A Summary Measure of Health Disparity

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SYNOPSIS

Objectives. Eliminating health disparities is a goal of Healthy People 2010. In order to track progress toward this goal, we need improved methods for measuring disparity. The authors present the Index of Disparity (ID) as a summary measure of disparity.

Methods. The ID, a modified coefficient of variation, was used to measure disparity across populations defined on the basis of race/ethnicity, income, education, and gender. Disparity was also assessed for a diverse range of health indicators and over time to monitor trends.

Results. Disparity in cardiovascular disease deaths decreased based on gender from 1989 to 1998 but was largely unchanged based on race/ethnicity. The magnitude of disparities in cervical cancer and cholesterol screening, smoking, exercise, and health insurance ranged from 1.9% to 78.6%. The largest disparities for health indicators were not associated with any particular population classification, whether defined on the basis of race/ethnicity, education, or income.

Conclusions. To eliminate disparities, we need a means to assess disparities across many types of health indicators. Furthermore, for a given health indicator, disparities may differ for populations defined on the basis of race/ethnicity, education, income, and so on. The ID is a simple method for summarizing disparities across groups within a population that can be applied across health indicators regardless of magnitude, over time to monitor trends, and across different populations.

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One of three overarching goals for the Healthy People 2000 objectives was to reduce health disparities among Americans.[1] Further, in Healthy People 2010, the elimination of health disparities across various population groups in the United States replaces reducing disparities as an overarching goal.[2] In order to monitor progress toward this goal, an appropriate method for assessing disparity must be adopted. Disparity may be considered broadly in terms of the magnitude of variation across all groups. Alternatively, disparity may be considered narrowly in terms of how different a specific population group is from the overall population. This is an important distinction for purposes of monitoring and eliminating disparities. We need to monitor disparities broadly across all groups, while simultaneously working to eliminate them.

Disparity can be defined as a marked difference or inequality between two or more population groups defined on the basis of race or ethnicity, gender, educational level, or other criteria. Discussions of disparity in health generally focus on differences between two groups in a population. Differences are shown as pairwise comparisons, and may be demonstrated using the ratio of two rates,[3,4] simple comparison of rates,[5,6] hazard ratios,[7] or relative risks.[8,9] Other methods of describing disparity—including range, Gini coefficient, index of dissimilarity, and slope index of inequality—have been considered, but may be inappropriate in some situations.[10]

Pairwise comparisons may be appropriate when the goal is to improve health status for a particular group or population. For broader discussions of disparity, pairwise comparisons become complicated when the definitions of groups or populations result in more than two or three groupings, such as with racial/ethnic populations. Thus, to more simply describe health disparity across population groups, a more inclusive, summary measure of the differences is needed.

We present the Index of Disparity (ID) as a simple, summary measure of disparity across population groups: where groups may be defined in terms of race/ethnicity, education, gender, and/or income. The ID is compared across several dimensions of health, including mortality, morbidity, utilization of preventive services, and risk behaviors. The ID is also employed to examine trends in disparity by gender and race/ethnicity for cardiovascular disease (CVD) death rates.

METHODS

The ID is defined as the average of the absolute differences between rates for specific groups within a population and the overall population rate, divided by the rate for the overall population and expressed as a percentage.

$$\text{Index of disparity} = \left(\Sigma \left| r_{(1-n)} - R \right| / n \right) / R * 100$$

where r = group rate and R = total population rate.

Populations are subdivided based on characteristics of individuals within a population. These types of subdivisions are referred to here as *groups*. Populations are based on which characteristic defines groups within a population. For example, a population may be characterized by income, with groups defined by level of income. Or, a population may be characterized by education, with groups defined by level of educational attainment, and so on. The ID is very similar to the coefficient of variation. Instead of taking squared differences, however, the ID takes absolute differences, which improves its utility for tracking change over time. Also, by using the rate for the total population rather than the average of the group rates, a clear connection to a specific group is achieved.

For the present study, we calculated IDs for several measures of health for groups within populations. For measures of mortality (CVD, unintentional injury, and infant mortality), low birthweight, air quality, and tuberculosis, the results are shown based on groups characterized by race and Hispanic origin: American Indian or Alaska Native; Asian or Pacific Islander; black non-Hispanic; Hispanic; and white non-Hispanic. For measures of health services (e.g., utilization of screening tests) and health behavior (e.g., smoking), disparity in populations was calculated for groups characterized by income, race/ethnicity, and educational attainment. These calculations are based on individuals 18 years of age and older, except the health insurance measure, for which the population consisted of people younger than 65 years of age.

The IDs for mortality measures were calculated from death rates per 100,000 population that were age-adjusted to the 1940 U.S. population. Numerators (numbers of deaths) are from National Vital Statistics System mortality tapes and exclude records for which age, race, or ethnicity were recorded as "unknown" or "not stated." Denominators for rates (population size) are Census Bureau estimates by sex, single-year age, race, and Hispanic origin (ST-98-32 through ST-98-40) released September 1999 for the years 1990–1998, and sex, five-year age group, race, and Hispanic origin for 1989.[11]

The ID for low birthweight was calculated from the percentage of live births of infants who weighed <2,500 g, excluding unknowns, obtained from the National Vital Statistics System natality tapes for 1998.

The ID for infant mortality was calculated from the number of deaths per 1,000 live births, obtained from the National Vital Statistics System linked birthdeath files for 1998.

For the purpose of this article, estimates of the number of people in the U.S. living in counties that did not meet any National Ambient Air Quality Standards (NAAQS) were calculated directly from the interim database maintained by the U.S. Environmental Protection Agency (EPA) Office of Air Quality Planning and Standards, Information Transfer and Program Integration Division.[12] Counties in which one or more of the six criteria pollutants exceeded NAAQS were tabulated by state and year. So-called "secondary exceedences" were used, such that a county had to have at least two recorded values in excess of the NAAQS to be in exceedence. Any county with at least two exceedences was considered in exceedence of the standards. Annual Census Bureau estimates of the population by race/ethnicity in the counties that exceeded any standard were used to calculate the percentage of individuals living in counties exceeding EPA air quality standards for each state.[11]

Tuberculosis incidence rates were from the Centers for Disease Control and Prevention.[13]

IDs for indicators related to health screening and health behavior were calculated from data taken from the 1997 and 1998 National Health Interview Surveys, conducted by the National Center for Health Statistics.[14,15] IDs were based on prevalence estimates of individuals without health insurance, individuals who had never been screened for blood cholesterol, those without regular physical exercise, those who were current smokers, and women who had never had a Pap test.

Changes in death rates from 1989 to 1998 and differences in death rates across racial/ethnic groups were tested for statistical significance. Unless otherwise specified, reported differences are statistically significant. Methods are currently being developed to estimate the standard error and confidence intervals for the ID. Therefore, estimates of disparity shown here should be viewed as illustrative of a method for summarizing disparity and not definitive for specific levels of disparity.

RESULTS

Comparisons of disparities across five racial/ethnic groups for several measures of health are shown in Table 1. For each measure of health, rates for each racial/ethnic group are shown along with the ID. The ID for the five racial/ethnic groups for CVD mortality was 30.4% in 1998—somewhat lower than the IDs for deaths due to unintentional injury (33.7%) and infant mortality (36.4%). These values of the ID indicate the average deviation of the group rates from the total rate relative to the total rate expressed as a percentage, i.e., the "spread" of the group rates around the total rate. Using the ID, we can compare across measures of health more easily and see that disparity is greatest for tuberculosis (170.3%) and least for percentage of low birthweight births (23.0%). Further, it can be seen that measures of mortality are intermedi-

Table 1. Rates for racial/ethnic groups and Index of Disparity (ID) for selected measures of health, United States, 1998

Health measure	*American Indian or Alaska Native*	*Asian or Pacific Islander*	*Black non-Hispanic*	*Hispanic*	*White non-Hispanic*	*Total*	*ID*
Cardiovascular disease death rate[a]	123.8	95.6	246.3	109.3	155.8	161.2	30.4%
Unintentional injury death rate[b]	55.6	14.4	36.9	28.0	29.5	30.1	33.7%
Infant mortality rate[c]	9.3	5.5	13.9	5.8	6.0	7.2	36.4%
Percent low birthweight[d]	6.8	7.4	13.2	6.4	6.6	7.6	23.2%
Percent living with poor air quality[e]	30.2	60.9	45.8	59.8	35.9	40.6	29.5%
Tuberculosis case rate[f]	12.6	36.6	17.8	13.6	2.3	6.8	170.3%

[a]Cardiovascular disease deaths/100,000 age-adjusted to 1940 standard million

[b]Unintentional injury deaths/100,000 age-adjusted to 1940 standard million

[c]Infant (<1-year-old) deaths/1,000 live births

[d]Low birthweight/100 live births

[e]Percent of U.S. population living in counties not meeting National Ambient Air Quality Standards

[f]Tuberculosis incidence/100,000 population

Table 2. Income, race/ethnicity, and education specific rates and Index of Disparity (ID) for selected measures of health, 1997 and 1998 National Health Interview Surveys

Variable	No health insurance 1998 Percent	Current smoker 1998 Percent	Never had cholesterol checked 1998 Percent	Never had Pap test 1998 Percent	No moderate exercise 1998 Percent
Income					
All incomes	16.6	24.0	28.0	7.5	85.2
Poor	32.8	33.6	39.6	12.2	88.3
Near poor	30.9	30.9	36.1	8.3	85.5
Middle/high	8.1	21.4	23.4	5.8	83.7
ID	78.6	26.5	28.9	32.1	1.9
Race/ethnicity					
All race/ethnicity	16.6	24.0	28.0	7.5	85.2
American Indian or Alaska Native	38.7	35.0	38.5	12.0	86.5
Asian/Pacific Islander	18.3	13.0	29.4	21.5	85.4
Black non-Hispanic	20.4	24.7	30.2	5.7	89.9
Hispanic	34.1	18.5	37.6	14.6	88.9
White non-Hispanic	12.5	25.3	26.3	6.3	83.9
ID	59.5	24.7	18.1	76.0	2.6
Education					
All education levels	16.6	24.0	28.0	7.5	85.2
<8 years	43.1	26.7	43.0	17.1	93.2
9–11 years	31.2	38.1	34.7	7.3	89.1
12 years	17.9	28.9	37.5	4.5	86.3
13–15 years	12.9	23.5	19.6	3.1	82.9
≥16 years	6.3	10.9	12.9	2.9	83.0
ID	72.3	29.5	39.1	58.2	4.1

SOURCE OF DATA: References 14 and 15.

ate between the tuberculosis case rate and environmental quality.

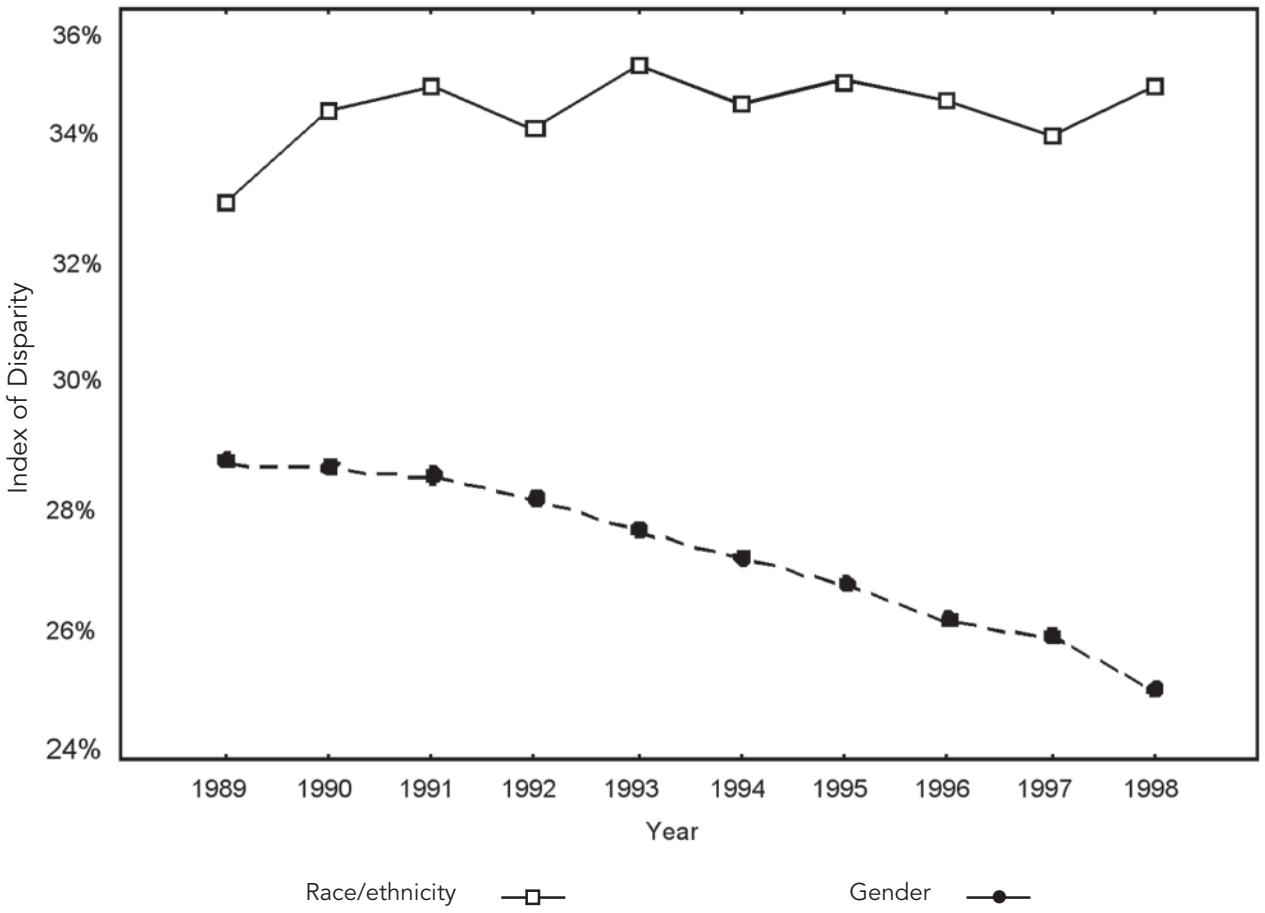
The value of the ID as a summary measure of disparity should be apparent from an examination of a multivariate set of data such as in Table 1. The table shows five population groups and six measures of health, but the level of disparity across racial/ethnic groups and across measures can be readily seen through inspection of the IDs. The ID can also be used to assess disparity for a specific measure of health across different characteristics of a population. For example, in Table 2, the prevalence rates for several preventive health and health behavior measures are presented for populations characterized by income, race/ethnicity, and educational attainment.

The first data column in Table 2 shows prevalence estimates for lack of health insurance for populations characterized by income, race/ethnicity, and educational attainment. Disparities in health insurance coverage are consistently high (59.5%–78.6%) across all population groupings. Disparity is consistently moderately high for smoking (24.7%–29.5%), but more variable for cholesterol (18.1%–39.1%) and highly variable for cervical cancer screening. Low levels of disparity are shown for lack of exercise.

Disparity across racial/ethnic groups for cervical cancer screening is very high (76.0%) and more than twice as large as the ID for the population characterized by income groups (32.1%). In sharp contrast, disparities for "no moderate exercise" are consistently very small (1.9%–4.1%) and reflect the fact that, regardless of how populations are characterized, the prevalence of inactivity is very high. Comparisons across populations show that disparity for a given health indicator (e.g., cervical cancer screening) may differ considerably depending on how the population is grouped.

Finally, the ID can also be used to monitor changes in disparity over time. Figure 1 shows the change in disparities for CVD deaths from 1989 to 1998 for populations defined by race/ethnicity and by gender. Dis-

Figure 1. Index of Disparity by gender and race/ethnicity for age-adjusted cardiovascular disease death rates, United States, 1989–1998

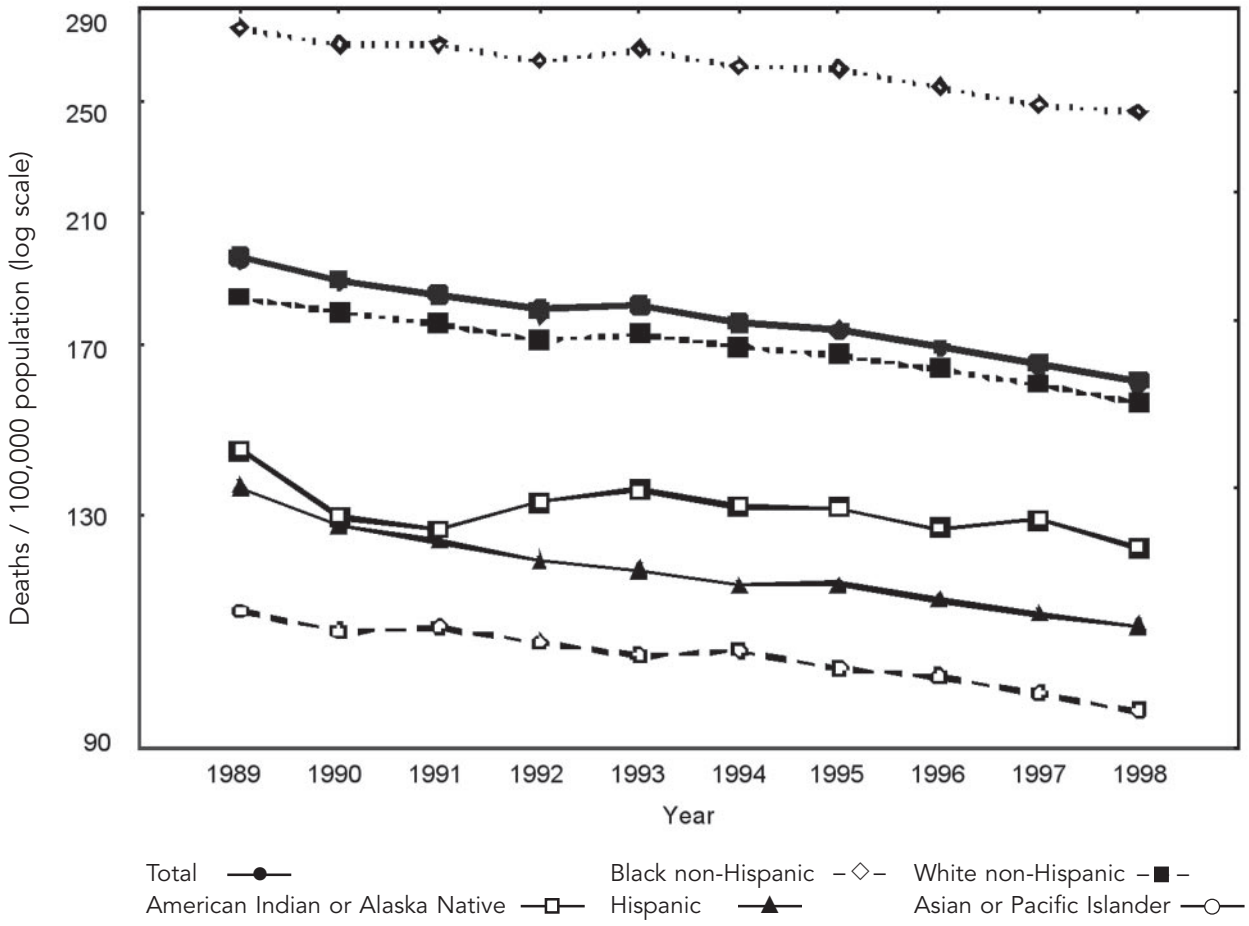


parity across racial/ethnic groups increased slightly (1.6%) but was highly variable within a narrow range of values. In contrast, gender disparity decreased much more substantially (12.5%) and exhibited much less year-to-year variability. In order to be able to fully interpret the meaning of these changes in disparity, it is necessary to examine the changes in individual group rates for each population type.

Disparity in age-adjusted CVD death rates increased across racial/ethnic populations from 1989 to 1998, while at the same time rates declined (Figure 2). Although all of the individual group rates declined, they did not all decline equally. The Hispanic group shows the largest reduction (19.8%), and the black non-Hispanic group had the smallest reduction (12.6%). Indeed, all other racial/ethnic groups had greater reductions in rates than the black non-Hispanic group. So, while all rates declined, some declined faster, and rates for individual groups grew farther apart. The overall CVD death rate (the denominator value of the ID) declined 17.8%, while the mean deviation (the numerator value of the ID) declined only 13.2%. This resulted in an increase in the ID and, therefore, an increase in disparity.

In contrast, the disparity in CVD death rates for gender-based population groups declined from 1989 to 1998 (Figure 3). Figure 3 shows that death rates for males—the group with the highest rate—declined 20.7%, while rates for females declined 15.1%. The overall value of the CVD death rate (the denominator value of the ID) declined 17.8%, while the mean deviation (the numerator value of the ID) declined 28.0%. This resulted in a decrease in the ID, i.e., a decrease in disparity.

Figure 2. Age-adjusted cardiovascular disease death rates by race/ethnicity, United States, 1989–1998

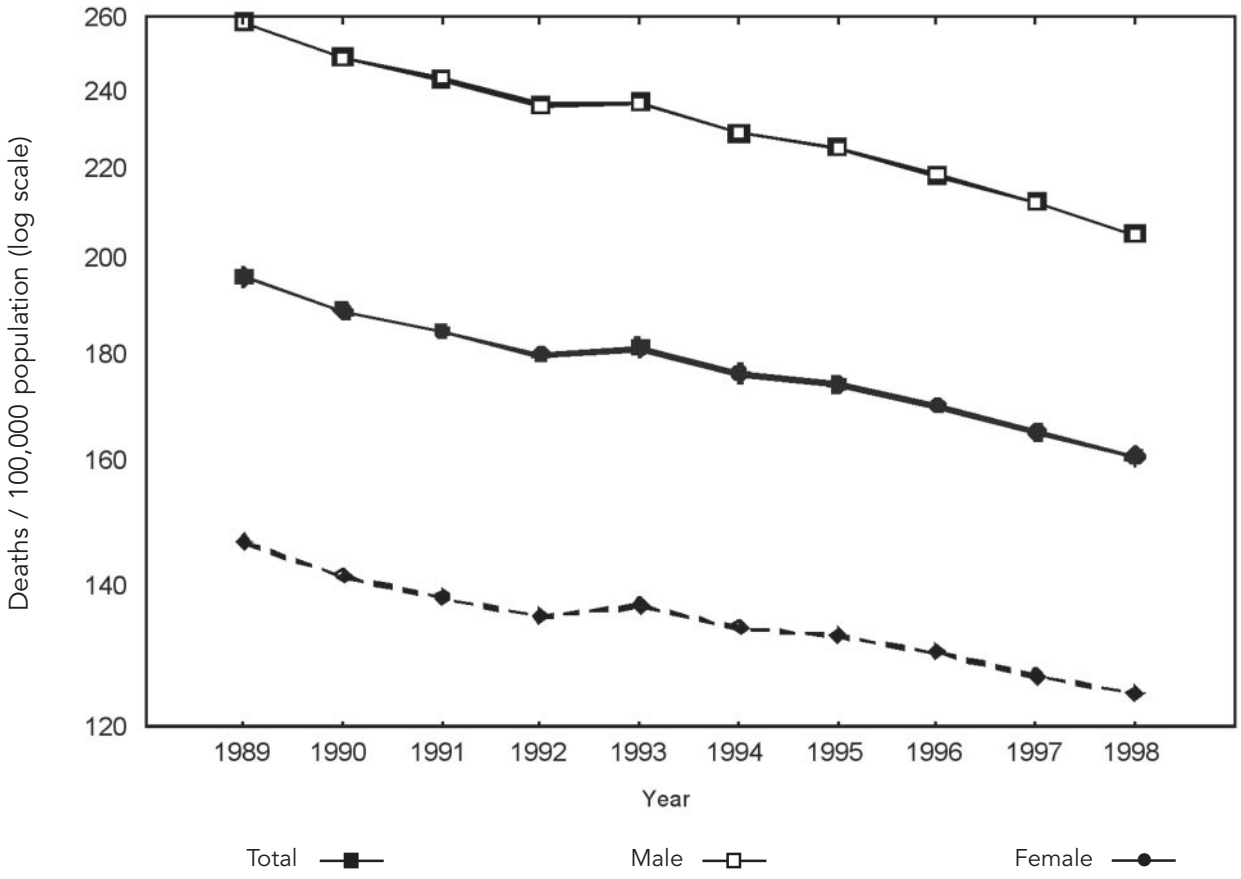


DISCUSSION

Disparity is usually discussed in terms of an absolute or percentage difference between two groups (e.g., racial/ethnic groups) or between a specific group and the overall population. From the data on CVD death rates presented in Table 1, it could be said that the death rate for black non-Hispanics in 1998 was 58% higher than that for white non-Hispanics, which in turn was 26% higher than that for Native Americans/Alaska Natives. Furthermore, death rates for Native Americans/Alaska Natives were 13% higher than those for Hispanics, which are 14% higher than those for Asians/Pacific Islanders. These are important comparisons that highlight the magnitude of the differences in death rates between racial/ethnic groups, but that do little to describe the overall disparity across racial/ethnic groups in CVD death rates. Figure 2 shows that CVD death rates for racial/ ethnic groups are declining—a very good thing. Yet, in terms of reducing disparity, progress cannot be readily assessed.

There are any number of other statistics that could be used to summarize variation in groups of rates. For example, the ratio of the highest group rate to the lowest group rate is a way to compare measures of health based in different units, but a single ratio does not capture the internal variability or distribution of group-specific rates. In addition to ratio approaches, we have considered dissimilarity indices, mean log differences, and others. In general, other approaches do not combine the capacity to summarize disparity, the flexibility to allow comparisons across measures, or the ability to track over time. It is beyond the scope of this article to evaluate the many measures that have been considered, in addition to the current index, but others have compared various measures using European health data.[10]

Figure 3. Age-adjusted cardiovascular disease death rates by gender, United States, 1989–1998



The ID is a useful, flexible way to summarize differences in rates across groups within a population. We have shown its application across various domains of health, including mortality, morbidity, behavior, and utilization of health services. It was also used to assess disparity in a single health measure across populations characterized by race/ethnicity, income, and educational attainment. Finally, the ID is useful in tracking disparity over time, as was shown with populations characterized by race/ethnicity and gender.

The elimination of health disparities will require a reliable way to measure disparity as well as a clear understanding of differences across populations identified in terms of race/ethnicity, income, and so on. The ID provides a way to measure disparity and can serve as a preliminary step in seeking to address who is most at risk, where they are, and why they are disadvantaged.

More effective progress in eliminating disparities can be made by first focusing on measures with the greatest disparity. This could be done by setting priorities for intervention based on a rapid assessment of disparity using a summary measure such as the ID across multiple measures and domains of health. Next, a careful determination should be made of the overall impact on public health of the observed disparity and the practical implications for eliminating the observed disparity. Finally, because it monitors change over time, the ID could be used to evaluate progress in reducing disparities and, if necessary, as the basis for revising priorities.

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