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Alcohol and Suicide Death Among American Indians of New Mexico: 1980–1998

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The relationship between alcohol use prior to suicide was explored among American Indian decedents in New Mexico for the years 1980 through 1998. The suicide data were collected from New Mexico Vital Statistics and toxicology reports from the New Mexico Office of the Medical Investigator and matched on a case-by-case basis. Detailed analyses were undertaken for all cases of resident New Mexico Indians from the Navajo, Pueblo, and Apache cultures. Alcohol was detected in 69% of all suicides of American Indians with some variance by major tribal cultural groups (range = 62.1% to 84.4%). This is higher than in suicides among the overall New Mexico population (44.3%). The mean blood alcohol concentration (BAC) of the drinking Indian decedents at suicide was 0.198 (± SD of .088). Mean BACs were high for both males (0.199) and females (0.180) who had been drinking. Over 90% of the Indian decedents who had been drinking had BACs greater than the legal intoxication level of 0.08. The Navajo had the lowest percentage of cases that were alcohol involved, and their mean BAC was lower than the other two cultural groups. Alcohol use for completed suicides also varied somewhat by age, sex, method of suicide, and place of occurrence, but very little by whether the decedent was an on or off reservation resident. Analyses indicated that alcohol use prior to suicide was significantly more associated with male suicides than for females, and it was negatively correlated for those who died by overdose and also those using other drugs at suicide. Otherwise, alcohol use did not significantly differentiate American Indian suicides by age, use of firearms, hanging, use of other methods, or residence, for the presence of alcohol was a

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factor very commonly associated with all of these variables. Heavy alcohol consumption is, therefore, an important factor in over two thirds of all completed suicides among the Indians of New Mexico.

Alcohol is commonly involved as a precipitating factor in many suicides. Numerous studies, for example, have demonstrated that alcoholics have much higher annual and lifetime rates of suicide and suicide attempts than do those in the general population (Borges, Walters, & Kessler, 2000; Mayfield & Montgomery, 1972; Merrill, Milner, Owens, & Vale, 1992; Murphy, 1992). Furthermore, those with several types of mental disorders (e.g., depression) also have higher rates of suicide that are frequently alcohol related (Beck, Weissman, & Kovacs, 1976; Conwell et al., 1996; Harris & Barraclough, 1997). But more specific to this study, drinking, alcohol abuse, and intoxication often precede the completion of suicide and may elevate risk and occurrence of suicide and attempts greatly (Abel & Zeidenberg, 1985; Ford, Rushforth, Rushforth, Hirsch, & Adelson, 1979; Goodman, Istre, Jordan, Herndon, & Kelaghan, 1997; Smith et al., 1987; Welte, Abel, & Wieczorek, 1988), partly because of the disinhibition effect of ethanol in impulsive individuals with existing social and psychological problems (Beck et al., 1976; Kendall, 1983; Weiss & Hufford, 1999).

In a large study of violence in Erie County, New York, Abel and Zeidenberg (1985) found that suicides accounted for 21% of all violent deaths, one third of the suicide victims had been drinking prior to the suicide, and over 20% were legally intoxicated at the time of death (blood alcohol concentration ≥ 0.10).[1]. In Western Australia, Hayward, Zubrick, and Silburn (1992) found that 36% of suicides had measurable blood alcohol concentrations (BACs). As is common in many studies of this type, those who were drinking prior to suicide were more likely to be young males with relationship problems and little tendency to seek professional help (Hayward et al., 1992). In both of the above studies, the consumption of alcohol prior to suicide was implicated as having a disinhibition effect. Hlady and Middaugh (1988) and Goodman et al. (1991) found 59% and 40% of suicides, respectively, in Alaska and Oklahoma were alcohol involved, and 31% and 24%, respectively, of the decedents were intoxicated. In North Carolina 35% involved alcohol and 26% of decedents were intoxicated (Smith et al., 1989). Other studies have generally found that alcohol use is associated with one fourth to one half of all suicides in large populations (Baker, O'Neill, Gunsberg, & Li, 1992; Flavin, Franklin, & Francis, 1990; Ford et al., 1979; NIAAA, 1990, 1997; Smith et al., 1989).

BACKGROUND

Suicide and Alcohol among Indians

Among American Indians and Alaska Natives, a more frequent relationship between alcohol use and suicidal death has been documented in two statewide studies. In Alaska, Hlady and Middaugh (1988) reported more alcohol-related suicides among Alaska Natives than among non-Natives (79% vs. 48%), and a greater frequency of blood alcohol concentrations above intoxication levels (54% vs. 20%). In Oklahoma alcohol involvement was higher among Indian suicides (80%) than among any other group, and intoxication levels (≥0.10) were found in over 65% of the Indian suicides compared to 24% of all suicides (Goodman et al., 1991). A number of studies among a variety of tribes in various regions of North America have been published that further define the relationship of

1. Blood alcohol concentration (BAC) is expressed in this article as grams (gm) per deciliter (dl) of blood.

alcohol to suicide. In at least 29 other studies of completed suicide among American Indian and Alaska Natives, the proportion of alcohol involvement ranged from 30% in a study of the Northwest Territory of Canada (Butler, 1965) to 100% in a study of the Ottawa (Fox, Manitonabi, & Ward, 1984). It was also consistently as high as 80% to 86% in studies of the Shoshone, Papago, Pacific Northwest Coastal tribes and other Indians in British Columbia, the Northwest Territory, and other locales (see Table 1). Calculating a simple study-by-study average of these works (not weighted by sample size) yields an average alcohol involvement of 69% (± *SD* of 15.5). Therefore, studies of Indian and Alaska Native suicide indicate a more frequent relationship between alcohol and suicidal death than published articles concerning non-Indian populations. An examination of Table 1, which summarizes the major North American Indian and Alaska Native studies, indicates that 21 of 26 studies (81%) have reported alcohol-involvement that exceeds the upper limit of alcohol involvement of virtually all non-Indian studies in the United States, Canada, and Europe of approximately 50% (see, for example, Hlady & Middaugh, 1988).

The studies that compare Indian to non-Indian populations within the same geographic region of the United States and Canada have found almost universally that alcohol involvement is higher among Indian suicides than among the local, non-Indian populations. As cited before, in Alaska, where the suicide rate is relatively high for both Natives and non-Natives, alcohol involvement was almost twice as high for the Natives as for the others (Hlady & Middaugh, 1988). The same was true in Oklahoma (Goodman et al., 1991). In Manitoba, Canada, suicides of people aged 24 and under were studied by Sigurdson, Staley, Matas, Hildahl, and Squair, (1994). The Native youth suicide rate was almost ten times that of the non-Native rate (50 vs. 5.3 per 100,000), and alcohol involvement was 61% for Native youth and 43% for non-Native youth. Eighty percent of Indian suicides in the Northwest Territory of Canada were alcohol-related from 1950–1986, but non-Indian suicides involved alcohol in 48% of the cases (Young, Moffatt, & O'Neill, 1992).

Other studies report high levels of intoxication among Indian suicides. In British Columbia 60% of the Natives were acutely intoxicated (20% with BAC above 0.20) compared to 24% of the non-Natives (Cooper, Corrado, Carlberg, & Adams, 1992). In a second study in British Columbia, Cutler and Morrison (1971) found that Indians accounted for 54.8% of all sudden deaths where blood alcohol concentrations were over 0.08%; and in Kenora, Ontario, at least half of the Indian suicides had alcohol levels above the 0.08 level (Kenora Social Planning Council, 1973). Also in Canada, Young et al. (1992), reported that 54% of suicide decedents had BACs above 0.10, and Sigurdson et al. (1994) reported that Native suicides had BACs of 0.08 compared to 0.05 for non-Natives. Only one other study among Indians in the United States contains similar information, but with a very small sample. Sanddal (1996) reported alcohol involvement in 22 suicides in Montana out of 35 Indian cases from 1989 to 1992. The mean BAC was 0.13 with a range of 0.0 to 0.370. Sixty-four percent of these Montana Indian suicides involved alcohol.

Alcohol and Suicide Attempts Among Indians

Among American Indian suicide attempters, alcohol involvement appears to be lower than for completed suicides. As shown in Table 1, only six studies out of the many reviewed contained data on alcohol involvement for suicide attempts. One study reported 30% alcohol-relatedness for adolescents. The range for adults is 41% to 83% (André & Ghachu, 1975 Conrad & Kahn, 1974; Zitzow & Desjarlait, 1994) and the mean is 60.3%. It is consistent with the non-Indian literature to find slightly less alcohol involvement associated with attempted suicide (NIAAA, 1990; Roizen, 1982).

Therefore, this literature review re-

TABLE 1
Alcohol Use and Blood Alcohol Levels Prior to Suicide in Previous Population Studies of North American Indians and Alaska Natives

Study	BAC	% Completed Suicides	% Suicide Attempts	Place
André and Ghachu, 1975	—	78	83	Zuni, NM
Berman, 1979	—	86	—	Shoshone
Butler, 1965	—	30	—	Northwest Territory, Yukon
Claymore, 1988	—	—	64	Sioux
Conrad & Kahn, 1974	—	80	41	Papago
Cooper, et al., 1992	20% > 0.20	60	—	British Columbia
Cutler & Morrison, 1971	(Indians 58% of deaths > .08%)			British Columbia
Duck Valley, 1970	—	73	—	Shoshone
Fox, et al., 1984	—	100	—	Ottawa
Fullerton, et al., 1995	—	39	—	New Mexico
Goodman, et al., 1991	65% > 0.10	80	—	Oklahoma
Hlady and Middaugh, 1988	—	79	—	Alaska Natives
Hochkirchen, 1985(b)	—	80	—	Pacific N.W.
Jarvis & Boldt, 1982	—	72	—	Alberta
Kenora, 1973	50% > 0.08	70	—	Ontario
Kettl & Bixler, 1991	—	55	—	Alaska Natives
Kost-Grant, 1983	—	71	—	Alaska Natives
Levy, 1965	—	47	—	Navajo
Marshall and Soulé, 1988	—	68	—	Alaska Natives
May, 1973	—	63	55	Sioux
Sanddal, 1996	0.13	64	—	Montana
Shore, et al., 1972	—	—	44	Shoshone
Sigurdson, et al., 1994	0.08	61	—	Manitoba
Spaulding, 1985–86	—	80	—	Ojibway
Szabo, 1991	—	46	—	Saskatchewan
Termanson & Peters, 1979	—	80	—	British Columbia
Trott, et al., 1981	—	70–82	—	Manitoba
Westermeyer & Brantner, 1972	(Alcohol toxicology tests more frequently done on Indians)			Minnesota
Westermeyer & Peake, 1983	—	82	—	Minnesota
Young, et al., 1992	54% > 0.10	80	—	NW Territories
Zitzow & Dejarlais, 1994	—	—	30 (adolescents) 75 (adults)	Northern Plains

—Indicates no measure was reported for the cited article

veals that alcohol and suicide are acutely associated in a higher percentage of suicides among Indian and Alaska Natives than is reported for non-Indian populations. It is also evident that few studies of Indians in the United States have reported on the magnitude of alcohol involvement in suicide. The majority of the studies with the most detailed data on alcohol involvement, including reporting actual BACs, were carried out in Canada. The data in this paper present a detailed analysis of the nature of alcohol involvement in American Indian suicide deaths in New Mexico. The specific focus is on alcohol involvement in completed suicides; suicide attempts are not addressed.

Alcohol Involvement in all New Mexico Suicide Deaths

The present study was carried out in New Mexico. For the overall population of New Mexico, alcohol was present in 44.3% of the suicides from 1990–1999 (Office of the Medical Investigator, 1990–1999). This provides a statewide, regionally relevant statistic for all ethnic groups to compare with the American Indian data which follow. American Indians comprise 9% of the state's population, the highest percentage of Indians in any state except Alaska.

Drinking Among the Indian Populations of New Mexico

Studies of drinking among representative samples of the general population of Indians in New Mexico are rare in the published literature. Among the Navajo fewer adults drink at all than in the general population of the United States. Studies have shown that 52% to 64% of Navajo males and 13% to 40% of Navajo females drink at all compared to 72% and 50%, respectively, of the males and females in the general U.S. population (Levy & Kunitz, 1974; May, 1996; May & Smith, 1988). Therefore, fewer Navajos drink than do people in the general population of the United States. No comparable studies have been carried out among the Pueblo and Apache, but the general prevalence of drinking among the Pueblo is believed to be similar to the Navajo and higher among the Apache (see Curley, 1967; May, 1982, 1996). American Indians of most tribes studied to date, however, are characterized as binge drinkers in their younger years (e.g., < 40) who consume alcohol infrequently, but drink substantial amounts on days when they do drink (May, 1996; May & Gossage, 2001). Thus, among the three Indian cultural groups in New Mexico, fewer adults drink than the general population of the United States, but when drinking occurs a great deal of adverse consequences result from morbidity, mortality, arrest, and violent events.

Purpose of the Study

The purpose of this study was fourfold. First, we intended to examine and document whether alcohol was a significant factor in completed suicides among American Indians in New Mexico, as it had been found to be highly related to suicide among Indians in the other areas of the North American continent. Second, we asked if Indian suicides were more likely to be alcohol related than among others in New Mexico? Third, we asked what were the major differences in the frequency and magnitude of alcohol-related suicides between the three Indian cultural groups in New Mexico? Fourth, we wanted to define whether alcohol was more commonly an associated factor with Indian suicides committed by a particular sex or age group, by method, by place of occurrence, or when other substances were used. Answering each of these questions would help guide prevention and intervention efforts.

METHODS

There were two major data sources used in this study. Death certificates were obtained from the New Mexico Health and Environment Department for all American Indians who committed suicide in New Mexico. Second, medical investigator reports, which contained the toxicology information, were obtained from the New Mexico Office of the Medical Investigator (OMI) for all American Indians who committed suicide in New Mexico. These documents were matched and cross-checked for each case to assure completeness, as illustrated in Table 2. The data set spans the period 1980–1998. The suicides included were restricted to Apache, Navajo, and Pueblo Indians who both lived and died in New Mexico, and whom were identified as American Indian on the death certificates. Tribes of Apache, Navajo, and Pueblo make up the only contemporary Indian populations who live on the 25 federally recognized reservations in the state and represent over 90% of all New Mexico Indians.

While Indians of other tribes do live in the state, they are not representative of the dominant traditional cultures of New Mexico over the past 150 years or today. For a case to be included, both the death certificate and OMI report had to list the cause of death as suicide. There were very few suicide cases for Indians of other tribes in New Mexico and who were, therefore, not included. Also, one case of a 96-year-old man who committed suicide by walking in front of a train was eliminated from the larger data set because it misleadingly skewed the rates for elders. Although he had an OMI report, he was not screened for the presence of alcohol and therefore his case is not relevant to this paper.

Tribal affiliation was recorded on virtually all death certificates from 1980 to the present. For those certificates on which it was not included, tribal affiliation was determined from triangulation of the information on birthplace, burial place, surname, and place of residence at the time of death (see Webb, Campbell, Schwartz, & Sechrist, 1966). Therefore, to repeat, this article contains data on all Apache, Navajo, and Pueblo resident Indians committing suicide in New Mexico during this time period.

Most of the data on the presence of alcohol in the decedent's body were obtained from the toxicology section of the OMI reports. BACs categorized as "less than 0.01" were recorded as "no alcohol present" and given a value of .000 in our data set before the detailed analyses were undertaken (See Tables 3–6). This has been the lower limit of blood alcohol concentration used in a majority of all studies on this topic. In a small number of cases the OMI screened for the presence of ethanol (alcohol) in parts of the body other than the blood: vitrious, bile, urine, and in the fluids of the brain, chest, and liver. If any of these measures were positive at the level of 0.01% (expressed as grams (gm) per deciliter (dl) of fluid) or greater, then the case was classified by the OMI as "alcohol present." We believe that all possible data and legitimate evidence of any significant drinking in the hours immediately preceding death was documented.

All the statistics for this paper were computed using SPSS 10.1.0 for Windows (SPSS Inc., 2000). When comparing two means, Levene's test for equality of variances determined whether equal variances could be assumed in the computation of *t*-tests for the equality of means. Degrees of freedom were reported accordingly. When comparing more than two means, Levene's test for homogeneity of variances determined which post hoc test was used to determine the differences between the groups: Tukey honestly significant difference when the variances were homogeneous and Tamhane's statistic when the variances were not homogeneous.

RESULTS

In Table 2, the presence of alcohol in suicide victims is documented for the 19-year study period for the three cultural groups individually and combined. The first line of Table 2 indicates that 383 (87.2%) of the 439 Indian suicides had a matched OMI report. Of these, 347 (90.6%) were screened for alcohol. The screening rate was quite uniform across the three cultural groups (88.1% to 91.9%). Line three provides the results. As indicated in the table, in 69.4% of the cases some alcohol was detected; the highest percentage of positive results were found among the Apache (81.8%), followed by the Pueblo (78.4%), and the lowest percentage among the Navajo (62.4%). Chi-square analysis indicates that significantly more Navajo cases had an OMI report than the other two groups, and that alcohol was least likely to be present in the Navajo suicide cases. There was, however, no significant difference in the percentage screened for the presence of alcohol across cultural groups.

The specific BAC levels are found in Table 3. In 31.2% of the cases either no alcohol was detected, or the level was below the study threshold of 0.010. Therefore, given study definitions (BAC $\geq$ 0.01), 68.8% of the cases were considered positive for alcohol in this study, and these cases are included in subsequent analyses. Significantly, more Nav-

TABLE 2
Total American Indian Suicides in New Mexico, Cases Screened for Alcohol, and Alcohol Detected by all Modes of Measurement: 1980–1998

	Apache ($n = 46$)		Navajo ($n = 237$)		Pueblo ($n = 156$)		All Three Combined ($n = 439$)	
	n	%	*n*	%	*n*	%	*n*	%
Have OMI report[a]	36	78.3	221	93.2	126	80.8	383	87.2
Screened for alcohol[b]	33	91.7	203	91.9	111	88.1	347	90.6
Alcohol present[c]	27	81.8	126	62.4	87	78.4	240	69.4

[a] $\chi^2 = 16.89$, $df = 2$, $p \leq .0001$
[b] $\chi^2 = 1.39$, $df = 2$, *ns.*
[c] $\chi^2 = 11.30$, $df = 2$, $p \leq .005$

TABLE 3
Blood Alcohol Concentration (BAC) for Apache, Navajo, and Pueblo Suicides: 1980–1998*

	Apache ($n = 29$)		Navajo ($n = 194$)		Pueblo ($n = 107$)		All Three Combined ($n = 330$)	
BAC by Category[a]	*n*	%	*n*	%	*n*	%	*n*	%
.000–.009	5	17.2	75	38.7	23	21.5	103	31.2
.010–.039	0	0.0	7	3.6	0	0.0	7	2.1
.040–.079	0	0.0	9	4.6	5	4.7	14	4.2
.080–.159	5	17.2	27	13.9	23	21.5	55	16.7
.160–.239	4	13.8	50	25.8	36	33.6	90	27.3
.240–.319	9	31.0	17	8.8	15	14.0	41	12.4
.320+	6	20.7	9	4.6	5	4.7	20	6.1
For all suicides								
Range	.000–.450		.000–.555		.000–.369		.000–.555	
Mean[b]	.206		.116		.155		.136	
SD	.129		.118		.103		.118	
Median	.240		.119		.167		.147	
For suicides with BAC ≥ .01								
Range	.080–.450		.010–.555		.047–.369		.010–.555	
N	24		119		84		227	
Mean[c]	.249		.188		.197		.198	
SD	.096		.095		.071		.089	
Median	.250		.184		.200		.195	

*Expressed as grams per ml of blood.
[a] $\chi^2 = 42.45$, $df = 12$, $p \leq .0001$
[b] $F = 9.90$, $df = 2$, $p \leq .0001$
[c] $F = 4.78$, $df = 2$, $p \leq .01$

ajo decedents (38.7%) had not been drinking prior to suicide than victims from the other two cultural groups. Navajo BACs were significantly lower overall and also for those who had been drinking. But a majority of all suicide victims, 66.7% of the entire sample (see Table 3) or 96.9% of those with a positive BAC, had consumed enough alcohol to be considered "impaired" (≥0.04). Furthermore, 62.4% of the entire sample and 90.7% of those with alcohol present were legally intoxicated (≥0.08) by current New Mexico driving standards. Fully 45.8% of the entire sample and 66.5% of the alcohol-involved cases were even further intoxicated to a level two or more times the legal limit for driving. The Apache suicide victims were most likely to have been drinking and were most concentrated in the highest BAC categories with 51.7% ≥ 0.24 (three times legal driving levels) compared to 18.7% for the Pueblo and 13.4% for the Navajo.

For those victims with a positive BAC, the mean was 0.198, and the median was 0.195. The Apache had the highest mean (0.249), the Navajo the lowest (0.188), and the Pueblo were intermediate (0.197). But all levels are very high.

An analysis of variance indicates a statistically significant difference in the mean BAC levels for the Apache, Navajo, and Pueblo groups. Further analysis indicates statistically significant differences between BAC means for Apache and Navajo groups and Navajo and Pueblo groups, but not for Apache and Pueblo groups. It is possible that there may be a significant difference between Apache and Pueblo groups, but it is not seen due to the smaller number of suicides and the large confidence interval for the mean of the Apache group.

A similar analysis of variance of suicide utilizing only the decedents with BAC ≥ .01 also indicates a statistically significant difference in the mean BAC levels for the three groups. There are significant differences between the Apache and Navajo groups and the Apache and Pueblo groups but not the Navajo and Pueblo groups.

In Table 4, BACs are presented by age, sex, and method of suicide for the 227 cases where data were available and alcohol was detected. All American Indian suicides where alcohol was present occurred prior to age 65, and alcohol involvement was lowest in ages 5–14 (16.7%), 45–54 (57.1%), and 55–64 (57.1%). Percentage of alcohol involvement (76.8%) and mean BACs (0.208) are highest in ages 25–34 for the total sample. There is some variation in this pattern by cultural group (e.g., Apache and Pueblo involvement and mean BAC are higher than the Navajo), but alcohol-related suicides clearly cluster in ages 15–44.

Male suicides were more likely to involve alcohol consumption than female suicides (71.2% vs. 50%). However, for those cases with alcohol present, the mean levels were not very different between the males (0.199, $SD \pm .0859$) and the females (0.181, $SD \pm .1144$). The low number of female suicides among the Apache and Pueblo make detailed comparisons across groups unreliable.

Finally in Table 4, alcohol was consistently involved (68% to 79%) in over two thirds of suicides by all methods except overdoes (45%). Mean BAC was consistently very high for all methods except overdose (0.123). For other methods (0.211), firearms (0.199), and hanging (0.201) it is more than two times the New Mexico legal limit of intoxication.

Table 5 presents cross tabulations of alcohol involvement with three additional variables for the total Indian suicide data set. There is little difference in alcohol measures by residence or place of occurrence. Both on and off reservation residents have similar alcohol involvement (69.6 vs 66.7%) and BAC (0.202, $SD = .09$ vs 0.187, $SD = .09$). Jail suicides have a slightly lower involvement than those which occur in the home (61% vs 71%) and also a lower BAC than suicides in the home, but that is to be expected from restricted access to alcohol once victims are incarcerated. When other drugs are present, the presence of alcohol is lower (49% vs 74.5%) and the BAC is lower (–0.042).

The Spearman correlations and tests of significance of BAC levels with several variables are presented in Table 6 for the en-

TABLE 4

Percent Alcohol-Involved Suicides and Mean Blood Alcohol Concentrations ≥ .01 for Apache, Navajo, and Pueblo Suicides by Age, Sex, and Method of Suicide, 1980–1998

	Apache ($n = 24$)				Navajo ($n = 119$)				Pueblo ($n = 84$)				All Three Combined ($n = 227$)			
			BAC				BAC				BAC				BAC	
Characteristic	*n*	%	x̄	*SD*	*n*	%	x̄	*SD*	*n*	%	x̄	*SD*	*n*	%	x̄	*SD*
Age																
5–14	1	100.0	.082	0.0[a]	0[b]	0.0	0.0	0.0	0	0.0	0.0	0.0	1	16.7	.082	0.0
15–24	6	60.0	.203	.066	43	60.6	.193	.088	35	83.3	.179	.067	84	68.3	.188	.078
25–34	10	90.9	.277	.086	45	71.4	.190	.105	30	83.3	.214	.065	85	77.3	.208	.094
35–44	6	100.0	.274	.120	25	64.1	.180	.089	11	73.3	.232	.068	42	70.8	.207	.094
45–54	1	100.0	.256	0.0	3	27.3	.216	.163	7	87.5	.158	.090	11	55.0	.183	.094
55–64	*[c]	*	*	*	3	75.0	.139	.040	1	33.3	.211	0.0	4	57.1	.157	.107
65–74	*	*	*	*	0	0.0	0.0	0.0	0	0.0	0.0	0.0	0	0.0	0.0	0.0
75–84	*	*	*	*	0	0.0	0.0	0.0	0	0.0	0.0	0.0	0	0.0	0.0	0.0
85+	*	*	*	*	0	0.0	0.0	0.0	0	0.0	0.0	0.0	0	0.0	0.0	0.0
Total	24	82.8	.249	.096	119	61.3	.189	.095	84	78.5	.197	.071	227	68.8	.198	.089
Sex																
Male	22	81.5	.239	.090	104	63.4	.193	.094	82	81.2	.197	.071	208	71.2	.199	.086
Female	2	100.0	.351	.141	15	50.0	.158	.103	2	33.3	.182	.057	19	50.0	.181	.114
Method																
Overdose	*	*	*	*	9	47.4	.123	.084	0	0.0	0.0	0.0	9	45.0	.123	.084
Firearms	10	76.9	.261	.097	54	63.5	.186	.101	51	79.7	.206	.077	115	71.0	.199	.092
Hanging	14	87.5	.239	.098	40	58.0	.201	.083	30	78.9	.184	.058	84	68.3	.201	.079
Other	0	0.0	0.0	0.0	16	76.2	.206	.102	3	75.0	.238	.066	19	76.0	.211	.096

[a] *SD* = 0.0 because only one suicide in this category
[b] Suicides exist in the categories labeled 0, but none have BAC ≥ .01
[c] No suicides exist in the category labeled * in the data set

TABLE 5
Blood Alcohol Concentrations for Suicides by Place of Residence, Place of Occurrence, and the Presence of Other Drugs, 1980–1998

	BAC ≥ .01 %	Mean[a]	*SD*[a]	Range[a]	Median[a]
Place of Residence					
On reservation	69.6	.202	.088	.013–.555	.202
Off reservation	66.7	.187	.089	.010–.414	.184
Place of Occurrence					
Home	70.8	.194	.087	.013–.555	.195
Jail	60.7	.173	.071	.044–.294	.188
Presence of Other Drugs					
No other drugs	74.5	.203	.085	.013–.450	.195
Other drugs	49.0	.161	.114	.030–.555	.137

[a]For cases with BAC ≥ .01

TABLE 6
Associations of Blood Alcohol Concentration with Multiple Variables among American Indian Suicides in New Mexico and Related Tests of Significance, 1980–1998

	Spearman's rho[a]		Chi-square				*t*-test				
Variable	r_s	*p*	%	χ^2	*df*	*p*	x̄	*SD*	*t*	*p*	*df*
Sex											
Male (1)	–.147	≤.01	71.2	7.06	1	≤.01	.142	.116	2.58	≤.01	328
Female (0)			50.0				.090	.121			
Age	–.026[b]	NS									
Method											
Overdose (1)	–.174	≤.002	45.0	5.61	1	≤.05	.055	.083	3.23	≤.001	24
Other (0)			70.3				.141	.118			
Firearms (1)	.042	NS	70.9	0.72	1	NS	.142	.119	–0.83	NS	328
Other (0)			66.7				.131	.116			
Hanging (1)	.013	NS	68.3	0.02	1	NS	.137	.114	–0.13	NS	328
Other (0)			69.1				.136	.119			
Other (1)	.055	NS	78.0	0.66	1	NS	.160	.124	–1.06	NS	328
OD, Hanging, & Firearms (0)			68.2				.134	.117			
Residence											
*On reservation (1)	.058	NS	69.6	0.27	1	NS	.141	.119	–1.13	NS	328
Off reservation (0)			66.7				.125	.115			
Other Drugs											
Present (1)	–.284	≤.001	49.0	10.72	1	≤.001	.079	.113	3.78	≤.001	184
Absent (0)			74.5				.151	.115			

*This includes reservation, checkerboard area, & off reservation communities that are predominantly Indian residents.

[a]Because most variables tested are not interval or ratio scaled, correlations were computed via a point bisereal method, Spearman's rho (r_s).

[b]The correlation of age and BAC was produced by a Pearson correlation (*r*) since two interval level measurements are involved.

tire Indian group in order to summarize important factors of association with alcohol-involved suicide among New Mexico Indians. Only three significant relationships were found. Alcohol-involved suicides are more characteristic of males ($r_s = .147$, $p \leq .01$), negatively associated with overdose deaths ($r_s = .172$, $p \leq .001$), and also inversely related to the presence of other drugs ($r_s = -.273$, $p \leq .001$). Both chi-square analyses and *t*-test analyses provide confirmation of these findings. In other words, male suicides are significantly more likely to involve alcohol, but overdose deaths and the presence of other drugs are much less likely to be alcohol involved. An equally important message is that all other variables tested by correlation indicate that alcohol consumption prior to death is not significantly associated with a particular age or pattern of residence; nor is it disproportionately more involved in any other particular method of suicide (firearms, hanging, or other) or residence pattern (on/off reservation). With the exception of the three significant correlations above, alcohol consumption prior to the act is a common and rather equal risk factor in most American Indian suicides in New Mexico.

DISCUSSION

Suicide among American Indians in New Mexico was found to be highly alcohol-related (69%), more so than in most similar studies in other U.S. populations. The Indian rate is also 57% higher (69% vs 44%) than the statewide rate for New Mexico (Office of the Medical Investigator, 1990–1999). But alcohol involvement is at a virtually identical rate to the average of the previous studies of Indian and Alaska Native suicide reviewed in the introduction and Table 1. For all three Indian cultural groups, alcohol was not only present in a majority of suicides, but the average BAC was very high ($m = 0.198$). This average is more than two times the legal intoxication level for driving a motor vehicle in New Mexico and generally higher than BAC levels reported in the previous studies of Indian suicide elsewhere. The young age of the Indian population and the concentration of suicide in the younger adult population certainly play a role in the high overall levels of alcohol involvement in Indian suicides, as they do among other non-Indian populations (Brent et al., 1987, 1993). The American Indian population in New Mexico is considerably younger than the rest of the state population, as 70.2% Indians are below 35 years of age compared to 56.6% for the rest of the state (New Mexico Department of Health, 2000). Younger adults report higher rates of alcohol use in general, and have been found to have higher BACs in all forms of injury and traumatic death than in older segments of the population (Abel & Zeidenberg, 1985; Hayward et al., 1992; NIAAA, 1990). Therefore, it is not surprising that a higher percentage of alcohol-related suicides and higher BACs were found in the age categories of 15 to 44. Suicide rates are highest below age 35 among virtually all tribes of American Indians (May & Van Winkle, 1994; May, 1990) including New Mexico (Van Winkle and May, 1993). Furthermore, episodic intoxication or binge drinking is most common in these age categories among most Indian groups (May, 1996; May and Gossage, 2001).

The fact that male suicides were found to be significantly more associated with alcohol than females is not a surprise, for males tend to drink more alcohol and more frequently among New Mexico tribes (Kunitz & Levy, 2000). Seventy-one percent of male suicides were alcohol-related compared to only half of the females. But somewhat surprising was the equality of the BACs for both sexes. Males and females who were drinking pre-suicide did not have greatly different BACs (0.199 for males vs 0.181 for females). Clearly, female decedents who drank prior to suicide also drank heavily. Alcohol has been implicated as a disinhibitor that makes impulsive suicide more likely (Beck et al., 1976, Beck, Steer & McElroy, 1982, Beck, Steer, & Trexler, 1989).

Alcohol involvement by either percentage or level of drinking did not vary greatly by location of suicide (on/off reserva-

tion or place of occurrence). Since alcohol is not sold on most New Mexico reservations because of tribally-imposed prohibition, this is a somewhat unique finding. But there was a difference in alcohol involvement associated with drugs. Those decedents who used other drugs prior to suicide were less likely to be drinking (49% vs. 75%) and had slightly lower BACs (0.161 vs. 0.203).

The correlation analysis indicates no significant associations beyond the above points. Female suicides, suicides by overdose, and those that involved other drugs were less likely to be associated with alcohol; however, alcohol was an equally and substantially important factor in all other major variables. That is, it was equally correlated with all other methods of suicide (firearms, hanging, and other methods), and it did not vary significantly by age.

The lowest rate of alcohol involvement in suicide was found among Navajo suicides. While this may reflect a lower prevalence of drinking among the Navajo than among the Apache (see Levy & Kunitz, 1974; Kunitz & Levy, 1991; Curley, 1967), another explanation is also relevant. Most Navajos live on a much larger and more isolated reservation than do the Apache and Pueblo tribes, and it is governed by tribal prohibition of alcohol. Therefore, access to alcohol among the latter two cultural groups is much easier due to short distances to travel for the purchase of alcohol, and the fact that some Pueblos and the Apache reservations have legalized alcohol on their reservation.

When considering the implications of this study for prevention, one might turn to considerations of policy that arise from these findings. In Alaska Native villages (Berman, Hull, & May, 2000; Landen et al., 1997) alcohol prohibition has been found to be associated with lower rates of suicide (and violent death in general), and suicidal deaths were not transported or transferred elsewhere by those seeking alcohol in the legal communities. On the other hand, prohibition reservations in certain parts of the lower forty-eight states have had higher rates of suicidal death through long time periods (May, 1986). Therefore, alcohol control policy in Alaska and the lower forty-eight states might diverge in two different directions. The lower rates of suicide and alcohol-related suicide among the Navajo may possibly reflect the effectiveness of prohibition and isolation on a very large reservation, a condition that is rare for other reservations.

Community-based prevention programs have been used effectively among American Indians in a number of locations. Among the Shoshone-Bannock of Idaho, the suicide rate declined substantially in the late 1970s and the 1980s with the presence of a comprehensive community initiative to prevent suicide among adolescents and young adults (Levy, 1988; May, 1987; Shore, Bopp, Waller, & Dawes, 1972). Among the Apache of Northern New Mexico, suicide and suicide attempts have been reduced substantially by a comprehensive community-based education, treatment and prevention program that targets youth ages 15–18 (DeBruyn, Hymbaugh, Simpson, Wilkins, & Nelson, 1994; DeBruyn, Hymbaugh, & Valdez, 1988; Serna, May, & Sitaker, 1998). School-based programs proved to be effective in reducing suicide in a southwestern Pueblo tribe in the 1980s and 1990s (LaFromboise, 1996; LaFromboise and Howard-Pitney, 1994, 1995). And one successful suicide, suicide attempt, and violence prevention program of note among the Ottawa of Canada linked suicide prevention directly to an alcoholism treatment program. The key personnel used for screening, consultation, and counseling in this program were specially trained indigenous alcohol counselors (Fox et al., 1984; Ward, 1984; Ward & Fox, 1977).

On the individual level, limiting access to alcohol for people with substantial suicide risk in the lower forty-eight states is and will, therefore, probably remain a clinical, case-by-case or individual-by-individual consideration for the prevention of suicide. Specifically, this study implies that limiting access to both means of suicide (firearms, ropes, drugs, and knives) and alcohol are prime considerations for meaningful clinical intervention to prevent suicide in high risk individuals.

These interventions may be even more important among high risk individuals of the three Indian cultures of this study than in the non-Indian population. While a recent study indicated that "clinicians should be aware that measures of hopelessness may be of limited value in assessing suicidal risk in Aboriginal adolescents" (Enns, Inayatulla, Cox, & Cheyne, 1997), clinicians should be aware that heavy alcohol use is very frequently associated with completed suicide among Indian adults under the age of 45.

CONCLUSION

This study has added new data for understanding the nature of a strong, extant relationship between alcohol and suicidal death among American Indians of the three cultural groups in New Mexico. Whether these findings can be extrapolated directly to other Indian cultural groups or tribes is not clear. Certainly some of the findings, such as the greater use of alcohol by males, the high blood ethanol levels from binge drinking, and variation by tribe are likely generalizable (see May, 1990), as they are consistent with the other studies of alcohol-related suicides among Indians referenced in this paper. But others, such as the high blood alcohol levels for the drinking females, the lack of variation in alcohol involvement by most methods, and the small variations for suicides on and off reservation may not be common among other Indian groups or in other states.

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