility for the health and well-being of *all* our children, we are unlikely to make dramatic progress on infant mortality.

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<sup>1</sup>Monthly Vital Statistics Report, Vol. 45, No. 10, Supplement 2; April 30, 1997; Table 9.

<sup>2</sup>United Nations 1994 Demographic Yearbook, p 375 ff. The NCHS figure for the US in 1993 was 8.4; this is typical of the level of discrepancy between different measurements of such statistics.

<sup>3</sup>Advance Report of Final Mortality Statistics, 1993; table 26.

<sup>4</sup>Monthly Vital Statistics Report, Vol. 45, No. 11, Supplement (June 10, 1997): Report of Final Natality Statistics, 1995.

<sup>5</sup>Op cit, table 2.

<sup>6</sup>Op cit, table 28.

<sup>7</sup>Op cit, table 44.

<sup>8</sup>Birth rates among black teenagers have actually dropped every year since 1991 and are currently well below the rates of 1970: op cit, table 4.

<sup>9</sup>*Tobacco and Children, an economic evaluation of the medical effects of parental smoking*, by C. Andrew Aligne, MD, and Jeffrey J. Stoddard, MD; July 1997.

<sup>10</sup>Report of Final Natality Statistics, 1995; table 28.

<sup>11</sup>American Association of School Administrators, web-page report on the Third International Mathematics and Science Study ([www.aasa.org/timssTC.htm](http://www.aasa.org/timssTC.htm)), apparently now outdated; general information on th TIMSS is still available, for example at <http://ustimss.msu.edu>.

Table 1: US Mortality rates  
July 1995 - June 1996

	Blacks	Whites
All ages	856.1	912.5
Infants	1580.3	641.6
1-4	70.4	33.9
5-14	33.1	20.8
15-24	154.9	82.5
25-34	273.8	118.3
35-44	496.9	201.4
45-54	899.5	409.1
55-64	1806.2	1047.3
65-74	3500.6	2491.5
75-84	6814.2	5786.9
85+	14218.5	15554.0
Age-adjusted	754.0	473.9

Table 2: Infant mortality rates (1993)

Japan	4.3
Norway	5.1
Switzerland	5.6
Australia	5.8
Germany	5.8
Ireland	6.0
<b>CANADA</b>	6.3
Austria	6.5
Italy	7.4
Spain	7.6
Israel	7.8
<b>UNITED STATES</b>	8.2
Cyprus	8.5
Czech Republic	8.5
Greece	8.5
Costa Rica	9.4
Hungary	12.5
Chile	13.1
Poland	13.4
Russian Fed.	20.3



Figure 1  
Crude and age-adjusted mortality rates

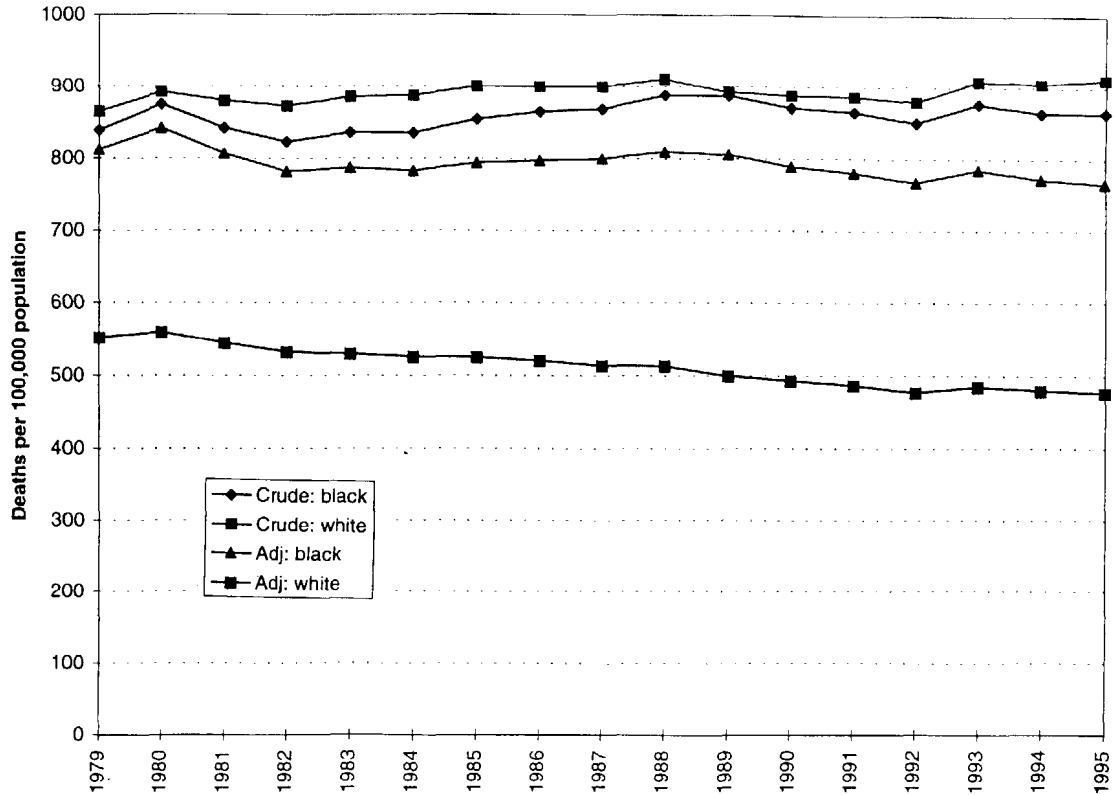


Figure 2  
Infant mortality rates

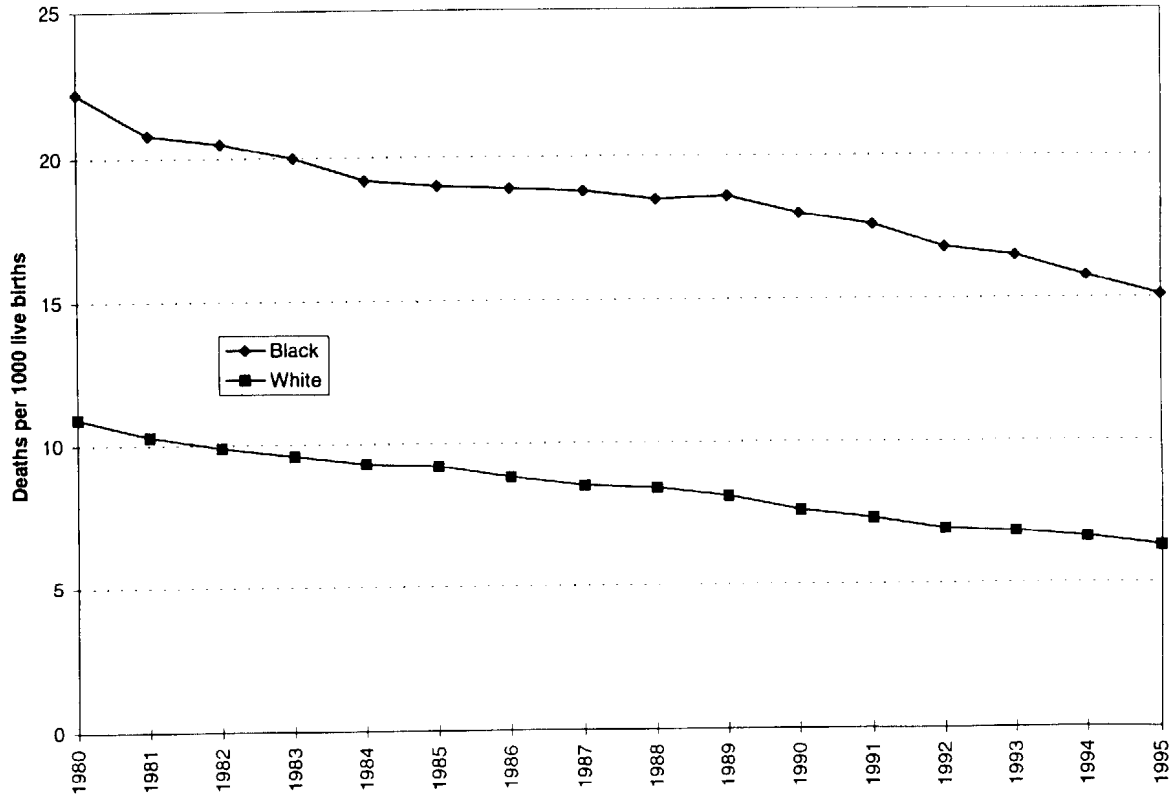


Figure 3

Median birthweights by age and race of mother

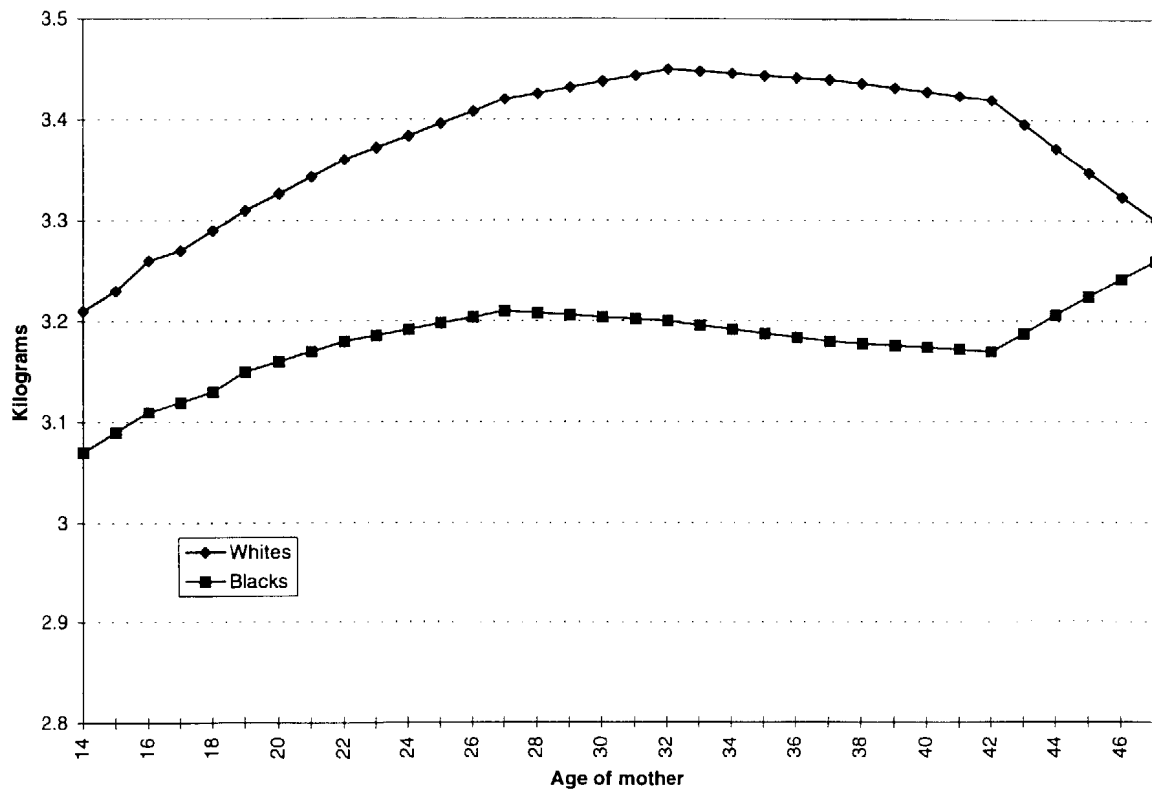


Figure 4  
Percentile birthweights (1995)

