

Defining Disparities in Cardiovascular Disease for American Indians

Trends in Heart Disease and Stroke Mortality Among American Indians and Whites in Montana, 1991 to 2000

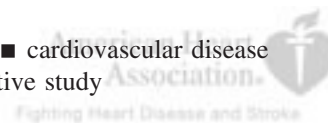
Todd S. Harwell, MPH; Carrie S. Oser, MPH; Nicholas J. Okon, DO;
Crystelle C. Fogle, MBA, MS, RD; Steven D. Helgerson, MD, MPH; Dorothy Gohdes, MD

Background—Disparities in stroke and heart disease have been well defined in many populations in the United States. Relatively few studies, however, have assessed current disparities in cardiovascular disease in American Indian populations and compared trends with other regions of the United States.

Methods and Results—Using mortality data, age-adjusted all-cause, heart disease, and stroke mortality rates (per 100 000) were calculated for American Indians and whites from 1991 to 1995 and 1996 to 2000. The all-cause mortality rate was strikingly higher for American Indians than for whites. For example, during 1996 to 2000, the all-cause mortality rate for American Indians (1317, ± 61) was more than half again greater than that for whites (831, ± 8). Heart disease mortality declined significantly in whites (237 to 216 per 100 000) in Montana over the past decade and declined, although not significantly, in American Indians (326 to 283 per 100 000). Stroke mortality also declined significantly in whites (64 to 60 per 100 000) but not in American Indians (80 to 81 per 100 000) during this time period. The proportion of deaths before age 65 years for heart disease and stroke was considerably higher in Indian men (45% and 36%) and Indian women (29% and 28%) compared with white men (21% and 11%) and white women (8% and 7%).

Conclusions—The disparity in heart disease and stroke mortality exists between American Indians and whites in Montana. Regional or state-level surveillance data will be needed to describe the changing patterns of heart disease and stroke mortality and cardiovascular risk factors in many native communities in the United States and Canada. (*Circulation*. 2005;112:2263-2267.)

Key Words: Indians, North American ■ mortality ■ cardiovascular disease
■ cerebrovascular accident ■ comparative study



The elimination of racial and ethnic disparities in cardiovascular disease is an important public health goal in the United States. Disparities in cardiovascular health have been well defined from national data showing markedly higher mortality from both heart disease and stroke in blacks compared with whites.¹ The disparity in cardiovascular disease for American Indians and Alaska Natives is only now being recognized.² Data from the few studies of American Indians and Alaska Natives conducted in the 1980s and 1990s suggested that heart disease and stroke mortality rates were considerably lower than the rates found in blacks or whites in the United States.^{1,3-7} However, data from the Strong Heart Study, a cohort study assessing cardiovascular disease and related risk factors in selected American Indian communities in Arizona, Oklahoma, and North and South Dakota, began to change the perception about disparities in cardiovascular health for Indians. The investigators showed that the cardio-

vascular disease mortality rates from 1984 to 1988 were 2-fold higher in Indians from North and South Dakota compared with the United States, whereas the rates in Indians in Arizona and Oklahoma were similar to the rates in the United States.⁸ The investigators also found that the incidence rates of nonfatal coronary heart disease for American Indians were 2-fold higher than other national estimates and were increasing.⁹ However, current data describing stroke mortality and trends are very limited, even though cardiovascular disease is now the leading cause of death in American Indian and Alaska Native communities.¹⁰

Cardiovascular risk factors are highly prevalent in native communities, but there are significant variations in smoking rates and diabetes across different regions of the United States. Nonetheless, the prevalence of multiple cardiovascular risk factors among American Indian and Alaska Native adults in 2003 was 47%, which was second only to the

Received May 6, 2005; revision received July 5, 2005; accepted July 15, 2005.

From the Montana Department of Public Health and Human Services, Helena (T.S.H., C.S.O., C.C.F., S.D.H., D.G.), and St Vincent Healthcare, Billings (N.J.O.), Montana.

Correspondence to Todd S. Harwell, MPH, Montana Department of Public Health and Human Services, Cogswell Building, C-317, PO Box 202951, 1400 Broadway, Helena, MT 59620-2951. E-mail tharwell@mt.gov

© 2005 American Heart Association, Inc.

Circulation is available at <http://www.circulationaha.org>

DOI: 10.1161/CIRCULATIONAHA.105.560607

prevalence of 49% found in US blacks.¹¹ Between 1997 and 2000, American Indians from the northern plains had a higher prevalence of diabetes and smoking compared with American Indians and Alaska Natives from other regions of the United States.¹² In Montana, the prevalence of cardiovascular risk factors in American Indian adults was significantly higher than in whites in 1999, and the prevalence of 2 or more risk factors for cardiovascular disease in Indian adults increased from 34% to 44% between 1999 and 2003.^{13,14} Recent strategic recommendations emphasized the importance of regional data to provide accurate surveillance in the efforts to address disparities for all ethnic groups.¹⁵ This is particularly important for American Indian communities in which there are significant variations in risk factor prevalence, and there is little current information about the temporal trends and disparities in either heart disease or stroke mortality in many regions of the United States. This report describes the trends in all-cause, heart disease, and stroke mortality in American Indians and whites in Montana from 1991 to 2000 and compares the burden with trends in the United States.

Methods

Data from Montana death certificates were analyzed to determine the all-cause, heart disease, and stroke mortality rates among Montana residents from 1991 to 2000. During this time period, there were 75 993 deaths among Montana residents, essentially all of which occurred among American Indians (4.5%) or whites (95.1%). Deaths among Montanans who were not classified as American Indian or white were excluded from these analyses. Heart disease and stroke deaths were classified by the underlying cause of death according to the International Classification of Diseases, Ninth Revision (ICD-9), between 1991 and 1998 and Tenth Revision (ICD-10) beginning in 1999. The ICD-9 codes 390 to 398, 402, 404, and 410 to 429 and the ICD-10 codes I00 to I09, I11, I13, and I20 to I51 were used to classify heart disease deaths. The ICD-9 codes 430 to 434 and 436 to 438 and the ICD-10 codes I60 to I69 were used to classify stroke deaths.

Age-adjusted heart disease, stroke, and all-cause mortality rates (per 100 000) and 95% CIs were calculated for American Indians and whites overall, and by sex from 1991 to 1995 and from 1996 to 2000. The age-adjusted mortality rates were calculated using the direct method and the 2000 standard population, and *z* tests were used to assess differences in mortality rates.¹⁶ The significance level for all analyses was $P < 0.05$ ($z > 1.96$). The relative risk of mortality for heart disease and stroke was calculated by dividing the age-adjusted mortality rates in American Indians by the rates in whites. Age-specific heart disease and stroke mortality rates were calculated for American Indians and whites <65 years of age and 65 years of age and older, overall, and by sex from 1991 to 2000.

Results

From 1991 and 1995, the age-adjusted heart disease and all-cause mortality rates (per 100 000) in Montana American Indians overall and in men and women were significantly higher than the rates in whites (Table 1). There were no significant differences in the age-adjusted stroke mortality rates in American Indians compared with whites overall or in men or women from 1991 to 1995. From 1996 to 2000, the age-adjusted heart disease and stroke mortality rates were significantly higher in American Indians overall and in men compared with whites. The age-adjusted all-cause mortality rates were significantly higher in American Indians overall and in men and women compared with whites between 1996 and 2000. For example, during 1996 to 2000, the all-cause

TABLE 1. Number of Deaths and Age-Adjusted Heart Disease, Stroke, and All-Cause Mortality Rates in American Indians and Whites, Montana, 1991–1995 and 1996–2000

	No. of Deaths (Age-Adjusted Rate per 100 000, 95% CI)	
	1991–1995	1996–2000
Heart disease		
American Indian		
Total	307 (326, ± 36)†	328 (283, ± 31)†
Men	186 (440, ± 63)†	218 (438, ± 58)†
Women	121 (239, ± 43)†	110 (178, ± 33)*
White		
Total	9532 (237, ± 5)	9879 (216, ± 4)*
Men	5161 (308, ± 8)	5269 (280, ± 8)*
Women	4371 (176, ± 5)	4610 (165, ± 5)*
Stroke		
American Indian		
Total	73 (80, ± 18)	82 (81, ± 17)†
Men	35 (80, ± 26)	34 (94, ± 31)†
Women	38 (78, ± 25)	48 (79, ± 22)
White		
Total	2599 (64, ± 3)	2745 (60, ± 2)*
Men	1039 (66, ± 4)	1076 (61, ± 4)
Women	1560 (63, ± 3)	1669 (59, ± 3)
All causes		
American Indian		
Total	1655 (1398, ± 67)†	1789 (1317, ± 61)†
Men	949 (1720, ± 110)†	1036 (1694, ± 104)†
Women	706 (1155, ± 84)†	753 (1057, ± 76)†
White		
Total	34 666 (853, ± 10)	37 590 (831, ± 8)*
Men	18 348 (1079, ± 16)	19 380 (1022, ± 14)*
Women	16 318 (683, ± 10)	18 210 (681, ± 10)

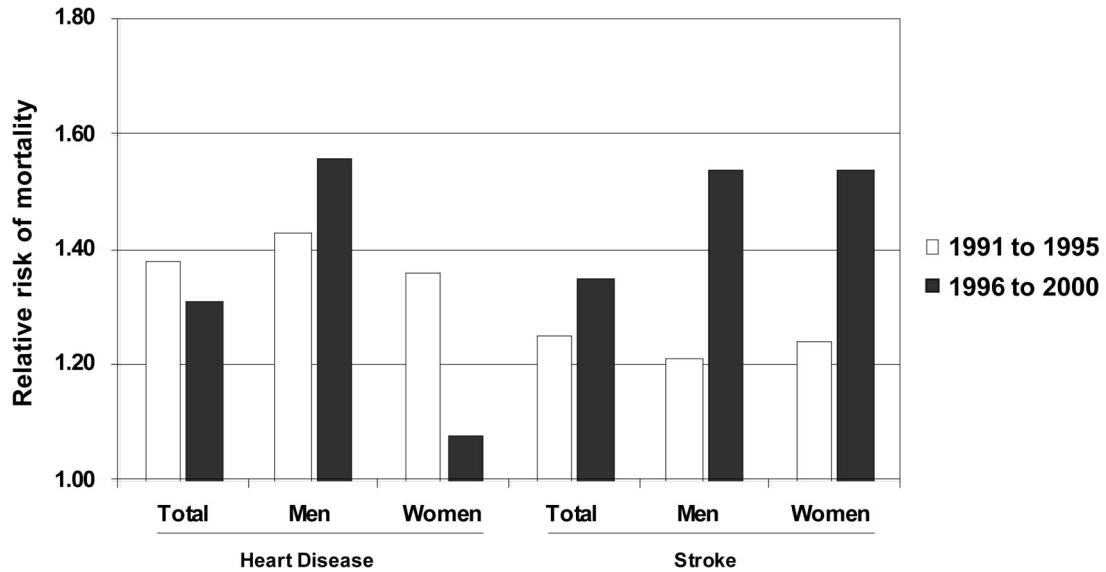
* $P \leq 0.05$ for comparisons within race between 1991–1995 and 1996–2000.

† $P \leq 0.05$ for comparisons within each time period between American Indians and whites.

mortality rate for American Indians (1317, ± 61) was more than half again greater than that for whites (831, ± 8).

The relative risks of mortality from heart disease and stroke were higher for American Indians compared with whites in both 1991 to 1995 and 1996 to 2000 (Figure). The relative risk of mortality for heart disease in Indian men compared with white men and for stroke in Indian men and women compared with white men and women increased from 1991 to 1995 and 1996 to 2000.

The age-adjusted heart disease mortality rates declined significantly among whites overall (-9%) and in men (-9%) and women (-6%) over the decade (Table 1). Among American Indians, the age-adjusted heart disease mortality rates declined significantly only among women (-25%) between 1991 to 1995 and 1996 to 2000. Despite an overall, although not significant, decline in heart disease mortality in American Indians (326, ± 36 to 283, ± 31), the rate for American Indians at the end of the decade was still greater



Relative risk of mortality from heart disease and stroke in American Indians and whites, Montana, 1991 to 1995 and 1996 to 2000.

than the rate at the beginning of the decade for whites (237, ±5). The age-adjusted stroke mortality rates declined significantly only among whites overall (-6%) over the decade. The age-adjusted all-cause mortality rates decreased significant for whites overall (-3%) and in men (-5%) over this time period.

The age-specific heart disease mortality rates between 1991 and 2000 were significantly higher in American Indian men 65 years old and older compared with white men 65 years old and older (Table 2). Among those <65 years of age, the overall age-specific stroke mortality rates were higher in American Indians compared with whites. The age-specific all-cause mortality rates were significantly higher in American Indians <65 years of age and in those 65 years of age and older overall and in men and women compared with whites during this time period. Forty percent of Indians who died of heart disease between 1991 and 2000 were less than 65 years of age compared with only 15% of whites. Similarly, 32% of Montana Indians who died of a stroke during this time period were less than 65 years of age compared with 8% of whites. Disturbingly, more than half (55%) of the Indians who died between 1991 and 2000 were <65 years of age compared with only 22% of whites.

Discussion

Overall heart disease mortality declined in American Indian women and whites overall and in men and women in Montana over the past decade. However, the disparity in heart disease mortality between Indians and whites remained. Stroke mortality also declined in Montana but only among whites overall. Among Indian men, cardiovascular rates were alarmingly high, and more than one-third of Indian men who died of these conditions were <65 years of age. Among Indian women, heart disease mortality rates declined over the decade and were similar to the rates found in white women in the second half of the decade. Stroke mortality rates in Indian women, however, remained stable during this decade. Premature cardiovascular mortality was also striking among Indian

women. More than one-quarter of deaths among Indian women as a result of cardiovascular disease occurred in those <65 years of age. Both heart disease and stroke contributed to the striking disparities in cardiovascular disease in Montana’s Indian communities.

Our findings are subject to a number of limitations. First, the number of stroke-related deaths in American Indians in Montana during the 10-year time period was small. Second, underreporting of American Indian race on death certificates and undercoverage of the census population may lead to inaccurate estimates of heart disease and stroke mortality. However, we previously found that American Indian race was accurately classified on the majority (>90%) of Montana death certificates between 1996 and 1998.¹⁷ In addition, another study conducted between 1989 and 1998 found that the national cardiovascular disease mortality estimates for American Indians and Alaska Natives were underestimated before adjustment for racial misclassification.² Thus, our mortality estimates are likely to be underestimates. A third limitation is the accuracy of the underlying cause of death reported on death certificates. Coronary heart disease as a cause of death may be overestimated on the death certificate.¹⁸ Cerebrovascular disease, however, has been found to be classified accurately on death certificates.¹⁹ Fourth, the ICD classification system was revised in 1999, but the comparability ratios between ICD-9 and ICD-10 classification codes for cerebrovascular disease (1.0588) and heart disease (0.9858) are similar.¹⁰

The importance of regional data is shown by our findings. Heart disease mortality was appreciably higher in American Indians in Montana compared with American Indians and Alaska Natives in the United States in 1990 (201 per 100 000) and in 2000 (178 per 100 000).¹⁰ The age-adjusted heart disease mortality rate for American Indian men in Montana from 1996 to 2000 (438 per 100 000) was similar to the mortality rate for black males in the United States in 2000 (393 per 100 000).¹⁰ Our findings also concur with those of a study in 2001 showing a significantly higher proportion of

TABLE 2. Age-Specific Heart Disease, Stroke, and All-Cause Mortality Rates and the Percentage of Deaths in Persons <65 Years of Age in American Indians and Whites, Montana, 1991–2000

	No. of Deaths (Age-Specific Rate per 100 000, 95% CI)		Percent <65 Years Of Age
	Age <65 Years	Age ≥65 Years	
Heart disease			
American Indian			
Total	251 (49, ±6)	384 (1613, ±161)	40
Men	183 (71, ±10)	221 (2146, ±283)*	45
Women	68 (26, ±6)	163 (1207, ±185)	29
White			
Total	2857 (41, ±2)	16 554 (1466, ±22)	15
Men	2144 (61, ±3)	8286 (1689, ±36)	21
Women	713 (21, ±2)	8288 (1295, ±28)	8
Stroke			
American Indian			
Total	49 (10, ±3)*	106 (445, ±85)	32
Men	25 (10, ±4)	44 (427, ±127)	36
Women	24 (9, ±4)	62 (459, ±114)	28
White			
Total	443 (6, ±1)	4901 (434, ±12)	8
Men	234 (7, ±1)	1881 (384, ±17)	11
Women	209 (6, ±1)	3020 (473, ±17)	7
All causes			
American Indian			
Total	1907 (369, ±16)*	1537 (6457, ±323)*	55
Men	1228 (476, ±27)*	757 (7350, ±524)*	62
Women	679 (262, ±20)*	780 (5776, ±405)*	47
White			
Total	15 814 (228, ±4)	56 442 (4999, ±41)	22
Men	10 166 (288, ±6)	27 562 (5619, ±66)	27
Women	5648 (165, ±4)	28 880 (4522, ±52)	16

* $P \leq 0.05$ for comparisons between American Indians and whites.

premature heart disease deaths (deaths in persons age 65 years and younger) in American Indians and Alaska Natives (36.0%) compared with whites in the United States (14.7%).²⁰

The disparity in heart disease and stroke mortality rates in American Indians less than 65 years of age compared with whites in Montana is probably because of the higher and increasing prevalence of cardiovascular disease risk factors.^{13,14} This highlights the importance of clinical and public health programs for the management and prevention of hypertension, high cholesterol, diabetes, obesity, and smoking.

Our findings also highlight the importance of regional stroke data for American Indians and Alaska Natives. The overall stroke mortality rate increased from 1990 (41 per 100 000) to 2000 (45 per 100 000) among American Indians and Alaska Natives in the United States.¹⁰ But the stroke mortality rates in Montana Indians during this time period were approximately 2-fold higher than the national rate for all races combined. In Montana, the stroke mortality rate in

American Indians is comparable to the stroke mortality rate in blacks in the United States (82 per 100 000 in 2000).¹⁰

In summary, despite their heterogeneous tribes and communities, American Indians and Alaska Native must be an integral part of the national discussion about disparities in cardiovascular health. National data must be supplemented by state or regional data to describe the changing patterns of heart disease and stroke mortality and cardiovascular risk factors in native communities across the United States and Canada. And the state and local surveillance must be used to design, implement, and evaluate clinical and public health programs aimed at reducing these disparities.

Acknowledgments

This project was supported through cooperative agreements (U32/CCU815663-05 and U50/CCU821287-03) with the Centers for Disease Control and Prevention, Cardiovascular Health Branch, and the Division of Diabetes Translation, in Atlanta, Ga. The contents of this report are solely the responsibility of the authors and do not necessarily represent the official views of the Centers for Disease Control and Prevention.

Disclosure

Dr Gohdes has served as a consultant to the State of Montana Cardiovascular Health and Diabetes Programs.

References

- Mensah GA, Mokdad AH, Ford ES, Greenlund KJ, Croft JB. State of disparities in cardiovascular health in the United States. *Circulation*. 2005;111:1233–1241.
- Rhoades DA. Racial misclassification and disparities in cardiovascular disease among American Indians and Alaska Natives. *Circulation*. 2005;111:1250–1256.
- Stansbury JP, Huang J, Williams LS, Vogel WB, Duncan PW. Ethnic disparities in stroke: epidemiology, acute care and postacute outcomes. *Stroke*. 2005;36:374–387.
- Gillum RF. The epidemiology of stroke in Native Americans. *Stroke*. 1995;26:514–521.
- Kattapong VJ, Becker TM. Ethnic differences in mortality from cerebrovascular disease among New Mexico's Hispanics, Native Americans, and non-Hispanic whites, 1958 through 1987.
- Ayala C, Greenlund KJ, Croft JB, Keenan NL, Donehoo RS, Giles WH, Kittner SJ, Marks JS. Racial/ethnic disparities in mortality by stroke subtype in the United States, 1995–1998. *Am J Epidemiol*. 2001;154:1057–1063.
- Ayala C, Croft JB, Greenlund KJ, Keenan NL, Donehoo RS, Malarcher AM, Mensah GA. Sex differences in US mortality rates for stroke and stroke subtypes by race/ethnicity and age, 1995–1998. *Stroke*. 2002;33:1197–1201.
- Lee ET, Cowan LD, Welty TK, Sievers M, Howard WJ, Oopik A, Wang W, Yeh J, Devereux RB, Rhoades ER, Fabsitz RR, Go O, Howard BV. All-cause mortality and cardiovascular disease mortality in three American Indian populations, aged 45–74 years, 1984–1988. The Strong Heart Study. *Am J Epidemiol*. 1998;147:995–1008.
- Howard BV, Lee ET, Cowan LD, Devereux RB, Galloway JM, Go OT, Howard WJ, Rhoades ER, Robbins DC, Sievers ML, Welty TK. Rising tide of cardiovascular disease in American Indians. The Strong Heart Study. *Circulation*. 1999;99:2389–2395.
- National Center for Health Statistics. *Health, United States 2004 With Chartbook on Trends in the Health of Americans*. Hyattsville, Md: 2004.
- Centers for Disease Control and Prevention (CDC). Racial/ethnic and socioeconomic disparities in multiple risk factors for heart disease and stroke—United States, 2003. *MMWR*. 2005;54:113–117.
- Denny CH, Holtzman D, Cobb N. Surveillance for health behaviors of American Indians and Alaska Natives: findings from the Behavioral Risk Factor Surveillance System, 1997–2000. *MMWR*. 2003;52:1–13.
- Harwell TS, Gohdes D, Moore K, McDowall JM, Smilie JG, Helgerson SD. Cardiovascular disease and risk factors in Montana American Indians and non-Indians. *Am J Prev Med*. 2001;20:196–201.
- Oser CS, Harwell TS, Strasheim C, Fogle CC, Blades LL, Gohdes D, Helgerson SD. Trends in cardiovascular disease risk factors among American Indians in Montana. *Am J Prev Med*. 2005;28:295–297.
- Mensah GA. Eliminating disparities in cardiovascular health: six strategic imperatives and a framework for action. *Circulation*. 2005;111:1332–1336.
- Anderson RN, Rosenberg HM. Age standardization of death rates: implementation of the year 2000 standard. *Nat Vital Stat Rep*. 1998;47:1–16, 20.
- Harwell TS, Hansen D, Moore KR, Jeanotte D, Gohdes D, Helgerson SD. Accuracy of race coding on American Indian death certificates, Montana 1996–1998. *Public Health Rep*. 2002;117:44–49.
- Lloyd-Jones DM, Martin DO, Larson MG, Levy D. Accuracy of death certificates for coding coronary heart disease as the cause of death. *Ann Intern Med*. 1998;129:1020–1026.
- Iso H, Jacobs DR Jr, Goldman L. Accuracy of death certificate diagnosis of intracranial hemorrhage and nonhemorrhagic stroke. The Minnesota Heart Survey. *Am J Epidemiol*. 1990;132:993–998.
- Centers for Disease Control and Prevention (CDC). Disparities in premature deaths from heart disease—50 States and the District of Columbia, 2001. *MMWR*. 2004;53:121–125.



Circulation

JOURNAL OF THE AMERICAN HEART ASSOCIATION