Age of first marijuana use and the occurrence of marijuana use disorders in Southwest California Indians

Cindy L. Ehlers [a],[*], Wendy S. Slutske [b], David A. Gilder [a], Philip Lau [a]

[a] *The Scripps Research Institute (TSRI), Department of Neuropharmacology (CVN-14), 10550 N. Torrey Pines Rd, La Jolla, CA 92037, USA*
[b] *University of Missouri, Columbia, Department of Psychological Sciences, 210 McAlester Hall, Columbia, MO 65211, USA*

Abstract

In several national surveys a younger age of substance usage has been associated with a higher likelihood of the development of dependence. Some studies have suggested that age at first use is primarily an environmentally driven variable, whereas others suggest that it may be partially mediated by a general vulnerability to exhibit problem behaviors. Although Native Americans, overall, have the highest prevalence of substance dependence of any US ethnic group, the relationship of age of first marijuana use on the development of dependence in Native American populations is relatively unknown. Demographic information and DSM-III-R diagnoses were obtained from 525 Southwest California Indian adults residing on contiguous reservations. Multinomial logistic regression was used to investigate the relationship between age of first use and marijuana use disorders. Early marijuana use was found to be strongly associated with abuse and dependence in this population, even in the presence of several other risk factors including externalizing diagnoses. These data suggest that effective environmental prevention efforts at reducing early marijuana use may be an important strategy to lower the prevalence of use disorders in this high risk population.
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1. Introduction

Marijuana is the most widely used illicit substance among Native and non-Native American adolescents and represents a major public health concern (Grob and Dobkin de Rios, 1992; US Congress, 1990). Data on lifetime use of marijuana in graduating high school seniors in the US has shown that use drastically increased from the 1960s to the 1970s and then began declining modestly and leveling off in the early 1980s (Swadi, 1992); perhaps followed by a reversal in that trend since 1992 (Johnston et al., 1975). Generally, these trends appear to be similar for Native American youth as well (Beauvais, 1996). However, over this time span several studies have demonstrated that the use of marijuana is disproportionately higher among Native than non-Native American adolescents (Bachman et al., 1991; Beauvais, 1992, 1996; Blum et al., 1992; Federman et al., 1997; Gfellner, 1994). As an example, Beauvais (1992) reported that Native

American adolescents living on reservations had 30-day and lifetime marijuana use rates of 33% and 77% respectively, as compared to non-Native adolescents with reported rates of 13% and 38%. Other studies have reported that thirty day and lifetime prevalence rates of marijuana use are 2–3 times higher in Native American high school seniors as compared to non-Natives (Plunkett and Mitchell, 2000).

While a number of studies have reported higher prevalence rates of drug use, few studies have employed instruments that allowed for the identification of use disorders in Native American adolescents. In one study DSM-III-R diagnoses were estimated in a sample of 109 Indian adolescents 14–16 years of age who were living on a reservation in the northern plains (Beals et al., 1997). They found that the 6 months prevalence of marijuana use disorders was 8.6%, as compared to a lifetime prevalence of 5.4% reported by Lewinsohn et al. (1993) in their mostly Caucasian sample (the Oregon Adolescent Depression project).

The etiological factors responsible for the higher prevalence of marijuana use and use disorders in Native Americans are largely unknown. In studies in the majority population, both genetic and

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environmental influences have been suggested to account for the variation in marijuana use, approximately in equal proportion (Tsuang et al., 1996; Kendler and Prescott, 1998; van den Bree et al., 1998; Kendler et al., 2000; Lynskey et al., 2002). Some psychosocial factors that may account for increased prevalence of marijuana use in Native American adolescents have been proposed such as: life stress (King and Thayer, 1993), lower grades in school, antisocial behavior, the use of alcohol and other illicit substances (Novins and Mitchell, 1998). All of these factors may be a result of marijuana use and not necessarily pre-disposing factors. Beauvais and colleagues have emphasized that Indian culture or traditions are not causative (see Beauvais et al., 1985; Oetting et al., 1989; Beauvais, 1992; Bates et al., 1997). Although marijuana dependence has a high heritability in Southwest California Indians, specific genetic factors and the genes that encode for them are as yet undiscovered (Wilhelmsen and Ehlers, 2005).

Prior research in non-Native populations provides good evidence that early marijuana use is associated with both persistent use, abuse and involvement with a wider range of substances, and negative social consequences (see Brook et al., 1999; 2002; Clark et al., 1998; Fergusson et al., 1996; Jessor and Jessor, 1977; Kandel, 1982; Kandel et al., 1978; Lynskey and Hall, 2000; Lynskey et al., 2003; Perkonigg et al., 1999; Robins and Przybeck, 1985). Mitchell et al. (1999) conducted one of the only longitudinal investigations of marijuana usage among Native American adolescents. They found that Native youth followed a trajectory of increased marijuana use during middle to late adolescence that slowed about age 16 and then tapered off around age 18. Longitudinal studies of the transitions between marijuana use–abuse–dependence have not been investigated in Native American adolescents.

The present report is part of a larger study exploring risk factors for substance dependence among Southwest California Indians (collectively called Mission Indians) (Ehlers et al., 2004a,b,c,d; Ehlers and Wilhelmsen, 2005, 2006; Garcia-Andrade et al., 1996, 1997; Gilder et al., 2004; Wall et al., 2003). In this study, the Semi-structured Assessment for the Genetics of Alcoholism (SSAGA) was employed to evaluate a sample of 525 reservation dwelling Southwest California Indians from eight contiguous reservations. The specific goals of this report were to examine the association between age of first marijuana use and marijuana use disorders (abuse and dependence) in Southwest California Indians, and to determine the significance of age of first marijuana use, in the context of several other indicators of problem behaviors, in relationship to the development of abuse and dependence.

2. Material and methods

2.1. Subjects

Participants were recruited from eight geographically contiguous reservations with a total population of about 3000 individuals, using a combination of a venue-based method for sampling hard-to-reach populations (Kalton and Anderson, 1986; Muhib et al., 2001), as well as a respondent-driven procedure

(Heckathorn, 1997) as previously described (Ehlers et al., 2004b; Gilder et al., 2004). The venues for recruitment included: tribal halls and culture centers, health clinics, tribal libraries, and stores on the reservations. A 10–25% rate of refusal was found depending on venue. Refusal rates were higher at tribal libraries and stores than health clinics and tribal halls/culture centers. Transportation from home to The Scripps Research Institute was provided by the study.

To be included in the study, participants had to be SWC Indian, at least 1/16th Native American Heritage (NAH), between the age of 18 and 70 years, and be mobile enough to be transported from his or her home to the General Clinical Research Center (GCRC) of The Scripps Research Institute (TSRI). The protocol for the study was approved by the Institutional Review Board (IRB) of TSRI, the Scientific Advisory Committee of the GCRC, and the Indian Health Council, a tribal review group overseeing health issues for the reservations where recruitment was undertaken.

2.2. Measures

Potential participants first met individually with research staff to have the study explained and give written informed consent. During a screening period, participants had blood pressure and pulse taken, and completed a questionnaire that was used to gather information on demographics, personal medical history, ethnicity, and drinking history (Schuckit, 1985). Each participant also completed an interview with the SSAGA (Bucholz et al., 1994) which was used to make substance use disorder and psychiatric disorder diagnoses according to DSM-III-R criteria (American Psychiatric Association, 1987). The SSAGA is a fully structured, poly-diagnostic psychiatric interview that has undergone both reliability and validity testing (Bucholz et al., 1994; Hesselbrock et al., 1999). It has been used in another Native American sample (Hesselbrock et al., 2000, 2003). Interviewers were trained by personnel from the COGA. The SSAGA interview includes retrospective lifetime assessments of marijuana use, abuse, and dependence.

Among those participants who had ever used marijuana or hashish, age of first marijuana use was assessed with the question "how old were you the first time you used marijuana?". The SSAGA was also used to make a lifetime diagnosis of marijuana abuse or dependence, conduct disorder, antisocial personality disorder (ASPD), and any anxiety/depressive disorder defined as: any of four anxiety disorders (panic disorder with or without agoraphobia, agoraphobia without panic, social phobia, and obsessive–compulsive disorder) and/or three affective disorders (major depressive disorder, bipolar I disorder, and dysthymic disorder) according to DSM-III-R criteria (American Psychiatric Association, 1987). All best final diagnoses were made by a research psychiatrist/addiction specialist.

2.3. Data analyses

The data analyses were based on the specific aims, the first aim of which was to determine the influence of age of first having tried marijuana on the occurrence of marijuana abuse and dependence. For these analyses, chi-square was used to

compare the number of individuals who developed abuse, dependence or no marijuana use disorders based on the age at which they had first tried the drug (<12 vs. >12; <13 vs. >13; <14 vs. >14; ≤15 vs. >15; ≤16 vs. >16; ≤17 vs. >17; ≤18 vs. >18; ≤19 vs. >19; ≤20 vs. >20; ≤21 vs. >21). The second aim of the study was to determine the significance of age of first trying marijuana on the development of marijuana abuse and dependence in the context of several other indicators of problems behaviors. A multinomial logistic regression analysis for marijuana dependence (yes or no) and abuse (yes or no) (vs. no use disorders as a reference) was conducted using the following risk variables: gender (M vs. F), Native American Heritage (<50% vs. >50% NAH), having a lifetime diagnosis of conduct disorder (yes or no), and having a diagnosis of antisocial personality disorder (ASPD) (yes or no), age over 30 (vs. thirty or under), being a high school dropout (or not), married (or not), having "any affective or anxiety disorder" defined as DSM-III-R any of four anxiety disorders (panic disorder with or without agoraphobia, agoraphobia without panic, social phobia, and obsessive–compulsive disorder) and/or three affective disorders (major depressive disorder, bipolar I disorder, and dysthymic disorder) (Gilder et al., 2004). The variance explained by this model was compared to the same model with the addition of age of first marijuana use on or before the age of 15 (yes or no). Participants with missing data were not included in those analyses (*n*=3).

3. Results

3.1. Demographic characteristics

Overall, the demographic characteristics [mean±SD: age (30.5±12.0 yrs), gender (41% male, 59% female) median

Table 2
Multinomial logistic regression analysis of DSM-III-R marijuana abuse and dependence (vs. no use disorder) not including age of onset of marijuana use

Variable	MJ abuse (*n*=58)			MJ dependence (*n*=173)		
	B	SE	Odds ratio	*B*	SE	Odds ratio
Male	0.14	0.32	1.15	0.73	0.21	2.1***
Native Am heritage	0.22	0.30	1.24	0.32	0.20	1.4
Age over 30	−0.28	0.33	0.76	−0.04	0.22	0.9
High school dropout	−0.15	0.31	0.86	0.28	0.20	1.3
ASPD (Antisocial Personality Disorder)	0.57	0.55	1.77	1.22	0.32	3.4***
CD (Conduct Disorder)	1.73	0.49	5.62**	1.16	0.42	3.2**
Not married	−0.38	0.37	0.69	0.15	0.28	1.16
Any anxiety or affective disorder	−0.007	0.38	0.99	0.09	0.26	1.1

In this table the results of a multinomial logistic regression are presented. In the first column the variables that are entered into the model are listed and the results are presented for the two outcomes: MJ abuse and MJ dependence in the second and third column. In this model only having a CD diagnosis was a significant predictor of MJ abuse whereas being male, and having a CD or an ASPD diagnosis were significant predictors of MJ dependence. The amount of variance explained by this model was 0.13 (Nagelkerke R^2). **$p<0.01$, ***$p<0.001$.

income ($28 K±0.2), percent unemployed (65%), educational attainment (11.6±1.6 yrs) and family status (single=28%, married/co-habitating=57%, divorced/widowed=9%)] of this sample are similar to available information for this tribe in the US census (United States Census Bureau, 1990) and have been reported previously for a smaller sample (Ehlers et al., 2004a,b). Of the 525 individuals evaluated in this sample, 173 (33%) met criteria for a lifetime DSM-III-R diagnosis of marijuana dependence and an additional 58 (11%) for marijuana abuse. Eighty-

Table 1
Age of onset of trying MJ on the development of abuse and dependence

Age at 1st MJ use	NO MJ use disorder	%	MJ abuse	%	Chi square	MJ dep	%	Chi square	Total	%
≤12	18	21%	14	16%	19.02*	55	63%	43.24*	87	17%
13	27	47%	6	11%	11.83*	24	42%	42.11*	57	11%
14	26	41%	7	11%	12.10*	31	48%	61.94*	64	12%
15	25	40%	7	12%	14.02*	30	48%	89.87*	62	12%
16	43	61%	11	16%	17.84*	16	23%	73.01*	70	13%
17	28	80%	4	11%	15.66*	3	9%	53.02*	35	7%
18	19	65%	3	10%	15.41*	7	24%	52.53*	29	6%
19	10	71%	2	14%	16.45*	2	14%	48.65*	14	3%
20	4	100%	0	0%	15.16*	0	0%	45.79*	4	1%
≥21	30	77%	3	8%	12.93*	6	15%	39.30*	39	7%
No MJ use	64	100%	0	0%	NA	0	0%	NA	64	12%
Total	294	56%	57	11%	NA	174	33%	NA	525	100%

In the first column, the ages that a participant could have first (1st) "tried" marijuana (MJ) are given. In the second column the number of participants at the age listed in column 1, who tried MJ and had not developed a MJ use disorder at interview is given in each corresponding row, followed by the percentage of those individuals compared to the total number "tried at that age" in the third column. In the fourth column the number of participants who had a MJ abuse diagnosis at interview who had tried MJ at the ages listed in column 1 is given followed by the percent of the total who tried at that age in the fifth column. The chi square values in the sixth column (*df*=1, for all analyses) are from a 2×2 contingency table comparing 1) participants at ≤ age listed for 1st MJ use in the corresponding row vs. 2) participants > that age for 1) no MJ use disorder vs 2) MJ abuse. In the seventh column the number of participants with MJ dependence at interview who had tried MJ at the ages listed in column 1 is given followed by the percent of the total who tried at that age in the eighth column. The chi square values in the ninth column (*df*=1, for all analyses) are from a 2×2 contingency table comparing 1) participants at ≤ age listed for 1st MJ use in the corresponding row vs. 2) participants > that age for 1) no MJ dependence vs 2) MJ dependence. In the tenth column the total number of participants that tried MJ at the corresponding ages listed in column 1 is given followed by the percentage of the total number of participants in the last column. *p values less than 0.0001.

eight (87%) percent of the population reported having ever used marijuana with a mean age of trying the drug of 15.45+4.91 (mean±SD).

3.2. The association between age of marijuana use and the development of abuse and dependence

The probability of having a lifetime marijuana dependence diagnosis was significantly associated with the age of first trying the drug. Table 1 presents data on the number of individuals, and the percent of the population, that have a lifetime diagnosis of marijuana dependence or abuse based on their age at having first tried the drug. Age at first trying the drug had a significant impact on the likelihood that a person would develop a marijuana use disorder. Marijuana use at less than or equal to 12 yrs of age (compared to those older than 12) resulted in marijuana dependence rates of 63% versus 27% which was highly significant (chi square=43.24, df=1, p<0.00001). First marijuana use at age 15 or younger (compared to those older than 15) also resulted in a significantly higher marijuana dependence rate of 51% versus 13% (chi square=86.38, df=1, p<0.000001). In contrast, when marijuana use first occurred at age 16 or younger the rates were under 46% (but still significant when compared to those who tried over the age of 17 (10%) (chi square=70, df=1, p<0.00001).

3.3. The association between age of first marijuana use and the development of abuse and dependence in the context of other problem behaviors

Multinomial logistic regression was used to determine the significance of age of first marijuana use in the context of

Table 3
Multinomial logistic regression analyses of DSM-III-R marijuana abuse and dependence (vs. no use disorder) including age of onset of marijuana use

Variable	MJ abuse			MJ dependence		
	(n=58)			(n=173)		
	B	SE	Odds ratio	B	SE	Odds ratio
Male	0.20	0.32	1.2	0.83	0.23	2.3***
Native Am heritage	0.19	0.30	1.2	0.33	0.22	1.4
Age over 30	0.20	0.35	1.0	0.49	0.25	1.6
High school dropout	−0.20	0.31	0.82	0.15	0.23	1.2
ASPD (Antisocial Personality Disorder)	0.28	0.55	1.3	0.77	0.35	2.3*
CD (Conduct Disorder)	1.5	0.50	4.7**	0.83	0.45	1.7
Not married	−0.38	0.38	0.69	0.16	0.31	1.2
Any anxiety or affective disorder	0.06	0.38	1.0	0.23	0.28	1.3
Age 1st tried <15 yrs	1.07	0.32	2.9**	2.15	0.25	8.6***

In this table the results of a multinomial logistic regression that included age first tried MJ as a variable are presented. In the first column the variables that are entered into the model are listed and the results are presented for the two outcomes: MJ abuse and MJ dependence in the second and third column. In this model having CD and age first tried less than or equal to 15 were both significant predictors of MJ Abuse whereas being male, having ASPD, and age first tried equal to or less than 15 were significant predictors of MJ dependence. The amount of variance explained by this model was more than double 0.30 (Nagelkerke R^2) compared to the previous model that did not include the age at first try variable. *p<0.05, **p<0.01, ***p<0.001.

several other indicators of problem behaviors, on the development of marijuana use disorders. Table 2 shows the results of this logistic regression model first entering all variables except the age of first use. In this model being male, having a diagnosis of antisocial personality disorder or conduct disorder were found to be significant contributors to marijuana dependence. In comparison, only having a conduct disorder diagnosis was found to be significantly associated with marijuana abuse. In order to determine if age of first trying the drug could account for additional variance in the models, the models were also run with the addition of the age of first MJ use. As seen in Table 3, age at first MJ use had a significant impact on the development of both abuse and dependence and also substantially increased the amount of variance explained by the model. In fact, age at first marijuana use was the strongest predictor of alcohol abuse and dependence in the model. This suggests that age at first use of marijuana increases risk for the development of abuse and dependence even within the context of other predisposing variables such as gender and presence of externalizing diagnoses.

4. Discussion

In the present analyses, early age of trying marijuana in Southwest California Indians was found to be significantly associated with both marijuana abuse and dependence. Consistent with the literature in other populations of non-Indians, several other risk factors were also found to be associated with marijuana dependence in this population including: being male (for dependence but not abuse), and having an externalizing diagnosis (conduct disorder or antisocial personality disorder). Interestingly, having an internalizing diagnosis (any affective or anxiety disorder) was not found to be associated with marijuana abuse or dependence in the presence of such predictors as externalizing diagnoses and gender. A number of other demographic variables in the model were also not significantly associated with marijuana use disorders such as: Native American heritage, current age, whether they were married, and whether they had dropped out of high school.

Understanding risk factors for marijuana use in Native American children and adolescents is crucial for a number of reasons. The finding that an early age of marijuana use is more likely to lead to abuse and dependence suggests that marijuana use may be more likely also to lead to a number of problem behaviors that are associated with use disorders in younger users. From a developmental point of view, marijuana exposure during adolescence could also potentially have long lasting neuronal consequences on the brain. During this time period, rapid changes in neural organization occur, including: a reduction in the number of synapses in cortical and subcortical structures, and changes in neurotransmitter and receptor levels (Huttenlocher, 1979; Lidow et al., 1991; Seeman, 1999; Teicher et al., 1995; Woo et al., 1997). It has been further suggested that these changes in CNS organization may make the brain uniquely vulnerable to insult by drug use/abuse. In fact some investigators have suggested, based on animal studies, that there may be a "drug-induced developmental neurotoxicity of adolescence"

(Crews et al., 2000; Slawecki and Ehlers, 2003; Slotkin, 2002). Thus, during adolescence, drugs may be both more "addicting" and more neurotoxic, a combination that makes drug abuse particularly malignant for adolescents.

There is substantial evidence that links an early history of antisocial behaviors to the development of substance use disorders (Cloninger et al., 1981; Kessler et al., 1997; Robins et al., 1962; Zucker et al., 1996). Early patterns of substance use may lead to other problem behaviors and conversely early antisocial orientations can contribute to the onset of drug taking (Robins, 1984; Robins and Przybeck, 1985). In the present study, while the presence of externalizing diagnoses was associated with the development of marijuana dependence, early age of trying the drug was also found to contribute additional explanatory power in the understanding of marijuana use disorders in SWC Indians.

Data from the National Comorbidity Survey (NCS) suggest that demographic predictors of use of a drug are different from predictors of the development of dependence (Warner et al., 1995). It has been suggested that environmental factors may be more important in predicting the transition between initiation of drug use whereas genetic factors may exert more influence on transitions from substance use to use disorders (Cadoret, 1992; Cadoret et al., 1995; Kendler and Prescott, 1998). The majority of studies investigating the heritability of substance dependence have reported moderate to substantial genetic influences on substance initiation, use and problem use/abuse/dependence (Gynther et al., 1995; Han et al., 1999; Heath et al., 1997; Kendler et al., 1999, 2000; Maes et al., 1999; McGue et al., 1992, 2000; Rhee et al., 2003; Tsuang et al., 1996). However, only a few studies have been conducted in Native American populations that have evaluated the heritability of substance use or use disorders (Ehlers et al., in press; Long et al., 1998; Wilhelmsen and Ehlers, 2005). Other behavioral problems that emerge during adolescence, such as conduct disorder, have also been found to have significant heritability in this SWC Indian population (Ehlers et al., 2004d). Taken together, these data suggest that both environmental and heritable factors most likely contribute to marijuana use and age at initiation.

The findings of this study have important implications for intervention and prevention efforts. If age of initiation strongly influences the development of marijuana dependence in this SWC Indian population, as well as in other Indian populations with high rates of marijuana dependence, then prevention efforts at reducing early marijuana use should be an important priority. Additionally, efforts aimed at reducing substance use by children and teens are also likely to lower exposure to other risk factors and consequences that are associated with underage substance use in other populations such as: dropping out of school, unprotected sex, early pregnancy, accidents and criminal behavior (Robins et al., 1962).

The results of this study should be interpreted in the context of several limitations. First, the findings may not generalize to other Native Americans or represent all SWC Indians. Second, only retrospective and cross-sectional data on marijuana use and use disorders were assessed. Additionally, some individuals assessed may not have passed through the age of risk for the development of drug dependence and thus the probabilities of

transition from first use to dependence could be underestimated. Despite these limitations, this report represents an important step in an ongoing investigation to determine genetic and environmental factors associated with substance use and use disorders in this high risk and understudied ethnic group.

Acknowledgements

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