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Motor-Vehicle Crash Fatalities among American Indians and Non-Indians in Arizona, 1979 through 1988

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ABSTRACT

Objectives. This study evaluated the contributions of rural residence, alcohol use, and pedestrian fatalities to the high American Indian motor-vehicle crash mortality rate in Arizona.

Methods. Records from the Fatal Accident Reporting System were used to examine mortality rates between 1979 and 1988.

Results. American Indians had increased relative risks in all motor-vehicle crash categories in all residence–gender groups. The percentage of excess mortality associated with alcohol varied from 36.8% to 66.7%, and the percentage associated with pedestrian deaths ranged from 27.2% to 55.4%.

Conclusions. Efforts to reduce excess motor-vehicle crash mortality among American Indians should concentrate on preventing pedestrian and alcohol-related fatalities. (*Am J Public Health.* 1997;87:282–285)

Introduction

In Arizona, as in the entire United States, motor-vehicle crashes are a major public health problem for American Indians.[1–7] In 1990, the age-adjusted motor-vehicle crash mortality rate was 23.8/100 000 for all ethnic groups and 81.6 for American Indians.[3] A high proportion of pedestrian deaths among American Indian motor-vehicle crash fatalities has been documented in several locations.[8–10]

Several hypotheses have been proposed or investigated to explain the elevated motor-vehicle crash fatality rate among American Indians. Some studies have indicated that alcohol intake is a partial explanation.[8,10,11] It has also been hypothesized that geographic factors are important, especially in western tribes where reservations are often located in isolated, rural areas.[11] It has been demonstrated that motor-vehicle crash mortality rates are higher in communities with low population densities.[12,13] These higher rates may be due to road characteristics, travel speeds, patterns of seat belt use, types of vehicles, and availability and quality of emergency services.[14] Other hypothesized causes of high American Indian motor-vehicle crash mortality include lax law enforcement, unlicensed drivers,[15] and social stress due to modernization.[16]

The purpose of this study was to examine motor-vehicle crash fatalities of American Indians and non-Indians in the state of Arizona and to study the relative

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contributions of three variables to the excess American Indian fatality rate: pedestrian fatalities, alcohol, and rural residence.

Methods

Two data sources for the years 1979 through 1988 were used in this study: the Fatal Accident Reporting System (FARS) and the National Center for Health Statistics (NCHS) Multiple Cause of Death data. The Fatal Accident Reporting System maintains data on each fatal motor-vehicle crash, including information on the vehicle, each person involved, and the circumstances of the crash. The race of each person killed is not listed. The NCHS multiple cause of death data come from death certificates and include cause of death and the race and residence of the person killed. As a means of obtaining details of each crash and correlating this information with the race of crash victims, the two data sets were matched via a process similar to that described by Fife.[17] The NCHS records for Arizona residents containing *International Classification of Diseases* (ICD) codes E810 through E825 were isolated. These records were matched to Fatal Accident Reporting System data through the common variables of age, gender, and date of death. Only fatalities that involved Arizona residents and that occurred in motor-vehicle crashes in Arizona were examined. Seventy-six percent of Fatal Accident Reporting System records and 80% of death certificates were matched. Unmatched records were eliminated from the analysis. An equal portion of American Indian and non-Indian death certificates were matched.

The race of each fatally injured person was identified from the NCHS file, and each matched data pair (case) was classified into American Indian and non-Indian categories. These two categories were further stratified, on the basis of residence, into urban and rural groups. Arizona has 15 counties; 2 were classified as urban during the years of the study (Maricopa, which contains Phoenix, and Pima, which contains Tucson). All other counties were classified as rural. One major Indian reservation, the Tohono O'odham in Pima County, is located along the Mexican border and was classified as rural; the other reservations in Pima and Maricopa counties are located next to, or in, major metropolitan areas and were classified as urban. One further subdivision was made on the basis of gender, leading to eight categories for analysis

TABLE 1—Motor Vehicle Crash Fatality Rates for American Indians and Non-Indians, by Gender and Residence: Arizona, 1979 through 1988

Type of Fatality	American Indians		Others		Relative Risk[b]	95% Confidence Interval
	No.	Rate[a]	No.	Rate[a]		
Urban males						
All	117	71.12	2745	24.01	3.0	1.7, 5.3
Pedestrian	41	30.32	510	4.36	7.0	1.9, 17.9
Alcohol related	61	38.68	809	7.24	5.3	1.9, 11.5
Rural males						
All	604	106.05	1043	34.03	3.1	2.4, 4.0
Pedestrian	197	38.44	119	3.68	10.4	6.3, 16.1
Alcohol related	235	44.14	368	12.55	3.5	2.2, 5.2
Urban females						
All	46	25.38	1161	9.45	2.7	0.9, 6.3
Pedestrian	20	11.96	234	1.78	6.7	0.8, 24.2
Alcohol related	17	9.52	189	1.70	5.6	0.7, 20.2
Rural females						
All	194	32.05	434	13.89	2.3	1.4, 3.6
Pedestrian	38	6.35	45	1.32	4.8	1.3, 12.3
Alcohol related	51	9.03	64	2.34	3.9	1.3, 9.1

[a]Annual age-adjusted mortality rate per 100 000.
[b]American Indian relative risk.

TABLE 2—Motor Vehicle Crash Fatality Rates for American Indians and Non-Indians, by Age: Arizona, 1979 through 1988

Age Group, y	American Indians		Others		Relative Risk[b]	95% Confidence Interval
	No.	Rate[a]	No.	Rate[a]		
Occupants						
<5	25	22.48	39	3.52	6.4	1.3, 31.2
5–14	21	10.28	72	3.33	3.1	0.6, 5.3
15–24	183	103.12	1059	42.06	2.5	1.5, 4.1
25–34	124	97.99	757	30.81	3.2	1.8, 5.8
35–44	51	62.30	350	19.56	3.2	1.3, 8.1
45–54	23	44.10	225	16.86	2.6	0.7, 10.0
55–64	17	40.59	180	14.70	2.8	0.6, 13.5
65–74	13	54.76	143	13.83	4.0	0.7, 24.0
75+	7	44.30	152	29.21	1.5	0.1, 16.4
Pedestrians						
<5	2	1.80	29	2.62	0.7	0.0, 64.7
5–14	8	3.92	104	4.82	0.8	0.1, 8.2
15–24	50	28.17	149	5.92	4.8	1.7, 13.2
25–34	64	50.58	115	4.68	10.8	4.0, 28.5
35–44	37	45.20	75	4.19	10.8	3.1, 37.3
45–54	32	61.36	65	4.87	12.6	3.3, 47.9
55–64	23	54.92	86	7.02	7.8	1.8, 33.1
65–74	17	71.61	71	6.87	10.4	1.9, 55.1
75+	12	75.95	85	16.34	4.7	0.7, 31.5

[a]Annual mortality rate per 100 000.
[b]American Indian relative risk.

TABLE 3—Percentage of Excess American Indian Motor Vehicle Crash Mortality Associated with Alcohol-Related and Non-Alcohol-Related Pedestrian and Occupant Fatalities

	Urban Males	Rural Males	Urban Females	Rural Females
Alcohol related				
Pedestrian	44.1	21.7	37.8	19.6
Occupant	22.6	22.2	11.3	17.2
Total	66.7	43.9	49.1	36.8
Non–alcohol related				
Pedestrian	11.0	26.6	26.1	7.6
Occupant	18.0	28.2	23.8	55.6
Total	33.3	56.1	50.9	63.2
Total pedestrian	55.4	48.3	63.9	27.2

Note. Pedestrian and occupant percentages do not sum to the total in the non-alcohol-related category because of a small number of nonpedestrian and nonoccupant fatalities (i.e., bicyclists and others).

TABLE 4—Blood Alcohol Concentrations Measured in Motor Vehicle Crash Fatalities, Arizona, 1978 through 1987

Blood Alcohol Concentration, g/dL	American Indian Occupants		American Indian Pedestrians		Non-Indian Occupants		Non-Indian Pedestrians	
	No.	%	No.	%	No.	%	No.	%
0	29	14.6	8	6.5	1149	46.8	268	48.3
.01–.05	12	6.1	2	1.6	176	7.2	22	4.0
.06–.10	14	7.1	4	3.3	174	7.1	29	5.2
.11–.15	24	12.1	12	9.7	258	10.5	48	8.6
.16–.20	35	18.7	23	18.7	318	13.0	72	13.0
>.20	84	41.4	74	60.2	378	15.4	116	20.9

based on the American Indian/non-Indian, rural/urban, and male/female classifications. The number of fatalities in each category was divided by 10 to obtain the mean number per year.

The fatality was classified as alcohol related if, on the Fatal Accident Reporting System report, it was indicated that the police reported alcohol involvement. This determination is based on measurement of alcohol in blood, urine, saliva, or breath or police observation of behavior and of circumstances of the crash. If a blood alcohol concentration was measured, the recorded value is listed on the reporting system record.

Population denominators were calculated by using the midpoint of the 10-year study period based on extrapolation from the 1980 and 1990 censuses. Annual age-adjusted motor-vehicle crash mortality rates were calculated via the direct method; the 1940 US population was used as a standard. Relative risks and 95% confidence intervals were calculated according to Bailer and Edeser.[18]

The difference in age-adjusted mortality for all motor-vehicle crashes between American Indians and non-Indians was considered excess mortality per 100 000 population. The percentage of excess mortality associated with alcohol-related crashes and occurring among pedestrians was calculated by subtracting the non-Indian rate from the American Indian rate in each category, dividing the result by the excess mortality for all motor-vehicle crashes, and multiplying by 100.

As a means of calculating the percentage of excess motor-vehicle crash mortality due to rural residence for male and female American Indians, the American Indian motor-vehicle crash age-adjusted fatality rate was further adjusted for residence (by calculating what this age-adjusted fatality rate would have been if the rural–urban residence distribution had been the same as for non-Indians). The difference between the two rates was divided by the excess American Indian mortality for all motor-vehicle accidents and multiplied by 100.

We classified motor-vehicle crash times into five categories: early morning (12:01 through 6 AM), morning (6:01 AM through 12 noon), afternoon (12:01 through 5 PM), early evening (5:01 through 8 PM), and late evening (8:01 PM through 12 midnight). The proportion of motor-vehicle crash fatalities occurring in each category was compared for American Indians and non-Indians via contingency tables; a significance level of $P < .05$ was used.

Results

There were 6344 deaths that matched Fatal Accident Reporting System and NCHS records. These fatalities involved 5383 non-Indians and 961 American Indians. Census data showed that 78% of American Indians had a rural residence, as compared with 22% of non-Indians.

Table 1 lists the number and annual age-adjusted rate per 100 000 for all motor-vehicle crash fatalities, pedestrian fatalities, and alcohol-related fatalities in the eight study groups defined by gender, ethnicity, and residence. Relative risks were computed for American Indians relative to other Arizona residents in the four groups based on gender and residence. All American Indian/non-Indian relative risks were elevated regardless of gender or residence. Those for urban females were not statistically significant (the confidence interval included 1) because of the small number of fatalities in the sample; all others were significant.

Table 2 contains mortality rates and relative risks for occupants and pedestrians by age group. The American Indian occupant relative risk was elevated for all age groups, although it reached statistical significance only in the 15- to 44-year age group. The pedestrian relative risk was significantly elevated for American Indians between the ages of 15 and 74 years.

Table 3 lists the percentage of excess American Indian motor-vehicle crash mortality associated with alcohol-related and non-alcohol-related pedestrian and occupant fatalities. Both alcohol-related and pedestrian fatalities were major contributors to excess American Indian motor-vehicle crash mortality, although more so among urban than among rural residents. The percentage of excess American Indian mortality associated with rural residence was 11.4% in males and 17.6% in females. In comparisons of the time of fatality between American Indians and

non-Indians, no significant differences were found.

Blood alcohol concentrations were listed for 29% of American Indian fatalities and 30% of non-Indian fatalities. The distribution of these concentrations is listed in Table 4.

Discussion

This study explored the relative contribution of three variables to the excess American Indian motor-vehicle crash mortality in Arizona: alcohol-related fatalities, pedestrian fatalities, and rural residence. We found that pedestrian and alcohol-related fatalities were associated with a higher proportion of excess mortality than was rural residence.

It has been demonstrated previously that motor-vehicle crash occupant fatality rates are highest in counties of low population density.[12] This was true in Arizona in both the American Indian and the non-Indian populations, but rural residence explained only a small portion of the excess motor-vehicle crash mortality among American Indians.

The contribution of alcohol to excess American Indian motor-vehicle crash fatality deserves further exploration. While alcohol involvement in motor-vehicle fatalities has been decreasing nationwide,[19] it is unknown whether this decline is affecting American Indian and non-Indian populations equally. Since the classification of alcohol related on the Fatal Accident Reporting System records is based at times on police judgment, there is the possibility of bias affecting this variable. More study is needed to determine whether such bias occurs and, if so, how frequently.

The elevated rate of pedestrian motor-vehicle fatalities among American Indians has been documented in other studies.[8–10] In Arizona, we found the American Indian pedestrian fatality rate to be increased for both urban and rural males and females. The significant contribution of alcohol to pedestrian fatalities has been demonstrated by data from the National Highway Traffic Safety Administration.[20,21] Thirty-six percent of pedestrians killed are intoxicated; 57% of those are in the 25- to 34-year age group.[20] In New Mexico, tests showed that 90% of American Indian pedestrians involved in fatal crashes were intoxicated; the median blood alcohol concentration of these individuals was .24 g/dL.[8] In our study, 88.6% of American Indian pedestrians involved in such crashes who were tested had concentrations greater than 0.10 g/dL, as compared with 42.5% of other pedestrians.

It has been suggested that the prohibition of alcohol possession and sale on many Indian reservations contributes to the high American Indian pedestrian fatality rate because of the need to travel off reservations to drink, often by walking. Our data indicate, however, that urban American Indian pedestrian fatality rates in Arizona are nearly equivalent to those of rural American Indians among males and are higher among females. The percentage of excess female American Indian motor-vehicle crash fatalities occurring among pedestrians is twice as high in urban as in rural areas. Thus, ready access to alcohol outlets has not visibly lowered pedestrian fatalities in urban American Indian residents. Whether this would be true on reservations, where traffic congestion is much lighter, is unknown. It is also unclear how other differences between urban and rural settings affect pedestrian fatalities. This issue deserves further study.

During the study period, several programs were instituted in the state of Arizona and on Arizona Indian reservations to decrease motor-vehicle crash mortality. The Indian Health Service (IHS) began child restraint seat programs on reservations in 1983, and by 1987 child restraint seat loaner or sales programs were present in all Indian communities. In addition, the Bureau of Indian Affairs' highway safety projects supported tribal police department staffing and highway safety awareness activities. The White River Apache IHS conducted a study of pedestrian fatalities and initiated a highway lighting project in 1985–1986.[4] The Navajo Tribe passed a seat belt law in 1988 that was phased in over 3 years. These initiatives demonstrate the importance placed by the IHS, the Bureau of Indian Affairs, and the tribes on reducing American Indian motor-vehicle crash mortality. This study suggests that, if the burden of excess motor-vehicle crash mortality on American Indians is to be reduced significantly, the issues of alcohol-related and pedestrian fatalities will have to be addressed aggressively. □

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