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# The association between substance use disorders and early and combined use of alcohol and marijuana in two American Indian populations

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## Abstract

**Objective—**To study the relationships between early and combined use of alcohol and marijuana with diagnoses of alcohol and marijuana use disorders in two American Indian (AI) populations.

**Method—**Data were drawn from a psychiatric epidemiologic study of 3084 AIs living on or near two reservations. We analysed data for adults aged 18–54 years at the time of interview ($n$ = 2739). Logistic regression models were estimated to examine associations between early and combined use of alcohol and marijuana with lifetime diagnoses of abuse and dependence.

**Results—**Overall, younger AIs (18–29 years old) were more likely than older AIs (40–54 years old) to initiate substance use early and initiate use with marijuana, with or without alcohol. Persons who initiated alcohol use before age 14 were more than twice as likely as those who initiated use at older ages to meet criteria for alcohol or marijuana use disorders ($p < 0.01$). The odds of abuse or dependence were two to five times higher among persons who reported combined use of alcohol and marijuana ($p < 0.01$) than among those who reported use of either substance.

**Conclusions—**These findings document the need to address both early and combined use of alcohol and marijuana in prevention and treatment programmes.

### Keywords

American Indians; alcohol; marijuana

## Introduction

Recent national studies have documented the substantial burden of alcohol and drug use among American Indian and Alaska Native (AI/AN) populations (Stinson et al., 2006;

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Declaration of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

Gilman et al., 2008; U.S. Department of Health and Human Services, Substance Abuse and Mental Health Services Administration, Office of Applied Studies, 2010). AI/ANs were found to have the highest rates of lifetime alcohol dependence and marijuana use disorders among all racial/ethnic groups (Stinson et al., 2006; Gilman et al., 2008). Findings from an epidemiologic study of reservation-based American Indians (AIs) indicate that their rates of lifetime alcohol dependence are 40–100% higher than those of the US general population (Spicer et al., 2003; Beals et al., 2005). These high rates of lifetime alcohol dependence are in stark contrast to rates of current alcohol use, which among reservation-based AIs are often lower than US population rates (Beals et al., 2003b; O'Connell et al., 2005). At the same time, rates of marijuana use among AI youth may be higher than US rates as a whole (Plunkett & Mitchell, 2000; Wallace et al., 2002; Shaughnessy & Jones, 2003; Whitesell et al., 2007; U.S. Department of Health and Human Services, Substance Abuse and Mental Health Services Administration Office of Applied Studies, 2008). In one study of primarily reservation-based AI high school students, the prevalence of lifetime marijuana use was reported to be more than double the rate for US students in similar geographic areas (62.1% as compared to 34.5%; Plunkett and Mitchell, 2000).

The burden of substance use and its related mental, physical and social costs is exceedingly high among AI/ANs. For example, Naimi et al. (2008) reported that alcohol-attributable deaths accounted for 11.7% of all AI/AN deaths between 2001 and 2005. Furthermore, these authors reported that the age-adjusted rate for alcohol-attributable deaths among AI/ANs was approximately twice that of the US general population, and years of potential life lost due to such deaths among AI/ANs exceeded that of the US population by 6.4 years (36.3 vs. 29.9; Naimi et al., 2008). Understanding the nature of both alcohol and marijuana initiation and their relationship to abuse and dependence can inform efforts aimed at reducing this burden.

Numerous studies have documented that early substance use is associated with subsequent substance use disorders, mental health problems, lower educational attainment, work impairment, driving under the influence and poor health in the US general population (Kessler & Frank, 1997; Kessler, 2004; Breslau et al., 2008; Falk et al., 2008) as well as among AIs (Beals et al., 1997; Duclos et al., 1998; Robin et al., 1998; Borowsky et al., 1999; O'Connell et al., 2006). Research indicates early age of first substance use and combined use of multiple substances are associated with the development of substance use disorders in non-AI populations (Grant & Dawson, 1998; Wu et al., 2005; Hingson et al., 2006, 2008).

Few studies have assessed the relationships between early and combined substance use with use disorders among AI/ANs. However, several studies suggest the average age of first use of alcohol and marijuana among AIs is younger than for comparison populations, rates of combined alcohol and marijuana use are higher, and many initiate marijuana use before or at the same age as alcohol use (U.S. Congress Office of Technology Assessment, 1990; Beauvais, 1992b; Novins et al., 2001; Beauvais et al., 2004; Novins & Barón, 2004; O'Connell et al., 2007; Whitesell et al., 2007). These same studies indicate substance use differs by age, gender and tribe (Novins et al., 2001; O'Connell et al., 2007; Whitesell et al.,

2007), yet little is known about how such patterns of substance use relate to the development of substance use disorders.

The purpose of this article is to study the relationships between early onset and combined use of alcohol and marijuana and the development of alcohol and marijuana use disorders using data drawn from an epidemiologic study of two reservation-based populations: the American Indian Service Utilization Psychiatric Epidemiology, Risk and Protective Factors Project (AI-SUPERPFP) (Beals et al., 2003). We focus on marijuana as it is the most commonly used drug reported by AIs in this and other studies (Beauvais, 1992a; Johnston et al., 2002; Mitchell et al., 2003; Novins et al., 2001).

## Method

### Data

Data were drawn from AI-SUPERPFP, the first large-scale, population-based psychiatric epidemiologic study of reservation-based AIs which was designed to allow estimation of prevalence rates of substance use, DSM-based psychiatric disorders and service utilisation. AI-SUPERPFP worked with two closely affiliated Northern Plains (NP) tribes and one Southwest (SW) tribe. Selection of these tribal groups provided an opportunity to account simultaneously for both the diversity and common experiences among AIs. The NP and SW tribes have distinct and different histories (migration patterns, traditional forms of subsistence, cultural and linguistic heritages), yet they share, along with other AI groups, similar histories of colonisation, military resistance, imposed governance, mandatory boarding school education and active missionary movements.

The AI-SUPERPFP populations of inference were enrolled members of these tribes who lived on or within 20 miles of their reservations. Once located and found to be eligible, 73.7% of SW and 76.8% of NP AIs agreed to participate. Respondents ($n$ = 3084) ranged in age from 15 to 57 years and were interviewed between 1997 and 1999. AI-SUPERPFP methods are described in greater detail elsewhere (Beals et al., 2003a).

We included AI-SUPERPFP respondents who were aged 18–54 years at the time of interview in the statistical analyses ($n$ = 2739). Participants who were aged 15–17 years ($n$ = 157) were excluded from these analyses, as they may not have initiated substance use by the age of interview or had time to develop substance use disorders (Spicer et al., 2003; Whitesell et al., 2007). Participants who were aged 55–57 years also were excluded, as only two of the 56 adults in this age group reported marijuana use. In addition, they were more likely than younger adults to be a biased sample because of substance-related deaths (Naimi et al., 2008). For these two reasons we felt their inclusion would obscure key findings for the other age groups. A small percentage of respondents ($n$ = 132, 4.6%) were excluded from the analyses due to missing data regarding their substance use.

### Measures

**Demographic—**Measures were created from the survey data for age, gender and tribe.

**Substance use—**AI-SUPERPFP used the University of Michigan version of the Composite International Diagnostic Interview (UM-CIDI). Cultural concerns necessitated modification of the wording for some UM-CIDI questions (Beals et al., 2003a). Questions about alcohol and marijuana use were similar and organised hierarchically. With regard to alcohol, respondents were asked first about their age of first alcohol use and if they ever consumed 12 or more drinks during any 1 year. Those answering yes to the second question were classified as lifetime alcohol users. Similarly, respondents who reported consuming marijuana six times or more in their life were classified as lifetime marijuana users and information on their age of first marijuana use was obtained. These definitions of lifetime use excluded persons who rarely used alcohol or marijuana or only experimented with use. We refer to lifetime use of both substances as *combined use*.

**Early substance use—**We defined early use of alcohol and marijuana as use initiated before age 14. This definition was based on the fact that most individuals in the United States enter high school at this age, as well as on published findings concerning early substance use and use disorders (Libby et al., 2004; Degenhardt et al., 2007; Hingson et al., 2006) and the age distributions of first use of alcohol and marijuana among AI-SUPERPFP respondents (O'Connell et al., 2007; Whitesell et al., 2007). Among those who reported use of either or both substances, early substance use was defined as initiating use of at least one substance before age 14.

**Type of initiating substance—**In our previous studies, we found many AIs reported their first use of marijuana before or at the same age as their first use of alcohol; we refer to this pattern of substance use initiation as *atypical initiation* (Novins et al., 2001; Novins & Barón, 2004; O'Connell et al., 2007). We therefore classified persons with histories of both alcohol and marijuana use by initiating substance as follows: (1) alcohol alone or (2) atypical initiation.

**Substance abuse and dependence—**Using questions from the UM-CIDI, substance abuse and dependence were defined using diagnostic criteria published in the Diagnostic and Statistical Manual of Mental Disorders DSM-IV (American Psychiatric Association, 1987). We examined lifetime alcohol and marijuana abuse and dependence separately and then together, as the overwhelming majority (93.5%) of persons who used marijuana also used alcohol.

## Analytic methods

Variable construction was completed using the SPSS (Norusis, 2001) and SAS (SAS Institute Inc., 2001) statistical packages; descriptive and inferential analyses were conducted in STATA (Stata, 2001) using sample and non-response weights. We first examined bivariate associations between substance use, substance use initiation and substance use disorders by age, gender and tribe. Significant differences among gender/tribal groups were identified by non-overlapping confidence intervals. Significant differences across the three age groups within the same gender/tribal group were identified using logistic regression. Differences at the level of $p < 0.01$ are noted for both types of comparisons.

Second, we estimated multivariate logistic regressions to evaluate associations between patterns of early and combined substance use and age with lifetime abuse and dependence among substance users. The estimated coefficients are reported in the form of adjusted odds ratios (ORs) with 95% confidence intervals (CIs).

## Results

### Lifetime use of alcohol and marijuana

The prevalence of lifetime alcohol and lifetime marijuana use was similar among NP and SW males and NP females. Rates of alcohol use ranged from 67.1% to 74.6% and marijuana use ranged from 33.6% to 43.3% (see Table I). In contrast, lifetime use of alcohol and marijuana was significantly lower ($p < 0.01$) among SW females: 38.7% reported alcohol use and 18.0% reported marijuana use. Differences in age-specific prevalence rates for alcohol and marijuana use by gender and tribe were for the most part similar to those reported for all ages.

As only a small percentage of the sample reported lifetime use of marijuana without any alcohol use, rates of use of either substance were similar to those for alcohol use, and rates of combined use were similar to those for marijuana use. The prevalence of combined substance use among NP and SW males was 40.4% and 31.4%, respectively. NP females were significantly less likely than NP males to use both substances (29.8%, $p < 0.01$), and only 12.8% of SW females reported combined substance use.

Within gender/tribal groups, we observed little variation in alcohol use rates by age except among SW males. Lifetime alcohol use was 75.5% among SW males aged 40 years and older and 58.8% among SW males less than 30 years old ($p < 0.01$). However, rates of lifetime marijuana use did vary by age among SW males and females and NP females. Among these AIs, lifetime marijuana use among the youngest age group (persons less than 30 years old) ranged from 29.5% to 44.8%; these rates were statistically higher ($p < 0.01$) than those of AIs age 40 years and older.

### Age of first use of alcohol and marijuana

Approximately 30% of NP and SW male drinkers initiated alcohol use before age 14 years (see Table II). The percent of NP female drinkers who reported first use of alcohol before age 14 did not differ from that reported by males (26.1% for NP females as compared to 33.9% and 29.5% for NP and SW males, respectively). Only 15.6% of SW female drinkers reported early alcohol use. Although age of first alcohol use did not vary by age group among male drinkers, the percent of NP and SW female drinkers who reported initiating alcohol use before age 14 was higher ($p < 0.01$) in the youngest age group. For example, the prevalence of early use was 16.8% among NP female drinkers aged 40 years and older and 35.2% among NP female drinkers less than 30 years old.

Approximately 20% of NP and SW male and NP female marijuana users reported initiating use before age 14. Although only 9.0% of SW female marijuana users reported early use of marijuana, the prevalence of early use among SW females did not differ statistically from the prevalence among NP and SW males or NP females. Among NP and SW males and NP

females, differences across age groups were significant ($p < 0.01$) with one-third of the marijuana users in the youngest age group reporting early marijuana use.

Rates of early substance use among persons who reported use of either substance were similar to those of drinkers. Approximately 40% of NP and SW males and NP females who reported combined use initiated use of alcohol and/or marijuana by age 14; the rate among SW females with combined use was 27.3. Age group differences were significant among the NP females who reported combined use ($p < 0.01$); 54.9% in the youngest age group reported early substance use.

### Type of initiating substance

Among all persons who reported combined substance use, the prevalence of atypical substance use initiation (initiating substance use with marijuana with or without alcohol, rather than alcohol alone) ranged from 35.2% to 53.7% (see Table II). There were no significant differences by gender or tribe. The prevalence of atypical initiation varied by age among NP and SW males and NP females and was generally highest in the youngest age group ($p < 0.01$). For example, the percent of respondents in the youngest age group who reported atypical initiation ranged from 48.8% to 55.0%, compared to 10.8% to 23.5% for the oldest age group.

### Lifetime substance use disorders

For both tribal groups, the prevalence of lifetime alcohol disorders among lifetime drinkers was significantly higher ($p < 0.01$) for males than females. Over half of NP and SW male drinkers met criteria for a lifetime alcohol use disorder. The prevalence of an alcohol use disorder among NP and SW female drinkers was 42.9% and 32.1%, respectively (see Table III).

In contrast to the prevalence of lifetime alcohol use disorders, the prevalence of lifetime marijuana use disorders among lifetime marijuana users did not vary by gender. Prevalence rates ranged from a low of 22.6% among SW females to 30.9% among SW males. We observed only one significant difference in the prevalence of alcohol or marijuana use disorders related to age group; younger NP males who used marijuana were more likely to report a marijuana use disorder than were the oldest NP male users ($p < 0.01$).

The prevalence of lifetime use disorders among AIs who reported lifetime use of either substance was similar to that of alcohol use disorders among drinkers. Nearly half of AIs who reported use of either substance had a lifetime alcohol and/or marijuana use disorder (48.5%, $n = 866$). Among those with a disorder, nearly three-quarters had alcohol abuse or dependence, 6.6% had marijuana abuse or dependence and 25.5% had both. However, approximately three-quarters of males and over half of females with combined substance use had alcohol and/or marijuana abuse or dependence.

### Correlates with lifetime substance use disorders

We estimated multivariate logistic regressions by gender to examine the associations between patterns of alcohol and marijuana initiation, age and tribe with lifetime alcohol and

marijuana abuse and dependence (see Table IV). Correlates of alcohol use disorders were remarkably similar across gender. Drinkers who initiated alcohol use before age 14 years were more than twice as likely to have an alcohol use disorder as those who initiated use at older ages (ORs of 2.31 for male and female drinkers, $p < 0.01$). Combined substance use, as compared to use of alcohol alone, was associated with significantly higher odds of alcohol abuse and dependence. The odds among females who used both substances were 1.82 ($p < 0.05$) for those who initiated use with alcohol first and 3.33 ($p < 0.01$) for those who reported atypical initiation.

Correlates of lifetime marijuana use disorders differed by gender. Among males, age was significantly associated with marijuana use disorders while among females, patterns of substance use were. More specifically, male marijuana users less than 30 years old were twice as likely as males users aged 30–39 years to have a marijuana use disorder (OR = 2.03, $p < 0.01$). For females, atypical initiation, as compared to initiating use with alcohol alone, increased the odds of a marijuana use disorder (OR = 3.48, $p < 0.01$). The odds of a marijuana use disorder among female marijuana users who did not drink were 2.45 times higher than among females who reported combined substance use and initiating use with alcohol alone ($p < 0.05$).

Early marijuana use was not found to be significantly associated with alcohol or marijuana use disorders among males or females, but it is noteworthy that early use of marijuana was correlated with atypical initiation (phi coefficient of 0.30). Equally important is that we were unable to identify a relationship between age and disorder in any of the other regressions. This finding indicates that substance users less than 30 years old were just as likely as older users to be diagnosed with an alcohol or marijuana use disorder after controlling for other variables in the regression model.

Correlates of lifetime substance use disorders among AIs who reported use of either alcohol or marijuana were very similar to those of alcohol use disorders noted above for males and females. However, the odds of either type of disorder were two to five times higher among persons who reported combined use of alcohol and marijuana ($p < 0.01$) than among those who reported use of either alcohol or marijuana. The odds of a use disorder among males who reported marijuana use, yet not alcohol use, were approximately half of those who reported only alcohol use ($p < 0.05$). In addition, NP males who reported use of either substance were less likely ($p < 0.05$) than SW males to have a use disorder, controlling for other correlates of substance use. Among those who reported lifetime combined use of alcohol and marijuana, none of the correlates included in the logistic regression significantly influenced the risk of lifetime abuse or dependence.

## Discussion and conclusions

That early alcohol use, combined use of alcohol and marijuana and atypical initiation (initiating use with marijuana with or without alcohol) were associated with a greater likelihood of abuse and dependence in this study highlight the need to increase the effectiveness of substance use prevention and treatment programs for AIs, especially among youth. This is particularly important as findings for the US general population suggest early

age of onset of alcohol use is associated with multiple and longer episodes of dependence, and meeting a wider range of dependence symptoms (Hingson et al., 2006).

In general, the AIs in the youngest age group (less than 30 years old) were more likely than those in the oldest age group to initiate substance use early and more likely to initiate substance use with marijuana with or without alcohol. These patterns of substance use initiation place them at greater risk of developing alcohol and marijuana use disorders. When we also consider that the younger AIs already had rates of substance use disorders comparable to those of their older counterparts, despite having less time between substance use initiation and age of interview, the burden of substance use among AIs with early age of onset may far exceed that among those who initiate use at older ages and may place a greater burden on substance use treatment services over time.

Although patterns of substance use among males did not differ between NP and SW males, NP males who reported use of either alcohol or marijuana were less likely than SW males to be diagnosed with a substance use disorder. Tribal differences among females were not observed. It may be that perceptions of the psychological, behavioural and physical consequences of alcohol and marijuana use differ by tribe and gender and NP males are less likely to endorse symptoms of abuse or dependence than SW males.

These findings have a number of important implications for prevention and treatment. First, patterns of early and combined substance use indicate that prevention efforts should not only target younger adolescents and their families but also focus on both alcohol and marijuana. The prevalence of lifetime alcohol or marijuana use disorders among NP and SW males and females who reported combined substance use ranged from a low of 52.5% among SW females to a high of 75.9% among SW males. Second, methods to improve early identification of youth with substance use issues should be enhanced to reduce the onset of substance use disorders and related hazards. As sovereign nations, federally recognised tribes may examine policies aimed at reducing the burden of substance use in their communities. Many statutes address the legality of sales and consumption as well as taxation (Kovas et al., 2008). Tribes may evaluate their policies concerning driving under the influence and other violations related to substance use to identify persons in need of treatment. Finally, treatment programs for youth and young adults should be evaluated with regard to access, utilisation, cultural appropriateness and comprehensiveness (Beauvais et al., 2004; Hawkins et al., 2004; Novins et al., 2004; Fickenscher et al., 2005). Comprehensive outpatient and residential programs for youth with substance use disorders are costly, and financing of such programmes is limited. Research concerning the long-term mental, physical and social outcomes of programmes is needed to inform policies concerning increasing access and resources for such services.

Limitations of the AI-SUPERPFP study design, instrumentation and sample are published elsewhere (Beals et al., 2003a). They include reliance on self-reports of psychiatric symptoms using structured protocols to assess the prevalence of substance use disorders. Retrospective reporting of age of first use may be subject to reporting bias, particularly for older persons who are reporting about events that may have occurred decades ago (Labouvie et al., 1997). This bias may account for some of the differences in age of onset observed in

this study. Of note is that retrospective reporting of the rank ordering of first use of different substances was found to be more reliable than the actual specific age of first use (Labouvie et al., 1997), suggesting that our examination of combined use and atypical initiation may be particularly relevant when considering these findings among the older age groups included in this study. It is important to note that, in studies of the US population, high rates of dependence among younger adults (age 18–23 years), as compared to older adults, may be explained in part by younger adults' higher reports of dependence symptoms related to "increased tolerance" and "using more than intended"; these symptoms may mean something different to younger adults than older adults (Harford et al., 2005; Caetano & Babor, 2006; Degenhardt et al., 2007). Additional research is needed to examine symptoms of abuse and dependence reported by younger and older AIs to better understand their treatment needs (Harford et al., 2005; Caetano & Babor, 2006; Degenhardt et al., 2007). Finally, the population of inference was two reservation-based tribes, but there are over 500 federally designated tribes in the United States with considerable heterogeneity among them (U.S. Department of Health and Human Services, Substance Abuse and Mental Health Services Administration, Center for Mental Health Services, 2001). Additionally, the majority of AIs do not live on tribal lands (U.S. Census Bureau, 2003), and they may experience patterns of substance use that differ from those reported here (Beauvais, 1996; O'Connell et al., 2005). Consequently, the results of this study may not extend to other AI populations.

Despite these limitations, our findings point to three important factors related to substance use disorders: early use of alcohol, combined use of both marijuana and alcohol and initiating substance use with marijuana with or without alcohol. All of these factors should be considered in the development of prevention and treatment programmes for these communities. As younger AIs were more likely to report these patterns of use and may, therefore, be at greater risk for developing substance use disorders, the burden on treatment services – and the need for improved prevention efforts – may grow considerably as these younger AIs enter middle adulthood.

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**Table I**

Lifetime use of alcohol and marijuana by gender, tribe and age.

| | Males | | Females | |
|---|---|---|---|---|
| | Northern plains | Southwest | Northern plains | Southwest |
| | Number | Number | Number | Number |
| Age | | | | |
| <30 years | 262 | 167 | 310 | 252 |
| 30–39 years | 214 | 152 | 198 | 188 |
| 40+ years | 226 | 218 | 248 | 304 |
| All ages | 702 | 537 | 756 | 744 |

| | % | CI | % | CI | % | CI | % | CI |
|---|---|---|---|---|---|---|---|---|
| Lifetime use alcohol | | | | | | | | |
| <30 years | 74.2 | 66.3–80.8[sf] | 58.8 | 48.7–68.2[sf,t] | 60.4 | 52.8–67.6[sf] | 38.8 | 31.2–47.1[nm,sm,nf] |
| 30–39 years | 70.9 | 61.6–78.6[sf] | 63.9 | 58.9–78.0[sf,t] | 73.0 | 63.7–80.7[sf] | 38.7 | 30.0–48.2[nm,sm,nf] |
| 40+ years | 79.5 | 70.6–86.2[sf] | 75.5 | 67.1–82.4[sf,t] | 69.2 | 60.8–76.6[sf] | 38.5 | 31.2–46.3[nm,sm,nf] |
| All ages | 74.6 | 69.7–78.9[sf] | 68.1 | 62.6–73.2[sf] | 67.1 | 62.3–71.5[sf] | 38.7 | 34.0–43.5[nm,sm,nf] |
| Lifetime use marijuana | | | | | | | | |
| <30 years | 46.6 | 38.4–55.l[sf] | 44.8 | 35.2–54.9[t] | 36.5 | 29.4–44.3[t] | 29.5 | 22.7–37.5[nm,t] |
| 30–39 years | 42.3 | 33.5–51.7[sf] | 39.0 | 29.3–50.0[sf,t] | 38.7 | 29.8–48.4[sf,t] | 16.8 | 10.9–25.0[nm,sm,nf,t] |
| 40+ years | 40.6 | 32.0–49.8[sf] | 25.8 | 18.6–34.9[sf,t] | 24.9 | 18.0–33.3[sf,t] | 7.8 | 4.4–13.5[nm,sm,nf,t] |
| All ages | 43.3 | 38.2–48.5[sf] | 36.2 | 30.9–41.8[sf] | 33.6 | 29.0–38.6[sf] | 18.0 | 14.6–22.1[nm,sm,nf] |
| Lifetime use of alcohol and/or marijuana | | | | | | | | |
| <30 years | 76.9 | 69.2–83.2[sf] | 66.1 | 56.0–74.8 | 66.5 | 59.0–73.2[sf] | 48.8 | 40.7–57.0[nm,nf] |
| 30–39 years | 73.7 | 64.6–81.2[sf] | 74.6 | 64.5–82.6[sf] | 75.7 | 66.6–83.0[sf] | 42.9 | 33.9–52.4[nm,sm,nf] |
| 40+ years | 82.4 | 73.8–88.6[sf] | 77.5 | 69.3–84.1[sf] | 71.6 | 63.3–78.7[sf] | 40.0 | 32.7–47.8[nm,sm,nf] |
| All ages | 77.4 | 72.7–81.5[sf] | 72.9 | 67.6–77.6[sf] | 71.0 | 66.3–75.2[sf] | 43.9 | 39.2–48.8[nm,sm,nf] |
| Lifetime combined substance use | | | | | | | | |
| <30 years | 43.9 | 35.8–52.3[sf] | 37.6 | 28.5–47.7[sf,t] | 30.5 | 23.7–38.2 | 19.6 | 13.9–26.9[nm,sm,t] |
| 30–39 years | 39.5 | 30.9–48.8[sf] | 33.6 | 24.5–44.1[sf,t] | 36.0 | 27.3–45.7[sf] | 12.6 | 7.6–20.2[nm,sm,nf,t] |
| 40+ years | 37.8 | 29.4–46.9[sf] | 23.8 | 16.8–32.4[sf,t] | 22.4 | 15.9–30.7[sf] | 6.2 | 3.2–11.6[nm,sm,nf,t] |

| | % | CI | % | CI | % | CI | % | CI |
|---|---|---|---|---|---|---|---|---|
| All ages | 40.4 | 35.5–45.6[sf] | 31.4 | 26.4–36.9[sf] | 29.8 | 25.3–34.6[nm,sf] | 12.8 | 9.8–16.4[nm,sm,nf] |

Note: CI indicates confidence intervals calculated at the 99% level. The superscripts nm, sm, nf and sf indicate American Indian Northern Plains and Southwest males and Northern Plains and Southwest females, respectively, and are used to indicate significant ($p < 0.01$) pairwise comparisons between gender/culture groups. Statistically significant differences ($p < 0.01$) within one gender/culture group among the three age groups (<30 years, 30–39 years, 40+ years) are indicated through use of the superscript t. Lifetime combined substance use is lifetime use of both alcohol and marijuana.

**Table II**

Age of first substance use and atypical progression of use among lifetime substance users by gender, tribe and age.

| | Males | | | | Females | | | |
|---|---|---|---|---|---|---|---|---|
| | Northern plains | | Southwest | | Northern plains | | Southwest | |
| | % | CI | % | CI | % | CI | % | CI |
| Lifetime alcohol users | | | | | | | | |
| First used alcohol <14 years | | | | | | | | |
| <30 years | 31.3 | 23.0–40.9 | 29.5 | 19.1–42.7 | 35.2 | 26.2–45.5[t] | 25.3 | 15.6–38.2[t] |
| 30–39 years | 34.7 | 25.3–45.6 | 29.6 | 19.4–42.2 | 25.6 | 16.9–36.7[t] | 13.2 | 5.9–26.9[t] |
| 40+ years | 35.6 | 26.6–45.7[nf,sf] | 29.3 | 20.8–39.7[sf] | 16.8 | 10.2–26.3[nm,t] | 8.2 | 3.5–17.7[nm,sm,t] |
| All ages | 33.9 | 28.5–39.7[sf] | 29.5 | 23.6–36.1[sf] | 26.1 | 21.0–31.9 | 15.6 | 10.8–22.1[nm,sm] |
| Lifetime marijuana users | | | | | | | | |
| First used marijuana < 14 years | | | | | | | | |
| <30 years | 29.0 | 19.1–41.3[t] | 27.8 | 16.5–42.9[t] | 32.6 | 21.4–46.2[t] | 13.0 | 5.8–26.6 |
| 30–39 years | 21.3 | 12.1–34.8[sf,t] | 20.3 | 9.9–37.0[sf,t] | 21.8 | 11.4–37.8[sf,t] | 5.8 | 0.9–29.0 |
| 40+ years | 3.8 | 0.6–20.1[t] | 6.7 | 15.1–25.2[sf,t] | 2.8 | 2.1–28.0[t] | 0.0 | 0.0–11.9[sm] |
| All ages | 19.1 | 13.7–26.1 | 19.8 | 13.3–28.6 | 22.0 | 15.3–30.4 | 9.0 | 4.3–17.9 |
| Lifetime users of alcohol and/or marijuana | | | | | | | | |
| First used either substance <14 years | | | | | | | | |
| <30 years | 38.2 | 29.4–47.8 | 35.3 | 24.6–47.8 | 40.3 | 31.2–50.1[t] | 24.2 | 15.6–35.6[t] |
| 30–39 years | 37.6 | 28.0–48.2 | 29.3 | 19.5–41.4 | 28.8 | 19.8–39.8[t] | 13.0 | 6.1–25.7[t] |
| 40+ years | 34.9 | 26.2–44.8 | 28.6 | 20.2–38.7 | 17.5 | 10.9–27.1[t] | 7.8 | 3.4–17.0[t] |
| All ages | 36.9 | 31.5–42.7 | 30.8 | 25.0–37.2 | 29.4 | 24.2–35.2 | 15.7 | 11.1–21.7 |
| Lifetime combined substance use | | | | | | | | |
| First used either substance <14 years | | | | | | | | |
| <30 years | 43.0 | 31.0–55.9 | 41.5 | 26.7–57.9 | 54.9 | 40.5–68.6[t] | 35.9 | 20.6–54.7 |
| 30–39 years | 42.9 | 29.3–57.6 | 49.0 | 31.7–66.7 | 40.4 | 25.7–57.0[t] | 24.0 | 8.5–51.6 |
| 40+ years | 39.3 | 25.8–54.6 | 37.3 | 21.3–56.7 | 29.4 | 15.0–49.5[t] | 6.4 | 0.5–49.9 |
| All ages | 41.9 | 34.1–50.1 | 43.0 | 33.2–53.3 | 43.5 | 34.4–53.0 | 27.3 | 16.9–40.9 |
| Lifetime combined substance use | | | | | | | | |
| Atypical initiation | | | | | | | | |

| | Males | | | | Females | | | |
|---|---|---|---|---|---|---|---|---|
| | Northern plains | | Southwest | | Northern plains | | Southwest | |
| | % | CI | % | CI | % | CI | % | CI |
| <30 years | 55.0 | 37.4–62.6[t] | 48.8 | 33.1–64.7[t] | 54.1 | 39.6–67.9[t] | 53.0 | 35.0–70.3 |
| 30–39 years | 45.9 | 31.9–60.5[t] | 39.1 | 23.4–57.5[t] | 52.6 | 36.6–68.1[t] | 63.1 | 36.3–83.6 |
| 40+ years | 13.5 | 6.1–27.3[t] | 10.8 | 3.4–29.7[t] | 23.5 | 10.9–43.5[t] | 39.6 | 14.2–72.2 |
| All ages | 38.2 | 30.7–46.4 | 35.2 | 26.1–45.6 | 46.5 | 37.2–56.0 | 53.7 | 40.0–66.9 |

Note: CI indicates confidence intervals calculated at the 99% level. The superscripts nm, sm, nf and sf indicate American Indian Northern Plains and Southwest males and Northern Plains and Southwest females, respectively, and are used to indicate significant ($p < 0.01$) pairwise comparisons between gender/culture groups. Statistically significant differences ($p < 0.01$) within one gender/culture group among the three age groups (<30 years, 30–39 years, 40+ years) are indicated through use of the superscript t. Lifetime combined substance use is lifetime use of both alcohol and marijuana. Atypical initiation among lifetime combined substance users refers to initiating substance use with marijuana, with or without alcohol, as compared to initiating substance use with alcohol alone.

**Table III**

The prevalence of lifetime dependence and abuse among lifetime substance users by gender, tribe and age.

| | Males | | | | Females | | | |
|---|---|---|---|---|---|---|---|---|
| | Northern plains | | Southwest | | Northern plains | | Southwest | |
| | % | CI | % | CI | % | CI | % | CI |
| Lifetime alcohol users | | | | | | | | |
| Lifetime alcohol dependence/abuse | | | | | | | | |
| <30 years | 55.7 | 45.9–65.1[sf] | 57.8 | 44.6–70.0[sf] | 39.3 | 29.8–49.7 | 31.4 | 20.7–44.5[nm,sm] |
| 30–39 years | 54.8 | 43.9–65.2 | 61.0 | 48.2–72.4[sf] | 44.3 | 33.5–55.6 | 31.8 | 19.5–37.3[sm] |
| 40+ years | 58.3 | 48.2–67.7[sf] | 61.0 | 50.5–70.5[sf] | 45.3 | 35.2–55.8 | 33.0 | 22.2–45.9[nm,sm] |
| All ages | 56.2 | 50.3–62.0[nf,sf] | 60.1 | 53.2–66.6[nf,sf] | 42.9 | 36.9–49.1[nm,sm] | 32.1 | 25.2–39.8[nm,sm] |
| Lifetime marijuana users | | | | | | | | |
| Lifetime marijuana dependence/abuse | | | | | | | | |
| <30 years | 41.9 | 30.4–54.4[t] | 38.1 | 25.0–53.2 | 26.6 | 16.7–39.5 | 24.0 | 13.7–38.6 |
| 30–39 years | 25.8 | 15.4–39.9[t] | 23.8 | 12.4–40.9 | 29.6 | 17.2–45.9 | 19.5 | 7.0–43.9 |
| 40+ years | 22.3 | 12.3–37.2[t] | 29.5 | 15.5–48.7 | 21.2 | 10.3–38.7 | 23.0 | 6.5–56.1 |
| All ages | 30.7 | 23.9–38.4 | 30.9 | 22.8–40.4 | 26.5 | 19.4–35.0 | 22.6 | 14.4–33.6 |
| Lifetime users of alcohol and/or marijuana | | | | | | | | |
| Lifetime alcohol and/or marijuana dependence/abuse | | | | | | | | |
| <30 years | 58.7 | 49.1–67.8[nf,sf] | 58.7 | 46.2–70.2[sf] | 39.1 | 30.1–48.9[nm] | 33.4 | 23.5–45.1[nm,sm] |
| 30–39 years | 54.8 | 44.1–65.0 | 61.1 | 48.8–72.2[sf] | 44.5 | 33.9–55.6 | 33.8 | 21.7–48.4[sm] |
| 40+ years | 56.8 | 46.8–66.2[sf] | 60.2 | 49.9–69.7[sf] | 45.2 | 35.2–55.6 | 32.9 | 22.2–45.6[nm,sm] |
| All ages | 56.7 | 50.9–62.4[nf,sf] | 60.1 | 53.4–66.4[nf,sf] | 42.8 | 37.0–48.8[nm,sm] | 33.3 | 26.8–40.6[nm,sm] |
| Lifetime combined substance users | | | | | | | | |
| Lifetime alcohol and/or marijuana dependence/abuse | | | | | | | | |
| <30 years | 71.6 | 59.0–81.6 | 72.4 | 55.7–84.6 | 58.5 | 43.9–71.8 | 51.0 | 33.2–68.5 |
| 30–39 years | 71.4 | 56.8–82.6 | 76.5 | 58.0–88.4 | 58.4 | 42.0–73.1 | 46.1 | 22.8–71.2 |
| 40+ years | 80.1 | 66.3–89.2 | 80.3 | 60.6–91.5 | 54.0 | 35.5–71.4 | 68.3 | 35.0–89.6 |
| All ages | 73.9 | 66.3–80.4 | 75.9 | 66.1–83.6 | 57.4 | 47.9–66.4 | 52.5 | 38.9–65.8 |

Note: CI indicates confidence intervals calculated at the 99% level. The superscripts nm, sm, nf and sf indicate American Indian Northern Plains and Southwest males and Northern Plains and Southwest females, respectively, and are used to indicate significant ($p < 0.01$) pairwise comparisons between gender/culture groups. Statistically significant differences ($p < 0.01$) within one gender/culture group

among the three age groups (<30 years, 30–39 years, 40+ years) are indicated through use of the superscript t. Lifetime combined substance use is lifetime use of both alcohol and marijuana. Atypical initiation among lifetime combined substance users refers to initiating substance use with marijuana, with or without alcohol, as compared to initiating substance use with alcohol alone.

## Table IV

Correlates of lifetime alcohol and marijuana dependence and abuse among lifetime substance users by gender.

| | Male lifetime drinkers | | Female lifetime drinkers | |
|---|---|---|---|---|
| **Lifetime alcohol dependence/abuse** | **OR** | **CI** | **OR** | **CI** |
| First used alcohol <14 years | 2.31** | 1.63–3.27 | 2.31** | 1.51–3.52 |
| First used alcohol at an older age | 1.00 | | 1.00 | |
| First used marijuana <14 years | 1.01 | 0.54–1.91 | 1.37 | 0.67–2.81 |
| First used marijuana at an older age or non-user | 1.00 | | 1.00 | |
| Combined substance use, initiated with alcohol | 3.04** | 2.14–4.30 | 1.82* | 1.20–2.77 |
| Combined substance use, atypical initiation | 3.93** | 2.44–6.35 | 3.33** | 2.07–5.36 |
| Used only alcohol[a] | 1.00 | | 1.00 | |
| Northern Plains | 0.74 | 0.55–1.00 | 1.37 | 0.98–1.91 |
| Southwest | 1.00 | | 1.00 | |
| Age <30 years | 0.88 | 0.60–1.29 | 0.71 | 0.47–1.07 |
| Age 30–39 years[a] | 1.00 | | 1.00 | |
| Age 40+ years | 1.31 | 0.92–1.89 | 1.42 | 0.94–2.15 |

| | Male lifetime marijuana users | | Female lifetime marijuana users | |
|---|---|---|---|---|
| **Lifetime marijuana dependence/abuse** | **OR** | **CI** | **OR** | **CI** |
| First used alcohol <14 years | 1.39 | 0.83–2.33 | 1.87 | 0.97–3.59 |
| First used alcohol at an older age or non-user | 1.00 | | 1.00 | |
| First used marijuana <14 years | 1.16 | 0.64–2.08 | 1.06 | 0.49–2.26 |
| First used marijuana at an older age | 1.00 | | 1.00 | |
| Combined substance use, initiated with alcohol | 1.00 | | 1.00 | |
| Combined substance use, atypical initiation | 1.33 | 0.80–2.22 | 3.48** | 1.79–6.79 |
| Used only marijuana[a] | 0.86 | 0.40–1.83 | 2.45* | 1.12–5.35 |
| Northern Plains | 0.99 | 0.65–1.50 | 1.23 | 0.71–2.14 |
| Southwest | 1.00 | | 1.00 | |
| Age <30 years | 2.03** | 1.24–3.32 | 0.92 | 0.50–1.68 |
| Age 30–39 years[a] | 1.00 | | 1.00 | |
| Age 40+ years | 1.10 | 0.62–1.97 | 1.04 | 0.48–2.26 |

| | Male lifetime users of alcohol and/or marijuana | | Female lifetime users of alcohol and/or marijuana | |
|---|---|---|---|---|
| **Lifetime alcohol and/or marijuana dependence/abuse** | **OR** | **CI** | **OR** | **CI** |
| First used alcohol <14 years | 2.27** | 1.61–3.21 | 2.16** | 1.45–3.24 |
| First used alcohol at an older age or non-user | 1.00 | | 1.00 | |
| First used marijuana <14 years | 1.22 | 0.64–2.33 | 1.23 | 0.63–2.42 |
| First used marijuana at an older age | 1.00 | | 1.00 | |

| Lifetime alcohol and/or marijuana dependence/ abuse | Male lifetime users of alcohol and/or marijuana | | Female lifetime users of alcohol and/or marijuana | |
|---|---|---|---|---|
| | OR | CI | OR | CI |
| Combined substance use, initiated with alcohol | 3.22** | 2.26–4.57 | 1.96** | 1.30–2.96 |
| Combined substance use, atypical initiation | 4.81** | 2.94–7.88 | 4.12** | 2.58–6.58 |
| Used only marijuana | 0.44* | 0.21–0.93 | 0.98 | 0.51–1.88 |
| Used only alcohol[a] | 1.00 | | 1.00 | |
| Northern Plains | 0.70* | 0.52–0.95 | 1.24 | 0.90–1.70 |
| Southwest | 1.00 | | 1.00 | |
| Age <30 years | 0.96 | 0.65–1.40 | 0.76 | 0.51–1.12 |
| Age 30–39 years[a] | 1.00 | | 1.00 | |
| Age 40+ years | 1.23 | 0.86–1.76 | 1.35 | 0.91–2.02 |

| Lifetime alcohol and/or marijuana dependence/abuse | Male lifetime combined substance users | | Female lifetime combined substance users | |
|---|---|---|---|---|
| | OR | CI | OR | CI |
| First used alcohol <14 years | 1.46 | 0.83–2.56 | 1.42 | 0.74–2.70 |
| First used alcohol at an older age or non-user | 1.00 | | 1.00 | |
| First used marijuana <14 years | 1.74 | 0.83–3.65 | 1.66 | 0.73–3.77 |
| First used marijuana at an older age | 1.00 | | 1.00 | |
| Combined substance use, initiated with alcohol[a] | 1.00 | | 1.00 | |
| Combined substance use, atypical initiation | 1.37 | 0.79–2.39 | 1.71 | 0.96–3.03 |
| Northern Plains | 0.90 | 0.56–1.43 | 1.14 | 0.67–1.93 |
| Southwest | 1.00 | | 1.00 | |
| Age <30 years | 0.91 | 0.54–1.54 | 0.96 | 0.54–1.69 |
| Age 30–39 years[a] | 1.00 | | 1.00 | |
| Age 40+ years | 1.77 | 0.95–3.28 | 1.40 | 0.69–2.82 |

Note: OR indicates odds ratio and CI indicates confidence intervals calculated at the 95% level. Combined substance use is lifetime use of both alcohol and marijuana. Atypical initiation among lifetime alcohol and marijuana users refers to initiating substance use with marijuana with or without alcohol as compared to initiating substance use with alcohol alone.

[a]The referent groups in the logistic regressions were chosen to identify the risks associated with atypical patterns of use. The logistic regressions of alcohol dependence and abuse were estimated with the referent group being users of only alcohol. The referent group in the regression of marijuana dependence and abuse were respondents who reported combined substance use and initiating use with alcohol. We chose age 30–39 years as the referent group for the age variables to distinguish patterns of use between this age group and the youngest age group.

*Significance at the 0.05 and 0.01 level, respectively.

**Significance at the 0.05 and 0.01 level, respectively.