Title: Alcohol Dependence and Conduct Disorder among Navajo Indians(*)
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Abstract:

Objective: The purpose of this study is to examine the association between conduct disorder before age 15 and subsequent alcohol dependence, and to describe the lifetime prevalence of alcohol dependence among Navajo Indian women and men. Method: This was a case-control design which included both men (n = 735) and women (n = 351) and in which the Diagnostic Interview Schedule was used for the diagnosis of the lifetime history of alcohol dependence and conduct disorder. Alcohol dependent cases were selected from inpatient and outpatient treatment programs (204 men, 148 women). Whenever possible, controls were matched for age, sex and community of residence and were randomly selected and interviewed until a nonalcohol dependent individual was found. Among the men, there were 374 alcohol dependent controls and 157 nonalcohol dependent controls. Among the women, the figures were 60 and 143, respectively. When combined, the controls comprise samples of the adult male and female populations from which estimates of lifetime prevalence of alcohol dependence, and of the amount of alcohol dependence in the population attributable to conduct disorder, may be inferred. Results: Conduct disorder is a risk factor for alcohol dependence among both men and women. Lifetime prevalence of alcohol dependence in this population is high (70.4% for men and 29.6% for women), but the amount of alcohol dependence in the population attributable to conduct disorder is low. On the other hand, among the alcohol dependent, those with conduct disorder had the most severe alcohol- and nonalcohol-related problems. Conclusions: The potential limitations of the study are those common to case-control designs, especially biased recall by cases. There are also potential sampling biases among the controls. It is shown that none of the potential biases invalidate the findings, which support the hypothesis that in this population conduct disorder is a risk for alcohol dependence. The implications for primary prevention of alcohol dependence are discussed. (J. Stud. Alcohol 60: 159-167, 1999)

Full Text:

As many as 40% of men and 20% of women in alcohol treatment programs meet the criteria for antisocial personality (ASP) disorder (Hesselbrock et al., 1985; Ross et al., 1988). These alcohol dependent people are likely to manifest more severe alcohol-related problems than others, are more likely to have family histories of alcohol abuse, to have a wider array of other problems and to not improve as significantly after treatment (Kadden et al., 1989; Litt et al., 1992; Rounsaville et al., 1987). In the population-based Epidemiological Catchment Area Study the odds ratio for people with ASP having alcohol dependence was 21, higher than for any other comorbid condition (Regier et al., 1990).

Similar observations have until now not been made of Native Americans who use alcohol to excess. In a 25-year follow-up of three groups of Navajo Indians, however, one of which was composed of people who had been given disulfiram to treat alcohol abuse, we observed that the men who died within the first 10 years following entry into the program had been substantially

younger (mean age 28.1 years) at the time of treatment than those who survived (mean age 35.0). When the men who died were matched with men of the same age who survived, age at first arrest was younger for those who died (21.0 vs 26.0), they tended to have been arrested more frequently and they were more likely to have attended school (Kunitz and Levy, 1994, pp. 82-86). The numbers (32) were very small and the data from the first interviews insufficient to be definitive, but the evidence suggested that the men who died were part of a subset of alcohol dependent men who would have met the criteria for ASP. There were not enough women drinkers in the study to draw any inferences about the prevalence of ASP among them.

As a result of that follow-up study, we designed the case-control study reported here. The purpose was to investigate the hypothesis that among Navajo Indians both alcohol dependence in general as well as the most severe alcohol-related problems are most likely to be manifested by individuals who have met the criteria for the first stage of ASP, conduct disorder in childhood and early adolescence. The focus on conduct disorder reflected the importance of identifying risk factors in childhood and early adolescence that would predict especially severe alcohol-related problems in adulthood. Because ASP is so common among alcohol dependent people, and because such individuals are more refractory to treatment and manifest many problems besides alcohol dependence, we were particularly interested in determining whether we could detect such people early, before alcohol problems began.

This article assesses the degree to which conduct disorder is a risk factor for alcohol dependence and documents the differences in severity of alcohol-related and other problems between Navajo Indian men and women with and without conduct disorder. It assesses the magnitude of the contribution that conduct disorder makes to alcohol dependence in the population and describes the lifetime prevalence of alcohol dependence and conduct disorder among Navajo adults.

Method

Sample

The 1990 U.S. census enumerated 225,298 Navajos, nearly two-thirds (146,001) of whom lived on reservation and other trust lands under the jurisdiction of the Navajo Nation. The Indian Health Service administers eight "service units" within Navajo Country, two of which are relevant to this study: (1) Shiprock, the most populous service unit with a population of 26,710 Indians in 1990, and (2) Tuba City, with a 1990 population of 15,800 Indians.

Male and female cases and controls were drawn from each of the two service units. Cases were drawn from alcohol treatment programs. Controls were matched by age, sex and community of residence and were drawn from lists provided by the Indian Health Service (IHS) hospitals in Tuba City and Shiprock. Because of differences in the IHS data bases as well as in referral patterns, the methods used to select cases and controls differed somewhat in the two service units.

All Shiprock male cases were interviewed while they were inpatients in one of two 28-day programs. About half of the female cases from the Shiprock service unit were also interviewed while in the same programs; however, since this provided insufficient cases, others were

obtained from lists of patients provided by the Navajo Nation's outpatient substance abuse treatment program.

In Tuba City 82% of the male and 79% of the female cases came from the tribal outpatient program. The main differences between the two service units are the sizes of the two populations and the fact that the Tuba City population is relatively isolated.

A stratified random-sampling procedure was used to obtain controls in each service unit, although the approaches differed somewhat. In the Shiprock service unit the communities were grouped into 20 geographic areas: 16 chapters and four off-reservation areas. Within each geographic stratum, there were nine age categories in 5-year intervals for those born between 1927 and 1972, yielding 360 sampling strata, equally divided by sex. In Tuba City, eight chapters and one off-reservation area were used as the sampling areas, yielding 162 sampling strata, again equally divided by sex.

In Shiprock, controls were selected from lists of all Navajos who had been seen at an IHS facility within the previous 10 years and had given an address within the Shiprock service unit. Within each sampling stratum the names were randomized and controls were sought by working down the list. Estimates of the success with which individuals were first located and then interviewed range from 30% for the youngest age cohort to 65% for the oldest. Interviews were conducted until a nonalcohol dependent control was located. It was not always possible to find such an individual.

In Tuba City the controls were selected from lists provided by the local IHS facility. As in Shiprock, the names were of all people with an address within the service unit who had been seen in an IHS facility within the previous 10 years (since 1982). A random number table was used to select four potential controls to match each case. Interviewing from these lists of four potential controls occurred until a nonalcohol dependent control was identified or the list was exhausted. When a list was exhausted, a new list of potential controls was randomly drawn and interviewed until a nonalcohol dependent control was found. Response rates in Tuba City were similar to those in Shiprock, and, as in Shiprock, nonalcohol dependent matches were not found for all cases.

The population was sampled for controls within strata defined by age, sex and locality. Corresponding to each case (CAS), interviews were conducted with demographically similar respondents until a nonalcohol dependent control (NADC) was found or until too many (3-4) alcohol dependent controls (DEP) had been encountered. The resulting sample of controls (NADCs and DEPs) is not biased in terms of alcohol dependence, as is demonstrated in the following section. On the other hand, the stratified sample of controls is representative of the age-sex-locality distribution of the cases and differs from that of the population at large. This distribution was compared with population data from the 1990 census and is described below. To adjust for these sampling strata, we have created a 12-fold stratification variable cross-classifying age ([is less than] 50, 50 and above), sex (male, female), and community of residence (border town, agency town, other reservation community) which is used in some of the regression analyses.

A total of 1,086 women and men were interviewed. Among the men, 95.8% were full Navajo, 2.7% were mixed Navajo/other Indian, and 1.5% were Navajo/non-Indian. The comparable figures for the women were 90.6%, 6.6% and 2.8%. Essentially the same percentages were found among cases as among controls.

Procedure

The interviews were very extensive and included the questions from the Diagnostic Interview Schedule (DIS) designed for the Epidemiological Catchment Area (ECA) Study (Robins and Regier, 1991). We included the items that allowed for the diagnosis of both alcohol dependence and conduct disorder. The sexual content of many of the ASP items were regarded as too threatening and inappropriate in the Navajo context, especially in field interviews. That and our focus on early manifestations of problems led us to exclude that scale and include only the items relevant to conduct disorder. The version of the DIS we used had been revised to match the criteria in DSM-III-R (American Psychiatric Association, 1987).

To diagnose alcohol dependence a series of 26 questions was used from the DIS. In DSM-III-R the number of symptoms reported is considered a measure of severity. The variable ALCUMSAB which appears in several analyses is the total number of affirmative answers to this series of questions from the DIS: the greater the number of affirmative responses, the more severe the alcohol dependence. In several analyses it is used rather than the dichotomous variable of alcohol dependence (yes/no). The various criteria do not need to have occurred at the same time. Some may have occurred sequentially over several years. It was also possible for people who were alcohol dependent to be in remission by the time they were interviewed. Nonetheless, in the analyses that follow they are treated as having a lifetime history of alcohol dependence.

The criteria for conduct disorder (CD) refer to the period before age 15 and, as with alcohol dependence, the number of affirmative answers is considered a measure of severity. When CD is treated as a dichotomous variable, the criterion is three or more affirmative responses. The variable ASYES is the total number of affirmative answers which, because of its skewness (most values being zero), has been transformed into log(ASYES + 1). It is used in those analyses requiring a continuous rather than a dichotomous variable.

Other items from the DIS included a history of use of substances other than alcohol and a few questions from the scale for ASP. There were also extensive questions having to do with family, occupational, marital, educational, substance use and drinking histories. Interviewing occurred between May 1993 and September 1995. Interviews ranged in length from 2 to 4 hours. Interviewees were requested to sign a consent form which had been approved both by the University of Rochester's Research Subjects Review Board (RSRB) and the RSRB composed of representatives of both the Navajo Tribe and the IHS. A Certificate of Confidentiality had been obtained to protect informants should they have reported any illegal activities. At the end of the interview, each informant was paid $30.

The interviewers were one Navajo nurse; three non-Indian doctoral level anthropologists all of whom had carried out independent field research on the Navajo Reservation; two non-Indian graduate students in anthropology, both of whom had also carded out independent research on

the Navajo Reservation; and one medical doctor with a Ph.D. in sociology who had carried out previous research on the Navajo Reservation. To achieve comparability, interviews were observed, administered to each other and discussed. The field workers were assisted by two Navajo field assistants/interpreters although translation into Navajo was rarely necessary.

Results

Figure 1 shows that the severity of alcohol dependence (ALCUMSAB) increases among both men and women from the nonalcohol dependent controls (NADC) to the alcohol dependent controls (DEP) to the cases taken from treatment programs (CAS). Among the cases, those from the inpatient programs had higher severity scores than those who were outpatients (data not shown). In turn, cases from outpatient sources had significantly higher scores than alcohol dependent controls. The result is to diminish the average severity of alcohol dependence among the cases and to make them as a group more nearly similar to the alcohol dependent controls. We return below to the consequences of this downward bias in severity of the cases.

Because more cases from Shiprock than Tuba City were inpatients, alcohol dependent controls from the two service units were compared using the same scale of severity (ALCSUMAB) to make certain that the populations did not differ. The scores for both male and female alcohol dependent controls did not differ between residents of the two service units. Thus, the controls do not differ by region, but the severity of the cases differs by source of treatment, which is determined by the regional differences in referral patterns.

In the present study we are concerned with conduct disorder that occurs before age 15, but alcohol dependence and abuse may occur at any age. In order to assert a causal association, conduct disorder must precede alcohol abuse and dependence. Therefore, the ages at which individuals first drank at all, first drank at least once a month for 6 months, and first thought that alcohol was a problem for them were all examined. The results are displayed in Table 1.

[TABULAR DATA 1 NOT REPRODUCIBLE IN ASCII]

People with a history of conduct disorder began drinking at an earlier age than did people without such a history, but in no sample nor subgroup within a sample did regular drinking begin on average at an age below 15, and in no group did problem drinking begin on average before the early 20s. Thus, for the majority of informants, even those with conduct disorder, regular alcohol use began after the age when conduct disorder was manifested, even though the age at which alcohol was first tried was substantially younger.

Comparisons of cases and controls

The data of this study consist of 352 cases (CAS) and 300 nonalcoholic controls (NADC) obtained under the original design as well as 434 alcohol dependent controls (DEP) sampled in the course of searching for nonalcoholics. It had been envisioned that the analysis would simply compare CAS with NADC, while controlling over various concomitants such as sex and age. One-sided tests were indicated because we were interested in the direction of the relationships of alcohol dependence with the explanatory variables, not simply the fact of a difference between

groups. In each case it was hypothesized that the group with more severe alcohol dependency would have higher levels of conduct disorder and dysfunction.

The large number of DEP observations, who could reasonably be expected to be intermediate to CAS and NADC, provided additional data to check the relationships of alcohol dependence with the explanatory variables. The expected relation of alcohol dependence to each explanatory variable should thus occur both in comparing CAS with DEP and in comparing DEP with NADC. Thus, for unemployment, CAS was compared with DEP to see if the former had more unemployment, and DEP was similarly tested against NADC. If both tests were significant (in the expected direction) this would be very strong evidence of an effect on alcohol dependence. This double test procedure is quite conservative, in that it tests each extreme group (CAS or NADC) against the intermediate group (DEP), and a test of the ordering might have been more powerful. We opted for the double checking involved in the conservative procedure in order to make very sure of avoiding claims that were not strongly supported by the data.

It should be noted that the two partial tests are negatively associated, since one uses the DEP sample as a "control" to compare with CAS, whereas the other uses it as the "treatment" to compare to NADC. Hence, a chance low p value in one might be reflected by a higher p value in the other.

The statistical association of alcohol dependence with a variety of dysfunctional behaviors, as well as with conduct disorder scale logASYES, was investigated in the following way. Logistic regressions of the alcohol dependence dichotomies (DEP versus NADC and CAS versus DEP) were run with respect to logASYES and each of the dysfunction indicator variables. Each of these regressions also included the stratification variable described above, so that any demographic "effects" should be partialled out in the analysis. Preliminary analyses showed that interactions with the stratification were negligible so the results are presented in terms of logistic regressions consisting of the stratification plus one of the above variables.

Table 2 reports the significance levels (one-sided p values) of the partial associations of alcohol dependence with logASYES and with each dysfunction, given the stratification. For each of these independent variables, both tests are in the expected direction (p values both below 0.5) and at least one of them is significant at p [is less than] .0001. The large number of tests significant at p [is less than] .0001 indicates that (1) multiplicity is not a problem, and (2) use of one-tailed tests has not resulted in overstating the significance of the results.

TABLE 2. Dependence of alcoholism on each dysfunction variable, given stratification: One-sided p values (based on logistic regression of alcohol dependence onto the stratification and each dysfunction variable)

	Comparing DEP with NADC	
Explanatory variables	Est. ([+ or -] SD)	p
Has hit partner	.604 [+ or -] .103	<.0001
Used other drugs	.773 [+ or -] .094	<.0001
logASYES	.900 [+ or -] .152	<.0001
Presently employed	-.027 [+ or -] .088	.381

Quit job > 1	.496 [+ or -] .218	.011
Fired from job > 1	1.285 [+ or -] .372	.0005
Arrested(a)	.553 [+ or -] .176	.002
Imprisoned(a)	.867 [+ or -] .269	.001
Drunken fights	1.401 [+ or -] .156	<.0001

Comparing CAS with DEP

Explanatory variables	Est. ([+ or -] SD)	p
Has hit partner	.082 [+ or -] .084	.163
Used other drugs	.125 [+ or -] .089	.080
logASYES	.776 [+ or -] .132	<.0001
Presently employed	-.762 [+ or -] .091	<.0001
Quit job > 1	.463 [+ or -] .120	.0001
Fired from job > 1	.468 [+ or -] .110	<.0001
Arrested(a)	.566 [+ or -] .114	<.0001
Imprisoned(a)	.782 [+ or -] .133	<.0001
Drunken fights	.316 [+ or -] .083	.0001

(a) Nonalcohol-related events.

Note: Nonalcohol-related offenses are for the most part theft and passing bad checks. Less common are the crimes against persons. Multiple logistic regression: Test of regression onto any one explanatory variable, partialling out the stratification.

The temporal, and possibly causal, order of the variables studied might well be conduct disorder symptoms first--as has been suggested above--alcohol dependence second and possibly dysfunctional behavior third. Table 2 has established dependence between conduct disorder and alcohol dependence, as well as between alcohol dependence and several dysfunctional behaviors. Dysfunctional behavior is therefore likely to be associated with conduct disorder, but this dependence may or may not be entirely explained by different levels of alcohol dependence. To test this, logistic regression of the dysfunctional variables onto conduct disorder, given the stratification, were run separately for CAS, DEP and NADC, and the resulting p values listed in Table 3. Because it was hypothesized that people with a history of conduct disorder would manifest more of the dysfunctional behaviors, one-sided p values are again used. The results show that conduct disorder is associated with dysfunctional behavior within the CAS and DEP groups but not among NADCs. Thus, conduct disorder is positively associated with alcohol dependence and is further associated with dysfunctional behavior.

TABLE 3. Tests of dependence of dysfunction variables on conduct disorder, within sample, given the stratification: One-sided p values (based on logistic regressions of each dysfunction variable on CD, given stratification)

	CAS	
Dysfunction variables	Est ([+ or -] SD)	p
Has hit partner	-.306 [+ or -] .131	.0100
Used other drugs	-.381 [+ or -] .137	.0026
Presently unemployed	.250 [+ or -] .140	.0376

Quit job > 1	-.162 [+ or -] .161	.1578
Fired from job > 1	-.217 [+ or -] .154	.0809
Arrested(a)	-.434 [+ or -] .177	.0072
Imprisoned(d)	-.503 [+ or -] .188	.0038
Drunken fights	-.457 [+ or -] .135	.0004

DEP

Dysfunction variables	Est. ([+ or -] SD)	p
Has hit partner	-.121 [+ or -] .121	.1567
Used other drugs	-.529 [+ or -] .146	.0002
Presently unemployed	.151 [+ or -] .116	.0974
Quit job > 1	-.424 [+ or -] .183	.0103
Fired from job > 1	-.128 [+ or -] .172	.2287
Arrested(a)	-.553 [+ or -] .156	.0002
Imprisoned(d)	-.823 [+ or -] .208	<.0001
Drunken fights	-.619 [+ or -] .127	<.0001

NADC

Dysfunction variables	Est. ([+ or -] SD)	p
Has hit partner	-.569 [+ or -] .264	.0122
Used other drugs	-.067 [+ or -] .225	.3822
Presently unemployed	.163 [+ or -] .213	.2222
Quit job > 1	-.105 [+ or -] .418	.0058
Fired from job > 1	Unstable	
Arrested(a)	Unstable	
Imprisoned(d)	Unstable	
Drunken fights	-.602 [+ or -] .407	.0697

(a) Nonalcohol-related events.

Note: Multiple logistic regression: Test of regression of any one dysfunction variable on CD, partialling out the stratification.

Finally, because conduct disorder is associated with greater severity of alcohol problems, and because ASP is associated with worse treatment outcomes, it was possible that people with a history of conduct disorder would be less likely than other alcohol dependent people to be in remission (defined, according to DSM-III-R, as follows: during the past 6 months either no use of alcohol or use of alcohol and no symptoms of dependence). On the other hand, selective mortality of the most severe cases with conduct disorder may have resulted in no effect. Thus, directionality was not predicted in advance and 2-sided p values are used. Among DEP 51.1% of men and 48.3% of women and among CAS 11.8% of men and 29.1% of women were in remission. For each of the alcohol dependent samples, logistic regressions of remission onto logASYES, given the stratification variable, were insignificant (p values for CAS: 0.5916, for DEP: 0.7756). Thus conduct disorder (logASYES) is not associated with remission.

Lifetime prevalence of alcohol dependence

We now consider the lifetime prevalence of alcohol dependence and conduct disorder, and the proportion of alcohol dependence in the population which is attributable to conduct disorder. To do this, we treat our controls as a sample of the Navajo population and use the proportion DEP as an estimate of lifetime prevalence.

The selection of the controls is not biased with respect to alcohol dependence or any variable associated with it, as the following argument demonstrates. Consider all first interviews: the probability of encountering a DEP is the proportion of DEPs in the population sampled (i.e., individuals demographically similar to the CAS considered). Denote this proportion p. Next, consider all second interviews (of which there will likely be fewer than first interviews), and again the probability of encountering a DEP is p since the same population is sampled. Similarly for the third interviews, the fourth, etc. So, for each order of interview, the probability of a DEP is p. Overall, adding up whatever the proportions of DEPs in the first, second, third, etc. interviews may be, the probability of encountering a DEP is still p. In other words, the method of sampling is unbiased for the proportion DEP.

On the other hand, because they were chosen to match the sex, age and community of residence of the cases, the controls do not have the same sex, age and geographic distribution as the Navajo population. The proportion DEP is obviously very different among men and women, so separate estimates of prevalence need to be made for each sex.

The next issue is whether overall estimates can be made for all men and for all women and whether, given the way the samples were selected, such estimates are representative of the population. Although the sampling was unbiased for alcohol dependence within strata, differential representation of strata could make the overall estimates unrepresentative of the Navajo adult population. To check this, the proportions DEP of each sex were calculated separately for the older and younger strata and, within these, for respondents from different community types. The results, displayed in Table 4, do not show significant differences in female proportions DEP, either by age group or by community type. The overall proportion DEP among all female controls is therefore used as an estimate of the prevalence of alcohol dependence among Navajo women.

TABLE 4. Proportion of controls alcohol dependent, by sex, age and community type

	Men		
	<50 yrs		[is greater than or equal to] 50 yrs
N	444		87
% Dep	72.5		59.8
[chi square] (df)		5.69 (1)	
p(a)		.02	
Agency town			
N	145		17
% Dep	81.4		35.3
Border town			
N	71		9

% Dep	66.2		66.7
Other reservations			
N	228		61
% Dep	68.9		65.6
[chi square] (df)	8.67 (2)		5.27 (2)
p(b)	.013		.072

Women

	<50 yrs		[is greater than or equal to] 50 yrs
N	182		21
% Dep	29.7		28.6
[chi square] (df)		.92 (1)	
p(a)		.917	
Agency town			
N	89		8
% Dep	32.6		62.5
Border town			
N	28		1
% Dep	32.1		NA
Other reservations			
N	65		12
% Dep	24.6		83.0
[chi square] (df)	1.24 (2)		
p(b)	.538		--(c)

(a) Chi-square comparison of proportions DEP in the two age groups, men and women separately.

(b) Chi-square test comparing proportions DEP in the three community types, within each age-sex category.

(c) Chi-square test of independence (for very small frequencies, as for women 50 and above, the test is omitted because it is not valid).

For men, on the other hand, Table 4 shows that some of the differences by age and by type of community are significant at p [is less than] .05. The overall estimate of proportion DEP among all male controls is therefore an average of prevalences among various strata and, thus, would qualify as an estimate of Navajo male prevalence only if the strata were correctly represented by the control sample.

A comparison of the sample of controls with census data for Shiprock and Tuba City shows that 16.4% of the sample's control men were in the 50-64 year old age group at time of interview, as compared to 19.0% of the men enumerated in the 1990 census. On the other hand, according to the census, the control men were rarer in border towns and more frequent in other reservation communities than were Navajo men (see Table 5). Thus, the male control sample is not seriously biased forage group, but it is biased for type of community and unless adjusted for population distribution cannot provide a prevalence estimate for the Navajo male population. When

adjustment is made for population distribution, the lifetime prevalence of alcohol dependence among men is 70.4% (the same as the unadjusted figure). For women the lifetime (unadjusted) prevalence rate is 29.6%.

TABLE 5. Distribution of male and female controls and the total population, Tuba City and Shiprock service units, in percent

Type of community	Men(a)	Women(b)	Census
Agency town	30.5	47.8	32.8
Other reservation	54.2	38.4	41.9
Border town	15.2	13.8	25.3

Source: Calculated from 1990 Census Population and Housing Characteristics of the Navajo Nation, Division of Community Development, Navajo Nation, Window Rock, AZ, 1993. "DEP and NADC.

We next estimate the amount of alcohol dependence in the population attributable to conduct disorder. To do this, one asks what the prevalence of alcohol dependence would be if there were no conduct disorder. This is calculated by comparing the prevalence of alcohol dependence among all those without conduct disorder to the prevalence in the total population. The results are displayed in Table 6.

TABLE 6. Percent alcohol dependent (DEP) among female and male controls with and without conduct disorder, by age group and type of community, with calculation of risk attributable to conduct disorder

	CD		No CD	
Column number	1	2	3	4
	N	% DEP	N	% DEP
Women	25	60.0	178	25.3
Men [is greater than or equal to] 50				
Agency town	1	NA	16	31.2
Border town	2	NA	7	71.4
Other reservation	4	75.0	57	64.9
Men < 50				
Agency town	45	91.1	100	77.0
Border town	16	81.2	55	61.8
Other reservation	50	86.0	178	64.0

	All controls	
Column number	5	6
	N	% DEP

Women	203	29.6	
Men [is greater than or equal to] 50			
Agency town	17	35.3	
Border town	9	66.7	
Other reservation	61	65.6	
Men < 50			
Agency town	145	81.4	
Border town	71	66.2	
Other reservation	228	68.9	

		Att. risk	95% CI(a)
Column number	7	8	9
	p(b)	Col. 6-col. 4	
Women	.001	4.3	2-7
Men [is greater than or equal to] 50			
Agency town	.163	4.1	-(c)
Border town	.571	-4.7	-(c)
Other reservation	.682	0.7	-2-4
Men < 50			
Agency town	.043	4.4	1-8
Border town	.148	4.4	-1-10
Other reservation	.003	4.9	2-7

Note: Computation of attributable risk: Standard errors are calculated by applying the usual formulas for variances of linear combinations of binomial proportions.

(a) Approximate confidence interval on attributable risk.

(b) p value for difference between proportion DEP among CD and among no-CD.

(c) No reliable estimate because of small sample of controls with CD.

To understand the calculations, consider the first row of Table 6. Among only those women controls without a history of conduct disorder, the percent with a history of alcohol dependence (DEP) is 25.3%. Among all women controls, including those with and those without a history of conduct disorder, the percent DEP is 29.6%. If there were no conduct disorder, the lifetime prevalence of alcohol dependence among women would be 25.3% not 29.6%. Thus, the attributable risk is 29.6%-25.3% = 4.3% (Gordis, 1996). Table 6 also displays 95% confidence intervals (CIS) for the attributable risks. The rest of the calculations in the table are done the same way. They indicate that, for both men and women, the amount of alcohol dependence that may be attributed to conduct disorder is well below 10%.

Discussion

The major limitations of this study have to do with its hybrid nature as both a case-control study and a survey of the population, and with the retrospective nature of the data on conduct disorder and alcohol dependence. We have taken considerable pains to explain why the controls are an adequate sample of the adult population even though their age, sex and community distribution is based upon the distribution of cases, not the total population.

High mobility and not refusals, especially among younger men, accounts for the high nonresponse rates. Often the IHS lists were outdated, vague and inconsistent, or simply wrong, in identifying place of residence. It is possible that the men we could not locate are different from the men we did interview in some way that biases our results. We think this unlikely because many of the men we did interview were themselves highly mobile, some being found on the tenth attempt. Thus it seems probable that our sample is not highly skewed in some unknown fashion that would bias the associations between conduct disorder and alcohol dependence.

It is also possible that the source of controls biased the selection in some fashion. This seems unlikely. The IHS is the major provider of care for Navajos on, and adjacent to, the reservation. People were known to the system not simply because they had been inpatients but because they had been brought for school physicals, food handler examinations and other equally minor as well as involuntary contacts. That is to say, there does not seem to have been a major selection bias. Indeed, in a previous study we found that this sampling frame allowed us to identify more reservation residents than were enumerated by the U.S. census (Kunitz and Levy, 1991). In sum, we think the evidence indicates that the source of controls did not introduce serious bias.

Case-control designs have many weaknesses, among them the potential biases caused by selecting cases from treatment settings. We have seen that cases from inpatient and outpatient sources differ in terms of severity. The result is to diminish the severity of alcohol dependence among the cases and to weaken the results of any tests of the importance of risk factors related to severity. To find effects despite this, and to observe similar effects in the alcohol dependent controls, adds strength to our results.

The retrospective nature of the data is always a problem, not simply in case-control studies but in population-based studies as well. The problem is at least twofold. First, there is a potential problem of recall bias. Are there consistent differences in the way individuals remember and report their histories such that alcohol dependent people are more (or less) likely to report the presence of risk factors than are nonalcohol dependent people? If recall is diminished similarly across groups, relative risk will remain unchanged but the population attributable risk may be less. If recall differs across groups, then it is possible to declare a significant difference when there is none.

One potential source of recall bias is treatment itself, for people may be taught to remember and tell their stories more completely in treatment than they would otherwise. Indeed, this is one of the major sources of bias in case-control studies. If there is greater recall of childhood misbehavior among cases than controls, then the strength of the association between conduct disorder and alcohol dependence will be greatly exaggerated. We have examined that possibility

by comparing the history of conduct disorder reported by male and female alcohol dependent controls who had been in treatment in the past with the history of those who have not. In neither comparison was the difference significant. That is, there was no evidence of differential recall. Thus, this source of potential bias does not seem to be important.

Second, there is a high likelihood of differential survival. Our follow-up study had provided evidence for this and indicated that people with a history of conduct disorder were more likely to die prematurely than people without such a history. The effect would be to weaken the observed association between conduct disorder and alcohol dependence in our sample, especially among older respondents, thus leading to a more conservative estimation of the causal association than might be the case in reality, and leading to an underestimation of attributable risk as well. This may well have occurred in the present study, for both lifetime prevalence of alcohol dependence and attributable risk due to conduct disorder were lower in people 50 years of age and above than in younger people.

As with the problem of diminished severity of the cases due to the source of referral, so in this case the effect of the bias is to weaken the importance of conduct disorder as a risk factor. Thus, to observe an effect with these biases operating suggests that we are observing a real and significant association. To address the problem of the reduction of attributable risk in the older cohorts, we briefly consider only male controls under 30, a group in which premature mortality has not yet had its most devastating effects and in which a history of conduct disorder is frequent. Population attributable risk is still only 8.9%. This is not trivial, but it leaves a lot of alcohol dependence unexplained and supports our inference that in the population in general conduct disorder is not a risk factor for most alcohol dependence.

The lifetime prevalence of alcohol dependence among male controls was 70.4% and among women, 29.6%. These rates are virtually identical to those reported in a Native American community in the Northwest (Leung et al., 1993) and stand in stark contrast to the ECA study, which found lifetime prevalence rates in

the United States population ranging from 12.2% to 15.1% among men 18-64, and from 3.5% to 2.2% among women 18-64 (Heizer et al., 1991, p. 91). The fact that prevalence is so high and that only a small proportion is attributable to conduct disorder indicates not simply that a great deal of alcohol dependence remains to be explained by other causes in this and other Native American communities, but that in absolute terms conduct disorder is an important risk factor because alcohol dependence is so frequent.

The lifetime prevalence of both alcohol dependence and conduct disorder are greater among men younger than 50 than among men 50-65. There are three possible reasons: (1) premature mortality among people with conduct disorder, as our follow-up study suggested; (2) a true increase among younger cohorts; and (3) a combination of the two. Cross-sectional data do not permit a definitive answer. There is, however, some evidence that both differential survival and differences between age cohorts are important with regard to conduct disorder. LogASYES is inversely and significantly correlated with age even among male NADCs with very low scores, among whom differential mortality would not appear to be an important factor. On the other hand, average daily consumption in ounces of alcohol is lower among younger than among older

men, and alcohol-related mortality has declined since the 1970s (Kunitz and Levy, 1994), indicating increasing moderation in consumption. This, too, is consistent with observations of Native American populations elsewhere (Leung et al., 1993) and will be the subject of a future report.

It has been known for many years that delinquency is a predictor of alcohol dependence (e.g., Vaillant, 1995, p. 381), and that ASP is more common among alcohol dependent people in treatment and in the general population than in the nonalcohol dependent population (Robins and Price, 1991; Robins et al., 1991). There has been substantial debate, however, about whether alcohol dependence with ASP represents a different type of alcohol dependence with a different etiology than when ASP is not present (e.g., Babor et al., 1992; Cloninger, 1987; Hall and Sannibale, 1996; Litt et al., 1992).

We do not propose to address these ontological issues here. There are, however, several points worth making. First, the fact that similar associations between conduct disorder and ASP on the one hand and conduct disorder and alcohol dependence on the other have been observed in several different populations (e.g., Yoshino and Kato, 1996) suggests that a transcultural, even if not necessarily a universal, process is at work. This is clearly a nontrivial finding that deserves continued attention.

Second, the significance for therapy of the association between ASP and alcohol dependence has been commented on and studied, but the potential significance for prevention has received less attention. For our present purposes this point is crucial, for, if conduct disorder is a predictor of both ASP and serious alcohol, as well as of nonalcohol-related problems, then there is some rationale for attempts at targeted early interventions.

This is important because among Navajo and many other Native Americans alcohol abuse is very prevalent and is usually thought to be very much the same from person to person. Thus, prevention programs tend to focus on health education and community awareness applicable to an entire population. These programs are not particularly well attuned to identifying and dealing with young people at especially high risk of developing the most severe problems. Our data suggest that such high-risk young people are identifiable, and that the severity of the problems they are likely to develop as young and middle-aged adults is sufficiently great that it is well worth complementing existing programs with some that are more narrowly focused, despite the fact that the impact on the prevalence of alcohol dependence in the total population is not likely to be great.

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