Mortality Profile of the Non-Hispanic American Indian or Alaska Native Population, 2019

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Abstract

Objectives—This report presents a mortality profile of the U.S. non-Hispanic American Indian or Alaska Native (AIAN) population for 2019. Standard mortality statistics, adjusted for race and Hispanic-origin misclassification on death certificates, are provided along with comparisons with the three major U.S. populations: non-Hispanic white, non-Hispanic black, and Hispanic.

Methods—The data used to produce the mortality statistics shown in this report include final mortality data for 2019; July 1, 2019, population estimates based on the 2010 decennial census; the 2018 and 2019 linked birth/infant death data files; and a data set consisting of 2010 decennial census AIAN records linked to mortality data. Age-specific and age-adjusted death rates, leading causes of death, and life expectancy estimates are adjusted for race and Hispanic-origin misclassification using adjustment factors produced from the census-mortality-linked data set.

Results—After adjusting for misclassification, the non-Hispanic AIAN population experienced substantially higher mortality than non-Hispanic white, non-Hispanic black, and Hispanic populations in the United States. Non-Hispanic AIAN persons experienced greater all-cause mortality, higher age-specific death rates at most ages but particularly at younger ages, and higher mortality for most of the top leading causes of death. They also had the lowest life expectancy at birth (71.8) compared with the non-Hispanic white (78.8), non-Hispanic black (74.8), and Hispanic (81.9) populations.

Keywords: cause of death • life expectancy • disparities • race • Hispanic origin • National Vital Statistics System

Introduction

To date, there has been a dearth of published national mortality statistics for the American Indian or Alaska Native (AIAN) population due to poor data quality among this population (1,2). Misclassification of race and ethnicity on U.S. death certificates is the primary source of data problems, although census population estimates also present challenges to the estimation of reliable mortality statistics for the AIAN population (3,4). Previous research has consistently shown that 30% or more of individuals who self-identify as non-Hispanic AIAN are misclassified to a different race and ethnicity group on death certificates (5–7). The main effect of race and Hispanic-origin misclassification on death certificates is substantial underestimation of mortality for this population.

This report presents a mortality profile of the U.S. non-Hispanic AIAN population for 2019. Standard mortality statistics, including age-specific and age-adjusted death rates, leading causes of death, and life expectancy estimates are provided along with comparisons with the three major U.S. populations: non-Hispanic white, non-Hispanic black, and Hispanic. The mortality statistics presented in this report for the non-Hispanic AIAN population are adjusted for misclassification of race and Hispanic origin on death certificates with classification ratios (adjustment factors) produced from a linkage of records of AIAN respondents to the 2010 decennial census with National Vital Statistics System (NVSS) mortality data (see Technical Notes for details).

Background

Mortality statistics for the U.S. AIAN population

Mortality statistics for the AIAN population have been included in data files produced and published from the U.S. NVSS beginning with the first publication of vital statistics for the U.S. registration areas for 1900 (8). While the earlier race categories included "Indian," published mortality statistics for this population were limited to death counts by state and territory, age, and sex (8). In ensuing years, detailed statistics other than aggregate death counts for the AIAN population were included in the broad categories "colored," "non-white," or "other races," combined with those for black, Chinese-, and Japanese-origin populations. More detailed mortality statistics, such as death rates by age and sex for the AIAN population, were first presented for data year 1960 (9). Between 1961 and 1993, detailed mortality statistics for the AIAN population were again grouped within the broad categories "non-white" or "other race." Detailed mortality statistics for the AIAN population separately were published again in 1994 and have since been published annually (10). Published detailed mortality statistics include sex-age-specific death counts and death rates, and leading causes of death. National life expectancy estimates, published for the white and black populations regularly since 1900, have not been produced for the entire non-Hispanic AIAN population until this report (11).

An important reason for the sparseness or absence of detailed mortality statistics for the U.S. AIAN population has been the misclassification of race and ethnicity on death certificates that has historically affected AIAN mortality data (1). Classification of race and Hispanic origin on death certificates is usually the responsibility of funeral directors who must gather the information from next of kin or rely on observation (6). This may be especially problematic for populations with large proportions of multiple-race persons, such as the AIAN population (6). The first study to evaluate race classification on death certificates, the 1960 Census-Death Certificate Matched Study, found that 21% of self-identified AIAN were incorrectly classified on death certificates (12). Four subsequent studies, covering deaths for years 1979–2011, similarly found high rates of racial misclassification for the AIAN population. Based on a linkage of Current Population Surveys (CPS) to NVSS mortality data (National Longitudinal Mortality Study), net misclassification rates between CPS self-identification and death certificate classification ranged between 30% and 45% (1,5–6). A study based on the AIAN Mortality Database (AMD), a linkage of Indian Health Service (IHS) patient registration records with NVSS mortality data for years 1990–2009, revealed that misclassification was lower in areas with higher concentrations of AIAN populations than in areas with lower concentrations, although still substantial; 20% compared with 82% (2).

To date, the most comprehensive and reliable mortality profile of the U.S. AIAN population is based on the AMD (3). A mortality profile of the non-Hispanic AIAN population in IHS Contract Health Service Delivery Area or Tribal Service Delivery Area counties (CHSDA counties) revealed vast disparities in all-cause and cause-specific mortality between the non-Hispanic AIAN and the non-Hispanic white populations (3). Adjusted for race and Hispanic-origin misclassification on death certificates, the non-Hispanic AIAN population experienced age-adjusted death rates that were 46% greater than those of the non-Hispanic white population in CHSDA counties during the period 2000–2009 (3). Mortality disparities were most evident in younger age groups. Non-Hispanic AIAN age group 25 to 44 years experienced all-cause death rates that were nearly three times higher than those of non-Hispanic white persons (3). Non-Hispanic AIAN males experienced considerably higher death rates for all 15 leading causes of death than the non-Hispanic white male population, with cause-specific rate ratios ranging from 1.09 for deaths due to Chronic lower respiratory diseases to 4.85 for deaths due to homicide. Similarly, with one exception (Alzheimer disease deaths), non-Hispanic AIAN females experienced higher death rates for the top 15 leading causes of death than non-Hispanic white persons, with rate ratios ranging from 1.03 for Chronic lower respiratory diseases to 5.36 for deaths due to Chronic liver disease and cirrhosis (3). Life expectancy at birth was 71.1, 68.0, and 74.3 for non-Hispanic AIAN total, male, and female populations, respectively, in CHSDA counties during the period 2007–2009 (4). By comparison, life expectancy at birth was 78.4, 76.0, and 80.7 years for non-Hispanic white total, male, and female populations, respectively, in 2008 (4).

An important limitation of the AMD-based study is that it pertains only to 64% of the non-Hispanic AIAN population; the segment that resides in the 637 CHSDA counties (3). As a result, the study omits AIAN persons who are not members of federally recognized tribes and therefore not eligible for IHS services. It excludes many AIAN persons living in urban areas that are not part of a CHSDA county (3). The current study expands upon the AMD-based study because it includes all U.S. non-Hispanic AIAN deaths, adjusted for misclassification, in 2019. As with the AMD study, the current study omits a small but important segment of the AIAN population (Hispanic AIAN). Population estimates, both intercensal and postcensal, based on the 2010 decennial census overestimate the Hispanic AIAN population as a result of the algorithm the Census Bureau used to impute responses of "some other race" to one, or a combination, of the five approved Office of Management and Budget race categories (3,4).

Data and Methods

The data used to produce the mortality statistics shown in this report include final numbers of deaths for the year 2019; July 1, 2019 population estimates based on the 2010 decennial census; and the 2018 and 2019 linked birth/infant death data files. An extract of the Census Bureau's 2010 decennial Census Edited File (CEF)-Census Unedited File (CUF) Match File containing records for persons classified as AIAN alone or in combination with another race was linked to NVSS death certificates for years 2010–2011 to produce classification ratios (correction factors). These ratios were used to correct for race and Hispanic-origin misclassification on death certificates for the non-Hispanic AIAN population (see Technical Notes for detailed description of data and methodology).

The non-Hispanic AIAN mortality statistics presented in this report have been adjusted for race and Hispanic-origin misclassification on death certificates using classification ratios and include number of deaths, age-specific and age-adjusted death rates, leading causes of death, and life expectancy estimates. The methodology used to estimate the classification ratios is the same as that developed for a previous study of racial and ethnic misclassification on death certificates based on the National Longitudinal Mortality Study (1,6). The classification ratios presented in this report consist of the ratio of CEF-CUF Match AIAN extract file non-Hispanic AIAN counts to death certificate non-Hispanic AIAN counts for the sample of decedents in the CEF-CUF Match AIAN-Mortality-linked data file. Classification ratios were estimated by decedent's sex, age, and cause of death. Differences in death rates between population groups are shown using death rate ratios. Age-specific and age-adjusted death rates for non-Hispanic white, non-Hispanic black, and Hispanic populations were not adjusted for misclassification. Previous studies have shown that misclassification for the former two populations is negligible with a classification ratio of 0.9995 for the non-Hispanic white population and 1.0047 for the non-Hispanic black population (11). Misclassification for the Hispanic population was greater than that of the other two groups with a classification ratio of 1.0329 (11). The methodology used to estimate life tables for the non-Hispanic AIAN population is the same as that used for the non-Hispanic AIAN population living in CHSDA counties and based on the AMD (4) (see Technical Notes for a detailed description of life table methods). The methods used to produce the life tables for the three other population groups are those used to produce the annual U.S. life tables (11).

Results

In agreement with previous evaluations of race and Hispanic-origin classification on death certificates, this study found that 34% (classification ratio of 1.3354) of non-Hispanic AIAN decedents were classified as a different race on death certificates, with 35% (1.3488) of males and 32% (1.3197) of females misclassified (1,2,5–7). Approximately 28% of self-identified non-Hispanic AIAN decedents were misclassified as non-Hispanic white on death certificates, followed by 4% misclassified as non-Hispanic black, and less than 1% misclassified as non-Hispanic Asian or Pacific Islander. Race and Hispanic-origin misclassification on death certificates varied by sex, age, and cause of death. The mortality statistics presented in the remainder of this report for the non-Hispanic AIAN population are adjusted for misclassification on death certificates using the classification ratios produced from the CEF-CUF Match AIAN-Mortality data file (see Technical Notes for detailed description of statistical methods).

Deaths and age-adjusted death rates

Deaths among non-Hispanic AIAN persons in the United States in 2019, after adjusting for race and Hispanic-origin misclassification, numbered 24,113 for both sexes; 13,127 to males and 10,987 to females (Table 1). The age-adjusted death rate for the non-Hispanic AIAN population was 1,036.7 per 100,000 U.S. standard population (Figure 1 and Table 1). The non-Hispanic AIAN rate ratios (rate for non-Hispanic AIAN divided by the rates for other groups) were 1.40, 1.17, and 1.98 for the non-Hispanic white, non-Hispanic black, and Hispanic populations, respectively (see Tables I-1 and I-2 for rates for non-Hispanic white, non-Hispanic black, and Hispanic populations). The age-adjusted death rate for non-Hispanic AIAN males was 1,209.6 with rate ratios of 1.39, 1.11, and 1.91 for non-Hispanic white, non-Hispanic black, and Hispanic males, respectively. For non-Hispanic AIAN females, the age-adjusted death rate was 880.6 with rate ratios of 1.40, 1.21, and 2.04 for non-Hispanic white, non-Hispanic black, and Hispanic females, respectively.

Age-specific death rates

The age-specific mortality profile of the non-Hispanic AIAN population in 2019 follows the expected pattern where mortality is relatively high at birth, reaches its lowest point for age group 5–14 years, and then increases steadily with age (Figure 2 and Table 1). Non-Hispanic AIAN males experienced higher mortality than female persons at all ages, except for age group 85 and over. The age-specific death rate for males (11,350.2) was 96% of that of females (11,838.8) for age group 85 and over and ranged from 6% (726.5 compared with 682.8 for age group under 1) to 79% (435.3 compared with 242.8 for age group 25–34) higher than those of females in other age groups under 85.

The non-Hispanic AIAN population had higher age-specific death rates than non-Hispanic white, non-Hispanic black, and Hispanic populations at most ages (Figures 3a–3c, Table 1, and Table I–1). The largest differences between the non-Hispanic AIAN and the other three populations for both males and females were for age groups 1–4, 25–34, 35–44, and 45–54, where ratios of non-Hispanic AIAN age-specific death rates to those of the other three populations ranged from a low of 1.61 to a high of 4.01 (Figure 3a). For age group under 1, death rates for non-Hispanic AIAN males (726.5) and females (682.8) were 43% (1,266.1) and 37% (1,080.0) lower than those of non-Hispanic black persons (Figures 3b and 3c). For age group 85 and over, death rates for non-Hispanic AIAN males (11,350.2) were 75% and 87% that of non-Hispanic white (15,123.0) and non-Hispanic black (13,094.9) persons, respectively. The non-Hispanic AIAN female death rate (11,838.8) for age group 85 and over was 88% that of non-Hispanic white females (13,464.4).

Leading causes of death

In 2019, the 15 leading causes of death for the non-Hispanic AIAN population accounted for 79.0% of all deaths occurring to this population (Table 2). Adjustment for misclassification did not change the content of the 15 leading causes list but did affect the ranking order of a few causes. The first two leading causes of death, Diseases of heart (heart disease) and Malignant neoplasms (cancer), accounted for 36.6% of all deaths. Accidents (unintentional injuries) was the 3rd leading cause of death, accounting for 10.6% of all deaths. Chronic liver disease

Figure 1. Age-adjusted death rates, by race and Hispanic origin and sex: United States, 2019

NOTES: AIAN is American Indian or Alaska Native. Non-Hispanic AIAN death rates have been adjusted for race and Hispanic-origin misclassification on death certificates.
SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.
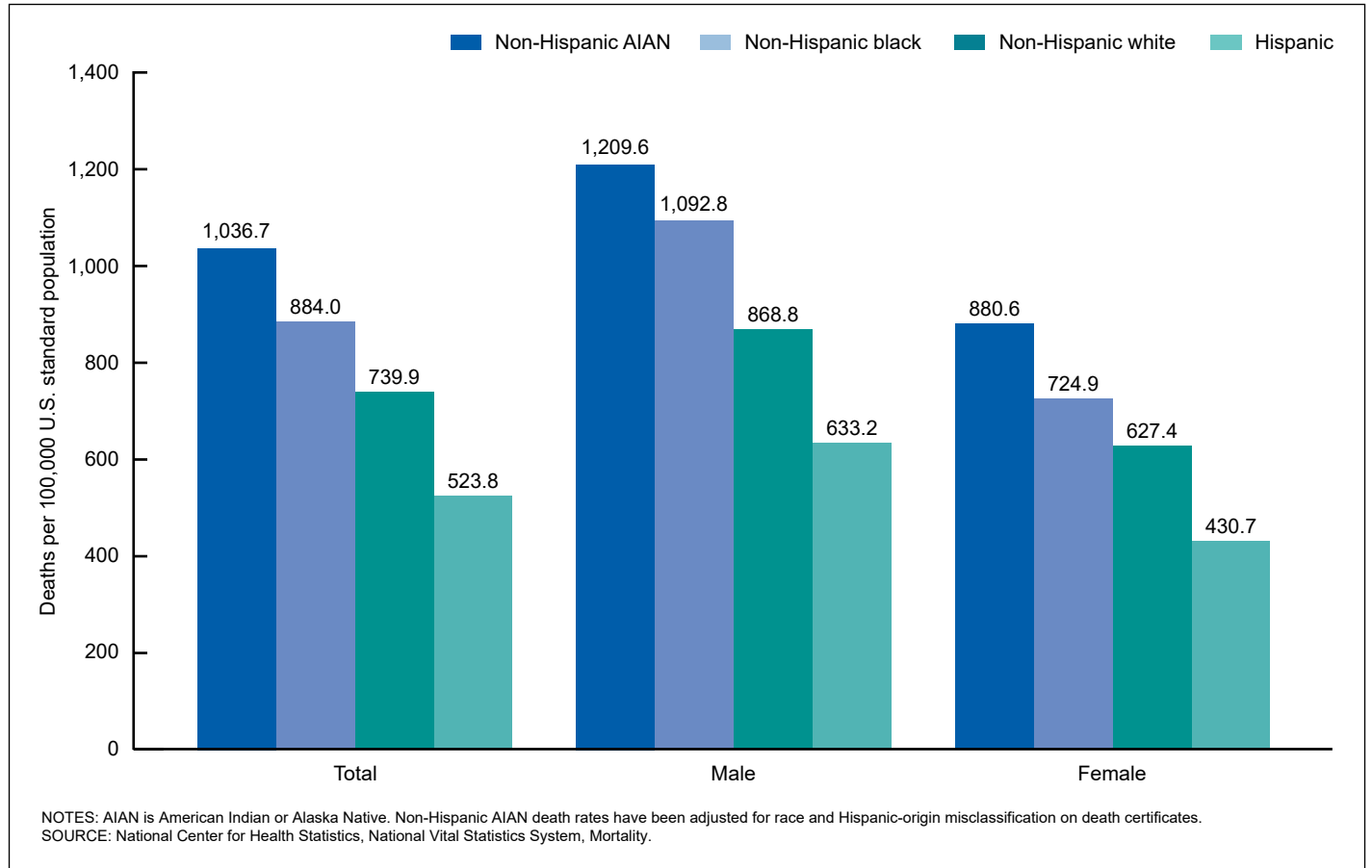
Figure 2. Age pattern of mortality for the non-Hispanic AIAN population, by sex: United States, 2019

NOTES: AIAN is American Indian or Alaska Native. Rates have been adjusted for race and Hispanic-origin misclassification on death certificates. Rates are plotted on a logarithmic scale.
SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.

Figure 3. Rate ratios of non-Hispanic AIAN to Hispanic, non-Hispanic white, and non-Hispanic black populations, by age and sex: United States, 2019

NOTES: AIAN is American Indian or Alaska Native. Non-Hispanic AIAN death rates have been adjusted for race and Hispanic-origin misclassification on death certificates.
SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.

and cirrhosis was the 4th leading cause of death (5.2% of all deaths). The 5th, 6th, and 7th leading causes of death, Chronic lower respiratory diseases, Diabetes mellitus (diabetes), and Cerebrovascular diseases (stroke), accounted for 13.7% of all deaths. Intentional self-harm (suicide), the 8th leading cause of death, accounted for 2.9% of all deaths. The 9th, 10th, 11th, and 12th leading causes, Nephritis, nephrotic syndrome and nephrosis (kidney disease), Influenza and pneumonia, Alzheimer disease, and Septicemia, accounted for 7.0% of all deaths. Assault (homicide), the 13th leading cause, accounted for 1.4% of all deaths.

Non-Hispanic AIAN males and females shared the same 15 leading causes, but the ranking order and age-adjusted death rates differed. For example, heart disease was the leading cause of death for males and accounted for 21% of all male deaths; the age-adjusted death rate for heart disease among males was 257.7 deaths per 100,000 U.S. standard population (Figure 4). In contrast, cancer was the leading cause for females and represented 17.9% of all female deaths; the age-adjusted death rate for cancer among females was 149.5. Of special note are differences in sex-specific rankings and death rates for select causes. For example, suicide was the 7th leading cause (4% of all deaths) for males and the 11th leading cause (1.5%) for females. Age-adjusted suicide death rates were 45.6 for males

and 14.1 and females. Homicide was the 9th leading cause (1.8%) for males but the 14th leading cause (0.8%) for females. Age-adjusted homicide death rates were 19.6 for males and 7.3 for females.

The non-Hispanic AIAN population experienced substantially greater cause-specific mortality for 13 and 14 of the 15 leading causes of death than the Hispanic and non-Hispanic white populations, respectively (Table 2, Figure 5, and Table I–2). When compared with the Hispanic population, the age-adjusted death rate for suicide for the non-Hispanic AIAN population was four times greater (rate ratio of 4.01 [29.3:7.3]), the largest difference of all the leading causes. When compared with the non-Hispanic white population, the death rate for homicide was five times higher (rate ratio of 5.00 [29.3:17.7]) for non-Hispanic AIAN persons, the greatest difference in rates for the leading causes. The age-adjusted death rate for liver disease for the non-Hispanic AIAN population was approximately four times the rate for non-Hispanic white persons (rate ratio of 4.06 [49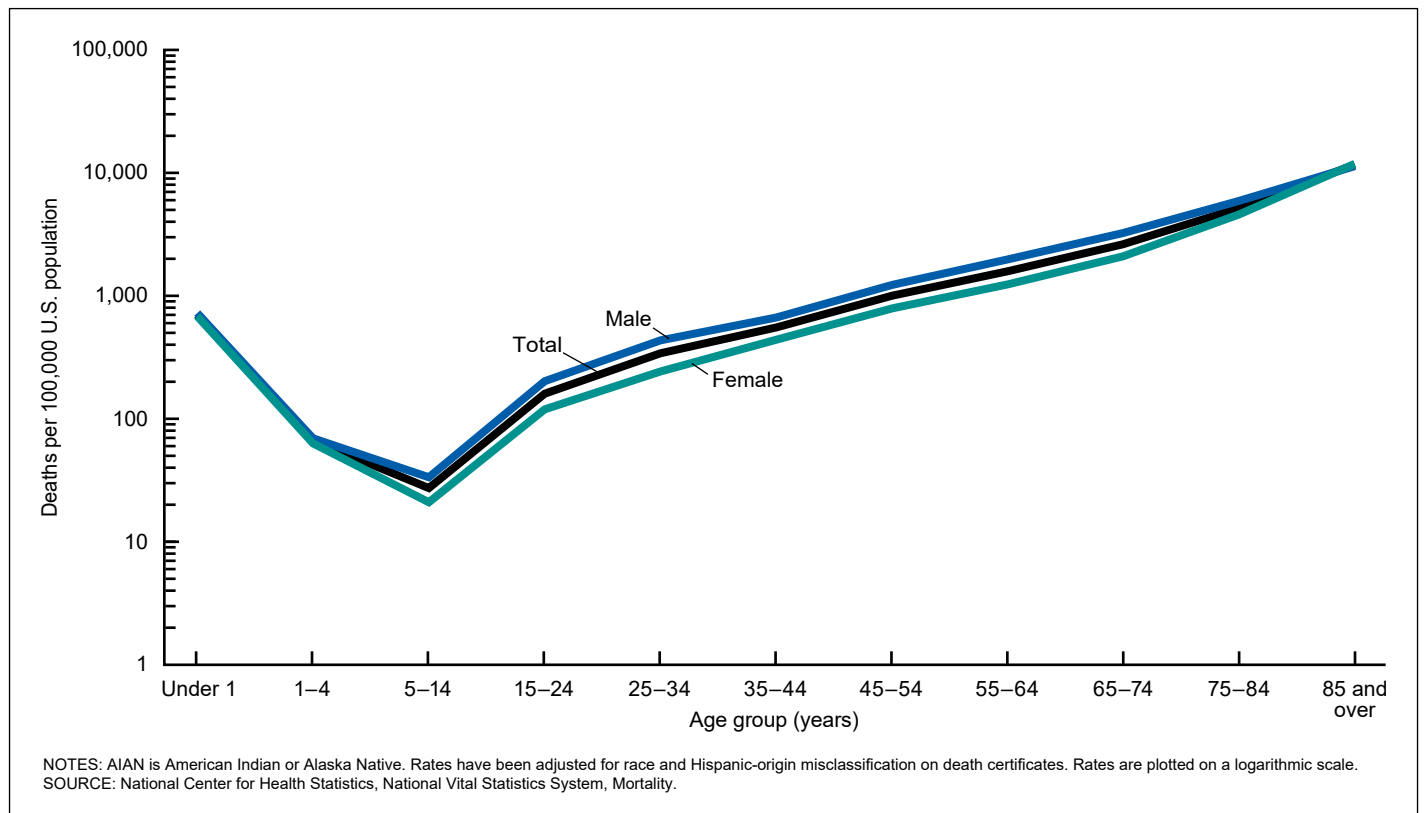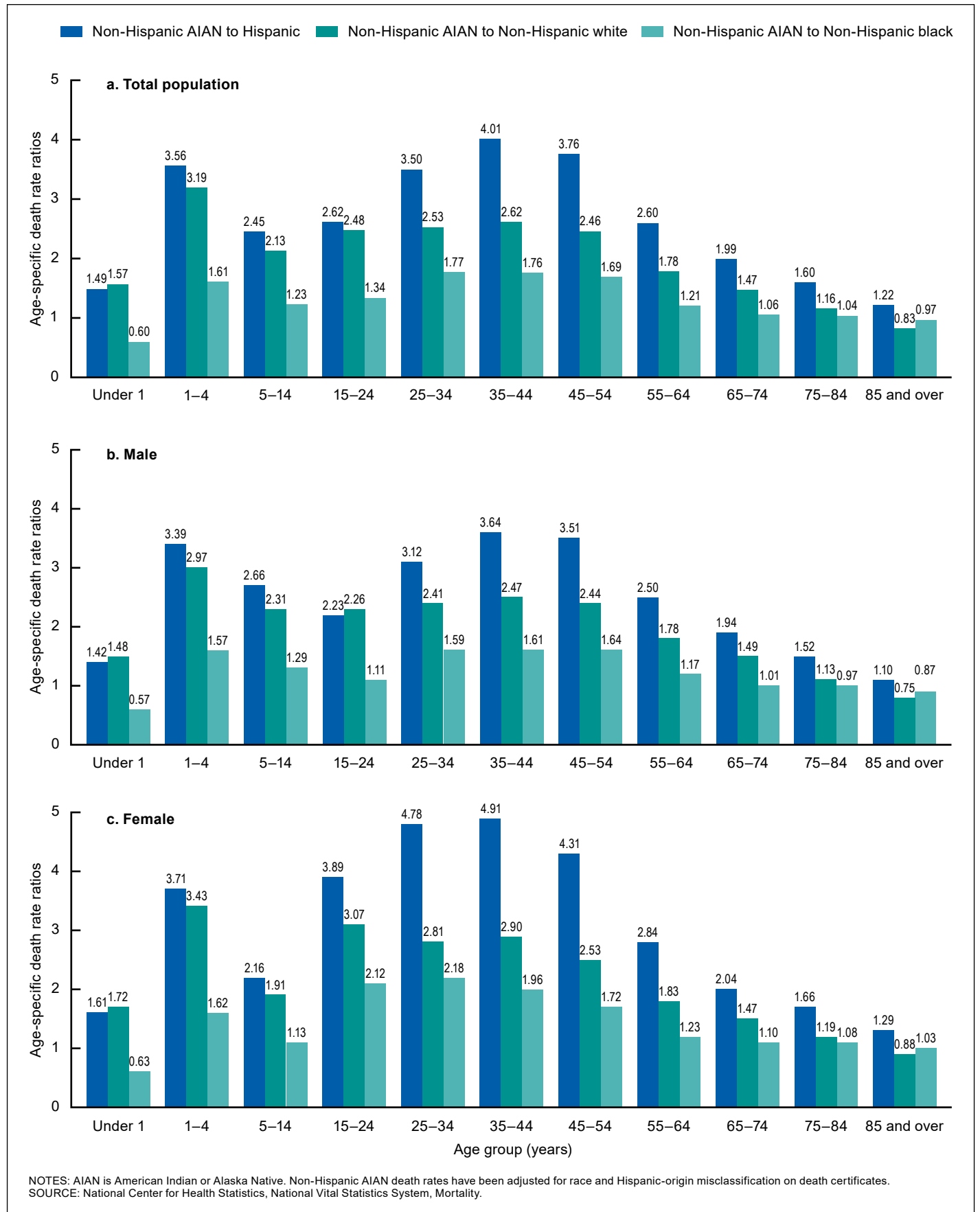.7:11.9]) and more than three times the rate for Hispanic persons (rate ratio of 3.43 [49.7:14.6]). The age-adjusted death rate for the top leading cause of death, heart disease, for non-Hispanic AIAN (198.9) was 20.2% higher (rate ratio of 1.20) than the rate for the non-Hispanic white population (166.4) and 86.0% higher (rate

Figure 4. Percent distribution for the 15 leading causes of death for non-Hispanic AIAN males and females: United States, 2019

NOTES: AIAN is American Indian or Alaska Native. Ranking of causes of death based on death counts adjusted race and Hispanic-origin misclassification on death certificates.
SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.
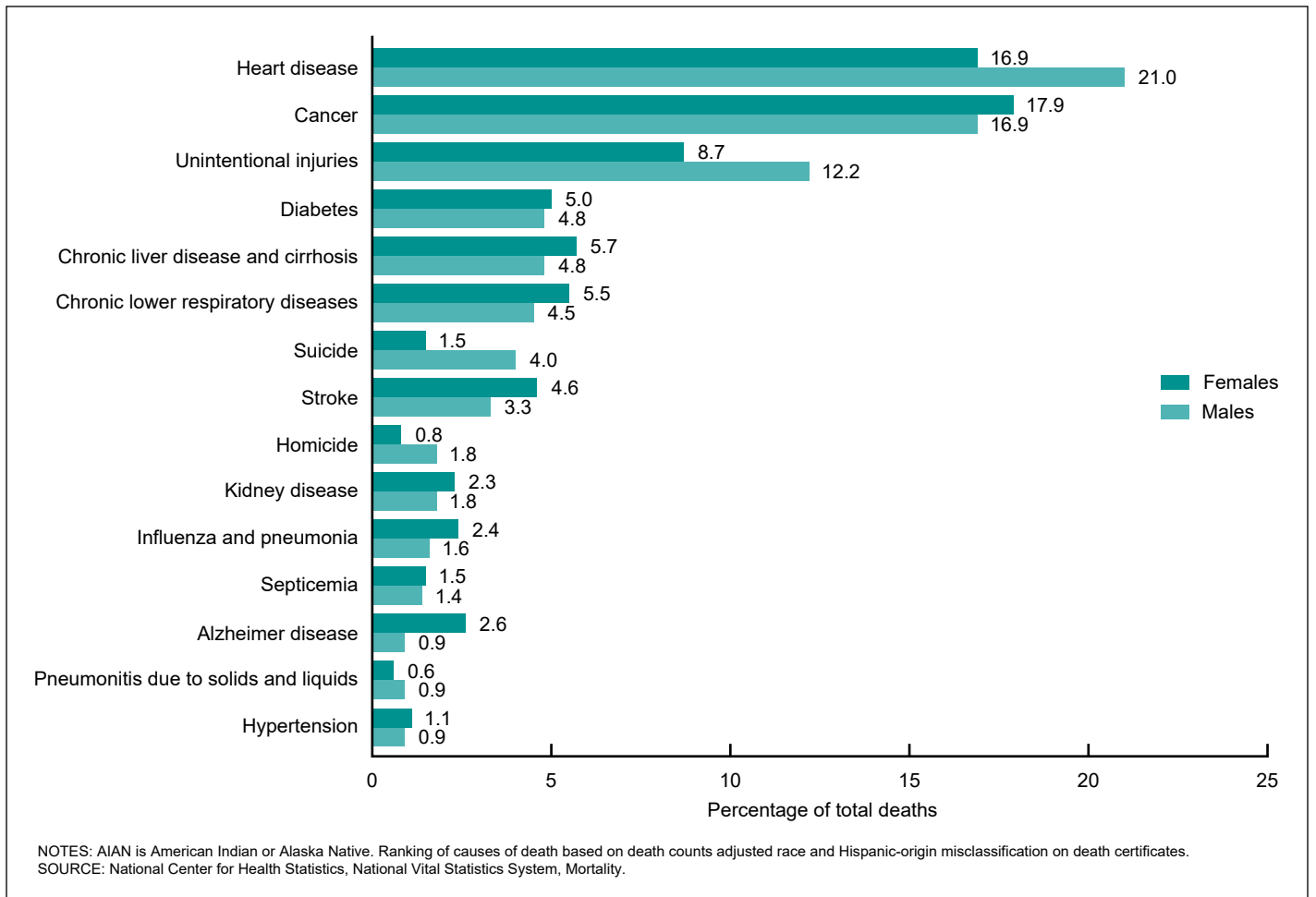
Figure 5. Age-adjusted death rate ratios by 15 leading causes of death for the non-Hispanic AIAN to Hispanic, non-Hispanic white, and non-Hispanic black populations: United States, 2019

NOTES: AIAN is American Indian or Alaska Native. Non-Hispanic AIAN death counts and age-adjusted death rates have been adjusted for race and Hispanic-origin misclassification on death certificates.
SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.
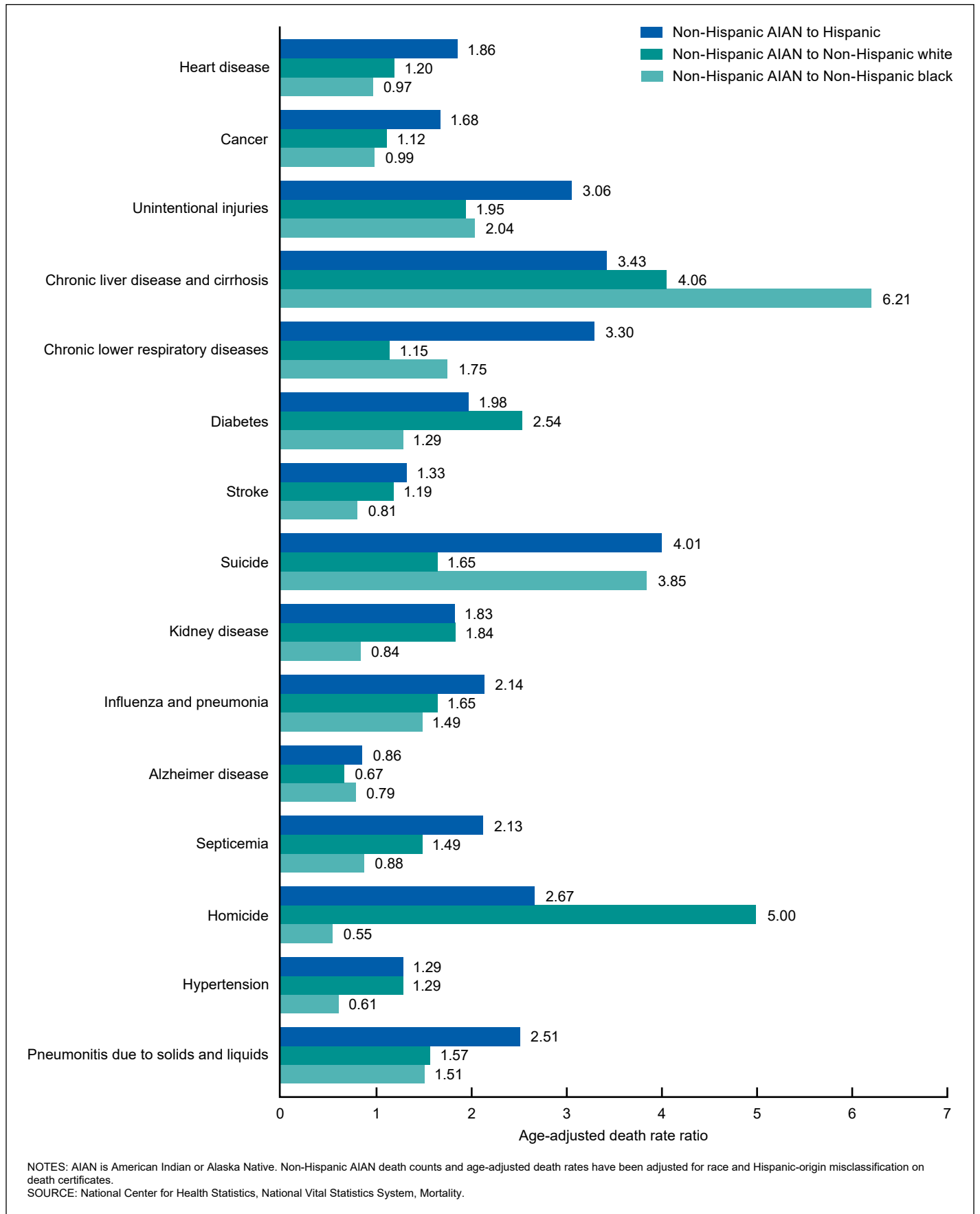
ratio of 1.86) than the rate for the Hispanic population (111.3). The age-adjusted death rate for liver disease for the non-Hispanic AIAN population was more than six times (rate ratio of 6.21 [49.7:7.7]) that for the non-Hispanic black population, the greatest difference among the leading causes. However, rates for the two top leading causes, heart disease and cancer, were very similar for non-Hispanic AIAN and non-Hispanic black persons (rate ratios of 0.97 [198.9:208.6] and 0.99 [172.2:173.1], respectively). Rates for 7 of the 15 leading causes were lower for non-Hispanic AIAN than non-Hispanic black persons with a homicide rate of nearly one-half (rate ratio of 0.55 [13.5:23.7]). The age-adjusted death rates by sex followed a similar pattern.

Life expectancy

In 2019, life expectancy at birth was 71.8 years for the total non-Hispanic AIAN population (Table and Table 3). By comparison, life expectancy at birth was 81.9 years for the Hispanic population, 78.8 years for the non-Hispanic white population, and 74.8 years for the non-Hispanic black population. The non-Hispanic AIAN population could expect to live 10.1 fewer years than the Hispanic population, 7 fewer years than the non-Hispanic white population, and 3 fewer years than the non-Hispanic black population.

Among the eight Hispanic origin-race-sex populations (Figure 6, Tables 4–5), non-Hispanic AIAN males had the lowest life expectancy at birth (68.6 years), followed by non-Hispanic black males (71.3), non-Hispanic AIAN females (75.0), non-Hispanic white males (76.3), non-Hispanic black females (78.1), Hispanic males (79.1), non-Hispanic white females (81.3), and Hispanic females (84.4). Life expectancy at birth for non-Hispanic AIAN males was 10.5 years lower than that of Hispanic males, 7.7 years lower than that of non-Hispanic white males, and 2.7 years lower than that of non-Hispanic black males. Non-Hispanic AIAN females experienced a disadvantage of 9.4 years relative to Hispanic females, 6.3 years relative to non-Hispanic white females, and 3.1 years relative to non-Hispanic black females.

In comparison with all three other groups, the non-Hispanic AIAN population experienced lower life expectancy throughout most of the age span (Table). The disadvantage is greatest at the youngest ages diminishing with increasing age and converting to an advantage at the oldest ages. The crossover happens earlier relative to the non-Hispanic black population, for age group 60–64 for males and age group 75–79 for females. It occurs at older ages relative to the non-Hispanic white (age group 80–84 for both males and females) and Hispanic (age group 90–94 for both males and females) populations.

Discussion and Summary

This report presented the first ever comprehensive mortality profile of the entire U.S. non-Hispanic AIAN population, adjusted for misclassification. It reveals that this population experiences substantially higher mortality than non-Hispanic white, non-Hispanic black, and Hispanic populations in the United States. Non-Hispanic AIAN persons experience greater all-cause mortality, higher age-specific death rates at most ages but particularly at younger ages, and higher mortality for most of the top leading causes of death. They experience mortality from chronic liver disease, suicide, and unintentional injuries that is considerably greater than that experienced by the other race and Hispanic-origin populations. The non-Hispanic AIAN

Table. Life expectancy at selected ages, by race and Hispanic origin and sex: United States, 2019

Age	Non-Hispanic AIAN			Hispanic			Non-Hispanic white			Non-Hispanic black		
	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
0.	71.8	68.6	75.0	81.9	79.1	84.4	78.8	76.3	81.3	74.8	71.3	78.1
1.	71.3	68.2	74.5	81.3	78.5	83.8	78.1	75.7	80.6	74.6	71.1	77.9
5.	67.5	64.4	70.7	77.3	74.6	79.9	74.2	71.8	76.6	70.7	67.3	74.0
10.	62.6	59.5	65.8	72.4	69.6	74.9	69.2	66.8	71.7	65.8	62.3	69.1
15.	57.7	54.6	60.8	67.4	64.6	69.9	64.3	61.9	66.7	60.9	57.4	64.1
20.	53.0	50.0	56.1	62.5	59.8	65.0	59.4	57.1	61.8	56.1	52.8	59.2
25.	48.5	45.6	51.5	57.8	55.1	60.2	54.7	52.4	56.9	51.5	48.4	54.5
30.	44.1	41.4	46.9	53.0	50.5	55.3	50.0	47.8	52.1	47.0	43.9	49.7
35.	40.0	37.4	42.6	48.3	45.9	50.4	45.3	43.2	47.4	42.4	39.6	45.0
40.	36.0	33.5	38.4	43.6	41.3	45.6	40.7	38.7	42.7	38.0	35.2	40.4
45.	32.0	29.7	34.3	38.9	36.7	40.9	36.2	34.3	38.0	33.6	31.0	35.9
50.	28.3	26.1	30.4	34.4	32.2	36.2	31.7	29.9	33.5	29.4	26.9	31.5
55.	24.8	22.8	26.7	29.9	27.9	31.6	27.4	25.7	29.0	25.3	23.0	27.3
60.	21.4	19.7	23.0	25.6	23.8	27.1	23.4	21.8	24.8	21.6	19.5	23.4
65.	18.2	16.7	19.5	21.6	19.9	22.9	19.5	18.1	20.7	18.2	16.3	19.7
70.	15.2	14.0	16.1	17.7	16.2	18.7	15.8	14.6	16.7	15.0	13.4	16.2
75.	12.2	11.3	13.0	14.0	12.8	14.8	12.3	11.3	13.1	12.0	10.7	12.9
80.	9.6	8.8	10.2	10.7	9.6	11.2	9.2	8.4	9.8	9.3	8.2	9.9
85.	7.4	6.7	7.8	7.8	6.9	8.1	6.6	6.0	7.0	6.9	6.2	7.3
90.	5.6	5.1	5.8	5.5	4.8	5.6	4.5	4.0	4.8	5.1	4.6	5.3
95.	4.2	3.8	4.3	3.8	3.3	3.8	3.1	2.7	3.2	3.7	3.4	3.8
100.	3.3	3.0	3.3	2.7	2.3	2.7	2.2	2.0	2.2	2.8	2.6	2.8

NOTE: AIAN is American Indian or Alaska Native.

SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.

Figure 6. Life expectancy at birth, by race and Hispanic origin and sex: United States, 2019

NOTES: AIAN is American Indian or Alaska Native. Life expectancy estimates based on death rates adjusted for race and Hispanic-origin misclassification on death certificates.
SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.
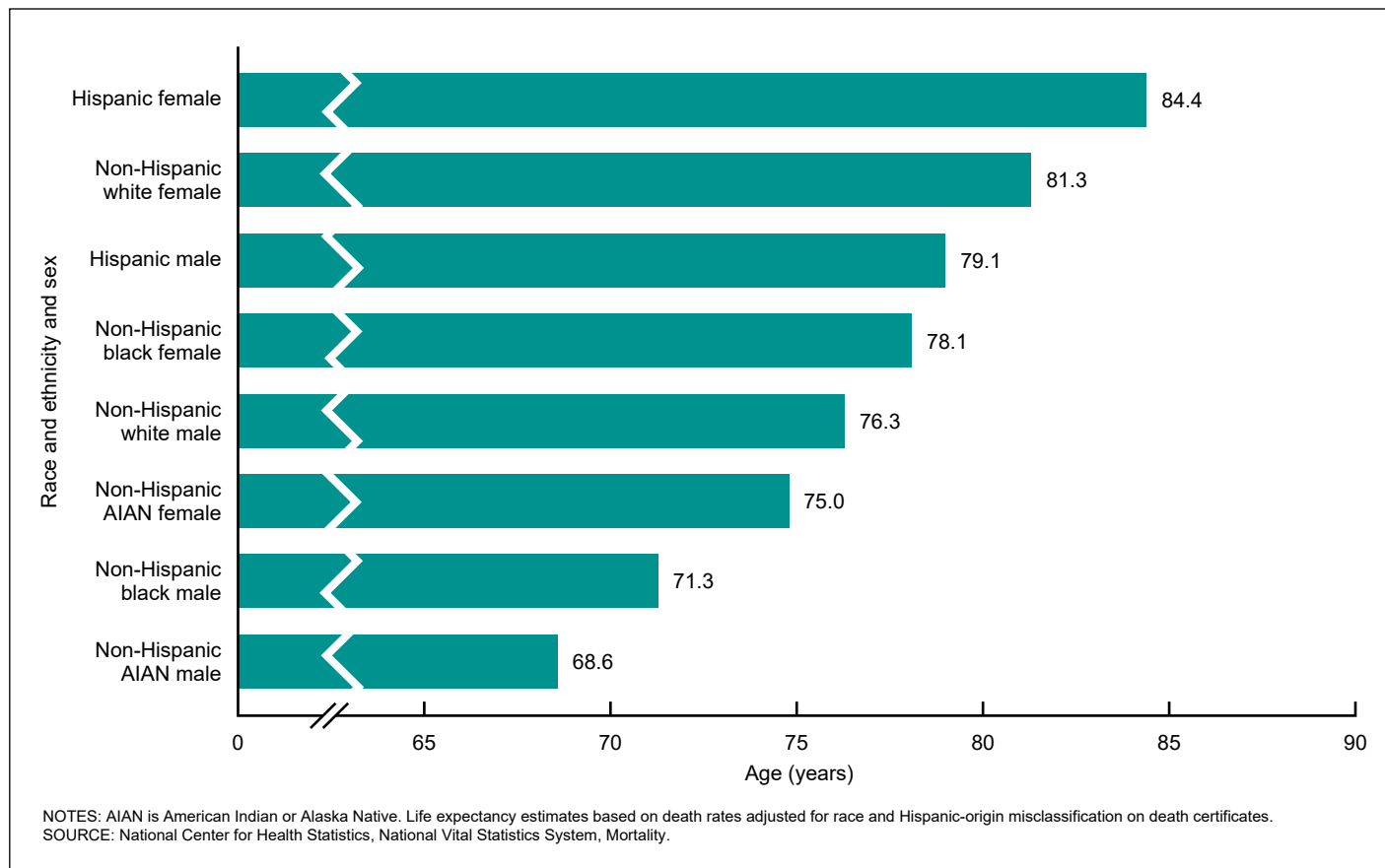
population has the lowest life expectancy at birth compared with the non-Hispanic white, non-Hispanic black, and Hispanic populations, with disadvantages ranging from 3.0 (non-Hispanic black) to 10.1 years (Hispanic).

The results of this study are consistent with those based on the AMD, even though the latter covered only 64% of the non-Hispanic AIAN population in the United States (3,4,13). For example, one study based on the AMD found that non-Hispanic AIAN all-cause mortality was 46% greater than that of the non-Hispanic white population (3). This study found that it was 40% greater. The same study also found that mortality from causes such as unintentional injury, chronic liver disease, diabetes, and homicide were multiple times those of the majority of the population (3). Finally, life expectancy at birth estimates based on the AMD were only slightly higher than those presented in this report (71.8 compared with 71.1 for the total population, 68.6 compared with 68.0 for males, and 75.0 compared with 74.3 for females) (4).

The racial and ethnic crossover in life expectancy (mortality), described here for the oldest AIAN population, has been observed in the United States for decades mostly in comparisons of white and black mortality. It is defined as the convergence, intersection, and inversion of the age-specific mortality curves of two distinct race groups in a population, where one group experiences higher mortality throughout most of the lifespan up until a given advanced age and then experiences lower mortality throughout the remaining life span (15). There are two explanations for this

phenomenon: data artifact and population selection. The data artifact explanation hypothesizes that the crossover is a function of poor data quality in the form of age misreporting at the oldest ages. The population selection explanation posits that, due to its disadvantaged status, one group experiences a higher mortality regime so that its frailest members succumb at younger ages, leaving the hardiest members to survive to the oldest ages. The advantaged population, on the other hand, experiences a more benign mortality regime and, as a result, frailer members survive to older ages where they tend to die sooner than disadvantaged persons and thus create the crossover effect (15). Both population selection and data artifact could be factors with the results for the non-Hispanic AIAN population shown in this report.

This study has important limitations. First, the results are based on adjusted data, not observed data. Although the classification ratios used to adjust the data are consistent with the findings of previous studies, they are not error free. The National Death Index (NDI) matching algorithm may have missed some true deaths (16). Census records that did not have the minimum required variables for matching were omitted from the records submitted to NDI. The census records submitted to NDI did not have social security numbers (SSN), an important matching variable, and the match relied on names, birth dates, sex, race, and state of residence. The lack of SSN could potentially lower the match rates and may explain some of the differences between the AMD and current non-Hispanic AIAN life tables (4,17). Second, a small segment of the AIAN population, Hispanic AIAN

persons, were omitted from the study. This could possibly bias the overall findings of the study. Hispanic persons have generally been shown to have lower mortality than non-Hispanic persons, so the omission may lead to the appearance of higher mortality among the AIAN population overall. However, the problem with population counts for this group warrants exclusion.

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List of Detailed Tables

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(Available from: https://www.cdc.gov/nchs/data/nvsr/nvsr70/nvsr70-12-tables.pdf.)

Table 1. Number of deaths and death rates, adjusted for misclassification, and rate ratios by sex for the non-Hispanic American Indian or Alaska Native population: United States, 2019

[Race and Hispanic-origin categories are consistent with 1997 Office of Management and Budget standards]

Sex and age group (years)	Non-Hispanic AIAN[1]		Rate ratio—Non-Hispanic AIAN to		
	Number[2]	Rate (standard error)[3]	Non-Hispanic white[1]	Non-Hispanic black[1]	Hispanic
Total					
All ages[3,4]	24,113	1,036.7 (9.9)	†1.40	†1.17	†1.98
Under 1	221	700.2 (106.6)	†1.57	†0.60	†1.49
1–4	87	66.8 (9.0)	†3.19	†1.61	†3.56
5–14	96	27.4 (3.4)	†2.13	1.23	†2.45
15–24	575	160.3 (8.2)	†2.48	†1.34	†2.62
25–34	1,281	340.8 (12.7)	†2.53	†1.77	†3.50
35–44	1,666	552.7 (17.8)	†2.62	†1.76	†4.01
45–54	2,892	1,005.1 (26.8)	†2.46	†1.69	†3.76
55–64	4,744	1,591.0 (35.1)	†1.78	†1.21	†2.60
65–74	5,042	2,628.3 (54.5)	†1.47	†1.06	†1.99
75–84	4,283	5,182.6 (112.4)	†1.16	1.04	†1.60
85 and over	3,137	11,654.7 (307.4)	†0.83	0.97	†1.22
Male					
All ages[3,4]	13,127	1,209.6 (16.1)	†1.39	†1.11	†1.91
Under 1	117	726.5 (154.0)	1.48	†0.57	1.42
1–4	46	69.4 (13.8)	†2.97	1.57	†3.39
5–14	59	33.5 (5.1)	†2.31	1.29	†2.66
15–24	369	202.0 (12.6)	†2.26	1.11	†2.23
25–34	831	435.3 (20.3)	†2.41	†1.59	†3.12
35–44	996	667.0 (27.6)	†2.47	†1.61	†3.64
45–54	1,721	1,230.4 (42.4)	†2.44	†1.64	†3.51
55–64	2,784	1,982.9 (57.8)	†1.78	†1.17	†2.50
65–74	2,882	3,249.6 (92.5)	†1.49	1.01	†1.94
75–84	2,169	5,927.8 (185.3)	†1.13	0.97	†1.52
85 and over	1,138	11,350.2 (492.0)	†0.75	†0.87	†1.10
Female					
All ages[3,4]	10,987	880.6 (12.3)	†1.40	†1.21	†2.04
Under 1	105	682.8 (128.3)	†1.72	†0.63	†1.61
1–4	40	63.0 (11.3)	†3.43	†1.62	†3.71
5–14	36	21.0 (4.3)	†1.91	1.13	†2.16
15–24	211	119.4 (10.6)	†3.07	†2.12	†3.89
25–34	449	242.8 (14.9)	†2.81	†2.18	†4.78
35–44	670	440.4 (22.8)	†2.90	†1.96	†4.91
45–54	1,170	791.7 (33.2)	†2.53	†1.72	†4.31
55–64	1,960	1,242.0 (41.8)	†1.83	†1.23	†2.84
65–74	2,168	2,100.9 (63.6)	†1.47	†1.10	†2.04
75–84	2,117	4,596.5 (138.5)	†1.19	†1.08	†1.66
85 and over	2,000	11,838.8 (393.5)	†0.88	1.03	†1.29

† Probability level less than 0.05.

[1]Includes only one race reported on the death certificate.

[2]Numbers of deaths are adjusted using classification ratios for all ages and each age category separately. Numbers for each age group may not add to the total shown for all ages.

[3]Rate for non-Hispanic AIAN all ages is adjusted to a standard 2000 population; see Technical Notes in this report.

[4]Includes age not states.

NOTE: AIAN is American Indian or Alaska Native.

SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.

Table 2. Number of deaths, percent of total deaths, age-adjusted death rates, and rate ratios by the 15 leading causes of death for the non-Hispanic American Indian or Alaska Native population, by sex: United States, 2019

[Age-adjusted death rates are per 100,000 U.S standard population; see Technical Notes in this report. Asterisks (*) preceding cause-of-death codes indicate they are not part of the *International Classification of Diseases, 10th Revision* (ICD–10); see Technical Notes. Race and Hispanic-origin categories are consistent with 1997 Office of Management and Budget standards]

		Non-Hispanic AIAN[2]			Rate ratio—Non-Hispanic AIAN to		
Rank[1]	Cause of death	Number[3]	Percent of total deaths	Rate (standard error)	Non-Hispanic white	Non-Hispanic black	Hispanic
	Total						
...	All causes.	24,113	100.0	1,036.7 (9.9)	†1.40	†1.17	†1.98
1	Diseases of heart . . . . I00–I09,I11,I13,I20–I51)	4,619	19.2	198.9 (4.5)	†1.20	†0.97	†1.86
2	Malignant neoplasms. . . . . (C00–C97)	4,188	17.4	172.2 (3.9)	†1.12	0.99	†1.68
3	Accidents (unintentional injuries). . . . . (V01–X59,Y85–Y86)	2,554	10.6	106.4 (2.9)	†1.95	†2.04	†3.06
4	Chronic liver disease and cirrhosis . . . .(K70,K73–K74)	1,251	5.2	49.7 (1.8)	†4.06	†6.21	†3.43
5	Chronic lower respiratory diseases . . . .(J40–J47)	1,192	4.9	50.2 (2.4)	†1.15	†1.75	†3.30
6	Diabetes mellitus . . . . (E10–E14)	1,181	4.9	49.0 (1.8)	†2.54	†1.29	†1.98
7	Cerebrovascular diseases . . . . (I60–I69)	938	3.9	41.5 (2.1)	†1.19	†0.81	†1.33
8	Intentional self-harm (suicide). . . . . (*U03,X60–X84,Y87.0)	701	2.9	29.3 (1.6)	†1.65	†3.85	†4.01
9	Nephritis, nephrotic syndrome and nephrosis. . . . .(N00–N07, N17–N19,N25–N27)	484	2.0	20.7 (1.3)	†1.84	†0.84	†1.83
10	Influenza and pneumonia. . . . .(J09–J18)	468	1.9	20.4 (1.3)	†1.65	†1.49	†2.14
11	Alzheimer disease . . . . (G30)	410	1.7	20.5 (1.7)	†0.67	†0.79	†0.86
12	Septicemia. . . . . (A40–A41)	337	1.4	13.9 (1.0)	†1.49	†0.88	†2.13
13	Assault (homicide). . . . . (*U01–*U02,X85–Y09,Y87.1)	327	1.4	13.5 (0.9)	†5.00	†0.55	†2.67
14	Essential hypertension and hypertensive renal disease. . . . .(I10,I12,I15)	229	0.9	10.2 (1.0)	†1.29	†0.61	1.29
15	Pneumonitis due to solids and liquids . . . .(J69)	172	0.7	7.6 (1.0)	†1.57	†1.51	†2.51
...	All other causes . . . . (residual)	4,977	20.6	211.7 (4.3)	†1.36	†1.18	†2.09
	Male						
...	All causes.	13,127	100.0	1,209.6 (16.1)	†1.39	†1.11	†1.91
1	Diseases of heart . . . .(I00–I09,I11,I13,I20–I51)	2,759	21.0	257.7 (7.9)	†1.23	0.99	†1.90
2	Malignant neoplasms. . . . . (C00–C97)	2,219	16.9	200.0 (6.4)	†1.11	0.95	†1.66
3	Accidents (unintentional injuries). . . . . (V01–X59,Y85–Y86)	1,601	12.2	138.7 (4.8)	†1.88	†1.76	†2.67
4	Diabetes mellitus . . . . (E10–E14)	631	4.8	56.6 (3.0)	†2.26	†1.23	†1.88
5	Chronic liver disease and cirrhosis . . . .(K70,K73–K74)	629	4.8	51.7 (2.6)	†3.25	†4.68	†2.50
6	Chronic lower respiratory diseases . . . .(J40–J47)	587	4.5	54.9 (3.9)	†1.20	†1.53	†2.97
7	Intentional self-harm (suicide). . . . . (*U03,X60–X84,Y87.0)	531	4.0	45.6 (3.1)	†1.62	†3.60	†3.92
8	Cerebrovascular diseases . . . . (I60–I69)	428	3.3	42.4 (3.4)	†1.22	†0.76	†1.27
9	Assault (homicide). . . . . (*U01–*U02,X85–Y09,Y87.1)	237	1.8	19.6 (1.6)	†5.37	†0.45	†2.46
10	Nephritis, nephrotic syndrome and nephrosis. . . . .(N00–N07, N17–N19,N25–N27)	235	1.8	22.3 (2.1)	†1.63	†0.75	†1.67
11	Influenza and pneumonia. . . . .(J09–J18)	204	1.6	19.8 (1.9)	†1.40	1.21	†1.73
12	Septicemia. . . . . (A40–A41)	177	1.4	15.5 (1.7)	†1.50	0.85	†2.03
13	Alzheimer disease . . . . (G30)	120	0.9	14.1 (2.3)	†0.59	†0.68	†0.74
14	Pneumonitis due to solids and liquids . . . .(J69)	118	0.9	13.5 (3.1)	†2.06	†1.96	†3.26
15	Essential hypertension and hypertensive renal disease. . . . .(I10,I12,I15)	113	0.9	11.0 (1.7)	†1.31	†0.58	†1.26
...	All other causes . . . . (residual)	2,498	19.0	226.4 (6.7)	†1.35	†1.11	†2.01

See footnotes at end of table.

Table 2. Number of deaths, percent of total deaths, age-adjusted death rates, and rate ratios by the 15 leading causes of death for the non-Hispanic American Indian or Alaska Native population, by sex: United States, 2019—Con.

[Age-adjusted death rates are per 100,000 U.S standard population; see Technical Notes in this report. Asterisks (*) preceding cause-of-death codes indicate they are not part of the *International Classification of Diseases, 10th Revision* (ICD–10); see Technical Notes. Race and Hispanic-origin categories are consistent with 1997 Office of Management and Budget standards]

| Rank[1] | Cause of death | Non-Hispanic AIAN[2] | | | Rate ratio—Non-Hispanic AIAN to | | |
		Number[3]	Percent of total deaths	Rate (standard error)	Non-Hispanic white	Non-Hispanic black	Hispanic
	Female						
...	All causes.	10,987	100.0	880.6 (12.3)	†1.40	†1.21	†2.04
1	Malignant neoplasms. . . . . (C00–C97)	1,965	17.9	149.5 (4.9)	†1.12	1.00	†1.67
2	Diseases of heart . . . .(I00–I09,I11,I13,I20–I51)	1,862	16.9	148.1 (5.1)	†1.15	†0.92	†1.78
3	Accidents (unintentional injuries) . . . .(V01–X59,Y85–Y86)	957	8.7	77.4 (3.6)	†2.15	†2.66	†4.35
4	Chronic liver disease and cirrhosis . . . . (K70,K73–K74)	625	5.7	48.2 (2.5)	†5.48	†8.60	†5.51
5	Chronic lower respiratory diseases . . . . (J40–J47)	606	5.5	46.5 (3.0)	1.11	†1.93	†3.61
6	Diabetes mellitus. . . . . (E10–E14)	551	5.0	42.5 (2.2)	†2.95	†1.32	†2.08
7	Cerebrovascular diseases . . . . (I60–I69)	510	4.6	40.6 (2.6)	†1.17	†0.86	†1.39
8	Alzheimer disease . . . . (G30)	290	2.6	24.6 (2.3)	†0.71	†0.87	10.9
9	Influenza and pneumonia . . . .(J09–J18)	265	2.4	21.1 (1.9)	†1.92	†1.81	†2.64
10	Nephritis, nephrotic syndrome and nephrosis. . . . . (N00–N07, N17–N19,N25–N27)	248	2.3	19.2 (1.7)	†2.04	10.9	†1.99
11	Intentional self-harm (suicide). . . . . (*U03,X60–X84,Y87.0)	167	1.5	14.1 (1.6)	†1.86	†4.82	†4.77
12	Septicemia. . . . . (A40–A41)	162	1.5	12.5 (1.3)	†1.46	0.87	†2.21
13	Essential hypertension and hypertensive renal disease . . . .(I10,I12,I15)	116	1.1	9.9 (1.4)	1.34	†0.65	1.35
14	Assault (homicide). . . . . (*U01–*U02,X85–Y09,Y87.1)	90	0.8	7.3 (1.1)	†4.21	1.14	†3.68
15	Pneumonitis due to solids and liquids . . . .(J69)	63	0.6	4.8 (0.8)	1.31	1.23	†2.12
...	All other causes . . . . (residual)	2,479	22.6	196.1 (5.6)	†1.37	†1.23	†2.16

... Category not applicable.
† Probability level less than 0.05.
[1]Rank based on adjusted number of deaths to misclassification of non-Hispanic AIAN on death certificates; see Technical Notes.
[2]Includes only one race reported on the death certificate.
[3]Numbers of deaths are adjusted using classification ratios for all causes and each cause separately. Numbers for each cause may not add to the total shown for all causes.

SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.

Table 3. Life table for the non-Hispanic American Indian or Alaska Native population: United States, 2019

Age (years)	Probability of dying between ages x and $x+1$ q_x	Number surviving to age x l_x	Number dying between ages x and $x+1$ d_x	Person-years lived between ages x and $x+1$ L_x	Total number of person-years lived above age x T_x	Expectation of life at age x e_x
0–1.	0.007871	100,000	787	99,385	7,175,096	71.8
1–2.	0.000989	99,213	98	99,164	7,075,711	71.3
2–3.	0.000657	99,115	65	99,082	6,976,547	70.4
3–4.	0.000476	99,050	47	99,026	6,877,465	69.4
4–5.	0.000469	99,003	46	98,979	6,778,439	68.5
5–6.	0.000309	98,956	31	98,941	6,679,460	67.5
6–7.	0.000257	98,925	25	98,913	6,580,519	66.5
7–8.	0.000221	98,900	22	98,889	6,481,606	65.5
8–9.	0.000190	98,878	19	98,869	6,382,717	64.6
9–10.	0.000166	98,859	16	98,851	6,283,848	63.6
10–11.	0.000158	98,843	16	98,835	6,184,997	62.6
11–12.	0.000184	98,827	18	98,818	6,086,162	61.6
12–13.	0.000268	98,809	26	98,796	5,987,343	60.6
13–14.	0.000419	98,783	41	98,762	5,888,547	59.6
14–15.	0.000622	98,741	61	98,711	5,789,785	58.6
15–16.	0.000858	98,680	85	98,638	5,691,075	57.7
16–17.	0.001090	98,595	107	98,542	5,592,437	56.7
17–18.	0.001291	98,488	127	98,424	5,493,895	55.8
18–19.	0.001440	98,361	142	98,290	5,395,471	54.9
19–20.	0.001552	98,219	152	98,143	5,297,181	53.9
20–21.	0.001664	98,066	163	97,985	5,199,039	53.0
21–22.	0.001796	97,903	176	97,815	5,101,054	52.1
22–23.	0.001936	97,728	189	97,633	5,003,238	51.2
23–24.	0.002083	97,538	203	97,437	4,905,605	50.3
24–25.	0.002233	97,335	217	97,226	4,808,169	49.4
25–26.	0.002365	97,118	230	97,003	4,710,942	48.5
26–27.	0.002497	96,888	242	96,767	4,613,939	47.6
27–28.	0.002671	96,646	258	96,517	4,517,172	46.7
28–29.	0.002916	96,388	281	96,248	4,420,655	45.9
29–30.	0.003225	96,107	310	95,952	4,324,407	45.0
30–31.	0.003587	95,797	344	95,625	4,228,455	44.1
31–32.	0.003950	95,453	377	95,265	4,132,830	43.3
32–33.	0.004268	95,076	406	94,873	4,037,565	42.5
33–34.	0.004490	94,671	425	94,458	3,942,692	41.6
34–35.	0.004630	94,245	436	94,027	3,848,233	40.8
35–36.	0.004767	93,809	447	93,585	3,754,206	40.0
36–37.	0.004933	93,362	461	93,132	3,660,621	39.2
37–38.	0.005078	92,901	472	92,665	3,567,489	38.4
38–39.	0.005206	92,430	481	92,189	3,474,824	37.6
39–40.	0.005336	91,948	491	91,703	3,382,635	36.8
40–41.	0.005463	91,458	500	91,208	3,290,932	36.0
41–42.	0.005631	90,958	512	90,702	3,199,724	35.2
42–43.	0.005904	90,446	534	90,179	3,109,022	34.4
43–44.	0.006312	89,912	568	89,628	3,018,843	33.6
44–45.	0.006819	89,344	609	89,040	2,929,215	32.8
45–46.	0.007356	88,735	653	88,409	2,840,175	32.0
46–47.	0.007894	88,082	695	87,735	2,751,766	31.2
47–48.	0.008456	87,387	739	87,018	2,664,031	30.5
48–49.	0.009044	86,648	784	86,256	2,577,013	29.7
49–50.	0.009655	85,865	829	85,450	2,490,757	29.0
50–51.	0.010299	85,036	876	84,598	2,405,307	28.3
51–52.	0.010947	84,160	921	83,699	2,320,709	27.6
52–53.	0.011548	83,238	961	82,758	2,237,010	26.9
53–54.	0.012062	82,277	992	81,781	2,154,252	26.2
54–55.	0.012506	81,285	1,017	80,777	2,072,471	25.5
55–56.	0.012899	80,268	1,035	79,751	1,991,695	24.8
56–57.	0.013313	79,233	1,055	78,705	1,911,944	24.1
57–58.	0.013815	78,178	1,080	77,638	1,833,239	23.4
58–59.	0.014466	77,098	1,115	76,540	1,755,601	22.8
59–60.	0.015253	75,983	1,159	75,403	1,679,060	22.1

See footnotes at end of table.

Table 3. Life table for the non-Hispanic American Indian or Alaska Native population: United States, 2019—Con.

Age (years)	Probability of dying between ages x and $x+1$ q_x	Number surviving to age x l_x	Number dying between ages x and $x+1$ d_x	Person-years lived between ages x and $x+1$ L_x	Total number of person-years lived above age x T_x	Expectation of life at age x e_x
60–61.	0.016116	74,824	1,206	74,221	1,603,657	21.4
61–62.	0.016989	73,618	1,251	72,993	1,529,436	20.8
62–63.	0.017881	72,367	1,294	71,720	1,456,443	20.1
63–64.	0.018772	71,073	1,334	70,406	1,384,723	19.5
64–65.	0.019685	69,739	1,373	69,053	1,314,317	18.8
65–66.	0.020684	68,366	1,414	67,659	1,245,264	18.2
66–67.	0.021800	66,952	1,460	66,222	1,177,605	17.6
67–68.	0.022992	65,493	1,506	64,740	1,111,383	17.0
68–69.	0.024240	63,987	1,551	63,211	1,046,643	16.4
69–70.	0.025543	62,436	1,595	61,638	983,432	15.8
70–71.	0.026959	60,841	1,640	60,021	921,793	15.2
71–72.	0.028511	59,201	1,688	58,357	861,773	14.6
72–73.	0.030165	57,513	1,735	56,645	803,416	14.0
73–74.	0.031949	55,778	1,782	54,887	746,770	13.4
74–75.	0.033938	53,996	1,833	53,080	691,883	12.8
75–76.	0.036136	52,163	1,885	51,221	638,804	12.2
76–77.	0.038684	50,278	1,945	49,306	587,583	11.7
77–78.	0.041817	48,334	2,021	47,323	538,277	11.1
78–79.	0.045653	46,312	2,114	45,255	490,954	10.6
79–80.	0.050091	44,198	2,214	43,091	445,698	10.1
80–81.	0.055028	41,984	2,310	40,829	402,607	9.6
81–82.	0.059921	39,674	2,377	38,485	361,778	9.1
82–83.	0.064717	37,297	2,414	36,090	323,293	8.7
83–84.	0.069436	34,883	2,422	33,672	287,203	8.2
84–85.	0.074300	32,461	2,412	31,255	253,532	7.8
85–86.	0.080514	30,049	2,419	28,839	222,277	7.4
86–87.	0.086669	27,630	2,395	26,432	193,438	7.0
87–88.	0.094191	25,235	2,377	24,046	167,005	6.6
88–89.	0.102228	22,858	2,337	21,690	142,959	6.3
89–90.	0.110790	20,521	2,274	19,385	121,269	5.9
90–91.	0.119880	18,248	2,188	17,154	101,885	5.6
91–92.	0.129495	16,060	2,080	15,020	84,731	5.3
92–93.	0.139627	13,980	1,952	13,004	69,710	5.0
93–94.	0.150258	12,028	1,807	11,125	56,706	4.7
94–95.	0.161361	10,221	1,649	9,396	45,581	4.5
95–96.	0.172901	8,572	1,482	7,831	36,185	4.2
96–97.	0.184835	7,090	1,310	6,434	28,354	4.0
97–98.	0.197108	5,779	1,139	5,210	21,920	3.8
98–99.	0.209657	4,640	973	4,154	16,710	3.6
99–100.	0.222411	3,667	816	3,259	12,556	3.4
100 and over	1.000000	2,852	2,852	9,297	9,297	3.3

NOTE: This life table is based on death rates that have been adjusted for race and Hispanic-origin misclassification on death certificates.

SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.

Table 4. Life table for non-Hispanic American Indian or Alaska Native males: United States, 2019

Age (years)	Probability of dying between ages x and x+1 q_x	Number surviving to age x l_x	Number dying between ages x and x+1 d_x	Person-years lived between ages x and x+1 L_x	Total number of person-years lived above age x T_x	Expectation of life at age x e_x
0–1..............	0.008649	100,000	865	99,331	6,864,446	68.6
1–2..............	0.001063	99,135	105	99,082	6,765,116	68.2
2–3..............	0.000626	99,030	62	98,999	6,666,033	67.3
3–4..............	0.000274	98,968	27	98,954	6,567,034	66.4
4–5..............	0.000540	98,941	53	98,914	6,468,080	65.4
5–6..............	0.000265	98,887	26	98,874	6,369,166	64.4
6–7..............	0.000224	98,861	22	98,850	6,270,292	63.4
7–8..............	0.000206	98,839	20	98,829	6,171,442	62.4
8–9..............	0.000204	98,818	20	98,808	6,072,614	61.5
9–10.............	0.000217	98,798	21	98,788	5,973,805	60.5
10–11............	0.000252	98,777	25	98,764	5,875,018	59.5
11–12............	0.000320	98,752	32	98,736	5,776,253	58.5
12–13............	0.000438	98,720	43	98,699	5,677,517	57.5
13–14............	0.000611	98,677	60	98,647	5,578,818	56.5
14–15............	0.000828	98,617	82	98,576	5,480,171	55.6
15–16............	0.001076	98,535	106	98,482	5,381,595	54.6
16–17............	0.001327	98,429	131	98,364	5,283,113	53.7
17–18............	0.001557	98,299	153	98,222	5,184,749	52.7
18–19............	0.001748	98,146	172	98,060	5,086,527	51.8
19–20............	0.001915	97,974	188	97,880	4,988,468	50.9
20–21............	0.002081	97,786	203	97,685	4,890,587	50.0
21–22............	0.002269	97,583	221	97,472	4,792,903	49.1
22–23............	0.002477	97,362	241	97,241	4,695,431	48.2
23–24............	0.002705	97,120	263	96,989	4,598,190	47.3
24–25............	0.002935	96,858	284	96,716	4,501,201	46.5
25–26............	0.003144	96,573	304	96,422	4,404,485	45.6
26–27............	0.003342	96,270	322	96,109	4,308,063	44.7
27–28............	0.003567	95,948	342	95,777	4,211,955	43.9
28–29............	0.003845	95,606	368	95,422	4,116,178	43.1
29–30............	0.004179	95,238	398	95,039	4,020,756	42.2
30–31............	0.004564	94,840	433	94,624	3,925,716	41.4
31–32............	0.004953	94,407	468	94,174	3,831,092	40.6
32–33............	0.005296	93,940	497	93,691	3,736,919	39.8
33–34............	0.005539	93,442	518	93,184	3,643,228	39.0
34–35............	0.005695	92,925	529	92,660	3,550,044	38.2
35–36............	0.005853	92,396	541	92,125	3,457,384	37.4
36–37............	0.006039	91,855	555	91,577	3,365,259	36.6
37–38............	0.006197	91,300	566	91,017	3,273,681	35.9
38–39............	0.006323	90,734	574	90,448	3,182,664	35.1
39–40............	0.006442	90,161	581	89,870	3,092,216	34.3
40–41............	0.006554	89,580	587	89,286	3,002,346	33.5
41–42............	0.006720	88,993	598	88,694	2,913,060	32.7
42–43............	0.007029	88,395	621	88,084	2,824,366	32.0
43–44............	0.007526	87,773	661	87,443	2,736,282	31.2
44–45............	0.008164	87,113	711	86,757	2,648,839	30.4
45–46............	0.008853	86,402	765	86,019	2,562,082	29.7
46–47............	0.009544	85,637	817	85,228	2,476,063	28.9
47–48............	0.010264	84,819	871	84,384	2,390,835	28.2
48–49............	0.011010	83,949	924	83,487	2,306,451	27.5
49–50............	0.011782	83,024	978	82,535	2,222,964	26.8
50–51............	0.012582	82,046	1,032	81,530	2,140,429	26.1
51–52............	0.013396	81,014	1,085	80,471	2,058,898	25.4
52–53............	0.014186	79,929	1,134	79,362	1,978,427	24.8
53–54............	0.014912	78,795	1,175	78,207	1,899,065	24.1
54–55............	0.015575	77,620	1,209	77,015	1,820,858	23.5
55–56............	0.016192	76,411	1,237	75,792	1,743,843	22.8
56–57............	0.016808	75,174	1,264	74,542	1,668,051	22.2
57–58............	0.017463	73,910	1,291	73,265	1,593,509	21.6
58–59............	0.018210	72,619	1,322	71,958	1,520,244	20.9
59–60............	0.019063	71,297	1,359	70,617	1,448,286	20.3

See footnotes at end of table.

Table 4. Life table for non-Hispanic American Indian or Alaska Native males: United States, 2019—Con.

Age (years)	Probability of dying between ages x and $x+1$ q_x	Number surviving to age x l_x	Number dying between ages x and $x+1$ d_x	Person-years lived between ages x and $x+1$ L_x	Total number of person-years lived above age x T_x	Expectation of life at age x e_x
60–61.	0.019970	69,938	1,397	69,239	1,377,668	19.7
61–62.	0.020916	68,541	1,434	67,824	1,308,429	19.1
62–63.	0.021976	67,108	1,475	66,370	1,240,605	18.5
63–64.	0.023171	65,633	1,521	64,872	1,174,234	17.9
64–65.	0.024494	64,112	1,570	63,327	1,109,362	17.3
65–66.	0.025971	62,542	1,624	61,729	1,046,035	16.7
66–67.	0.027551	60,917	1,678	60,078	984,306	16.2
67–68.	0.029117	59,239	1,725	58,377	924,228	15.6
68–69.	0.030558	57,514	1,758	56,635	865,851	15.1
69–70.	0.031888	55,757	1,778	54,868	809,216	14.5
70–71.	0.033283	53,979	1,797	53,080	754,348	14.0
71–72.	0.034815	52,182	1,817	51,274	701,268	13.4
72–73.	0.036372	50,365	1,832	49,449	649,994	12.9
73–74.	0.037984	48,534	1,844	47,612	600,545	12.4
74–75.	0.039750	46,690	1,856	45,762	552,933	11.8
75–76.	0.041555	44,834	1,863	43,903	507,171	11.3
76–77.	0.043668	42,971	1,876	42,033	463,268	10.8
77–78.	0.046720	41,095	1,920	40,135	421,235	10.3
78–79.	0.051163	39,175	2,004	38,172	381,101	9.7
79–80.	0.056873	37,170	2,114	36,113	342,928	9.2
80–81.	0.063774	35,056	2,236	33,938	306,815	8.8
81–82.	0.070268	32,821	2,306	31,667	272,877	8.3
82–83.	0.075730	30,514	2,311	29,359	241,209	7.9
83–84.	0.080249	28,204	2,263	27,072	211,850	7.5
84–85.	0.085310	25,940	2,213	24,834	184,778	7.1
85–86.	0.092185	23,727	2,187	22,634	159,945	6.7
86–87.	0.098564	21,540	2,123	20,478	137,311	6.4
87–88.	0.107101	19,417	2,080	18,377	116,833	6.0
88–89.	0.116193	17,337	2,014	16,330	98,456	5.7
89–90.	0.125842	15,323	1,928	14,359	82,125	5.4
90–91.	0.136041	13,395	1,822	12,483	67,767	5.1
91–92.	0.146775	11,572	1,699	10,723	55,283	4.8
92–93.	0.158020	9,874	1,560	9,094	44,560	4.5
93–94.	0.169741	8,314	1,411	7,608	35,466	4.3
94–95.	0.181893	6,902	1,256	6,275	27,858	4.0
95–96.	0.194422	5,647	1,098	5,098	21,584	3.8
96–97.	0.207262	4,549	943	4,078	16,486	3.6
97–98.	0.220337	3,606	795	3,209	12,408	3.4
98–99.	0.233565	2,812	657	2,483	9,199	3.3
99–100.	0.246856	2,155	532	1,889	6,716	3.1
100 and over	1.000000	1,623	1,623	4,827	4,827	3.0

NOTE: This life table is based on death rates that have been adjusted for race and Hispanic-origin misclassification on death certificates.

SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.

Table 5. Life table for non-Hispanic American Indian or Alaska Native females: United States, 2019

Age (years)	Probability of dying between ages x and x + 1 q_x	Number surviving to age x l_x	Number dying between ages x and x + 1 d_x	Person-years lived between ages x and x + 1 L_x	Total number of person-years lived above age x T_x	Expectation of life at age x e_x
0–1.	0.007062	100,000	706	99,442	7,495,074	75.0
1–2.	0.000907	99,294	90	99,249	7,395,632	74.5
2–3.	0.000681	99,204	68	99,170	7,296,383	73.5
3–4.	0.000669	99,136	66	99,103	7,197,213	72.6
4–5.	0.000396	99,070	39	99,050	7,098,110	71.6
5–6.	0.000349	99,031	35	99,013	6,999,060	70.7
6–7.	0.000287	98,996	28	98,982	6,900,046	69.7
7–8.	0.000233	98,968	23	98,956	6,801,064	68.7
8–9.	0.000174	98,945	17	98,936	6,702,108	67.7
9–10.	0.000113	98,927	11	98,922	6,603,172	66.7
10–11.	0.000063	98,916	6	98,913	6,504,250	65.8
11–12.	0.000049	98,910	5	98,908	6,405,337	64.8
12–13.	0.000100	98,905	10	98,900	6,306,429	63.8
13–14.	0.000232	98,895	23	98,884	6,207,529	62.8
14–15.	0.000423	98,872	42	98,851	6,108,645	61.8
15–16.	0.000649	98,830	64	98,798	6,009,794	60.8
16–17.	0.000864	98,766	85	98,724	5,910,996	59.8
17–18.	0.001038	98,681	102	98,630	5,812,272	58.9
18–19.	0.001145	98,579	113	98,522	5,713,642	58.0
19–20.	0.001203	98,466	118	98,407	5,615,120	57.0
20–21.	0.001261	98,347	124	98,285	5,516,713	56.1
21–22.	0.001337	98,223	131	98,158	5,418,428	55.2
22–23.	0.001406	98,092	138	98,023	5,320,270	54.2
23–24.	0.001466	97,954	144	97,882	5,222,247	53.3
24–25.	0.001524	97,811	149	97,736	5,124,365	52.4
25–26.	0.001565	97,661	153	97,585	5,026,629	51.5
26–27.	0.001620	97,509	158	97,430	4,929,044	50.5
27–28.	0.001737	97,351	169	97,266	4,831,614	49.6
28–29.	0.001944	97,181	189	97,087	4,734,348	48.7
29–30.	0.002229	96,993	216	96,885	4,637,261	47.8
30–31.	0.002567	96,776	248	96,652	4,540,377	46.9
31–32.	0.002904	96,528	280	96,388	4,443,724	46.0
32–33.	0.003203	96,248	308	96,094	4,347,337	45.2
33–34.	0.003413	95,939	327	95,776	4,251,243	44.3
34–35.	0.003549	95,612	339	95,442	4,155,467	43.5
35–36.	0.003681	95,273	351	95,097	4,060,025	42.6
36–37.	0.003838	94,922	364	94,740	3,964,927	41.8
37–38.	0.003982	94,558	377	94,369	3,870,188	40.9
38–39.	0.004115	94,181	388	93,987	3,775,818	40.1
39–40.	0.004252	93,794	399	93,594	3,681,831	39.3
40–41.	0.004391	93,395	410	93,190	3,588,237	38.4
41–42.	0.004558	92,985	424	92,773	3,495,047	37.6
42–43.	0.004795	92,561	444	92,339	3,402,274	36.8
43–44.	0.005121	92,117	472	91,881	3,309,935	35.9
44–45.	0.005507	91,645	505	91,393	3,218,054	35.1
45–46.	0.005908	91,141	538	90,871	3,126,661	34.3
46–47.	0.006308	90,602	571	90,316	3,035,789	33.5
47–48.	0.006726	90,031	606	89,728	2,945,473	32.7
48–49.	0.007169	89,425	641	89,105	2,855,745	31.9
49–50.	0.007633	88,784	678	88,445	2,766,640	31.2
50–51.	0.008131	88,106	716	87,748	2,678,195	30.4
51–52.	0.008629	87,390	754	87,013	2,590,447	29.6
52–53.	0.009063	86,636	785	86,243	2,503,434	28.9
53–54.	0.009395	85,851	807	85,447	2,417,191	28.2
54–55.	0.009658	85,044	821	84,634	2,331,743	27.4
55–56.	0.009867	84,223	831	83,807	2,247,110	26.7
56–57.	0.010116	83,392	844	82,970	2,163,302	25.9
57–58.	0.010500	82,548	867	82,115	2,080,332	25.2
58–59.	0.011086	81,681	905	81,229	1,998,218	24.5
59–60.	0.011835	80,776	956	80,298	1,916,989	23.7

See footnotes at end of table.

Table 5. Life table for non-Hispanic American Indian or Alaska Native females: United States, 2019—Con.

Age (years)	Probability of dying between ages x and $x+1$ q_x	Number surviving to age x l_x	Number dying between ages x and $x+1$ d_x	Person-years lived between ages x and $x+1$ L_x	Total number of person-years lived above age x T_x	Expectation of life at age x e_x
60–61.	0.012681	79,820	1,012	79,314	1,836,691	23.0
61–62.	0.013512	78,808	1,065	78,275	1,757,377	22.3
62–63.	0.014286	77,743	1,111	77,188	1,679,102	21.6
63–64.	0.014949	76,632	1,146	76,059	1,601,914	20.9
64–65.	0.015550	75,487	1,174	74,900	1,525,855	20.2
65–66.	0.016185	74,313	1,203	73,711	1,450,955	19.5
66–67.	0.016949	73,110	1,239	72,491	1,377,243	18.8
67–68.	0.017848	71,871	1,283	71,230	1,304,753	18.2
68–69.	0.018920	70,588	1,336	69,920	1,233,523	17.5
69–70.	0.020158	69,253	1,396	68,555	1,163,603	16.8
70–71.	0.021532	67,857	1,461	67,126	1,095,048	16.1
71–72.	0.023046	66,396	1,530	65,630	1,027,922	15.5
72–73.	0.024752	64,865	1,606	64,063	962,292	14.8
73–74.	0.026701	63,260	1,689	62,415	898,229	14.2
74–75.	0.028941	61,571	1,782	60,680	835,814	13.6
75–76.	0.031552	59,789	1,886	58,846	775,134	13.0
76–77.	0.034542	57,902	2,000	56,902	716,288	12.4
77–78.	0.037820	55,902	2,114	54,845	659,386	11.8
78–79.	0.041229	53,788	2,218	52,679	604,541	11.2
79–80.	0.044720	51,570	2,306	50,417	551,862	10.7
80–81.	0.048233	49,264	2,376	48,076	501,444	10.2
81–82.	0.052070	46,888	2,441	45,667	453,368	9.7
82–83.	0.056584	44,447	2,515	43,189	407,701	9.2
83–84.	0.061683	41,932	2,586	40,638	364,512	8.7
84–85.	0.066631	39,345	2,622	38,034	323,873	8.2
85–86.	0.072644	36,724	2,668	35,390	285,839	7.8
86–87.	0.078627	34,056	2,678	32,717	250,449	7.4
87–88.	0.085960	31,378	2,697	30,029	217,732	6.9
88–89.	0.093848	28,681	2,692	27,335	187,703	6.5
89–90.	0.102308	25,989	2,659	24,660	160,368	6.2
90–91.	0.111350	23,330	2,598	22,031	135,708	5.8
91–92.	0.120979	20,733	2,508	19,478	113,676	5.5
92–93.	0.131191	18,224	2,391	17,029	94,198	5.2
93–94.	0.141975	15,833	2,248	14,709	77,169	4.9
94–95.	0.153309	13,585	2,083	12,544	62,460	4.6
95–96.	0.165161	11,503	1,900	10,553	49,916	4.3
96–97.	0.177487	9,603	1,704	8,751	39,363	4.1
97–98.	0.190233	7,899	1,503	7,147	30,612	3.9
98–99.	0.203332	6,396	1,301	5,746	23,465	3.7
99–100.	0.216710	5,095	1,104	4,543	17,719	3.5
100 and over	1.000000	3,991	3,991	13,176	13,176	3.3

NOTE: This life table is based on death rates that have been adjusted for race and Hispanic-origin misclassification on death certificates.

SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.

Technical Notes

Data

Vital statistics data

Death counts used to calculate the mortality estimates presented in this report are final numbers of deaths for 2019 collected from death certificates filed in state vital statistics offices and reported to the National Center for Health Statistics (NCHS) as part of the National Vital Statistics System (NVSS). Hispanic origin and race are reported separately on the death certificate.

Beginning with the 2018 data year, all 50 states and the District of Columbia reported deaths based on the 2003 revision of the U.S. Standard Certificate of Death for the entire year (14). The revision is based on the 1997 Office of Management and Budget (OMB) standards (18). The 1997 standards allow individuals to report more than one race and increased the race choices from four to five by separating the Asian and Pacific Islander groups. The Hispanic category did not change, remaining consistent with previous reports. The Hispanic origin and race groups in this report follow the 1997 standards and combine Hispanic origin and race to produce the following categories: non-Hispanic Native American or Alaska Native (AIAN), non-Hispanic white, non-Hispanic black, and Hispanic.

Census population data

The population data used to estimate the death rates and life tables for 2019 shown in this report are postcensal population estimates based on the 2010 decennial census and are available from the U.S. Census website, https://www2.census.gov/programs-surveys/popest/datasets/2010-2019/national/asrh/nc-est2019-alldata-r-file20.csv. Reflecting the 1997 OMB guidelines on race and ethnicity reporting, the 2010 census included an option for individuals to report more than one race and provided for the reporting of Asian persons separately from Native Hawaiian or other Pacific Islander persons (18).

American Indian or Alaska Native Census-Mortality-linked data

Under a collaborative agreement between NCHS and the U.S. Census Bureau, an extract of the 2010 Census Edited File (CEF)-Census Unedited File (CUF) Match File containing records for persons classified as AIAN alone or in combination with another race in the 2010 decennial census were linked to the National Death Index (NDI) to identify decedents for the period April 1, 2010, to December 31, 2011. The CUF file contains final housing and population counts after count imputation procedures were applied and were the final counts for the 2010 Census used to calculate apportionment of the U.S. House of Representatives. The CEF file was the result of the demographic edits applied to the CUF. The CEF-CUF Match File is a linkage of the CUF and CEF by person-record used to ascertain the effects of the edits. The CEF-CUF Match AIAN Extract File used for this study included records with the minimum required matching identifiers, such as names and dates of birth, for submission to NDI (16). A total of 4,746,003 original records were submitted to NDI and 34,366 deaths for the period April 1, 2010, through December 31, 2011, were identified. Decedent records were linked to corresponding NVSS death certificates. Technical Notes Table I presents a breakdown of CEF-CUF Match AIAN extract records by race, Hispanic origin, and vital status.

Table I. CEF-CUF Match AIAN Extract—Mortality-Linked Data

Race and Hispanic origin	Living	Deaths
Total	4,746,003	34,366
AIAN alone	2,633,422	20,301
AIAN in combination.	2,112,581	14,065
Non-Hispanic AIAN alone	1,984,565	18,278
Non-Hispanic AIAN in combination.	1,627,651	12,798
Hispanic AIAN alone	648,857	2,023
Hispanic AIAN in combination	484,930	1,267

NOTE: AIAN is American Indian or Alaska Native.

SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.

Methods

Classification ratios

The 34,366 CEF-CUF Match AIAN Extract—Mortality Linked Data decedent records were used to develop correction factors (classification ratios) to correct for race and Hispanic-origin misclassification on death certificates for the AIAN population. Classification ratios are defined as the ratio of CEF-CUF Match AIAN Extract File race and Hispanic-origin counts to death certificate counts for the sample of decedents in the CEF-CUF Match AIAN Extract—Mortality Data File. For example, the classification ratio for the non-Hispanic AIAN population is estimated as the number of decedents identified as non-Hispanic AIAN on the CEF-CUF Match AIAN Extract Data File to the number identified as non-Hispanic AIAN on the death certificate. This is basically a ratio of row to column totals in a bivariate table of CEF-CUF Match AIAN Extract File (row) by death certificate (column) classification. It can be interpreted as the net difference in assignment of non-Hispanic AIAN between the two data collection systems. The classification ratios can be easily interpreted as adjustment factors to correct for the bias found on death certificates (1).

The classification ratios were estimated by decedents' sex, age, and cause of death. The variables used for analyses were derived from the death certificate and include two age groupings (0, 1–4, 5–14, 15–24, 25–34, 35–44, 45–54, 55–64, 65–74, 75–84, and 85 and over; and 0–24, 25–44, 45–64, 65–84, and 85 and over), sex, and the 2019 15 leading causes of death.

Table II. Classification ratios, by sex and age for the non-Hispanic American Indian or Alaska Native population

Age group (years)	Total (standard error)	Male (standard error)	Female (standard error)
All ages[1]	1.3354 (0.007)	1.3488 (0.010)	1.3197 (0.011)
Under 1	0.9630 (0.132)	0.9444 (0.181)	1.0000 (0.161)
1–4	1.1618 (0.080)	1.2857 (0.138)	1.0303 (0.082)
5–14	1.0990 (0.066)	1.0806 (0.077)	1.1282 (0.119)
15–24	1.1462 (0.029)	1.1201 (0.033)	1.2190 (0.056)
25–34	1.1375 (0.025)	1.1557 (0.032)	1.1033 (0.040)
35–44	1.1799 (0.022)	1.1815 (0.027)	1.1772 (0.036)
45–54	1.3915 (0.021)	1.3913 (0.027)	1.3916 (0.033)
55–64	1.4281 (0.019)	1.4547 (0.026)	1.3917 (0.029)
65–74	1.3654 (0.017)	1.4244 (0.025)	1.2980 (0.023)
75–84	1.3099 (0.017)	1.3367 (0.025)	1.2852 (0.022)
85 and over	1.3862 (0.022)	1.3727 (0.036)	1.3944 (0.028)

[1]Includes ages not stated.

SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.

Classification ratios and standard errors are calculated as follows (see Tables II–III for classification ratios):

$$CR_X = \frac{SR_X}{DR_X}$$

$$SE\left(CR_X\right) =$$

$$\sqrt{\frac{1}{DR_X^2} \cdot \left\{ Var\left(SR_X\right) - 2 \cdot CR_X \cdot Cov\left(SR_X, DR_X\right) + CR_X^2 \cdot Var\left(DR_X\right) \right\}}$$

where x denotes the age group, SR_X is self-reported race in census data, and DR_X is proxy reported race on death certificates.

Adjusted death counts, death rates, and standard errors (SE)

Age-specific death counts and rates, and age-adjusted death rates adjusted for race and Hispanic-origin misclassification were estimated as follows:

Age-Specific Death Count = $D_X \cdot CR_X$

Age-Specific Death Rate (ASDRx) = $R_X = \frac{D_X}{P_X} \cdot CR_X$

Age-Adjusted Death Rate (AADR) =

$$R' = \sum_x [(\frac{D_X}{P_X} \cdot CR_X) \cdot W_X],$$

$$SE(R_X) =$$

$$\sqrt{[CR_X^2 \cdot SE(D_X)^2) + (D_X^2 \cdot SE(CR_X)^2)] / P_X^2}$$

$$SE(R') = \sqrt{\sum_x [W_X^2 \cdot SE(R_X)^2]}$$

where D_x is the number of deaths in age group x in 2019, P_x is the 2019 mid-year population in age group x, CR_x is the age-specific classification ratio, and W_x is the age-specific weight based on the U.S. 2000 standard population (19). Age-specific death counts, R_x, and R', adjusted for misclassification, were estimated by sex and cause of death.

Life tables

Adjustments for unknown age

An adjustment is made to account for the small proportion of deaths each year for which age is not reported on the death certificate. The number of deaths in each age category is adjusted proportionally to account for those with not-stated ages. The following factor (F) is used to make the adjustment. F is calculated for the total and for each sex group within a racial and ethnic population for which life tables are constructed:

$$F = \frac{D}{D^a}$$

where D is the total number of deaths and D^a is the total number of deaths for which age is stated. F is then applied by multiplying it by the number of deaths in each age group.

Adjustment for misclassification of Hispanic origin and race on death certificates

The AIAN Census-Mortality-linked data described above were used to adjust the age-specific number of deaths for aged 1–95 and over for the non-Hispanic AIAN population by sex, as follows:

$$_nD_x = {_nD_x^F} \cdot {_nCR_x},$$

where $_nD_x^F$ is the age-specific number of deaths adjusted for unknown age as described above, $_nCR_x$ are the sex- and age-specific classification ratios used to correct for the misclassification of Hispanic origin and race on death certificates, and $_nD_x$ are the final age-specific counts of death adjusted for age and Hispanic origin and race misclassification.

Classification ratios for infant deaths are unreliable due to small sample sizes and, as a result, corrections for racial and ethnic misclassification of infant deaths are addressed by using infant death counts and live birth counts from the 2018 and 2019 linked birth/infant death data files rather than the traditional birth and death data files (20,21). In the linked file, each infant death record is linked to its corresponding birth record so that the race and ethnicity of the mother reported on the birth record can be ascribed to the infant death record. As a result, race- and ethnicity-specific infant mortality rates estimated with the

linked file do not suffer from the problem of racial and ethnic discrepancies between the numerator and denominator of the rate.

Interpolation of P_x and D_x

Anomalies—both random and those associated with reporting age at death—can be problematic when using vital statistics and census data by single years of age to estimate the probability of death (22). Graduation techniques are often used to eliminate these anomalies and to derive a smooth curve by age. Beers ordinary minimized fifth difference formula is used to obtain smoothed values of population counts (P_x) and death counts (D_x) from 5-year age groupings of $_nP_x$ from aged 0 to 99 and $_nD_x$ from aged 5 to 99, and where $_nD_x$ has first been adjusted for not-reported age and Hispanic origin and race misclassification on the death certificate (23).

Calculation of the probability of dying (q_x)

The first step in the calculation of a complete period life table is the estimation of the age-specific probability of dying, q_x, which is derived from the age-specific death rate, m_x (24). In the life table cohort,

$$m_x = \frac{d_x}{L_x} \quad ,$$

where d_x is the number of deaths occurring between ages x and $x+1$, and L_x is the number of person-years lived by the life table cohort between ages x and $x+1$. The conversion of the age-specific death rate, m_x, to the age-specific probability of death, q_x, is as follows:

$$q_x = \frac{m_x}{1+(1-a_x)m_x}$$

where a_x is the number of person-years lived in the age interval by members of the life table cohort who died in the interval. When the age interval is 1 year, except at infancy, $a_x = 1/2$; in other words, deaths occur on average midway through the age interval. As a result,

$$q_x = \frac{m_x}{1+\frac{1}{2}m_x} \quad .$$

Because the complete period life table is based on the age-specific death rates of a current population observed for a specific calendar year, the life table death rate is equivalent to the observed death rates of the current population:

$$m_x = \frac{d_x}{L_x} = M_x = \frac{D_x}{P_x}$$

where D_x is the Beers smoothed number of deaths adjusted for not-stated age and Hispanic origin and race misclassification on the death certificate (for the Hispanic, non-Hispanic single-race white, and non-Hispanic single-race black populations) and P_x is the Beers smoothed population at risk of dying between ages x and $x+1$. Then,

$$q_x = \frac{M_x}{1+\frac{1}{2}M_x} = \frac{D_x}{P_x+\frac{1}{2}D_x} \quad .$$

This procedure is used to estimate vital statistics age-specific probabilities of death for aged 1–99.

Calculation of q_x at age 0

The higher mortality observed in infancy is associated with a high concentration of deaths occurring at the beginning of the age interval rather than in the middle. As a result, whenever possible it is best to assign deaths to the appropriate birth cohorts. Therefore, the probability of death at birth, q is calculated using a birth cohort method that employs a separation factor (f) defined as the proportion of infant deaths in year t occurring to infants born in the previous year ($t-1$). The value f is estimated by categorizing infant deaths by date of birth. The probability of death is then calculated as

$$q_0 = \frac{D_0(1-f)}{B^t} + \frac{D_0(f)}{B^{t-1}}$$

where D_0 is the number of infant deaths adjusted for not-stated age in 2019, B^t is the number of live births in 2019, and B^{t-1} is the number of live births in 2018.

Probabilities of dying at the oldest ages

Due to the unreliability of vital statistics data for the oldest ages, Medicare data is used to supplement vital statistics data for aged 65 and over for the total, non-Hispanic white, and non-Hispanic black populations in the production of national life tables (11). However, it is not possible to use Medicare data for the AIAN population due to inconsistencies in the Medicare race and ethnicity classification system for racial and ethnic populations other than white and black populations (4,11). As a result, it was necessary to use other methods to estimate mortality at the oldest ages for the non-Hispanic AIAN population. The Brass relational logit model was used to estimate mortality for aged 85 and over (25,26). This model is used to estimate the annual U.S. life tables for the Hispanic population and was used to estimate U.S. life tables for the non-Hispanic AIAN population living in Contract Health Service Delivery Area or Tribal Service Delivery Area counties for the period 2007–2009 (4,11).

The Brass relational logit model expresses the age-specific mortality pattern of a population of interest as a function of the age-specific mortality pattern of a standard population and is expressed as:

$$\overline{Y}_x = \alpha + \beta Y_x^s$$

where $\overline{Y}_x$ is the predicted logit of the probability of death, q_x, in the population of interest, that is,

$$\text{logit}\,[q_x] = \ln\left[\frac{q_x}{1-q_x}\right]$$

Y_x^S is the logit of the probability of death in the standard population, q_x^S, that is,

$$\text{logit}\,[q_x^S] = \ln\left[\frac{q_x^S}{1-q_x^S}\right]$$

α is the predicted parameter that measures the level of mortality of the population of interest relative to the standard population, and β is the predicted parameter that measures the slope of the

mortality function of the population of interest relative to the standard population (24–26).

A maximum-likelihood generalized linear model estimation procedure is used to fit equation in the age range 45–84. The resulting predicted parameters α and β were then used to estimate the predicted probability of death for aged 85–120 in the Hispanic population. The value q_x, was predicted to age 120 in order to estimate the life table population until no survivors remain, as was done for the other population groups. This information is then used to estimate L_x for aged 100–120, which is used to close the table with the age category 100 and over, combined (discussed below).

Predicted $\bar{q}_x$ is estimated by transforming its logit, $\bar{Y}_x$, back as follows:

$$\bar{q}_x = \frac{\exp[\bar{Y}_x]}{1 + \exp[\bar{Y}_x]} = \frac{\exp[\alpha + \beta Y_x^s]}{1 + \exp[\alpha + \beta Y_x^s]} \, .$$

To ensure a smooth transition from vital q_x^V and predicted $\bar{q}_x$, the two were blended from aged 80–84 with a graduating process as follows:

$$q_x = \frac{1}{6}[(85 - x)q_x^V + (x - 79)\bar{q}_x] \, .$$

when $x = 80, \ldots, 84$.

Finally, to close the table at aged 100 and over (combined), $_\infty q_{100}$ is set equal to 1.0 because all survivors to this age will die at some point in the open-ended age interval. Once q_x is obtained for each single year of age, the other life table functions are easily calculated.

Survivor function (l_x)

The life table radix, l_0, is set at 100,000. For ages greater than 0, the number of survivors remaining at exact age x is calculated as

$$l_x = l_{x-1}(1 - q_{x-1}).$$

Decrement function (d_x)

The number of deaths occurring between ages x and $x+1$ is calculated from the survivor function:

$$d_x = l_x - l_{x+1} = l_x q_x$$

Note that $_\infty d_{100} = {}_\infty l_{100}$ because $_\infty q_{100} = 1.0$.

Person-years lived (L_x)

Person-years lived for aged 1–99 is calculated assuming that the survivor function declines linearly between ages x and $x + 1$ This gives the formula

$$L_x = \frac{1}{2}(l_x + l_{x+1}) = l_x - \frac{1}{2}d_x \, .$$

For $x = 0$, the separation factor f is used to calculate L_0:

$$L_0 = f l_0 + (1 - f) l_1$$

Finally, $_\infty L_{100}$ is estimated as the sum of the extrapolated L_x values for aged 100–120.

Person-years lived at and above age x (T_x)

T_x is calculated by summing L_x values at and above age x:

$$T_x = \sum_{x=0}^{\infty} L_x.$$

Life expectancy at age x (e_x)

Life expectancy at exact age x is calculated as

$$e_x = \frac{T_x}{l_x} \, .$$

Table III. Classification ratios and standard errors, by sex and age for the 15 leading causes of death for the non-Hispanic American Indian or Alaska Native population

[Asterisks (*) preceding cause-of-death codes indicate they are not part of the *International Classification of Diseases, 10th Revision* (ICD–10); see Technical Notes in this report. Race category is consistent with 1997 Office of Management and Budget standards]

Rank[1]	Sex and cause of death (based on *International Classification of Diseases, 10th Revision*)	All ages[2]	0–24	25–44	45–64	65–84	85 and over
	Both sexes						
1	Diseases of heart . . . . (I00–I09,I11,I13,I20–I51)	1.4397 (0.020)	1.0000 (0.135)	1.2293 (0.066)	1.4854 (0.036)	1.4253 (0.030)	1.4778 (0.048)
2	Malignant neoplasms . . . . (C00–C97)	1.4059 (0.019)	1.2692 (0.131)	1.2091 (0.084)	1.4674 (0.033)	1.3709 (0.025)	1.4483 (0.066)
3	Accidents (unintentional injuries) . . . . (V01–X59,Y85–Y86)	1.2481 (0.020)	1.1495 (0.038)	1.1600 (0.029)	1.4469 (0.047)	1.2457 (0.053)	1.1633 (0.099)
4	Chronic liver disease and cirrhosis . . . . (K70,K73–K74)	1.1591 (0.023)	1.0000 (0.000)	1.0221 (0.035)	1.2381 (0.033)	1.1207 (0.056)	0.8333 (0.159)
5	Chronic lower respiratory diseases . . . . (J40–J47)	1.5324 (0.049)	1.5000 (0.661)	1.0656 (0.080)	1.1748 (0.036)	1.1873 (0.029)	1.1809 (0.062)
6	Diabetes mellitus . . . . (E10–E14)	1.1742 (0.021)	1.0000 (0.000)	1.2500 (0.402)	1.7770 (0.120)	1.4675 (0.060)	1.4337 (0.108)
7	Cerebrovascular diseases . . . . (I60–I69)	1.3679 (0.039)	1.1000 (0.187)	1.0714 (0.105)	1.4324 (0.094)	1.3307 (0.052)	1.4907 (0.097)
8	Intentional self-harm (suicide) . . . . (*U03,X60–X84,Y87.0)	1.2835 (0.042)	1.0507 (0.049)	1.2722 (0.061)	1.7200 (0.144)	1.3000 (0.415)	0.0000 (0.000)
9	Nephritis, nephrotic syndrome and nephrosis . . . . . (N00–N07,N17–N19,N25–N27)	1.2971 (0.046)	2.0000 (1.581)	1.1000 (0.108)	1.3165 (0.089)	1.2826 (0.063)	1.3333 (0.128)
10	Influenza and pneumonia . . . . (J09–J18)	1.2755 (0.042)	1.2500 (0.351)	1.2273 (0.135)	1.2877 (0.087)	1.2212 (0.063)	1.3590 (0.087)
11	Alzheimer disease . . . . (G30)	1.3758 (0.073)	0.0000 (0.000)	0.0000 (0.000)	1.0000 (0.000)	1.3951 (0.103)	1.3659 (0.107)
12	Septicemia . . . . (A40–A41)	1.2906 (0.050)	1.2388 (0.088)	1.0879 (0.054)	1.0000 (0.103)	1.0000 (0.183)	0.0000 (0.000)
13	Assault (homicide) . . . . (*U01–*U02,X85–Y09,Y87.1)	1.1200 (0.042)	1.3333 (0.430)	1.1765 (0.171)	1.3372 (0.086)	1.3333 (0.082)	1.0938 (0.109)
14	Essential hypertension and hypertensive renal disease . . . . (I10,I12,I15)	1.2288 (0.075)	0.0000 (0.000)	1.2500 (0.501)	1.4138 (0.154)	1.1250 (0.117)	1.2162 (0.127)
15	Pneumonitis due to solids and liquids . . . . (J69)	1.4203 (0.114)	1.0000 (0.000)	1.2500 (0.518)	1.2500 (0.201)	1.6800 (0.261)	1.3333 (0.147)
…	All other causes . . . . (residual)	1.2992 (0.016)	1.1095 (0.061)	1.1829 (0.036)	1.3834 (0.032)	1.2805 (0.025)	1.3426 (0.043)
	Male						
1	Diseases of heart . . . . (I00–I09,I11,I13,I20–I51)	1.4654 (0.027)	0.9000 (0.168)	1.2018 (0.081)	1.5000 (0.043)	1.4849 (0.042)	1.4830 (0.081)
2	Malignant neoplasms . . . . (C00–C97)	1.4448 (0.027)	1.4167 (0.224)	1.2105 (0.119)	1.5134 (0.048)	1.4116 (0.036)	1.4553 (0.090)
3	Accidents (unintentional injuries) . . . . (V01–X59,Y85–Y86)	1.2285 (0.023)	1.1244 (0.042)	1.1709 (0.036)	1.3816 (0.053)	1.1981 (0.066)	1.3684 (0.165)
4	Diabetes mellitus . . . . (E10–E14)	1.2046 (0.032)	1.0000 (0.000)	0.9717 (0.043)	1.2325 (0.045)	1.1186 (0.086)	0.7500 (0.237)
5	Chronic liver disease and cirrhosis . . . . (K70,K73–K74)	1.1407 (0.031)	1.5000 (0.707)	1.0556 (0.100)	1.1713 (0.051)	1.2597 (0.048)	1.2286 (0.119)
6	Chronic lower respiratory diseases . . . . (J40–J47)	1.6298 (0.077)	1.0000 (0.000)	0.8000 (0.322)	1.9322 (0.207)	1.5951 (0.093)	1.4375 (0.184)
7	Intentional self-harm (suicide) . . . . (*U03,X60–X84,Y87.0)	1.3253 (0.049)	1.0000 (0.378)	1.0000 (0.156)	1.4314 (0.145)	1.3770 (0.079)	1.5667 (0.210)
8	Cerebrovascular diseases . . . . (I60–I69)	1.3864 (0.063)	1.0286 (0.056)	1.3613 (0.073)	1.7119 (0.160)	1.8333 (0.756)	0.0000 (0.000)
9	Assault (homicide) . . . . (*U01–*U02,X85–Y09,Y87.1)	1.1180 (0.047)	2.0000 (1.732)	1.1667 (0.189)	1.2889 (0.105)	1.3226 (0.105)	1.3478 (0.161)
10	Nephritis, nephrotic syndrome and nephrosis . . . . . (N00–N07,N17–N19,N25–N27)	1.3139 (0.065)	1.0000 (0.522)	1.5000 (0.365)	1.2222 (0.099)	1.1455 (0.078)	1.2121 (0.101)
11	Influenza and pneumonia . . . . (J09–J18)	1.1958 (0.053)	0.0000 (0.000)	0.0000 (0.000)	0.0000 (0.000)	1.3030 (0.163)	1.3500 (0.255)
12	Septicemia . . . . (A40–A41)	1.3548 (0.086)	1.2642 (0.104)	1.0822 (0.057)	0.9667 (0.099)	1.0000 (0.302)	0.0000 (0.000)
13	Alzheimer disease . . . . (G30)	1.3208 (0.139)	1.3333 (0.444)	1.2500 (0.203)	1.4286 (0.150)	1.4000 (0.146)	0.8571 (0.136)
14	Pneumonitis due to solids and liquids . . . . (J69)	1.6552 (0.223)	0.0000 (0.000)	1.3333 (0.696)	1.3636 (0.152)	1.3750 (0.277)	1.0769 (0.181)
15	Essential hypertension and hypertensive renal disease . . . . (I10,I12,I15)	1.2963 (0.116)	1.0000 (0.000)	1.2500 (0.523)	1.2500 (0.508)	2.6667 (0.758)	1.2222 (0.178)
…	All other causes . . . . (residual)	1.2992 (0.023)	1.1125 (0.089)	1.1915 (0.049)	1.4324 (0.046)	1.2688 (0.038)	1.2574 (0.066)

See footnotes at end of table.

Table III. Classification ratios and standard errors, by sex and age for the 15 leading causes of death for the non-Hispanic American Indian or Alaska Native population—Con.

[Asterisks (*) preceding cause-of-death codes indicate they are not part of the *International Classification of Diseases, 10th Revision* (ICD–10); see Technical Notes in this report. Race category is consistent with 1997 Office of Management and Budget standards]

Rank[1]	Sex and cause of death (based on *International Classification of Diseases, 10th Revision*)	Age group (years)					
		All ages[2]	0–24	25–44	45–64	65–84	85 and over
	Female						
1	Malignant neoplasms . . . . (C00–C97)	1.3618 (0.026)	1.2000 (0.226)	1.2917 (0.112)	1.4556 (0.064)	1.3466 (0.041)	1.4747 (0.060)
2	Diseases of heart . . . . (I00–I09,I11,I13,I20–I51)	1.4051 (0.029)	1.1429 (0.156)	1.2075 (0.119)	1.4165 (0.046)	1.3234 (0.036)	1.4404 (0.099)
3	Accidents (unintentional injuries) . . . . (V01–X59,Y85–Y86)	1.2881 (0.036)	1.2143 (0.079)	1.1379 (0.050)	1.5984 (0.100)	1.3188 (0.088)	1.0333 (0.123)
4	Chronic liver disease and cirrhosis . . . . (K70,K73–K74)	1.1830 (0.033)	1.0000 (0.000)	1.0933 (0.058)	1.2456 (0.049)	1.1228 (0.072)	1.0000 (0.000)
5	Chronic lower respiratory diseases . . . . (J40–J47)	1.4498 (0.063)	0.0000 (0.000)	1.0800 (0.133)	1.1797 (0.050)	1.1262 (0.036)	1.1525 (0.071)
6	Diabetes mellitus . . . . (E10–E14)	1.1432 (0.027)	0.0000 (0.000)	2.0000 (1.091)	1.6625 (0.144)	1.3486 (0.079)	1.4314 (0.133)
7	Cerebrovascular diseases . . . . (I60–I69)	1.3540 (0.050)	1.1667 (0.191)	1.1333 (0.144)	1.4333 (0.123)	1.2879 (0.069)	1.4615 (0.108)
8	Alzheimer disease . . . . (G30)	1.4018 (0.085)	1.1212 (0.102)	1.0000 (0.109)	1.7500 (0.333)	0.5000 (0.261)	0.0000 (0.000)
9	Influenza and pneumonia . . . . (J09–J18)	1.3510 (0.065)	0.0000 (0.000)	1.0000 (0.000)	1.3529 (0.154)	1.2500 (0.077)	1.3200 (0.196)
10	Nephritis, nephrotic syndrome and nephrosis . . . . . (N00–N07,N17–N19,N25–N27)	1.2806 (0.066)	1.5000 (0.459)	1.1250 (0.135)	1.3929 (0.164)	1.2931 (0.098)	1.4667 (0.135)
11	Intentional self-harm (suicide) . . . . (*U03,X60–X84,Y87.0)	1.1522 (0.079)	1.1429 (0.155)	0.0000 (0.000)	1.0000 (0.000)	1.4583 (0.134)	1.3710 (0.115)
12	Septicemia . . . . (A40–A41)	1.2482 (0.061)	0.0000 (0.000)	1.1111 (0.145)	1.2500 (0.497)	1.0000 (0.000)	0.0000 (0.000)
13	Essential hypertension and hypertensive renal disease . . . . (I10,I12,I15)	1.1719 (0.097)	0.0000 (0.000)	1.1111 (0.270)	1.2745 (0.104)	1.2857 (0.095)	1.1600 (0.138)
14	Assault (homicide) . . . . (*U01–*U02,X85–Y09,Y87.1)	1.1282 (0.099)	0.0000 (0.000)	1.0000 (0.000)	1.5714 (0.446)	1.0000 (0.118)	1.2917 (0.172)
15	Pneumonitis due to solids and liquids . . . . (J69)	1.2500 (0.119)	0.0000 (0.000)	0.0000 (0.000)	1.2500 (0.213)	1.1250 (0.190)	1.4167 (0.226)
…	All other causes . . . . (residual)	1.2993 (0.021)	1.1053 (0.079)	1.1714 (0.054)	1.3288 (0.044)	1.2903 (0.033)	1.3870 (0.055)

… Category not applicable.

[1] Rank based on number of deaths in 2019 adjusted for race and Hispanic-origin misclassification on death certificates; see Technical Notes.

[2] Includes ages not stated.

SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.

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