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ABSTRACT

This report summarizes current knowledge and research on the quality and reliability of death rates by race and Hispanic origin in official mortality statistics of the United States produced by the National Center for Health Statistics (NCHS). It provides a quantitative assessment of bias in death rates by race and Hispanic origin and identifies areas for targeted research. Death rates are based on information on deaths from death certificates filed in the states and compiled into a national database by NCHS, and on population data from the Census Bureau. Researchers summarized selected studies of race/Hispanic origin misclassification and undercoverage on deaths and population. They made estimates on the separate and joint bias on death rates by race and Hispanic origin from the two sources. They made simplifying assumptions about the stability of the biases over time and among age groups. Original results are presented using an expanded, updated database from the National Longitudinal Mortality Study. Death rates for all groups show net effects of race misclassification and undercoverage. For whites and blacks, published death rates are overstated in official publications by 1.0 percent and 5.0 percent, respectively, resulting mainly from undercounts in the census. Death rates for other minority groups are understated as follows: American Indians, 21 percent; Asian or Pacific Islanders: 11 percent; and Hispanics, 2 percent. (SM)

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Vital and Health Statistics

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Data Evaluation and Methods Research
No. 128

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Center for Health Statistics

Hyattsville, Maryland
September 1999
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Abstract

Objectives

This report provides a summary of current knowledge and research on the quality and reliability of death rates by race and Hispanic origin in official mortality statistics of the United States produced by the National Center for Health Statistics (NCHS). It also provides a quantitative assessment of bias in death rates by race and Hispanic origin. It identifies areas for targeted research.

Methods

Death rates are based on information on deaths (numerators of the rates) from death certificates filed in the states and compiled into a national database by NCHS, and on population data (denominators) from the Census Bureau. Selected studies of race/Hispanic-origin misclassification and under coverage are summarized on deaths and population. Estimates are made of the separate and the joint bias on death rates by race and Hispanic origin from the two sources. Simplifying assumptions are made about the stability of the biases over time and among age groups. Original results are presented using an expanded and updated database from the National Longitudinal Mortality Study.

Results

While biases in the numerator and denominator tend to offset each other somewhat, death rates for all groups show net effects of race misclassification and under coverage. For the white population and the black population, published death rates are overstated in official publications by an estimated 1.0 percent and 5.0 percent, respectively, resulting principally from undercounts of these population groups in the census. Death rates for the other minority groups are understated in official publications approximately as follows: American Indians, 21 percent; Asian or Pacific Islanders, 11 percent; and Hispanics, 2 percent. These estimates do not take into account differential misreporting of age among the race/ethnic groups.

Keywords: *death rates • race and ethnicity • evaluation • data quality*

Quality of Death Rates by Race and Hispanic Origin: A Summary of Current Research, 1999

by Harry M. Rosenberg, Jeffrey D. Maurer, National Center for Health Statistics; Paul D. Sorlie, National Heart, Lung, and Blood Institute; Norman J. Johnson, Bureau of the Census; Marian F. MacDorman, Donna L. Hoyert, National Center for Health Statistics; James F. Spitler, PricewaterhouseCoopers; and Chester Scott, National Center for Health Statistics

Introduction

This report provides a summary of current knowledge and research on the quality and reliability of death rates by race and Hispanic origin published in official mortality statistics of the United States by the National Center for Health Statistics (NCHS) and other agencies. Presentation of race data in NCHS compilations such as *Health, United States* and *Vital Statistics of the United States* includes qualifications and notes on the reliability of the data (1,2). However, in view of the importance of these statistics in efforts to measure and redress race disparities in health, this report summarizes what we know and do not know about the quality, validity, and reliability of these data. As such, it serves as an introduction to issues of data quality for mortality statistics by race and ethnic origin produced by NCHS. Additional studies—expanding on these topics—are being undertaken.

Measuring Race Differentials in Mortality

Death rates from the National Vital Statistics System are key indicators of the health of the U.S. population as a whole and of specific race and ethnic groups. Race-specific mortality data identify health disparities, such as:

- A black infant is more than twice as likely as a white infant to die in the first year of life.
- Death rates for most causes of death are much higher for black persons than white persons.
- Black people are more than 40 percent as likely to die in any year as white people.
- Black life expectancy is lower than white life expectancy by more than 6 years (3).

Death rates by race and Hispanic origin are widely used, for example, to set health targets at the national and State levels in *Healthy People* (4) and to

This is to acknowledge helpful suggestions from Mary Anne Freedman, Jennifer H. Madans, Diane M. Makuc, Elsie R. Pamuk, and James A. Weed—of the National Center for Health Statistics, and from Howard R. Hogan and Jeffrey E. Kallan of the Bureau of the Census. The report was edited by Thelma W. Sanders and typeset by Jacqueline M. Davis of the Publications Branch.

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identify disparities in health outcomes (5). Mortality data by race appear regularly in the annual health report to the Congress, *Health, United States* (1), and in vital statistics publications (2).

Death rates are based on two sources of information: death certificate information from the vital statistics system (the numerator of rates) and population data from the Bureau of the Census (the denominator of the rates). Each of these sources is subject to bias and error resulting from problems of reporting, classification, and coverage. Evaluation studies over many years have demonstrated that death rates for black and white persons are sound and relatively accurate. In contrast, mortality statistics for other race and ethnic groups are far less accurate. This report summarizes what is known about the quality of race and ethnicity data for the two sources, discusses the implications of these evaluations, and identifies a number of areas where important gaps in knowledge need to be addressed through research and evaluation.

Methods

This summary is based on a review of the literature on the quality and completeness of race and Hispanic-origin reporting on death certificates and on censuses focusing on misclassification and undercoverage. The review is not exhaustive; it covers only readily available and generally current work, limiting itself to the variables of race and Hispanic origin to the exclusion of other variables known to affect the quality, validity, and reliability of death rates. Excluded in the review is the completeness and reliability of age reporting, which is known to vary among race/ethnic groups, and, accordingly, to differentially affect death rates. This study brings together estimates of bias in the numerator and denominator of death rates, thereby providing a general quantitative indication of the joint impact of race and Hispanic origin misreporting and undercoverage. Simplifying assumptions are made as regards reporting bias over time and among age groups. Also included are original analyses of data from the National Longitudinal Study bringing up to date results previously reported, which were based on a more limited number of years and a smaller database.

Death Certificate Items on Race and Hispanic Origin

Data on mortality (the numerator of death rates) in the United States is based on information on certificates filed in State vital statistics offices (2). Demographic information on the certificates, such as age, race, ethnicity, sex, educational attainment, marital status, occupation, and industry, is recorded by the funeral director based on information provided by an informant, usually a family member, or—in the absence of an informant—based on observation. Cause of death is provided by the attending physician, medical examiner, or coroner. A copy of the current U.S. Standard Certificate of Death, recommended by NCHS for use by the States, is shown in figure 1. Most State certificates closely follow this model. The race item on the U.S. Standard Certificate, item 15, is as follows:

RACE—American Indian, Black, White, etc. (Specify).

Sometimes a single race is entered; sometimes, multiple races. When more than one race is entered, the first-mentioned race is recorded in the data files.

Mortality statistics for the Hispanic-origin population are based on information collected on death certificates using one of two basic formats recommended by NCHS. The first format, which is the one that appears on the U.S. Standard Certificate of Death (item 14), is directed specifically toward obtaining information on Hispanic origin.

HISPANIC ORIGIN—Was decedent of Hispanic Origin? (Specify No or Yes—If Yes, specify Cuban, Mexican, Puerto Rican, etc.) ____ No ____ Yes. Specify:

The second format is a more general ancestry item, as follows:

ANCESTRY—Mexican, Puerto Rican, Cuban, African, English, Irish, German, Hmong, etc. (Specify):

Census Items on Race and Hispanic Origin

Information on the population by race and Hispanic origin (the denominator of death rates) is produced by the U.S. Bureau of the Census based on the information reported in the respective decennial censuses of population and based on demographic estimates for years after or between censuses (6). The census questions ask for the race and Hispanic origin of respondents, who may self-report or respond for others in the household. For the 1990 census, not-stated race was allocated using imputation procedures for individual records. No adjustments were made for persons who were not counted in the census, and similarly, population estimates for years after the census are not adjusted to account for persons who were not enumerated. For the 1990 census, certain adjustments were made for problems in age reporting (6).

Data Presentation

Mortality statistics, as frequencies or as rates, are tabulated separately by race and Hispanic origin. The broad race categories are white, black, American Indian (including Aleuts and Eskimos), and Asian or Pacific Islanders. The category "Asian or Pacific Islander" can be disaggregated into the more specific race groups of Chinese, Hawaiian, Japanese, Filipino, and Other Asian or Pacific Islander. For selected States, race data are available in greater detail for certain Asian subgroups (7). The American Indian category includes American Indian, Alaska Native, Eskimo, and Aleut. If multiple races are reported, the first-mentioned is coded, with the exception that if the race entry indicates a mixture of Hawaiian and any other race, the entry is coded as Hawaiian.

The Hispanic-origin population may be classified into specific subgroups: Mexican, Puerto Rican, Cuban,

TYPE/PRINT IN PERMANENT BLACK INK FOR INSTRUCTIONS SEE OTHER SIDE AND HANDBOOK

LOCAL FILE NUMBER

U.S. STANDARD CERTIFICATE OF DEATH

STATE FILE NUMBER

NAME OF DECEDENT: For use by physician or institution

SEE INSTRUCTIONS ON OTHER SIDE

DECEDENT

1. DECEDENT'S NAME *(First, Middle, Last)* | 2. SEX | 3. DATE OF DEATH *(Month, Day, Year)*

4. SOCIAL SECURITY NUMBER | 5a. AGE–Last Birthday *(Years)* | 5b. UNDER 1 YEAR: Months, Days | 5c. UNDER 1 DAY: Hours, Minutes | 6. DATE OF BIRTH *(Month, Day, Year)* | 7. BIRTHPLACE *(City and State or Foreign Country)*

8. WAS DECEDENT EVER IN U.S. ARMED FORCES? *(Yes or no)*

9a. PLACE OF DEATH *(Check only one; see instructions on other side)*
HOSPITAL: ☐ Inpatient ☐ ER/Outpatient ☐ DOA
OTHER: ☐ Nursing Home ☐ Residence ☐ Other *(Specify)*

9b. FACILITY NAME *(If not institution, give street and number)* | 9c. CITY, TOWN, OR LOCATION OF DEATH | 9d. COUNTY OF DEATH

10. MARITAL STATUS – Married, Never Married, Widowed, Divorced *(Specify)* | 11. SURVIVING SPOUSE *(If wife, give maiden name)* | 12a. DECEDENT'S USUAL OCCUPATION *(Give kind of work done during most of working life. Do not use retired.)* | 12b. KIND OF BUSINESS/INDUSTRY

13a. RESIDENCE - STATE | 13b. COUNTY | 13c. CITY, TOWN, OR LOCATION | 13d. STREET AND NUMBER

13e. INSIDE CITY LIMITS? *(Yes or no)* | 13f. ZIP CODE | 14. WAS DECEDENT OF HISPANIC ORIGIN? *(Specify No or Yes – If yes, specify Cuban, Mexican, Puerto Rican, etc.)* ☐ No ☐ Yes *Specify:* | 15. RACE – American Indian, Black, White, etc. *(Specify)* | 16. DECEDENT'S EDUCATION *(Specify only highest grade completed)* Elementary/Secondary (0-12) | College (1-4 or 5+)

PARENTS

17. FATHER'S NAME *(First, Middle, Last)* | 18. MOTHER'S NAME *(First, Middle, Maiden Surname)*

INFORMANT

19a. INFORMANT'S NAME *(Type/Print)* | 19b. MAILING ADDRESS *(Street and Number or Rural Route Number, City or Town, State, Zip Code)*

DISPOSITION

20a. METHOD OF DISPOSITION
☐ Burial ☐ Cremation ☐ Removal from State
☐ Donation ☐ Other *(Specify)* _____

20b. PLACE OF DISPOSITION *(Name of cemetery, crematory, or other place)* | 20c. LOCATION – City or Town, State

SEE DEFINITION ON OTHER SIDE

21a. SIGNATURE OF FUNERAL SERVICE LICENSEE OR PERSON ACTING AS SUCH ▶ | 21b. LICENSE NUMBER *(of Licensee)* | 22. NAME AND ADDRESS OF FACILITY

PRONOUNCING PHYSICIAN ONLY

Complete items 23a-c only when certifying physician is not available at time of death to certify cause of death.

23a. To the best of my knowledge, death occurred at the time, date, and place stated. *Signature and Title* ▶ | 23b. LICENSE NUMBER | 23c. DATE SIGNED *(Month, Day, Year)*

ITEMS 24-26 MUST BE COMPLETED BY PERSON WHO PRONOUNCES DEATH

24. TIME OF DEATH M | 25. DATE PRONOUNCED DEAD *(Month, Day, Year)* | 26. WAS CASE REFERRED TO MEDICAL EXAMINER/CORONER? *(Yes or no)*

CAUSE OF DEATH

SEE INSTRUCTIONS ON OTHER SIDE

27. PART I. Enter the diseases, injuries, or complications that caused the death. Do not enter the mode of dying, such as cardiac or respiratory arrest, shock, or heart failure. List only one cause on each line.

		Approximate Interval Between Onset and Death
IMMEDIATE CAUSE (Final disease or condition resulting in death) →	a.	
	DUE TO (OR AS A CONSEQUENCE OF):	
Sequentially list conditions, if any, leading to immediate cause. Enter UNDERLYING CAUSE (Disease or injury that initiated events resulting in death) LAST	b.	
	DUE TO (OR AS A CONSEQUENCE OF):	
	c.	
	DUE TO (OR AS A CONSEQUENCE OF):	
	d.	

PART II. Other significant conditions contributing to death but not resulting in the underlying cause given in Part I. | 28a. WAS AN AUTOPSY PERFORMED? *(Yes or no)* | 28b. WERE AUTOPSY FINDINGS AVAILABLE PRIOR TO COMPLETION OF CAUSE OF DEATH? *(Yes or no)*

29. MANNER OF DEATH
☐ Natural ☐ Pending Investigation
☐ Accident
☐ Suicide ☐ Could not be Determined
☐ Homicide

30a. DATE OF INJURY *(Month, Day, Year)* | 30b. TIME OF INJURY M | 30c. INJURY AT WORK? *(Yes or no)* | 30d. DESCRIBE HOW INJURY OCCURRED

30e. PLACE OF INJURY – At home, farm, street, factory, office building, etc. *(Specify)* | 30f. LOCATION (Street and Number or Rural Route Number, City or Town, State)

CERTIFIER

SEE DEFINITION ON OTHER SIDE

31a. CERTIFIER *(Check only one)*

☐ CERTIFYING PHYSICIAN *(Physician certifying cause of death when another physician has pronounced death and completed Item 23)*
To the best of my knowledge, death occurred due to the cause(s) and manner as stated.

☐ PRONOUNCING AND CERTIFYING PHYSICIAN *(Physician both pronouncing death and certifying to cause of death)*
To the best of my knowledge, death occurred at the time, date, and place, and due to the cause(s) and manner as stated.

☐ MEDICAL EXAMINER/CORONER
On the basis of examination and/or investigation, in my opinion, death occurred at the time, date, and place, and due to the cause(s) and manner as stated.

31b. SIGNATURE AND TITLE OF CERTIFIER ▶ | 31c. LICENSE NUMBER | 31d. DATE SIGNED *(Month, Day, Year)*

32. NAME AND ADDRESS OF PERSON WHO COMPLETED CAUSE OF DEATH (ITEM 27) *(Type/Print)*

REGISTRAR

33. REGISTRAR'S SIGNATURE ▶ | 34. DATE FILED *(Month, Day, Year)*

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Figure 1. Certificate of death

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Central and South American, and Other and Unknown Hispanic.

Results

Data Quality for Deaths

Since the 1950's, a number of studies have assessed the accuracy of race and Hispanic-origin information reported on death certificates (8–10). These studies generally compare race and Hispanic origin reported on the death certificate with information reported on another source, such as the censuses, surveys, or other vital records. These studies, undertaken periodically, provide snapshots of the reliability of race data. Studies have been undertaken separately for the general population, that is, persons of all ages, and for infants (children under 1 year of age), and are presented separately in this section of the report.

Results for Race, All Ages

For the general population, a number of studies have demonstrated good agreement between race reported on the death certificate and other sources for white and black decedents, but poorer consistency between the two sources for other racial groups. An early study compared race reported on a sample of about 340,000 death certificates with race for the same individual reported on the 1960 census records (8). Results are shown in two ways: agreement on a record-by-record basis and agreement of counts by race on a net basis. Although there may not be perfect agreement at the level of individual records, the aggregate counts could be very close. The study (denoted as the "census study") shows a high level of agreement—greater than 98 percent—between the two sources at the level of individual record comparisons for white and black decedents but poorer agreement for some of the numerically smaller minority groups (table 1). For example, for American Indians, agreement between the individual records was only [illegible] percent.

Comparisons made at the aggregate or net level for each race group are expressed as ratios of the census count to the death certificate count. The ratios for black and white persons are 1.0, indicating that the total number of deaths based on the two sources was about the same for these two major race groups. However, the ratio of 1.12 for American Indians indicates that 12 percent more deaths would have been classified as American Indian using the census information, compared with the race information reported on death certificates. Using the census information, 4 percent more deaths would have been reported for Japanese, 7 percent more for Chinese, and 28 percent more for Filipinos, in 1960.

The National Longitudinal Mortality Study (NLMS) has been one of the most valuable databases for evaluating the quality of race data on the death certificate (11). Initiated by the National Heart, Lung, and Blood Institute (a component of the National Institutes of Health), in collaboration with the Census Bureau and NCHS, the NLMS is a large database comprised of selected Current Population Survey (CPS) files (spanning the years 1973–85) linked to death certificates for 1979–89.[1] The linkage between the CPS and death certificates is carried out using NCHS' National Death Index (NDI).[2] Currently, the NLMS has a population base of 1.3 million persons and includes a total of 96,000 deaths through 1989.

As part of this review, we updated the earlier evaluation study based on the NLMS (9) by comparing race reported on death certificates for 1979–89 with responses to race questions on a total of nine of the CPS files in the NLMS database, comprising a total of more than 40,000 records.[3] The race information in the CPS is reported for households in which the decedent was alive at the time of interview; the information can therefore be considered accurate and can be used as a benchmark. In contrast, race information on the death certificate is that reported by the funeral director based on responses from an informant, often a surviving family member, or based on observation by the funeral director. The ratio of the number of deaths based on the CPS to that based on death certificates was 1.0 for both white and black decedents, indicating no net difference in race assignment (figure 2, table 1), the same as in the census study conducted more than 20 years earlier. Also, the record-by-record comparison shows a level of agreement for the two major race groups of greater than 98 percent, again about the same in both studies. In contrast, for American Indians, record-by-record agreement is much lower in the NLMS than in the earlier census study, 57 percent compared with 79 percent. Correspondingly, the ratio showing the net relationship between the two data sources for American Indians was 1.37 based on the NLMS study, much higher than in the earlier study (1.12). This means that almost 40 percent more persons were identified as American Indians in the CPS than on the corresponding death certificates. The increase in the ratio between the 1960 study and the present study is consistent with the large increase in self-reporting of American Indians between the 1960 and the 1990 censuses, described below. For Asian or Pacific Islanders, the ratio was 1.13 in the NLMS.

[1]The Current Population Survey (CPS) is a monthly survey comprised of about 60,000 U.S. households. Carried out by the Census Bureau, the survey asks questions about labor force participation for the Bureau of Labor Statistics and is the source of national unemployment figures. During certain months of the year, the survey asks supplemental questions on various social, demographic, and economic topics. The CPS results are published in the Census Bureau's *Current Population Report* series.

[2]The National Death Index (NDI) is a central computerized index of death record information, which contains a standard set of identifying information for each death in the United States. The information is provided to NCHS by State vital statistics records offices to assist researchers in identifying and locating death records in the State offices. The NDI is widely used to establish if individuals in a study have died and to identify the State office from which the certificate can be acquired for matching purposes.

[3]The files that were included were the following: the CPS files for March 1979, April 1980, August 1980, December 1980, March 1981, March 1982, March 1983, March 1984, and March 1985; excluded were the files of February 1973, March 1973, Census 1980 (File 8024), and September 1985 because of incomplete matches or other technical considerations.

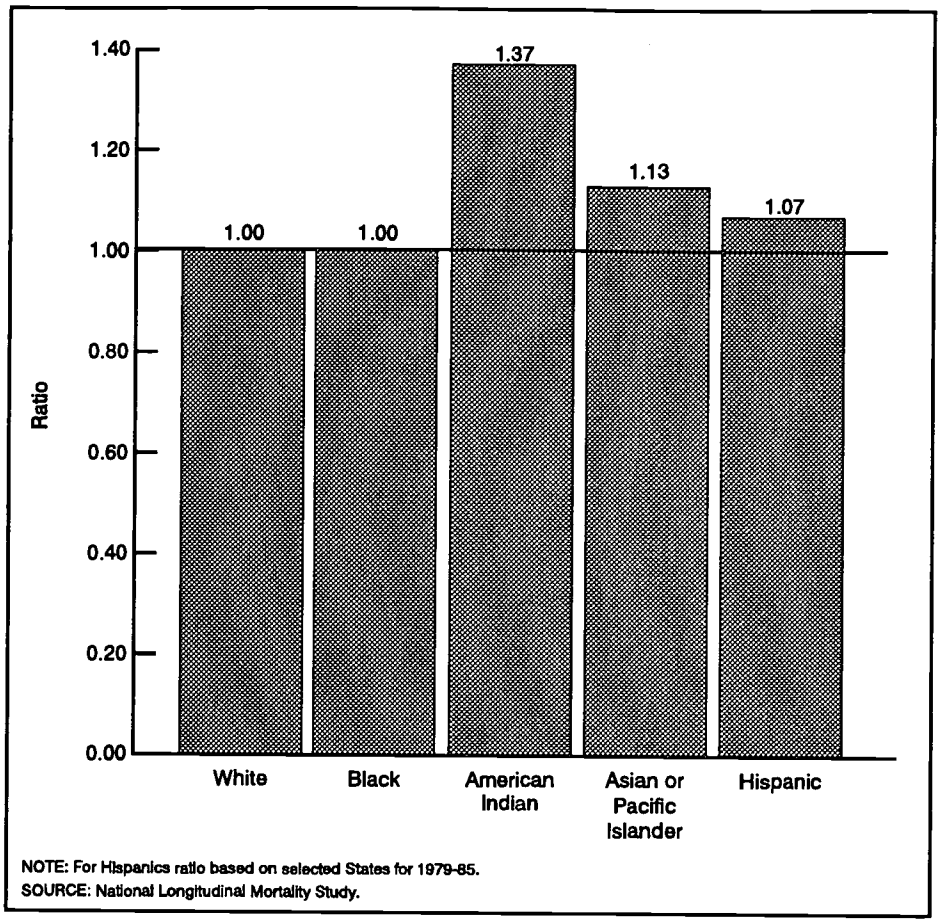

Figure 2. Ratio of Current Population Survey deaths to death certificate deaths by race and origin: United States, 1979–89

Comparisons of race reporting were also made in the 1986 National Mortality Followback Survey (NMFS)(10). The NMFS was a sample of 18,733 decedents with oversampling for selected causes of death, black persons, and persons under 55 years of age. A questionnaire was mailed to the death certificate informant, usually the decedent's next of kin, to ascertain the same information as asked on the death certificate, as well as additional information about the circumstances of the decedent. The NMFS provides a measure of the reliability of the race initially reported; however, the NMFS cannot be regarded as an independent source, because in many cases the informant is the same person who initially provided race information to the funeral director to be recorded on the death certificate. Ratios for NMFS were as follows: for white persons, 0.99; black persons, 0.99; American Indians, 1.22; and Asian or Pacific Islanders, 1.12. (The ratios for American Indians and Asian or Pacific Islanders are subject to considerable sampling variation because of the small numbers in the sample.) Using a design and sample size similar to that of the 1986 survey, an NMFS was carried out again in 1993. Preliminary ratios from the 1993 NMFS for race are as follows: white persons, 0.93; black persons, 0.97; and American Indians, 1.10.

A study conducted by the Indian Health Service (IHS) compared the race of patients in IHS health care facilities or IHS-funded health care during 1986–88 with the race reported on death certificates (12). Underreporting of American Indian or Alaska Native for all areas combined was 11 percent but varied greatly among the States. Because the IHS patient population group is a specialized group, it is difficult to generalize the results to the total United States; however, the results are instructive in showing considerable geographic variation in reporting reliability.

Results for Hispanic Origin, All Ages

The NLMS also provides information on the reliability of Hispanic origin reported on the death certificate (9). On the basis of 12 of the CPS files matched to death certificates for the years 1979–85 for the 21 States that had a Hispanic-origin item on their death certificates, record-by-record agreement for Hispanic origin was 89.7 percent (11) (table 1, figure 2). The ratio of the number of deaths reported as Hispanic origin on the CPS divided by deaths reported as Hispanic on the death certificate was 1.07, indicating net underreporting on death certificates. For the specified Hispanic groups, the ratios were 1.11 for Mexicans, 1.04 for Puerto Ricans, 1.07 for Cubans, and 0.89 for Other Hispanic Persons. Because of small sample size, these ratios are characterized by considerable sampling variability.

Results for Infants

Infant mortality rates as traditionally produced in vital statistics also are subject to bias resulting in part from misreporting race and Hispanic origin (3). These biases have been observed and measured in a large number of studies that compare race and Hispanic origin data reported on the death certificate with that reported on the birth certificate for the same infant (2,13–17). Race and Hispanic origin of the mother and father is considered to be more reliable on the birth certificate, as it is usually reported by the mother at the time of delivery (information on the race of the infant is not obtained on the birth certificate) (16). In contrast, race and Hispanic origin of a deceased infant are reported by a funeral director based on information supplied by an informant, such as a parent, or, in the absence of an informant, based on observation.

An additional source of bias in traditional infant mortality rates by race and Hispanic origin is related to the

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different referent in the numerator and denominator of the rates. The numerator of the rates is the total number of infant deaths in a specified group, and the denominator is the total number of live births in that group. However, the numerator of the traditional rate refers to the race or Hispanic origin of the infant, but the denominator refers to the race or Hispanic origin of the mother. Ideally, the race or Hispanic origin in the numerator and denominator would be classified in the same way, either as that of the infant or that of the mother. The two sources of bias in traditional infant mortality rates—misreporting on the death certificate and different referents in numerator and denominator—are both addressed in an alternative and preferred data set for infant mortality based on linking infant death records with their corresponding birth records (14–17). In the linked file, each infant death record is linked to its corresponding birth record, such that the race or Hispanic origin of the mother reported on the birth certificate can also be ascribed to the infant death, thereby ensuring consistency of reporting in the numerator and denominator of the rates and correcting for both sources of bias in the traditional rates. Comparing infant mortality rates from these two sources (the linked and traditional files) makes it possible to assess the comparability of the traditional infant mortality rates by race and Hispanic origin (table 2, table 3, and figure 3) with rates from the linked file considered the standard. Data for the race comparisons were combined for the years 1995 and 1996 to create more robust estimates of infant mortality for the Asian and Pacific Islander races, because the number of infant deaths in a given year for some of these groups is quite small.

A measure of comparability of the rates by race and Hispanic origin is the ratio of the infant mortality rates from the linked file to that of the traditional mortality file. A ratio of 1.0 would mean that the rates calculated from the two files were exactly the same. A ratio exceeding 1.0 is an indication that the traditional file underestimates the rate; a ratio of less than 1.0 indicates that the traditional file overestimates the rate. Figure 2 shows comparisons between the two sources by race; table 3 presents comparisons by Hispanic origin. The ratio for white infants is 1.0; for black infants, 0.97, indicating a good net correspondence in race from the two sources. However, for American Indians, the ratio is 1.14, indicating that rates where race is based on the linked file are 14 percent higher than those based on the traditional file. Ratios among specific population groups of Asian Americans varied greatly. Underestimates were greatest for Japanese infants, with a ratio of 2.04, indicating that infant mortality rates based on the linked file are more than twice as high as those based on the traditional file. The ratios for Filipinos were 1.68, and for Chinese, 1.21. The ratio for Hawaiians was 0.85, indicating a higher rate based on the traditional file, possibly because on death records on which Hawaiian was reported in combination with another race, coding procedures always give preference to Hawaiian.

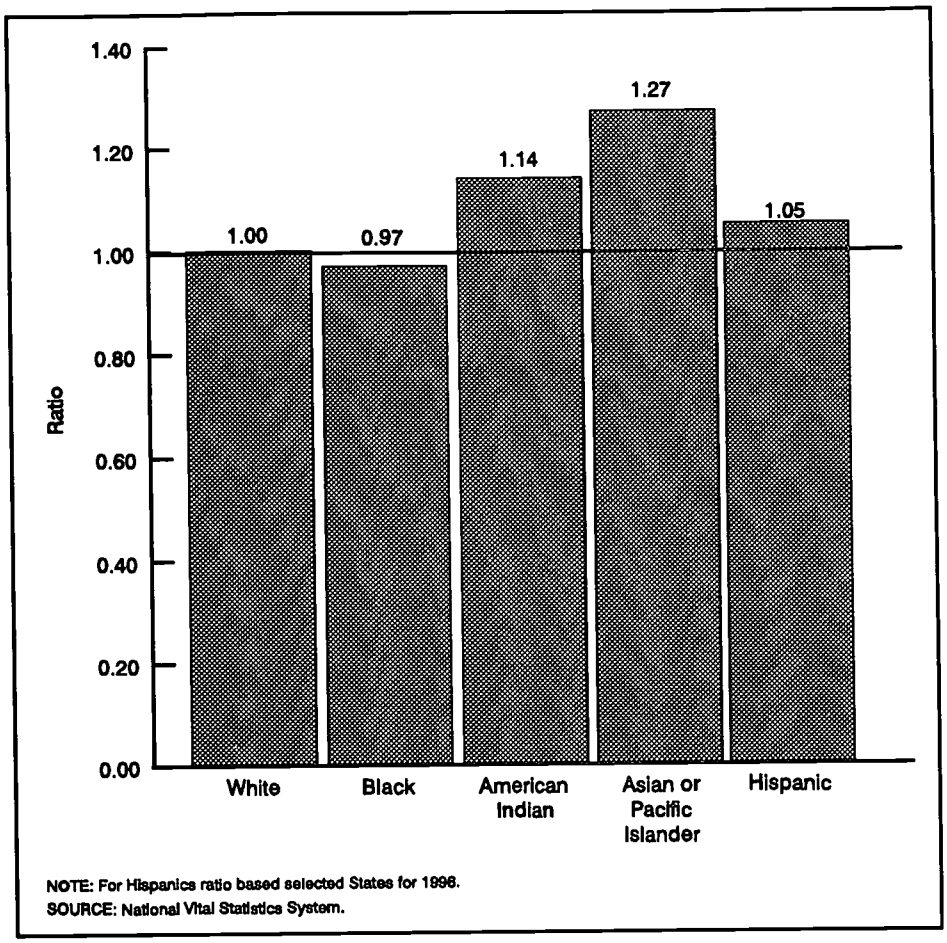

Figure 3. Ratio of linked to traditional infant mortality rates by race and Hispanic origin: United States, 1995–96

Table 3 shows comparisons for infant mortality rates for Hispanic origin for 1996 based on the linked and traditional files. For total Hispanic-origin infants, the ratio was 1.05, indicating that rates are about 5 percent higher using the linked file. For Mexican and Cuban infants, the rates were about the same (ratios of 1.00 and 1.02, respectively), but rates for Puerto Rican infants were 12 percent higher when Hispanic origin was based on the linked file.

Results for Race, Age, and Sex

Data from the NLMS permit an assessment of variations in the reliability of race reporting by age and sex. Results using data for the nine CPS files matched against death certificates for 1979–89 are shown in table 4. By gender for all ages combined, the ratios are 1.0 for black and white males and females, but for American Indians, the ratios are much larger for males (1.53) than for females (1.15). A similar

pattern occurs for Asian or Pacific Islanders, with ratios of 1.15 and 1.10, respectively. However, the ratios for American Indians and Asian or Pacific Islanders are based on very small numbers and are therefore subject to considerable sampling variation.

By age, the ratios are close to 1.0 for black and white decedents across the age spans, indicating little variation in reporting bias by age. For American Indians and Asian or Pacific Islanders, the ratios vary by age but, being based on very small numbers, are subject to considerable sampling variation.

Data Quality for Population

Problems of validity and reliability of race and Hispanic-origin reporting can also arise from errors in population counts and estimates that comprise the denominator of death rates. As in the case of errors in counts of deaths, bias can result from either misclassification or from undercoverage. For deaths, the problem of undercoverage is very small, because death registration in the United States is virtually complete (2), so the problem is essentially that of misclassification. In contrast, for population counts and estimates, the problem is one of undercoverage, especially for the minority groups, where it can have important consequences for death rates. Undercoverage in the census affects even death rates for the white and black population, where race misclassification on the death certificates has been demonstrated to be small.

The Census Bureau has a long tradition of using statistical and demographic methods to evaluate the coverage of the population census. Among these is the postenumeration survey, a 1990 survey of a large sample of the population, stratified by census region, division, race, place/size, housing tenure/age, and sex, and completed by September following the April 1990 census enumeration (18). Records from the postenumeration survey were compared with census records to ascertain accuracy and completeness of coverage in the census. Problems of census coverage are expressed in terms of "net census undercount" (2,18). Coverage ratios by age, race, and sex for the 1990 census are shown in table 5. A ratio of less than 1.0 indicates a net census undercount, and over 1.0, a net census overcount. In general, females were more completely enumerated in the 1990 census than males; the white population was more completely enumerated than the black population; and the younger population was more completely counted than the extreme elderly (persons 85 years of age and over). Underenumeration was serious among black males 25–34 years of age, who, with a ratio of 0.87, were undercounted by 13 percent. Undercounting was serious in other age groups for black males; for black females, coverage was generally better than for black males. For white males and females, reporting was better than for their black counterparts, but for all groups, underreporting was serious for the elderly, that is, for persons age 85 years and over. Among white males, undercounting of 5 percent occurred for the age group 25–34 years.

Using the postenumeration survey, the Census Bureau has made estimates of undercounting among population subgroups (18) (figure 4). The estimated undercount for non-Hispanic white and other in the 1990 census was 0.7 percent; black persons, 4.6 percent; Hispanic persons, 5.0 percent; Asian and Pacific Islanders, 2.4 percent; and American Indians living on Federal Indian reservations, 12.2 percent. Further, studies have shown that self-identification of American Indians in successive censuses has changed over time. About 33 percent of the growth in the American Indian population between 1960 and 1990 has been attributed to increased self-reporting as American Indian. Studies have shown that this finding differs by geographic area and by educational attainment (19,20). The increase in self-reporting of American Indian is reflected in the change in the ratio that shows the discrepancy between death certificate and

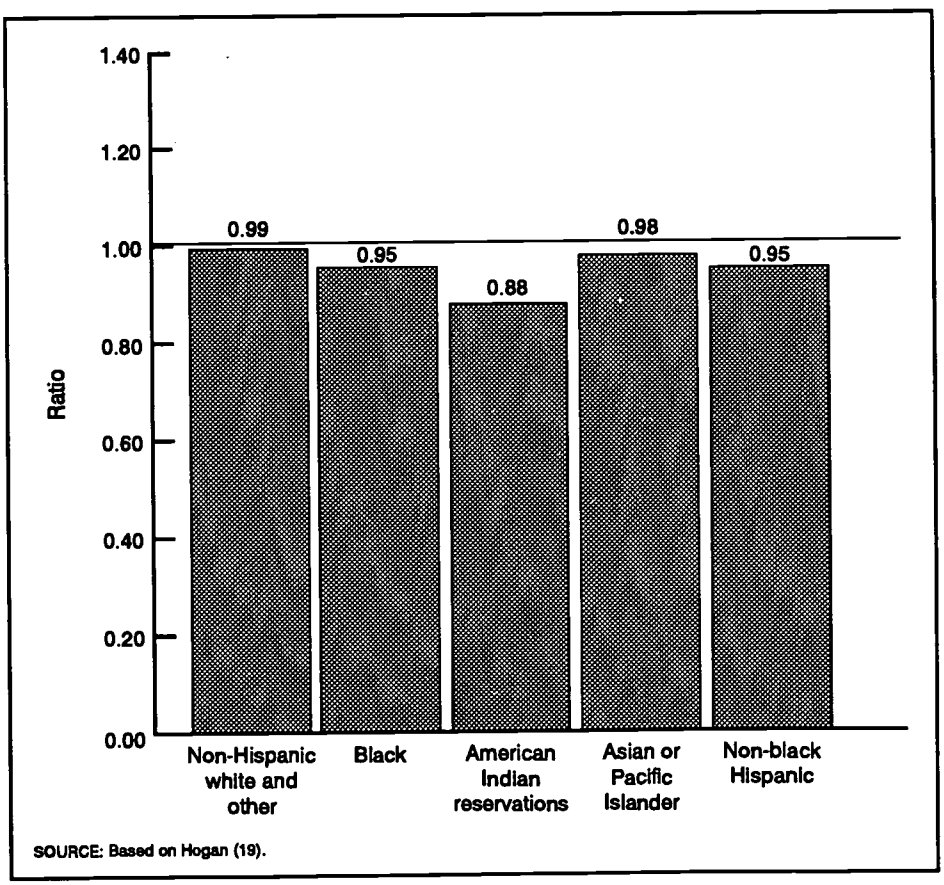

Figure 4. Ratio of census-level population to population adjusted for net census undercount by race and Hispanic origin, 1990

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census/CPS reporting between the 1960 study and the current NLMS results (table 1).

Consequences for Rates

Results show that reporting of race for white and black decedents on death certificates is highly reliable for both infants and the population of all ages. Generally speaking, misclassification in numerator data (deaths), taken alone, results in death rates that are too small. In contrast, the undercoverage problem in the denominator data (population) tends to have the opposite effect: it biases rates upward. Thus, biases from misclassification of race and Hispanic origin in the numerator and denominator work in opposite directions, one tending to deflate rates, the other to inflate them. Consequently, a comprehensive estimate of death rates by race and Hispanic origin should take into account the offsetting reporting biases in the numerator and denominator. The approximate effects of reporting bias and undercoverage are illustrated in table 6 by making the simplifying assumption that the ratios and percent undercoverage previously reported for all age groups combined are the same as for individual age groups by race and Hispanic origin.[4] This is accomplished in table 6 by multiplying the reported age-adjusted death rates by a single ratio that corrects for the combination of bias in reporting on the death certificate as well as undercoverage in the census. Results are summarized in table A in a comparison of the reported age-adjusted death rates (rates are per 100,000 standard population) and rates adjusted for reporting bias in the numerator and undercoverage in the denominator.

Table A. Reported and adjusted death rates and percent differences: 1996

[Rates are per 100,000 U.S. standard population; see table 6]

	Reported	Adjusted	Percent difference (adjusted/reported)
White	466.8	462.1	–1.0
Black	738.3	701.4	–5.0
American Indian, including Aleuts and Eskimos	456.7	550.6	20.6
Asian or Pacific Islander	277.4	307.2	10.7
Hispanic	365.9	371.9	1.6

After adjustment, the white age-adjusted death rate is only 1 percent lower than the rate reported in the official vital statistics (5), reflecting the effect of adjusting for slight undercoverage of the white population in the 1990 census. The adjusted rate for black persons, in contrast, is about 5 percent lower than the official rate, reflecting adjustment for census undercount for this population group. For American Indians, adjusted rates are 21 percent higher than reported rates, reflecting the combined effects of misclassification in the numerator and undercoverage in the denominator. These adjustments change the relative level of mortality between the American Indian and white populations: Although the unadjusted American Indian rates are lower, the adjusted rates are higher than those of the white population. The Asian or Pacific Islander rates are 11 percent higher than the reported rates when adjusted. For Hispanic persons, the rates are increased by only 1.6 percent by adjustment, and they remain about 20 percent below those of the white population.

Although the adjusted death rates give the order of magnitude of the joint effect of race/Hispanic origin misclassification on the death certificate and undercount in the census, they are approximations. More precise estimates would require estimates of net census undercount by age and sex for other minority groups, and ultimately these need to be available by geographic areas, such as regions and States, because of possible geographic variation in census coverage. An additional consideration is whether the adjustment factors in the numerator and denominator are constant or whether they change over time for population groups other than American Indians. Further, are the NLMS factors used to adjust the numerator, which are based on deaths during 1979–89, applicable to deaths occurring in 1996? Are the factors used to adjust for undercount based on the 1990 census applicable to the 1996 population? Clearly, research is needed to address these issues.

Race misclassification and undercoverage in the census affect life expectancies, which are based on death rates. Thus, if life expectancy for all population groups combined for 1990 were adjusted for net census undercount, overall life expectancy would increase from 75.4 years to 75.6, that is, by 0.2 years (2). For the black population, life expectancy would increase by 0.6 years, and for the white population, by 0.2 years. The difference in life expectancy between the white and black populations would be reduced from 4.9 to 4.5 years in 1990. Comparable life-table data have not been published for Hispanic persons and other minority groups because of the data-quality issues that have been described.

Discussion and Conclusions

The quality, reliability, and accuracy of death rates by race and Hispanic origin vary among population groups. This review shows that, generally, death rates are reliable for the white and black populations. Results of evaluations for white and black persons from 1960 to the present show a high degree of consistency, on a net basis, between race reported on death certificates and independent sources such as surveys. To the extent that there are validity problems for white and black death rates, they tend to result from problems

[4]More precise estimates could be generated if estimates for net census undercount by age and sex were available for racial/ethnic groups other than black and white (table 5). Taking age-specific net census undercount explicitly into account results in slightly different adjusted death rates for white persons (459.1) and black persons (712.6), and percent differences (adjusted/reported) of –1.6 and –3.5, respectively. Taking gender and age into account, differences are larger for black males (–7.4 percent) than white males (–2.3), and for [illegible]ales (–1.5) than black females (–1.1).

in the denominator data, that is, population counts and estimates that are too small because of undercoverage of these groups, particularly young black and white males and elderly persons. The overall effect of black and white undercounts does not seriously distort analysis or interpretation of the resulting mortality data (2). However, for the other minority population groups, levels of mortality are seriously biased from misreporting in the numerator and undercoverage in the denominator of the death rates. In addition, although misreporting of age on death certificates and in the census is known to vary by race, this topic was considered outside the scope of this review (21–25).

Results of the evaluation studies have implications for official vital statistics. First, these results give confidence in death rates for the black and white populations. Second, they indicate a pressing need to make data users fully aware of the limitations of death rates for the smaller minority populations. This can be accomplished by placing cautions in prominent locations in tables and text. Further, the evaluation study results raise the question of whether official, routinely produced vital statistics should be adjusted for reporting biases. This is not current NCHS practice in part because information is not available for making adjustments in the numerator and denominator of rates at a requisite level of detail. Estimates of bias would be needed by age, race, and sex (and possibly other sociodemographic variables, such as occupation, industry, marital status, and educational attainment), at not only the national but also the State and possibly sub-State level.

Known biases in rates have implications for goal-setting exercises such as *Healthy People*, in which death rates are widely used in setting health objectives and monitoring progress toward these objectives. In the goals being formulated for *Healthy People 2010*, it is likely that greater detail will be shown for race and Hispanic origin than in previous versions of *Healthy People* (4). A variety of options needs to be explored to determine how to make aware of reporting biases in death rates for the smaller minority groups or whether to adjust objectives to take into account reporting biases. If adjustments are made to death rates to correct for bias, data users must be alerted that the adjusted figures differ from the official vital statistics as currently produced.

Users also need to be cognizant of the potential impact of changes in collecting and tabulating race resulting from changes in Federal guidelines. Over the next several years, major changes will occur in the way Federal agencies collect and tabulate data on race and Hispanic origin. When collecting race and ethnicity data, Federal programs must adhere to guidelines from the U.S. Office of Management and Budget, which were revised in October 1997 (26). The major difference between the current and new guidelines is the adoption of data-collection procedures in which respondents can identify with more than one race group. The Census Bureau will implement the new guidelines with the 2000 census. Other Federal programs, including vital statistics, must implement them no later than 2003. This radical departure will probably result in data discontinuities. Implications for the census characterization of the population by race and ethnicity and for vital statistics cannot be predicted; full understanding will require targeted evaluations. NCHS and the Census Bureau are to develop a research plan to investigate the effect of these changes.

Finally, can ameliorative steps be taken to improve race reporting on death certificates? Because information is collected by funeral directors near the time of death or shortly after death, the timing is not propitious for in-depth inquiries to family members or other informants about the race and ethnicity of the decedent. A development that may augur improvement is the increased use of "pre-need" arrangements for funerals and burials, where circumstances are less emotional and better information may be secured.

Death rates by race and Hispanic origin are important for monitoring the health status of these population groups and for informing policies and programs directed to reducing disparities. Wide gaps in information remain. We need to know if reporting bias in the numerators varies by geographic area or by sociodemographic variables, such as educational attainment and marital status, and whether the ratios are relatively constant over time. We need additional information on net census undercount, including estimates by age and gender for population groups other than white and black, and we need to determine the applicability of factors based on census years such as 1990 to the years after the census. We also need to assess the impact of age misstatement on death certificates and in the census on death rates by race and Hispanic origin.

Targeted database development, research, and evaluation are needed to fill these knowledge gaps, to provide an adequate database for understanding the quality of mortality statistics by race and Hispanic origin, and to better communicate the strengths and weaknesses of this information.

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Table 1. Percent agreement between number of deaths from death certificates and from census and Current Population Survey files, by race and Hispanic origin, and ratio of number of deaths: 1960 census and the National Longitudinal Mortality Study

Race[1] or Hispanic origin[2]	1960 census		NLMS [3] 1979–1985/1989	
	Percent agreement	Ratio of census to death certificate	Percent agreement	Ratio of CPS [4] to death certificate
White	99.8	1.00	99.8	1.00
Black	98.2	1.00	98.6	1.00
American Indian[5]	79.2	1.12	57.4	1.37
Asian or Pacific Islander	---	---	82.5	1.13
Japanese	97.0	1.04	---	---
Chinese	90.3	1.07	---	---
Filipino	72.6	1.28	---	---
Hispanic	---	---	89.7	1.07
Mexican	---	---	84.9	1.11
Puerto Rican	---	---	85.9	1.04
Cuban	---	---	80.0	1.07
Other Hispanic	---	---	47.6	0.89
Non-Hispanic	---	---	99.8	1.00

--- Data not available.

[1]NLMS race data are for nine CPS files and for deaths occurring 1979–89.

[2]NLMS Hispanic-origin data are for 12 CPS files and for deaths occurring 1979–85 for selected states.

[3]National Longitudinal Mortality Survey.

[4]Current Population Survey.

[5]Includes Aleuts and Eskimos.

Table 2. Infant mortality rates from the traditional and linked files, and ratios of the rates, by race: United States, 1995–96

Race	Infant mortality rate		Ratio of linked to traditional file
	Traditional file	Linked file	
All races	7.5	7.4	0.99
White	6.2	6.2	1.00
Black	14.9	14.4	0.97
American Indian[1]	8.3	9.5	1.14
Asian or Pacific Islander	4.1	5.2	1.27
Chinese	2.9	3.5	1.21
Japanese	2.3	4.7	2.04
Hawaiian	7.2	6.1	0.85
Filipino	3.4	5.7	1.68
Other Asian or Pacific Islander	4.8	5.6	1.17

[1]Includes Aleuts and Eskimos.

Table 3. Infant mortality rates from the traditional and linked files, and ratios of the rates, by Hispanic origin: Total of 49 States and the District of Columbia, 1996

Origin	Infant mortality rate		Ratio of linked to traditional file
	Traditional file	Linked file	
All origins[1]	7.3	7.4	1.01
Total Hispanic	5.9	6.2	1.05
Mexican	5.9	5.9	1.00
Puerto Rican	7.8	8.7	1.12
Cuban	5.1	5.2	1.02
Other Hispanic[2]	5.3	5.9	1.11
Non-Hispanic total[3]	7.6	7.7	1.01
Non-Hispanic white	6.1	6.2	1.02
Non-Hispanic black	14.7	14.4	0.98

[1]Includes Hispanic origin not stated.

[2]Includes Central and South American and other and unknown Hispanic.

[3]Includes races other than white and black.

NOTE: Data exclude Oklahoma, which did not have a question on Hispanic origin on its death certificate.

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Table 4. Ratio of deaths from Current Population Survey to deaths from death certificate by age, race, and sex, and number of deaths from the two sources: United States, 1979–89

Race, sex, and source of data	Total	Under 25 years	25–44 years	45–54 years	55–64 years	65–74 years	75 years and over
				Ratios[1]			
White	1.00	0.99	1.00	1.00	1.00	1.00	1.00
Male	1.00	0.99	1.00	0.99	1.00	1.00	1.00
Female	1.00	0.99	1.00	1.00	1.00	1.00	1.00
Black	1.00	0.99	1.00	1.00	1.00	1.01	1.01
Male	1.00	0.98	1.00	1.00	1.00	1.01	1.01
Female	1.00	1.00	1.00	0.99	1.01	1.01	1.00
American Indian[2]	1.37	1.46	1.17	1.45	1.37	1.31	1.49
Male	1.53	1.43	1.10	1.74	1.76	1.57	1.66
Female	1.15	*1.55	*1.43	*1.01	1.03	1.02	1.30
Asian or Pacific Islander[3]	1.13	1.46	1.17	1.06	1.06	1.17	1.09
Male	1.15	*1.26	1.26	1.12	0.98	1.17	1.15
Female	1.10	*1.78	1.09	0.95	1.23	1.17	1.02
				Number of deaths[4]			
White							
CPS[5]	52,056	1,454	3,123	4,345	10,003	15,140	17,991
Death certificate	52,209	1,471	3,136	4,361	10,037	15,180	18,024
Male							
CPS[5]	28,403	1,020	2,035	2,669	6,132	8,644	7,903
Death certificate	28,510	1,030	2,046	2,686	6,153	8,671	7,924
Female							
CPS[5]	23,653	434	1,088	1,676	3,871	6,496	10,088
Death certificate	23,699	441	1,090	1,675	3,884	6,509	10,100
Black							
CPS[5]	5,960	281	650	772	1,353	1,567	1,337
Death certificate	5,945	283	654	777	1,354	1,552	1,325
Male							
CPS[5]	3,142	186	374	407	775	817	583
Death certificate	3,136	188	376	409	778	810	575
Female							
CPS[5]	2,818	95	276	365	578	750	754
Death certificate	2,809	95	278	368	576	742	750
American Indian[2]							
CPS[5]	425	64	60	58	92	85	66
Death certificate	348	55	54	44	72	72	51
Male							
CPS[5]	261	49	37	41	51	50	33
Death certificate	207	44	35	29	36	38	25
Female							
CPS[5]	164	15	23	17	41	35	33
Death certificate	141	11	19	15	36	34	26
Asian or Pacific Islander[2]							
CPS[5]	540	28	61	66	103	128	154
Death certificate	498	21	56	62	98	113	148
Male							
CPS[5]	331	17	32	46	62	85	89
Death certificate	298	13	28	41	60	74	82
Female							
CPS[5]	209	11	29	20	41	43	65
Death certificate	200	8	28	21	38	39	66

* Ratio is unreliable because either the unweighted number of CPS deaths or the unweighted number of death certificate deaths or both are based on fewer than 20 deaths.

[1]Ratios based on weighted data for nine CPS files.

[2]Includes Aleuts and Eskimos.

[3]Includes Chinese, Filipino, Hawaiian, Japanese, and other Asian or Pacific Islander.

[4]Numbers based on unweighted data.

[5]Current Population Survey.

NOTE: Caution should be exercised in using ratios by age for American Indians and Asian or Pacific Islanders because of variability of the ratios, which are based on small numbers of deaths.

Table 5. Ratio of census-level resident population to resident population adjusted for estimated net census undercount, by age, sex, and race: April 1, 1990

Age	All races			White			Black		
	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female
All ages	0.98	0.97	0.99	0.98	0.97	0.98	0.94	0.92	0.97
0–4 years	0.96	0.96	0.96	0.97	0.97	0.97	0.92	0.91	0.92
5–14 years	0.97	0.98	0.98	0.97	0.98	0.97	0.94	0.94	0.94
15–24 years	1.01	1.01	1.01	1.00	1.01	1.00	0.98	0.97	0.99
25–34 years	0.96	0.95	0.98	0.96	0.95	0.98	0.91	0.87	0.96
35–44 years	0.98	0.97	1.00	0.98	0.97	0.99	0.94	0.89	0.98
45–54 years	0.98	0.96	0.99	0.98	0.96	0.99	0.93	0.88	0.98
55–64 years	0.98	0.96	1.00	0.98	0.97	1.00	0.95	0.89	1.01
65–74 years	1.00	0.98	1.01	0.99	0.98	1.00	1.02	0.97	1.06
75–84 years	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00
85 years and over	0.94	0.96	0.93	0.95	0.97	0.94	0.85	0.88	0.83

Table 6. Reported age-adjusted death rates and rates adjusted for reporting bias and undercoverage, by race and Hispanic origin: United States, 1996

[Age-adjusted rates per 100,000 U.S. standard population]

Race and origin	Reported age-adjusted rate[1]	1979–89 NLMS ratio[2]	1990 census undercount ratio[3]	Combined ratio[4]	Rates adjusted for reporting bias and estimated census undercount[5]	Race ratio[6] before adjustment	Estimated race ratio[6] after adjustment
White	466.8	1.00	0.99	0.99	462.1	1.00	1.00
Black	738.3	1.00	0.95	0.95	701.4	1.58	1.52
American Indian[7]	456.7	1.37	0.88	1.21	550.6	0.98	1.19
Asian or Pacific Islander[8]	277.4	1.13	0.98	1.11	307.2	0.59	0.66
Hispanic	365.9	1.07	0.95	1.02	371.9	0.78	0.80

[1]Rates published in (3).

[2]The National Longitudinal Mortality Study (NLMS) race ratios based on weighted data for nine Current Population Survey (CPS) files; NLMS ratios are the ratio of CPS-weighted number of deaths for a race group divided by the death certificate-weighted number of deaths for the corresponding race group. The ratio for Hispanic persons was based on 12 CPS files for selected States for 1979–85.

[3]The census-undercount ratio is based on the ratio of the 1990 resident census-level population to the resident population adjusted for net census undercount [based on Hogan (18)].

[4]The combined ratio is the product of multiplying the NLMS ratio by the census undercount ratio.

[5]Adjusted rate is the product of reported rate times combined ratio.

[6]Race ratio is the ratio of a rate for a race or origin group to the rate for the white population.

[7]Includes deaths among Aleuts and Eskimos.

[8]Includes deaths among Chinese, Filipino, Hawaiian, Japanese, and other Asian or Pacific Islanders.

NOTE: The NLMS ratios, the census undercount ratios, and the age-adjusted rates are subject to variability and/or biases. Therefore, caution should be exercised in interpreting the results based on these ratios.

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