Alcohol-Attributable Mortality Among American Indians and Alaska Natives in the United States, 1999–2009

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Objectives. We describe the relative burden of alcohol-attributable death among American Indians/Alaska Natives (AI/ANs) in the United States.

Methods. National Death Index records were linked with Indian Health Service (IHS) registration records to identify AI/AN deaths misclassified as non-AI/AN. We calculated age-adjusted alcohol-attributable death rates from 1999 to 2009 for AI/AN and White persons by sex, age, geographic region, and leading causes; individuals of Hispanic origin were excluded.

Results. AI/AN persons had a substantially higher rate of alcohol-attributable death than Whites from 2005 to 2009 in IHS Contract Health Service Delivery Area counties (rate ratio = 3.3). The Northern Plains had the highest rate of AI/AN deaths (123.8/100 000), and the East had the lowest (48.9/100 000). For acute causes, the largest relative risks for AI/AN persons compared with Whites were for hypothermia (14.2) and alcohol poisoning (7.6). For chronic causes, the largest relative risks were for alcoholic psychosis (5.0) and alcoholic liver disease (4.9).

Conclusions. Proven strategies that reduce alcohol consumption and make the environment safer for excessive drinkers should be further implemented in AI/AN communities. (*Am J Public Health.* 2014;104:S343–S349. doi:10.2105/AJPH.2013.301648)

Excessive alcohol consumption is a leading preventable cause of death in the United States and has had a greater health impact on American Indians and Alaska Natives (AI/ANs) than on other racial groups.[1] Alcohol-related mortality is a useful measure of the burden of alcohol for a population and has been used in many settings.[2–5] Rates of specific causes of alcohol-related mortality such as hypothermia[6] and alcoholic liver disease[7] have been higher among AI/AN populations than among other racial groups. Cultural, socioeconomic, and alcohol availability differences between these 2 groups have contributed to disparities in alcohol-related mortality. In several settings, higher rates of alcohol-related mortality have been associated with lower socioeconomic status.[8,9] AI/AN alcohol-related mortality rates[10] and patterns of alcohol use[11] also vary by tribe and region.

Methods to measure alcohol-related mortality have developed over time.[2,12,13] These methods have evolved because of concerns that alcohol-related mortality was being underreported on death certificates. Methods based solely on underlying cause of death may underestimate the overall impact of alcohol on mortality.[3] A chart review by a medical panel resulted in a 600% increase in the number of alcohol-related deaths over those found by the original death certifiers when both underlying and contributory causes of death were considered.[14] In the United Kingdom, extending the definition of alcohol-related mortality to include deaths with alcohol as a contributory cause increased the percentage of deaths attributable to alcohol by almost 70%.[15]

Misclassification of AI/AN race varies by cause of death. Between 1996 and 1998, 91% of deaths in Montana determined to be AI/AN on the basis of the Indian Health Service (IHS) registration file were classified as such on the death certificate, whereas 98% of alcohol-related deaths determined to be AI/AN were classified as such on the death certificate.[16] In Washington State, a similar linkage for 1985 to 1990 found that younger age at death, underlying cause of death being alcohol related, and underlying cause of death not being cancer were associated with more consistent classification of AI/AN race on death certificates.[17]

Alcohol consumption is related to alcohol-related mortality,[5] and the price of alcohol is associated with consumption. An increase in price tends to decrease consumption and alcohol-related problems.[18] When the price of alcohol decreases, alcohol-related mortality can increase significantly, as was the case in Finland in 2004.[8] One effective way to increase the price of alcohol is to increase alcohol taxes.[19] Of the 64% of AI/AN tribes that permitted alcohol consumption in 2006, three quarters had no alcohol tax.[20] Reducing access to alcohol, particularly in remote Alaska, has been associated with lower alcohol-related injury death rates.[21] Environmental strategies, such as road engineering and lighting improvements, have also been successful in reducing alcohol-related injury death in AI/AN communities.[6] Alcohol detoxification centers have housed intoxicated people on cold nights to help prevent hypothermia deaths.

We investigated differences in alcohol-attributable death rates among AI/AN populations in the United States using the best available classification of AI/AN race.

METHODS

Detailed methods for generating the analytic mortality files are described elsewhere in this supplement.[22]

Population Estimates

We included bridged single-race population estimates developed by the US Census Bureau and the Centers for Disease Control and Prevention's National Center for Health Statistics (NCHS) and adjusted for the population shifts as a result of Hurricanes Katrina and Rita in 2005 as denominators in the calculation of death rates.[23,24] Bridged single-race data allow for comparability between the pre- and post-2000 racial/ethnic population estimates during this study period.

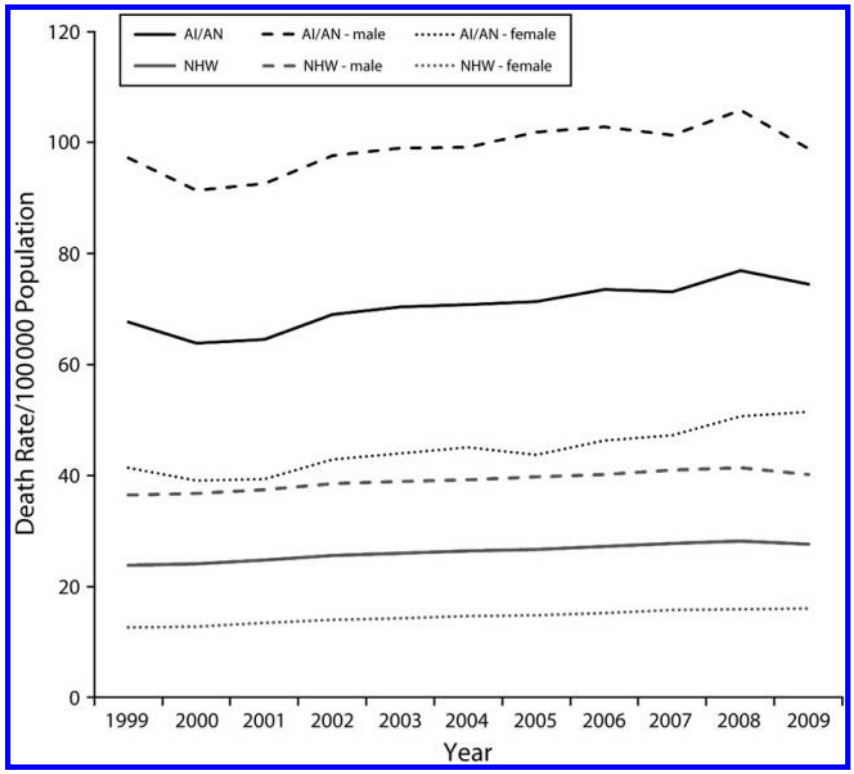
During preliminary analyses, it was discovered that the updated bridged intercensal population estimates significantly overestimated AI/AN persons of Hispanic origin.[25] To avoid underestimating mortality in AI/AN populations, we limited analyses to non-Hispanic AI/AN persons. Non-Hispanic White was chosen as the most homogeneous referent group. Therefore, all analyses were limited to non-Hispanic people. For conciseness, the qualifying term "non-Hispanic" was omitted henceforth when discussing both groups.

Death Records

Death certificate data are compiled by each state and sent, without personal identifiers, to the NCHS, where they are edited for consistency. The NCHS makes this information available to the research community as part of the National Vital Statistics System and includes underlying and multiple cause-of-death fields, state of residence, age, sex, race, and ethnicity.[26] NCHS applies a bridging algorithm nearly identical to that used by the Census Bureau to assign a single race to decedents with multiple races reported on the death certificate.[27]

The IHS patient registration database was linked to death certificate data in the National Death Index to identify AI/AN deaths misclassified as non-AI/AN.[22] After this linkage, a flag indicating a positive link to IHS was added to the National Vital Statistics System mortality file as an additional indicator of AI/AN ancestry. This file was combined with the population estimates to create an analytic file in SEER*Stat (called the AI/AN–US Mortality Database; National Cancer Institute, Bethesda, MD) that includes all deaths for all races reported to NCHS from 1990 to 2009. Race for AI/AN deaths in this report was assigned as reported elsewhere in this supplement.[22] In short, it combines race classification by NCHS on the basis of the death certificate and information derived from data linkages between the IHS patient registration database and the National Death Index.

The underlying cause of death was coded according to the *International Classification of Diseases, 10th Revision*.[28] We defined alcohol-attributable deaths on the basis of underlying cause of death using the definitions from the Centers for Disease Control and Prevention's Alcohol-Related Disease Impact (ARDI) Web site (http://apps.nccd.cdc.gov/DACH_ARDI/Default/Default.aspx). ARDI estimates alcohol-attributable deaths by multiplying the number of age- and sex-specific deaths from 54 alcohol-related conditions by the alcohol-attributable fractions (AAFs) for that condition.[13] For conditions that are, by definition, 100% attributable to excessive alcohol consumption (e.g., alcoholic cirrhosis of the liver), the total number of alcohol-attributable deaths equals the total number of deaths from that condition. For most chronic conditions that are less than 100% attributable to alcohol, the ARDI site calculates AAF using relative risk estimates from meta-analyses and prevalence data on alcohol consumption from the Behavioral Risk Factor Surveillance System. For most acute conditions (e.g., injuries) that are less than 100% attributable to alcohol, AAF estimates come from studies assessing the proportion of deaths from a particular cause when the decedent had a blood alcohol concentration of 0.10 grams per deciliter or more. For causes of death that are considered chronic (e.g., cancer, liver disease, cardiovascular disease), ARDI estimates alcohol-attributable deaths for decedents older than 20 years; for acute, or injury-related, causes, it calculates them for decedents older than 15 years. ARDI also estimates alcohol-attributable deaths for people younger than 15 years who died of several alcohol-related conditions, including motor-vehicle crashes, child maltreatment, fetal alcohol syndrome, and low birth weight. For this study, we used US all-races AAFs for the period 2001 to 2005, provided by the ARDI system.



Note. AI/AN = American Indian/Alaska Natives; IHS = Indian Health Service. Analyses are limited to people of non-Hispanic origin; NHW = non-Hispanic White. AI/AN race is reported from death certificates or through linkage with the IHS patient registration database. Rates are per 100 000 people and are age adjusted to the 2000 US standard population (11 age groups; Census P25-1130).
Source. AI/AN–US Mortality Database (1990–2009).

FIGURE 1—Alcohol-attributable death rate by race/ethnicity and sex among American Indians/Alaska Natives and non-Hispanic Whites: all counties, United States, 1999–2009.

TABLE 1—Average Annual Alcohol-Attributable Deaths and Death Rates by Indian Health Service Region and Sex for American Indians/Alaska Natives and non-Hispanic Whites: United States, 2005–2009

	AI/AN		White		
IHS Region/Sex	Deaths, No.	Rate (95% CI)	Deaths, No.	Rate (95% CI)	AI/AN:White RR (95% CI)
CHSDA counties					
Alaska					
Total	112	118.2 (108.1, 129.3)	162	35.0 (32.5, 37.7)	3.4 (3.0, 3.8)
Male	66	141.4 (125.3, 160.9)	116	47.7 (43.5, 52.4)	3.0 (2.5, 3.4)
Female	46	96.5 (84.0, 110.7)	46	21.2 (18.4, 24.4)	4.5 (3.7, 5.5)
East					
Total	49	48.9 (42.7, 56.1)	4225	27.0 (26.6, 27.4)	1.8 (1.6, 2.1)
Male	32	67.7 (56.8, 81.4)	2938	40.2 (39.5, 40.9)	1.7 (1.4, 2.0)
Female	17	32.2 (25.5, 40.5)	1286	15.0 (14.6, 15.3)	2.2 (1.7, 2.7)
Northern Plains					
Total	281	123.8 (117.0, 131.1)	2223	25.5 (25.0, 26.0)	4.9 (4.6, 5.2)
Male	182	167.0 (155.1, 180.4)	1538	37.4 (36.6, 38.3)	4.5 (4.1, 4.8)
Female	98	85.3 (77.6, 93.9)	685	14.4 (13.9, 14.9)	5.9 (5.4, 6.5)
Southern Plains					
Total	216	72.3 (67.9, 76.9)	1073	33.5 (32.6, 34.4)	2.2 (2.0, 2.3)
Male	149	104.3 (96.6, 112.9)	754	49.2 (47.7, 50.9)	2.1 (1.9, 2.3)
Female	66	43.3 (38.7, 48.4)	319	18.8 (17.8, 19.8)	2.3 (2.0, 2.6)
Pacific Coast					
Total	218	84.5 (79.3, 90.0)	5175	32.2 (31.8, 32.6)	2.6 (2.5, 2.8)
Male	141	112.9 (104.0, 122.7)	3518	46.0 (45.3, 46.7)	2.5 (2.3, 2.7)
Female	78	58.8 (52.9, 65.3)	1657	19.3 (18.9, 19.8)	3.0 (2.7, 3.4)
Southwest					
Total	505	119.9 (115.1, 124.9)	2646	34.8 (34.2, 35.4)	3.4 (3.3, 3.6)
Male	355	177.2 (168.6, 186.3)	1809	49.2 (48.2, 50.3)	3.6 (3.4, 3.8)
Female	150	69.3 (64.3, 74.6)	837	20.9 (20.2, 21.6)	3.3 (3.1, 3.6)
Total					
Total	1381	98.5 (96.1, 101.0)	15 504	29.9 (29.7, 30.1)	3.3 (3.2, 3.4)
Male	925	137.4 (133.2, 141.8)	10 674	43.5 (43.1, 43.8)	3.2 (3.1, 3.3)
Female	455	63.4 (60.7, 66.2)	4830	17.3 (17.1, 17.6)	3.7 (3.5, 3.8)
All counties					
Alaska					
Total	112	118.2 (108.1, 129.3)	162	35.0 (32.5, 37.7)	3.4 (3.0, 3.8)
Male	66	141.4 (125.3, 160.9)	116	47.7 (43.5, 52.4)	3.0 (2.5, 3.4)
Female	46	96.5 (84.0, 110.7)	46	21.2 (18.4, 24.4)	4.5 (2.5, 3.4)
East					
Total	162	28.6 (26.6, 30.8)	32 807	27.0 (26.9, 27.1)	1.1 (1.0, 1.1)
Male	112	41.2 (37.6, 45.3)	22 833	40.2 (40.0, 40.4)	1.0 (0.9, 1.1)
Female	50	17.2 (15.1, 19.6)	9974	15.0 (14.9, 15.1)	1.1 (1.0, 1.3)
Northern Plains					
Total	354	95.9 (91.2, 101.0)	10 064	24.2 (23.9, 24.4)	4.0 (3.8, 4.2)
Male	227	128.0 (119.8, 137.3)	6918	35.7 (35.3, 36.0)	3.6 (3.4, 3.8)
Female	126	67.3 (61.9, 73.2)	3145	13.7 (13.5, 13.9)	4.9 (4.5, 5.3)

Continued

Geographic Coverage

We conducted analyses using data from all US counties, as well as a subset of counties known as Contract Health Service Delivery Area (CHSDA) counties. CHSDA counties contain federally recognized tribal lands or are adjacent to tribal lands.[22] The IHS uses CHSDA residence to determine eligibility for services not directly available within the IHS. Linkage studies have indicated less misclassification of race for AI/AN persons in these counties.[29] The CHSDA counties also have higher proportions of AI/AN persons in relation to total population than do non-CHSDA counties, with 64% of the US AI/AN population residing in the 637 counties designated as CHSDA (these counties represent 20% of the 3141 counties in the United States).[22,29] Although less geographically representative, analyses restricted to CHSDA counties are presented for death rates in this article for the purpose of offering improved accuracy in interpreting mortality statistics for AI/AN persons. The 1 significant exception to this is Alaska, in which the entire population is included in CHSDA counties.

We completed analyses for all regions combined and by individual IHS region: Northern Plains, Alaska, Southern Plains, Southwest, Pacific Coast, and East.[22] Identical or similar regional analyses have been used for other health-related publications focusing on AI/AN persons,[30–32] and this approach was found to be preferable to the use of smaller jurisdictions, such as the Administrative Areas defined by IHS,[33] which yielded less stable estimates. Additional details about CHSDA counties and IHS regions, including population coverage, are provided elsewhere.[22]

Statistical Methods

Using data from 1999 to 2009, we directly age adjusted non–age-specific rates, expressed per 100 000 population, to the 2000 US standard population (Census P25-1130) using SAS version 9 (SAS Institute, Cary, NC). Readers should avoid comparison of these data with published mortality rates adjusted using a different standard population.

Using the age-adjusted mortality rates, we calculated standardized rate ratios (RRs) for AI/AN populations using White rates for comparison. RRs were calculated in Excel and

TABLE 1—*Continued*

Southern Plains					
Total	252	62.1 (58.6, 65.8)	5405	30.2 (29.8, 30.6)	2.1 (1.9, 2.2)
Male	174	88.4 (82.2, 95.1)	3765	44.3 (43.7, 44.9)	2.0 (1.9, 2.1)
Female	78	37.9 (34.2, 42.0)	1640	17.1 (16.7, 17.5)	2.2 (2.0, 2.5)
Pacific Coast					
Total	279	74.0 (70.0, 78.2)	9087	30.6 (30.3, 30.9)	2.4 (2.3, 2.6)
Male	180	98.3 (91.5, 105.7)	6229	44.0 (43.5, 44.5)	2.2 (2.1, 2.4)
Female	100	51.7 (47.1, 56.7)	2857	18.1 (17.8, 18.4)	2.9 (2.6, 3.1)
Southwest					
Total	532	114.4 (109.9, 119.1)	4202	32.8 (32.4, 33.3)	3.5 (3.3, 3.6)
Male	371	166.6 (158.7, 175.1)	2871	46.5 (45.7, 47.3)	3.6 (3.4, 3.8)
Female	161	67.7 (62.9, 72.7)	1331	19.8 (19.3, 20.3)	3.4 (3.2, 3.7)
Total					
Total	1691	73.8 (72.2, 75.5)	61 726	27.5 (27.4, 27.6)	2.7 (2.6, 2.7)
Male	1130	102.1 (99.2, 105.0)	42 733	40.6 (40.5, 40.7)	2.5 (2.4, 2.6)
Female	561	48.0 (46.2, 49.9)	18 993	15.6 (15.5, 15.7)	3.1 (3.0, 3.2)

Note. AI/AN = American Indian/Alaska Native; CHSDA = Contract Health Service Delivery Area; CI = confidence interval; IHS = Indian Health Service; RR = rate ratio. Analyses are limited to people of non-Hispanic origin. Counts less than 10 are suppressed; if no cases were reported, then rates and RRs could not be calculated. Cases aged 0–24 y are included in overall totals, but rows have been suppressed because of few cases. AI/AN race is reported from death certificates or through linkage with the IHS patient registration database. Rates are per 100 000 people and are age adjusted to the 2000 US standard population (11 age groups; Census P25-1130). RRs were calculated in SEER*Stat before rounding of rates and may not equal RRs calculated from rates presented in table.
Source. AI/AN-US Mortality Database (1990–2009).

were rounded for presentation in the tables. We calculated confidence intervals (CIs) for age-adjusted rates on the basis of methods described by Fay and Feuer.[34] CIs for RRs were calculated on the basis of methods described by Tiwari et al.[35] using SEER*Stat version 8.0.2 (National Cancer Institute, Bethesda, MD).

RESULTS

AI/ANs had substantially higher rates of alcohol-attributable death than Whites from 1999 to 2009 (Figure 1). AI/AN males had the highest rates, followed by AI/AN females, White males, and then White females. All of these groups had lower rates in 1999 than in 2009 (AI/AN males, 97.3 and 98.9, respectively; AI/AN females, 41.5 and 51.6; White males, 36.6 and 40.2; White females, 12.6 and 16.1).

In addition to higher death rates, the percentage of total deaths that were alcohol attributable was also higher among AI/AN persons (10.3% for AI/AN persons compared with 2.6% for Whites in 1999). In 2009, the percentage for AI/AN persons had increased to 10.7% compared with 3.3% for Whites. Also in 2009, there were 1760 alcohol-attributable deaths out of 16 504 total deaths among A/IAN persons and 63 252 alcohol-attributable deaths out of 1 942 372 total deaths among Whites.

Alcohol-attributable death rates for AI/AN populations from 2005 to 2009 varied by region. The Northern Plains had the highest rate (123.8) for CHSDA counties, followed in order by the Southwest, Alaska, Pacific Coast, Southern Plains, and East (48.9; Table 1). RRs comparing AI/AN rates with White rates also varied by region. For CHSDA counties, the Northern Plains had the highest RR (4.9), followed in order by the Southwest and Alaska, the Pacific Coast, the Southern Plains, and the East (1.8). The overall RR for all counties was 2.7, whereas that for CHSDA counties only was 3.3.

For AI/AN males in CHSDA counties, the Southwest had the highest death rate (177.2), and the East had the lowest death rate (67.7). For AI/AN females in CHSDA counties, Alaska had the highest rate (96.5), and the East had the lowest rate (32.2). For AI/AN males in CHSDA counties, the Northern Plains had the highest RR (4.5), and the East had the lowest RR (1.7). For AI/AN females in CHSDA counties, the Northern Plains (5.9) and Alaska (4.5) had the highest RRs, and the East had the lowest (2.2). The RR for all counties was 2.5 for males and 3.1 for females, and the sex-specific CHSDA county rates were both higher (3.2 and 3.7, respectively).

From 2005 to 2009, an average annual number of 1691 alcohol-attributable deaths occurred among AI/AN persons, of which 806 were a result of acute causes and 885 were a result of chronic causes. For Whites, of an average annual number of 61 726 alcohol-attributable deaths, 33 828 were a result of acute causes and 27 897 were a result of chronic causes. RRs for acute causes and chronic causes were greater for AI/AN persons (2.1 and 3.3, respectively; Table 2).

Leading acute causes among AI/AN persons included motor vehicle crashes (283 average annual deaths), poisoning (not alcohol; 110 deaths), homicide (109 deaths), and suicide (104 deaths). Leading chronic causes among AI/AN persons included alcoholic liver disease (488 deaths), alcoholic dependence (121 deaths), and liver cirrhosis–unspecified (119 deaths). For acute causes, the largest relative risks for AI/AN persons were for hypothermia (RR = 14.2) and alcohol poisoning (RR = 7.6). For chronic causes, the largest relative risks were for alcoholic psychosis (RR = 5.0), alcoholic liver disease (RR = 4.9), and alcohol dependence (RR = 4.5).

Alcohol-attributable death rates varied by age for both AI/AN and White persons from 2005 to 2009. The highest age-specific rates for both groups were among those 85 years and older (150.8 and 126.3, respectively; Table 3). This age group also had the lowest RR (1.2). The next highest age-specific death rate for AI/AN persons was among those aged 45 to 54 years (124.0), whereas for Whites it was among those aged 75 to 84 years (63.6). For AI/AN persons, the highest age-specific RRs were found among those aged 35 to 44 years (RR = 3.7) and 25 to 34 years (RR = 3.3).

DISCUSSION

Using methods that corrected many AI/AN deaths that had been misclassified as non-AI/AN, we found significant alcohol-attributable death rate disparities between AI/AN and White persons from 1999 to 2009. Of total deaths,

TABLE 2—Average Annual Number of Total and Alcohol-Attributable Deaths and Rates by Leading Causes of Alcohol-Related Death Among American Indians/Alaska Natives and non-Hispanic Whites: All Counties, United States, 2005–2009

	AI/AN		White		
Cause	Total Deaths	Alcohol-Attributable Deaths, No. (Rate per 100 000)	Total Deaths	Alcohol-Attributable Deaths, No. (Rate per 100 000)	AI/AN:White RR
Total	6764	1691 (73.8)	667 183	61 726 (27.5)	2.7
Acute cause					
Motor vehicle traffic crashes	798	283 (11.1)	28 123	8922 (4.5)	2.4
Suicide	464	104 (4.1)	28 934	6622 (3.1)	1.3
Poisoning (not alcohol)	383	110 (4.6)	21 694	6275 (3.1)	1.5
Fall injuries	144	45 (3.0)	19 499	6223 (2.4)	1.2
Homicide	232	109 (4.3)	4988	2344 (1.2)	3.7
Alcohol poisoning	75	75 (3.1)	873	872 (0.4)	7.6
Fire injuries	44	15 (0.7)	2066	790 (0.3)	2.1
Drowning injuries	63	18 (0.7)	2288	634 (0.3)	2.4
Motor vehicle nontraffic crashes	40	. . .[a] (0.2)	1380	221 (0.1)	2.3
Hypothermia	56	23 (1.1)	440	184 (0.1)	14.2
Other acute	99	17 (0.7)	4167	742 (0.3)	2.0
Subtotal	2398	806 (33.7)	114 453	33 828 (16.0)	2.1
Chronic cause					
Alcoholic liver disease	488	488 (21.2)	10 197	10 197 (4.3)	4.9
Liver cirrhosis–unspecified	299	119 (5.9)	14 211	5678 (2.3)	2.5
Alcohol dependence	121	121 (5.3)	2813	2813 (1.2)	4.5
Alcohol abuse	59	58 (2.5)	1588	1584 (0.7)	3.7
Stroke hemorrhagic	198	10 (0.6)	24 877	1276 (0.5)	1.1
Hypertension	286	. . .[a] (0.5)	41 000	1044 (0.4)	1.2
Ischemic heart disease	2052	. . .[a] (0.3)	340 097	627 (0.2)	1.1
Liver cancer	153	. . .[a] (0.4)	11 840	619 (0.2)	1.8
Acute pancreatitis	27	. . .[a] (0.3)	2319	555 (0.2)	1.5
Alcoholic psychosis	23	23 (1.1)	531	530 (0.2)	5.0
Other chronic	661	41 (2.0)	103 257	2976 (1.2)	1.7
Subtotal	4366	885 (40.2)	552 730	27 897 (11.5)	3.5

Note. AI/AN = American Indian/Alaska Native; IHS = Indian Health Service; RR = rate ratio. Analyses are limited to people of non-Hispanic origin. Cases aged 0–24 y are included in overall totals. AI/AN race is reported from death certificates or through linkage with the IHS patient registration database. Rates are per 100 000 people and were age adjusted to the 2000 US standard population (11 age groups; Census P25-1130). RRs were calculated in SEER*Stat before rounding of rates and may not equal RRs calculated from rates presented in the table.
Source. AI/AN–US Mortality Database (1990–2009).
[a]Counts of fewer than 10 are suppressed; if no cases were reported, then rates and RRs could not be calculated.

AI/ANs had a substantially greater percentage of alcohol-attributable deaths than Whites. AI/AN males had the highest race-and sex-specific rate. The Alaska region had the highest AI/AN rate and the highest AI/AN female rate, and the Southwest region had the highest AI/AN rate for males. The East had lower disparities than all other regions. The number of AI/AN alcohol-attributable deaths was relatively similar for acute and chronic causes, and rates increased during the time period for AI/AN and White persons.

RRs comparing alcohol-attributable death rates of AI/AN populations with those of Whites were elevated for all categories of acute and chronic causes. The overall RR for acute and chronic causes of alcohol-attributable death was almost 3 times higher among AI/AN persons than Whites. These rates underscore the tremendous burden that alcohol has among AI/AN groups. Hypothermia (RR = 14.2) and acute alcohol poisoning (RR = 7.6) are particularly unique among US subpopulations. Hypothermia, in particular, was highlighted in the study by Gallaher et al.,[6] demonstrating the problems associated with reservation prohibition and off-reservation alcohol consumption and the need to travel many miles to get home. This scenario also affected pedestrian fatalities. AI/AN individuals also suffer disproportionately from chronic alcohol-attributable causes of death. Alcoholic liver disease, liver cirrhosis, alcohol dependence, alcohol abuse, and alcoholic psychosis all stand out as chronic alcohol-attributable causes with RRs ranging from 2.5 to 5.0 for these categories.

Age-specific rates also demonstrated the impact that alcohol has on most age groups of AI/ANs with RRs peaking among people aged 35 to 44 years. Alcohol-attributable death rates are

TABLE 3—Average Annual Number of Total and Alcohol-Attributable Deaths and Rates by Age Group for American Indians/Alaska Natives and non-Hispanic Whites: All Counties, United States, 2005–2009

	AI/AN			White			
Age Group, Years	Total Deaths	Alcohol-Attributable Deaths, No. (%)	Alcohol-Attributable Death Rate	Total Deaths	Alcohol-Attributable Deaths, No. (%)	Alcohol-Attributable Death Rate	AI/AN:White RR
0–4	442	. . .[a] (1)	3.2	14 907	142 (1)	1.3	2.5
5–14	108	. . .[a] (4)	1.0	3252	112 (3)	0.5	2.2
15–24	698	189 (27)	42.0	18 921	4390 (23)	17.0	2.5
25–34	805	239 (30)	71.9	24 548	5159 (21)	21.9	3.3
35–44	1354	374 (28)	108.2	50 986	8141 (16)	29.3	3.7
45–54	2244	435 (19)	124.0	128 440	13 827 (11)	43.8	2.8
55–64	2616	253 (10)	110.4	214 645	10 892 (5)	42.9	2.6
65–74	2870	114 (4)	101.7	311 818	6662 (2)	42.9	2.4
75–84	2859	54 (2)	109.2	553 455	6918 (1)	63.6	1.7
≥ 85	2003	22 (1)	150.8	632 211	5484 (1)	126.3	1.2
Total	15 999	1691 (11)	73.8	1 953 185	61 726 (3)	27.5	2.7

Note. AI/AN = American Indian/Alaska Native; IHS = Indian Health Service; RR = rate ratio. Analyses are limited to persons of non-Hispanic origin. AI/AN race is reported from death certificates or through linkage with the IHS patient registration database. Rates are per 100 000 people and were age adjusted to the 2000 US standard population (11 age groups; Census P25-1130). RRs were calculated in SEER*Stat before rounding of rates and may not equal RRs calculated from rates presented in table.
Source. AI/AN-US Mortality Database (1990–2009).
[a]Counts of fewer than 10 are suppressed; if no cases were reported, then rates and RRs could not be calculated. Cases aged 0–24 years are included in overall totals, but rows have been suppressed because of few cases.

remarkably similar for most age groups 35 years and older with the exception of those aged 35 to 44 years and those aged older than 85 years, for whom the RR disparity almost disappears.

Limitations

Several limitations should be considered when interpreting the results presented in this article. First, although linkage with the IHS patient registration database improves the classification of race for AI/AN decedents, the issue is not completely resolved because AI/AN persons who are not members of the federally recognized tribes are not eligible for IHS services and not represented in the IHS database. Federally recognized tribes vary substantially in the proportion of Native ancestry required for tribal membership; therefore, eligibility for IHS services among AI/AN persons differs. Whether and how this discrepancy in tribal membership requirements may influence some of our findings is unclear, although our findings are consistent with prior reports. Furthermore, some decedents may have been eligible for—but never used—IHS services and therefore were not included in the IHS registration database. In addition, the findings from CHSDA counties do not represent all AI/AN populations in the United States or in individual IHS regions.[22] In particular, the East region includes only 15.4% of the total AI/AN population for that region. The analyses based on CHSDA designation exclude many AI/AN decedents in urban areas that are not part of a CHSDA county. AI/AN residents of urban areas differ from all AI/AN persons in poverty level, health care access, and other factors that may influence mortality trends.[36,37] These analyses revealed less variation for Whites than for AI/AN persons by IHS regions using data from CHSDA counties only. Perhaps alternative groupings of states or counties would reveal a different level of variation for Whites. Finally, although the exclusion of Hispanic AI/AN individuals from the analyses reduces overall AI/AN deaths by less than 5%, it may disproportionately affect some states.

Additional limitations were related to the methods for determining alcohol-related deaths. First, we used general-population AAFs to determine alcohol-related deaths and did not account for differences in AAFs between AI/AN and White populations. This might result in alcohol-attributable death underestimates for certain conditions (e.g., homicide and suicide) for which AAFs are thought to be higher among AI/AN populations.[38] Second, we used national AAFs for all regions, although data suggest that substantial differences exist in AAFs by region for some causes of alcohol-related death. Third, we used AAFs from a single 5-year period for the entire 11-year study period, eliminating any impact of changing AAFs on alcohol-attributable death rate trends. Additionally, using the underlying cause of death only to calculate alcohol-related deaths underestimates the true number of deaths, because additional deaths could be found by using multiple causes.

Conclusions

We found higher relative risks of alcohol-attributable death for AI/AN persons compared with Whites for specific groups and leading causes of death, which may point to particular opportunities to reduce these disparities. AI/AN persons from the Northern Plains and those aged 25 to 44 years had the highest RRs. Among leading causes of death, we found the highest relative risks for hypothermia, alcohol poisoning, alcoholic psychosis, alcoholic liver disease, and alcohol dependence. Alcoholic liver disease looms as a significant prevention opportunity for AI/AN persons with a high relative risk and is the cause of the most alcohol-attributable deaths.

Proven strategies that reduce alcohol consumption—including those listed in the Guide to Community Preventive Services,[39] such as increasing alcohol taxes and regulation of alcohol outlet density—and that make the environment less dangerous to excessive drinkers, such as road engineering and lighting improvements, should be further implemented in AI/AN communities. ■

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Contributors

M. Landen conceptualized the study and led the writing of the article. J. Roeber provided critical input into the study design, led the analysis, and assisted with the writing. T. Naimi assisted with the interpretation of the results and the writing and provided critical review. L. Nielsen contributed to the writing. M. Sewell provided critical insight and participated in the writing of the article.

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Institutional review board approval was not needed because the death data did not contain personal identifiers and no research was conducted on human participants.

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