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The Increasing Disparity in Mortality between Socioeconomic Groups in the United States, 1960 and 1986

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ABSTRACT

Background There is an inverse relation between socioeconomic status and mortality. Over the past several decades death rates in the United States have declined, but it is unclear whether all socioeconomic groups have benefited equally.

Methods Using records from the 1986 National Mortality Followback Survey (n = 13,491) and the 1986 National Health Interview Survey (n = 30,725), we replicated the analysis by Kitagawa and Hauser of differential mortality in 1960. We calculated direct standardized mortality rates and indirect standardized mortality ratios for persons 25 to 64 years of age according to race, sex, income, and family status.

Results The inverse relation between mortality and socioeconomic status persisted in 1986 and was stronger than in 1960. The disparity in mortality rates according to income and education increased for men and women, whites and blacks, and family members and unrelated persons. Over the 26-year period, the inequalities according to educational level increased for whites and blacks by over 20 percent in women and by over 100 percent in men. In whites, absolute death rates declined in persons of all educational levels, but the reduction was greater for men and women with more education than for those with less.

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Conclusions Despite an overall decline in death rates in the United States since 1960, poor and poorly educated people still die at higher rates than those with higher incomes or better educations, and this disparity increased between 1960 and 1986.

In recent decades death rates in this country have fallen, but the improvement has not been shared equally. There is a widening gap in the death rate between blacks and whites¹. Although the inverse relation between socioeconomic class and mortality has been documented in the United States,^{2,3} less is known about how this relation may be changing⁴. Studies in a number of other countries have demonstrated that lower socioeconomic classes have higher death rates than upper socioeconomic classes and that these differences have increased in the past several decades^{5,6,7}. The Black Report and other studies record a growing disparity in death rates between occupational classes in England and Wales since 1950^{8,9,10,11,12}. Similar gaps have been noted in France and Hungary during the past two decades, whereas in Sweden, Norway, Denmark, and Finland the differences have remained constant^{7,8}. In the United States, increased differences in mortality have been noted among older white men according to their level of education¹³.

This study examines changes in mortality rates from 1960 through 1986 according to income and level of education among persons 25 to 64 years of age in the United States. Kitagawa and Hauser used the 1960 Matched Record Study to demonstrate the inverse relation between socioeconomic status and the death rate². We replicated this approach with data from the 1986 National Mortality Followback Survey and the 1986 National Health Interview Survey.

Methods

Matched Record Study

The Matched Record Study of 1960 was a collaborative effort of the Bureau of the Census and National Center for Health Statistics. A sample of the death certificates of persons 25 years of age or older who died from May through August 1960 were matched against census information collected in the same year. The 62,400 matched records that included data on sex, race, family status, income, occupation, and educational attainment were used to calculate age-adjusted death rates for various socioeconomic classes and groups.

Kitagawa and Hauser used standardized mortality ratios, an indirect adjustment for age that is calculated by dividing the number of observed deaths by the number of expected deaths in a specific group. The 1960 survey was used to estimate the number of observed deaths. The number of expected deaths was calculated by multiplying the 1960 death rates by the census figures for various groups defined according to sex, race, family status, income, or education. Only the published data for 1960 are presented here, because the original data no longer exist, not having been routinely archived. Kitagawa and Hauser published results on the inequality in mortality for education and income groups among whites according to sex and family status. Because of the small number of blacks in their study, only the results for the groups that were subdivided according to sex and education were published.

National Mortality Followback Survey and National Health Interview Survey

The National Mortality Followback Survey and the National Health Interview Survey, both conducted in 1986, were used to develop measures comparable to the 1960 figures. For the rates and ratios shown here, the 1986 National Mortality Followback Survey provided the numerators, and the 1986 National Health Interview Survey provided the denominators.

The National Mortality Followback Survey is a nationally representative sample comprising 18,733 people 25 years of age or older who died in 1986^{14,15}; we analyzed the records of 13,491 of them (the exclusions are described below under Analytical Sample and Variables). Information obtained from death certificates was linked with data from questionnaires completed by next of kin. These data included information about income, education, and family status. All the states except Oregon (which accounted for 1 percent of the U.S. population) participated in the survey. When weighted, these records provide the estimated number of deaths used here as the numerators in the rates and ratios.

The National Health Interview Survey comprises a multistage probability sample of households from the civilian, noninstitutionalized U.S. population. The 1986 survey included 30,725 persons from 25 through 64 years of age and was weighted to represent the population at the middle of the year 1986,¹⁶ appropriately for the calculation of death rates. The 1986 National Health Interview Survey was used to estimate the sex, race, family-status, income, and education groups used as the denominators in the rates and ratios presented here.

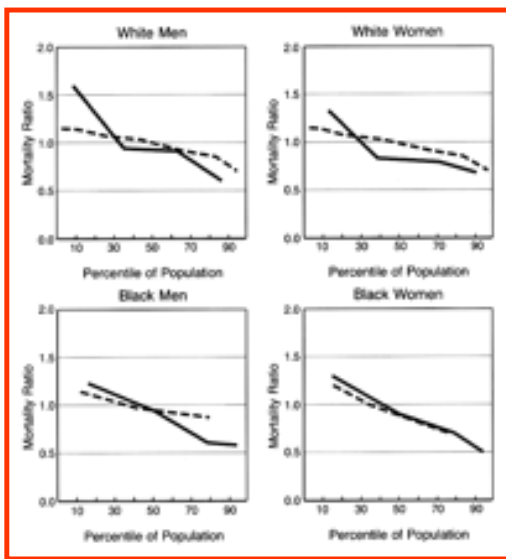
Mortality Ratios and the Index of Inequality

The mortality ratios presented in this study measure the relative differences in mortality between groups with different levels of education and income. They are ratios of standardized mortality ratios, calculated with the technique of Kitagawa and Hauser,¹³ by dividing the observed number of deaths by the number expected. In this study the number of observed deaths was obtained from the 1986 National Mortality Followback Survey. We obtained the number of expected deaths by multiplying the age-specific death rates for the entire U.S. population in 1960 by the age composition of each subgroup (i.e., those defined according to age, sex, race, education, or income), using the population estimates from the 1986 National Health Interview Survey.

Mortality ratios were calculated by dividing the standardized mortality ratio for each income or education subgroup by the standardized mortality ratio for the group of people of that sex and race. A mortality ratio of less than 1 indicates that the number of observed deaths in a particular education or income category was smaller than expected on the basis of age, sex, and race alone. A mortality ratio higher than 1 indicates that the number of observed deaths exceeds the number expected solely on the basis of age, sex, and race.

The mortality ratios corresponding to different education and income levels are plotted against the midpoint for the relevant percentile of the subgroup, with the population ordered from low to high status ([Figure 1](#) and [Figure 2](#)). The lowest income level among white women, for example, comprises 21 percent of that group and is therefore plotted at 10.5 on the abscissa of the graph. The proportion of the population in each higher income group is added and plotted at the respective midpoints. With this technique it is possible to plot on the same scale the distributions and ranges of income and education that differ both for the two study years and between

subgroups of the population. The plots make approximate adjustments for monetary inflation and increasing educational attainment by creating a relative scale for each subgroup.



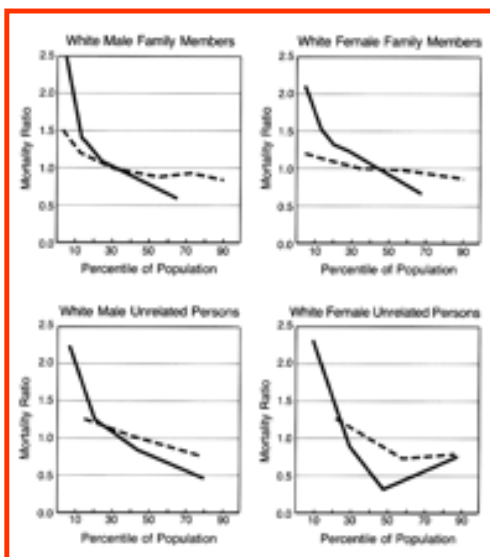
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Figure 1. Relative Mortality in 1960 (broken line) and 1986 (solid line) According to Percentile of Educational Attainment in Persons 25 through 64 Years of Age.

The levels of educational attainment used in the 1960 study were as follows: primary and middle school, 0 to 4 years, 5 to 7 years, and 8 years; high school, 1 to 3 years and 4 years; and college, 1 to 3 years and ≥ 4 years. The levels used in 1986 were: school, 0 to 11 years and 12 years; and college, 1 to 3 years and ≥ 4 years. See the Methods section for a discussion of the plotting of levels of educational attainment according to the percentile of the population. Mortality ratios are ratios of standardized mortality ratios, a method of indirect age adjustment. Data are from the 1960 Matched Record Study, the 1986 National Mortality Followback Survey, and 1986 National Health Interview Study.



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Figure 2. Relative Mortality in 1960 (broken line) and 1986 (solid line) According to Income and Family Status in White Men and Women (25 through 64 Years of Age).

The income levels used for family members in the 1960 study were as follows: $< \$2,000$, $\$2,000$ to $\$3,999$, $\$4,000$ to $\$5,999$, $\$6,000$ to $\$7,999$, $\$8,000$ to $\$9,999$, and $\geq \$10,000$. The levels used for unrelated people in 1960 were $< \$2,000$, $\$2,000$ to $\$3,999$, and $\geq \$4,000$. The levels used for family members in 1986 were $\leq \$10,999$, $\$11,000$ to $\$16,999$, $\$17,000$ to $\$18,999$, $\$19,000$ to $\$24,999$, and $\geq \$25,000$. The levels used for unrelated people in 1986 were $\leq \$6,999$, $\$7,000$ to $\$12,999$, $\$13,000$ to $\$24,999$, and $\geq \$25,000$. See the Methods section for a discussion of the plotting of income levels according to the percentile of the population. Mortality ratios are ratios of standardized mortality ratios, an indirect age adjustment. Data are from the 1960 Matched Record Study, the 1986 National Mortality Followback Survey, and the 1986 National Health Interview Study.

These plots indicate the relation between social class and mortality on the basis of the relative inequality (the divergence from the average) within a group. Lines that fall nearer the horizontal indicate more convergence within a group (that is, a weaker inverse relation between class and mortality). More vertical lines indicate

greater divergence from the average -- that is, more inequalities within the group. Comparing the lines for the two study years permits an assessment of changes over time in inequality between classes with respect to mortality within particular subgroups.

To summarize the difference in mortality across educational and income levels, we constructed an index ([Figure 3](#)) to represent the difference between levels of education or income across the entire group. For each education or income subgroup, the mortality ratio was subtracted from the mortality ratio for the group (considered to be equal to 1), and the absolute value of the difference was multiplied by the respective percentage of the population that belonged to that subgroup. The sum of these weighted differences in mortality ratios is the index score.

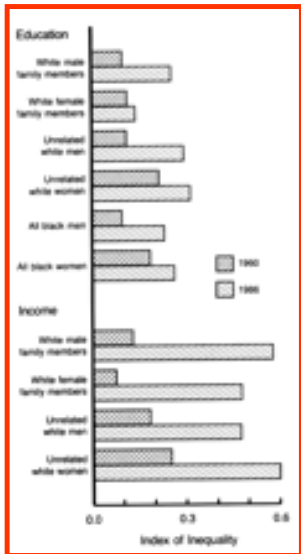


Figure 3. Increases from 1960 to 1986 in the Inequality in Mortality for Selected Education and Income Groups among Persons 25 through 64 Years of Age, According to Race, Sex, and Family Status.

The index of inequality is a summary measure of differences in mortality according to level of education or income among persons of similar sex, race, and family status, based on mortality ratios. See the Methods section for a more complete discussion. Data are from the 1960 Matched Record Study, the 1986 National Mortality Followback Survey, and the 1986 National Health Interview Study.

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The index score has an advantage over the comparison of extremes, a popular technique used to assess changes in the difference between classes. Comparisons of the mortality ratios for groups at the top and bottom of the education and income scales are distorted by the fact that at different times there are differing proportions of the population with the various levels of education and income. Our index overcomes this difficulty and aggregates the inequality in mortality across the entire scale. The advantages of indexes of this type have been discussed by Wagstaff et al¹⁷.

The statistical significance of the results of this study can be tested by examining the consistency of the direction of change from the first study year to the second. The sign test assesses the probability that observed increases in the index of inequality for all comparisons are due to chance. Because Kitagawa and Hauser did not calculate standard errors for their study and the original data are no longer available, no further statistical testing of the time trend is possible.

Analytical Sample and Variables

The analytical sample used in this study included the noninstitutionalized, civilian U.S. population (excluding that of Oregon) 25 to 64 years of age. The deaths of persons in the military and those of persons who lived in institutions for more than half the year were excluded from the numerator estimates derived from the National Mortality Followback Survey. The analysis was restricted to persons 25 to 64 years old because many of those who died over the age of 64 lived in institutions, and the National Health Interview Survey excluded institutionalized persons from its sample.

In their studies of race, Kitagawa and Hauser used the categories of white and nonwhite. The composition of the populations considered to be white and nonwhite has, however, changed since 1960. "White" now includes an increasing proportion of Hispanics, whereas "nonwhite" includes an increasing proportion of persons who are not of African descent. To make the comparisons as accurate as possible, we compared non-Hispanic whites from 1986 with whites of 1960 and blacks from 1986 with nonwhites of 1960. These categories are referred to here as white and black for both 1960 and 1986.

The indicators of socioeconomic class studied here include educational level and income. The family income of persons living in families and the individual income of unrelated people were used in the determination of income level. Unrelated people were considered to include persons living alone and those living with others who were not family members. Unmarried domestic partners were considered as family members.

Results

Poor or poorly educated persons have higher death rates than wealthier or better educated persons, and these differences increased from 1960 through 1986. The disparity in death rates among adults 25 to 64 years of age has widened in relation to income and educational level. Although death rates improved in the population as a whole, the benefits were not shared equally. From 1960 to 1986, the inequality in mortality related to educational level and income increased in each of the subgroups studied according to race, sex, and family status. Among whites, whereas death rates declined for persons of every educational level, the decline was steeper among men and women with more education than among those with less.

The inverse relation between mortality and socioeconomic class (as defined by educational attainment and income) was confirmed for adults 25 through 64 years of age in 1986 ([Table 1](#)). With increasing levels of education, direct age-adjusted death rates fell among white men, black men, white women, and black women in the United States. Similar relations were noted for income.

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Table 1. Death Rates in 1986 among Persons 25 through 64 Years Old in Selected Education and Income Groups According to Race and Sex.

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The mortality ratios showed the same patterns ([Figure 1](#)). The plotted indirect age-adjusted data for 1986 indicated inverse relations between educational class and mortality for each race, sex, and family-status subgroup studied. Among white men, mortality ratios decreased consistently as educational attainment rose. The ratio for

white men with 11 years or less of schooling was 1.6; for white men with at least 4 years of college, it was 0.6. That is, the age-adjusted mortality ratio for white men with the lowest educational attainment was more than 2 1/2 times higher than the comparable ratio for white men of the highest educational level. The education-related differential for white women was only 86 percent, ranging from a mortality ratio of 1.3 for white women with 11 years or less of schooling to a ratio of 0.7 for white women with at least 4 years of college. Similar trends were noted for black men and women. Mortality decreased with increasing educational attainment across the entire distribution, not only among those at the bottom of the education scale.

Previously published data from 1960 on death rates for people of various educational levels are shown with the 1986 mortality ratios in [Figure 1](#). This mode of presentation allows comparisons despite the increases in educational attainment over the 26-year period and the changes in the proportion of the population to have attained various educational levels.

When the 1960 data and the 1986 data are compared, it is apparent that the inverse relation between mortality and education has become stronger. Among whites and blacks of both sexes, the differences in mortality according to educational level were greater for 1986 than for 1960; the slopes of the lines for 1986 were steeper than those for 1960. This widening of differences in mortality with educational level was also observed among white family members and unrelated persons of both sexes. (More complete data are available elsewhere.^{*})

The patterns in the data for income level were similar to those for educational level. As shown in [Figure 2](#), higher-income groups had lower mortality ratios in 1986. Among white men from families with incomes under \$10,999, the mortality ratio of 2.5 was more than four times higher than the ratio of 0.6 for white men from families with incomes of \$25,000 or more. From 1960 through 1986, the differences in mortality widened between income groups. Among white family members, there were larger differences in mortality ratios between income levels in 1986 than in 1960; the slopes of the lines for 1986 were steeper than those for 1960. The same was true for unrelated people of both sexes.

An index of inequality was calculated to summarize and quantify the inequality in mortality rates across the entire group. The indexes for education ([Figure 3](#)) showed that from 1960 through 1986, inequality in mortality increased 30 percent for black women and 23 percent for white women. For both black and white men, inequality in mortality according to educational level doubled. The changes in the inequality index according to income were larger than the changes in the index according to education. The index of inequality in mortality rates for income groups more than doubled among unrelated people (both white men and white women) and more than tripled among white men and women who were family members.

This measure of cumulative inequality in mortality in a group revealed greater inequality in 1986 than in 1960 for each available comparison. The application of a two-sided sign test against a null hypothesis that there was no change in inequality determined the significance of this consistent direction of change. The consistent difference in sign for the six independent subgroups (sex, race, and family status) for education resulted in a significance level of $P = 0.031$. The consistent difference in sign for the four independent subgroups (sex and race) for income resulted in a significance level of $P = 0.13$.

Although death rates declined over the 26-year period in all groups, the decline was steeper for men and women of high educational attainment than for those with low levels of education (Figure 4). The study of absolute differences according to educational attainment was restricted to whites because no comparable data from 1960 were available for other groups. The direct age-adjusted death rate for white men 25 to 64 years of age declined by 50 percent (from 5.7 to 2.8 per 1000) among men of high educational attainment from 1960 through 1986 and dropped only 15 percent (from 9 to 7.6) among white men of low education. Comparison of the slopes suggested less dramatic changes among white women over the same period. The differing proportions of the population in the different educational groups and the changes in the social meaning of particular educational levels complicated comparisons of the direct age-adjusted rates. The mortality ratios previously presented avoid these complexities and support similar conclusions.

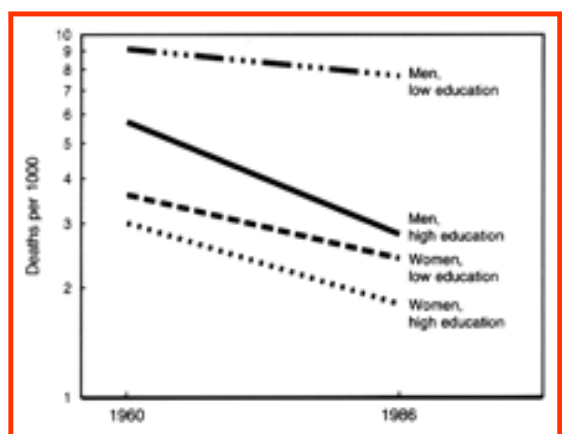


Figure 4. Death Rates in 1960 and 1986 among Whites 25 through 64 Years of Age, According to Sex and Educational Level.

Death rates shown are per 1000 population after direct adjustment for age to the 1940 U.S. population. Low level of education was defined in 1960 as <8 years of schooling and in 1986 as <11 years of schooling. High level of education was defined in 1960 as ≥ 1 year of college and in 1986 as ≥ 4 years of college. Data are from the 1960 Matched Record Study, the 1986 National Mortality Followback Survey, and the 1986 National Health Interview Study.

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Discussion

This study confirms the well-known inverse relation between socioeconomic class and mortality^{18,19} and documents that in the United States the relation between the two has become stronger. The presence of widening differences in mortality rates according to income and educational level should come as no surprise, given the broad social changes in this country since 1960. Increasing inequalities in income, education, and housing and a falling standard of living for a large segment of the U.S. population have been reported^{20,21}. Access to health care is a problem for a growing number of Americans²². Although Medicaid may have improved access and health outcomes for a portion of the population, it appears to have been insufficient to equalize the chances for survival among the poorest and least educated^{23,24}. The social distribution of behavior that presents health risks may be important in explaining the widening gap²⁵. It may be that people of higher socioeconomic status have adopted healthy lifestyles more rapidly^{26,27,28}.

These findings of increasing class differences in mortality among adults 25 through 64 years of age are generally confirmed by other work in this area. Duleep found no narrowing of differences in mortality according to income or education among white men 25 through 64 in a study comparing 1960 with the mid-1970s²⁹. Inspection of

those data suggests, however, that widening of the gap may have occurred. Using a longitudinal national survey, Feldman et al. reported increased differences according to educational level between the mortality rate for 1960 and the average rate for the period 1971 through 1984 among white men 55 years of age or older¹³. The differences among older white women showed no change. The changes we report here were weaker for women than for men. Our study examined a longer period than was assessed by either Duleep or Feldman et al. The widening gap between blacks and whites also supports our findings. Race has often been understood as a proxy for social class; among blacks, low income and poor education have an important effect on survival for both adults and infants^{30,31}. It should be noted, however, that the results of this study suggest that the gaps in mortality have widened for both blacks and whites.

This and other studies of social disparities shed light on the importance of class for an understanding of the gap in life expectancy between blacks and whites³². In the 1986 National Mortality Followback Survey, the differences in overall mortality according to race were eliminated after adjustment for income, marital status, and household size. Examining cause-specific mortality while controlling for these socioeconomic factors reveals that blacks have lower risks than whites for death from respiratory disease, accidents, and suicide; that they have the same risk for cancer and circulatory diseases; and that they have higher risks for infectious disease, homicide, and diabetes³³.

The general pattern of improvement in death rates among whites of all socioeconomic classes is less clear among blacks. No comparisons of absolute changes among blacks were possible in this study. Community-based studies suggest that death rates among blacks in areas of low socioeconomic status have changed very little since 1960^{34,35}. From 1960 through 1980, the age-adjusted death rate in Harlem has been static, although in the white and nonwhite populations overall this rate has fallen³⁵.

The causes of death that explain the time trend we have described have yet to be studied. A steeper decline in rates of deaths due to heart disease among men of higher socioeconomic status has been reported for similar periods^{36,37,38}. Before 1986, the acquired immunodeficiency syndrome was not a major cause of death. Cause-specific studies of mortality and morbidity are needed for the dynamics of the changes described here to be better understood.

The findings of this study must be interpreted with several caveats. We examined data from only 2 years over a 26-year period during which differences in mortality may have varied. Further research with additional sets of data is necessary. The 1986 National Mortality Followback Survey contains limited information on income at the high end of the socioeconomic scale. The highest category in the 1986 survey was for income of at least \$25,000, the median U.S. income for that year. A departure from the overall inverse relation between mortality and socioeconomic class was observed in the United Kingdom, where the death rate for the highest income group was slightly higher than the rate for the next highest income group³⁹. The limitations of the 1986 data do not permit assessment of this phenomenon in the United States.

Artifact must be considered in explaining the described trends. It is known that undercounting by the census inflates death rates among blacks to a small extent⁴⁰. The problem of undercounting may also affect people in groups of low income or low educational levels, heightening class relations such as those we describe³.

Finally, Kitagawa and Hauser attribute a small part of the difference in socioeconomic class to the decline in status as a person approaches death (i.e., with a declining income and occupational status) -- the drift hypothesis². There is no evidence to suggest a stronger tendency toward downward mobility in 1986. Furthermore, the association between education and mortality would not be affected by such factors.

Despite the important decline in death rates in this country since 1960, we have identified a greater disparity in mortality rates between people of different incomes and educational levels. As death rates have declined, poor and less educated people have not benefited equally in comparison with those who are wealthier and better educated. These differences are not confined to persons in extreme poverty but are seen across the socioeconomic spectrum. Improvements in life expectancy can be achieved with programs that address the underlying causes of the differential mortality. The results of this study raise serious questions about disparities in opportunity and equity in our nation.

We are indebted to Lester Curtin for statistical consultation; to Nelma Keen, Luong Tonthat, Janice Tandler, and Amy Gatton for assistance with the production of this analysis; and to the Poverty and Health Work Group for suggestions at various stages of the project.

* See NAPS document no. 05038 for three pages of supplementary material. To order, contact NAPS c/o Microfiche Publications, 248 Hempstead Tpk., West Hempstead, NY 11552.

Source Information

From the National Center for Health Statistics, Office of Planning and Extramural Programs, Rm. 1100, 6525 Belcrest Rd., Hyattsville, MD 20782, where reprint requests should be addressed to Dr. Pappas.

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