Correlates of Intentions to Use Cannabis among US High School Seniors in the Case of Cannabis Legalization

Joseph J. Palamar[1,2,3], **Danielle C. Ompad**[2,3,4], and **Eva Petkova**[5,6]

[1]New York University Langone Medical Center, Department of Population Health, One Park Avenue, 7th Floor, New York, NY 10016, USA

[2]Center for Health, Identity, Behavior, and Prevention Studies, New York University, 411 Lafayette Street, 5th floor, New York, NY 10003, USA

[3]Center for Drug Use and HIV Research, New York University, 411 Lafayette Street, 5th floor, New York, NY 10003, USA

[4]Department of Nutrition, Food Studies and Public Health, New York University, 411 Lafayette Street, 5th floor, New York, NY 10003, USA

[5]New York University Langone Medical Center, Department of Child and Adolescent Psychiatry, One Park Avenue, 7th Floor, New York, NY 10016, USA

[6]Nathan Kline Institute for Psychiatric Research, Orangeburg, NY, 10962, USA

Abstract

Background—Support for cannabis ("marijuana") legalization is increasing in the United States (US). Use was recently legalized in two states and in Uruguay, and other states and countries are expected to follow suit. This study examined intentions to use among US high school seniors if cannabis were to become legally available.

Methods—Data from the last five cohorts (2007–2011) of high school seniors in Monitoring the Future, an annual nationally representative survey of students in the US were utilized. Data were analyzed separately for the 6,116 seniors who reported no lifetime use of cannabis and the 3,828 seniors who reported lifetime use (weighted *N*s). We examined whether demographic characteristics, substance use and perceived friend disapproval towards cannabis use were

Correspondence to this article should be addressed to Joseph J. Palamar, One Park Avenue, 7th Floor, New York, NY 10016. Telephone: 1-646-754-4980, Fax: 1-646-754-5209, joseph.palamar@nyumc.org.

associated with 1) intention to try cannabis among non-lifetime users, and 2) intention to use cannabis as often or more often among lifetime users, if cannabis was legal to use.

Results—Ten percent of non-cannabis-using students reported intent to initiate use if legal and this would constitute a 5.6% absolute increase in lifetime prevalence of cannabis use in this age group from 45.6% (95% CI=46.6, 44.6) to 51.2% (95% CI=50.2, 52.2). Eighteen percent of lifetime users reported intent to use cannabis more often if it was legal. Odds for intention to use outcomes increased among groups already at high risk for use (e.g., males, whites, cigarette smokers) and odds were reduced when friends disapproved of use. However, large proportions of subgroups of students normally at low risk for use (e.g., non-cigarette-smokers, religious students, those with friends who disapprove of use) reported intention to use if legal. Recent use was also a risk factor for reporting intention to use as often or more often.

Conclusion—Prevalence of cannabis use is expected to increase if cannabis is legal to use and legally available.

Keywords

cannabis; attitudes; legalization; adolescents; intentions

Introduction

The United States (US) is undergoing a drastic change in attitudes toward cannabis ("marijuana") use and associated policy. The states of Colorado and Washington legalized recreational cannabis use in 2012 (Hawken, Caulkins, Kilmer, & Kleiman, 2013; Healy, 2012), an additional 15 states have decriminalized cannabis use, and 19 states and the District of Columbia now allow medical cannabis to be prescribed (Pew Research Center, 2013). While other countries (e.g., The Netherlands, Portugal, Spain, Italy) have partially or fully decriminalized use, Uruguay became the first country to legalize (and regulate) cannabis use in December of 2013 (Room, 2013; Romero, 2013). With public favor for legalization increasing, other states and countries are likely to follow suit. Given the lack of data that would allow us to examine how these recent policy changes affect prevalence of use, it is important to examine intentions to use in the case of legalization, as surrogate markers for actual behavior.

According to recent polls, more than half (52–58%) of adults in the US now support cannabis legalization (Pew Research Center, 2013; Swift, 2013) and 64% of adults feel the federal government should not take steps to enforce federal anti-cannabis laws in Colorado and Washington (Newport, 2012). Support for legalization is highest among young adults (ages 18–32), with 65% favoring legalization (Pew Research Center, 2013). In Australia, 65% of individuals age 12 and older feel that cannabis possession should not be a criminal offence, with males reporting higher support (Australian Institute of Health and Welfare, 2011). While more liberal cannabis laws appear to be driven by public support in many areas, interestingly, the legalization of cannabis in Uruguay does not appear to be as strongly supported by the public (CIFRA, 2013). It is unknown in all of these circumstances whether legalization (or decriminalization) would be associated with an increase in use.

Cannabis is the most frequently used illicit drug worldwide (United Nations Office on Drugs and Crime, UNODC, 2013) and among US adolescents and young adults, with 45.2% of high school seniors reporting lifetime use in 2012 and 36.4% reporting use in the past 12 months (Johnston, O'Malley, Bachman & Schulenberg, 2013a). Cannabis use has fluctuated among US youth over the last few decades—lifetime prevalence among high school seniors peaked at 60.4% in 1979 and declined to 35.3% in 1993, and lifetime use recently surpassed 45% again in 2011 for the first time since 2004. In 2011, 2.6 million individuals (age 12 or older) in the US initiated cannabis use and the average age of initiation is 17.5 (Substance Abuse and Mental Health Services Administration, SAMHSA, 2012), the most common age of US high school seniors (modal age: 18).

As prevalence of cannabis use has risen, the proportion of US high school seniors who disapprove of trying cannabis only once or twice has slowly declined from 58.6% in 2007 to 48.8% in 2012, while disapproval toward smoking cannabis regularly slowly dropped to 77.8% in 2012; this is the lowest rate of disapproval since 1981 (Johnston et al., 2013a). The proportion of high school seniors in favor of legalization has increased to the highest rate ever (39.3% in 2012) since Monitoring the Future (MTF) began assessing such attitudes in 1975; and of the proportion in favor of treating use as a minor violation have slightly decreased in recent years (e.g., 30% in 2008 to 26.8% in 2012) (Johnston et al., 2013a) as more students are now favoring full legalization. Moreover, perception of risk associated with using once or twice has also decreased to 14.8% (e.g., from 18.6% in 2007). However, the proportion who perceive cannabis as easy to access have remained relatively stable at about 82% (Johnston et al., 2013a).

While cannabis legalization would likely reduce rates of arrest and incarceration related to use, it is unknown whether legalization would be associated with higher rates of use, particularly among those at highest risk for use—adolescents approaching adulthood. There is a dearth of epidemiological data with regard to cannabis legalization; however, studies have begun to examine how various forms of decriminalization and depenalization relate to rates of use. Studies have found that overall, cannabis decriminalization or depenalization have generally not been associated with increased rates of use (Greenwald, 2009; Hughes & Stevens, 2010; MacCoun, 2010a; MacCoun & Reuter, 2011; Vuolo, 2013). However, results from some studies suggest temporary increases in prevalence of recent use in some subgroups after a form of decriminalization is implemented (e.g., Dutch coffee shop decriminalization) (Kilmer, Caulkins, Pacula, MacCoun, & Reuter, 2010; MacCoun, 2010b). It is unknown whether similar policies would have comparable effects elsewhere (e.g., in more heterogeneous areas) (Kleiman, Caulkins, & Hawken, 2011). It is estimated that consumption would increase in the case of full legalization, in part, due to a drop in prices; however, taxation and regulations would likely help prevent increases in initiation (Caulkins, Hawken, Kilmer, & Kleiman, 2012; Kilmer et al., 2010). Recent epidemiological studies have also yielded mixed results regarding the associations between local medicinal cannabis policies and rates of use. While some research suggests that adolescent cannabis use is higher in states that allow medicinal cannabis (Wall et al., 2011), others suggest that higher use may precede such laws (Harper, Strumpf & Kaufman, 2012).

Cannabis policy is rapidly evolving in some areas of the world and it is crucial to determine whether more liberal policies lead to increased incidence of cannabis use as well as problematic use. However, there is a lack of empirical data to examine the effects of such policies. In the absence of data to address these questions, we focus on surrogates for those outcomes: in the case of legalization, intentions to initiate use among non-users and intentions to use more among those who have already initiated used. Intentions are assumed to capture the motivational factors that may result in behaviors, and of all behavioral dispositions they are most closely linked to corresponding actions (Ajzen & Fishbein, 1980). For example, research suggests that intention not to smoke cigarettes is protective against smoking in national samples (Wakefield et al., 2004) and for this reason prevention programs often examine intention to smoke as an outcome variable (Bauer, Johnson, Hopkins, & Brooks, 2000). So while there is a lack of data regarding how changes in policy affect use, intention to use in the case of legalization would serve as an important indicator of who may be at highest risk for use if policies continue to shift.

Here we examine correlates of intention to use cannabis among US high school seniors if it were to become legalized. Examining intention to use cannabis among high school seniors would help delineate risk factors that could be targets of interventions and programs designed to prevent or delay use in an era of potential "normalization" of use.

Methods

Data were taken from MTF, an annual survey of high school students in approximately 130 public and private schools throughout 48 states in the US (Johnston et al., 2012b). The MTF protocol was reviewed and approved by the University of Michigan Institutional Review Board. Schools were selected through a multi-stage random sampling procedure: geographic areas were selected, then schools within geographic areas, and then students within selected schools. Since MTF assesses a variety of constructs, content is divided into six questionnaire forms, which are distributed randomly. This study focuses on data collected through Form 4, which assesses cannabis legalization attitudes in addition to drug use and demographics.

To examine the most current attitudes, we focused on cohorts 2007–2011. Thus, the data were collected prior to the legalization of recreational use in Colorado and Washington, but after medical cannabis legalization in up to 16 states. Data on state of residence are not available in MTF, which is an important contextual variable given the variation in cannabis policies between states. With respect to medical cannabis policy, 11 states legalized medical cannabis prior to the study (California in 1996; Alaska, Oregon and Washington in 1998; Maine in 1999; Hawai'i, Colorado and Nevada, in 2000; Montana and Vermont in 2004; and Rhode Island in 2006). Five states (New Mexico in 2007; Michigan in 2008; New Jersey and Arizona in 2010; and Delaware in 2011) and the District of Columbia legalized medical cannabis during the study (in 2010). Three states legalized medical cannabis after the study (Connecticut and Massachusetts in 2012 and New Hampshire in 2013).

MTF assessed age (<18 years, 18 years), sex, and race/ethnicity (white, black, Hispanic) of students, as well as population density where students reside (non-, small-, or large-metropolitan statistical areas [MSAs]). Small MSAs are defined as counties or groups of

counties with at least one city of at least 50,000 inhabitants and the 24 largest MSAs are defined as large MSAs (Johnston et al, 2012). Non-MSAs reflect the remaining areas. Students were asked about parents' educational attainment on an ordinal scale and a mean score for both parents (or the actual score was used if only one parent) was coded into three groups: low (1.0–3.0), medium (3.5–4.0), and high educational attainment (4.5–6.0) as a proxy of socioeconomic status (SES). Parent educational attainment has been coded similarly in previous MTF studies (Wallace et al., 2009). Level of religiosity was determined by two ordinal items assessing religious attendance and importance. These items were computed into a mean religiosity composite (range: 1–4) and divided into tertiles indicating low (1.0–2.0), moderate (2.5–3.0) and high (3.5–4.0) religiosity (Palamar, 2013). Students were asked how likely it is for them to graduate from a 4-year college and answer options were coded into: 1) definitely not or probably not, 2) probably, and 3) definitely. Students were also asked about the number of evenings they usually go out per week for fun and recreation and answers were coded into: 1) 0–1 evening(s), 2) 2–3 evenings, and 3) 4–7 evenings.

Students were asked if they had ever smoked cigarettes, and whether they had drunk alcohol ("more than just a few sips") within the last 12 months. Responses for each were coded into dichotomous variables indicating whether the student had used each substance. Similarly, students were asked, "On how many occasions (if any) have you used marijuana (weed, pot) or hashish (hash, hash oil) in your lifetime?" Ordinal responses were dichotomized to indicate whether cannabis ("marijuana") was ever used. We defined recent use as cannabis use (i) in the last 12 months, or (ii) in the last 30 days. Perceived peer disapproval of cannabis use was assessed through the following item: "How do you think your close friends feel (or would feel) about you trying marijuana (pot, weed) once or twice?" Peer disapproval answer options were 1) "Don't disapprove," 2) "Disapprove" and 3) "Strongly disapprove." Finally, the students were asked, "If marijuana were legal to use and legally available, which of the following would you be most likely to do?" Answer options were: 1) "Not use it, even if it were legal and available," 2) "Try it," 3) "Use it about as often as I do now," 4) "Use it more often than I do now," 5) "Use it less than I do now," and 6) "Don't know."

Statistical Analyses

We examined data for two non-overlapping subsamples. The first subsample consisted of 6,116 students who reported that they had never used cannabis in their lifetime and responded to the item addressing intention to try cannabis. The outcome variable (0="would not use," 1="would try") was dichotomous; we excluded data from those who answered "don't know" (*n*=468) and we removed the following options during data cleaning as they are ambiguous or inconsistent to reported non-lifetime use: would use: "as often" (*n*=49), "more often" (*n*=28), and "less often" (*n*=16). Among these non-lifetime-users we examined the correlates of intention to initiate cannabis use if cannabis were legal to use and legally available. The second subsample consisted of 3,828 students who reported lifetime cannabis use and had answered the cannabis legalization item. The outcome variable was trichotomous (0="would not use," 1="would use as often," 2="would use more often") and did not include data for those who answered "don't know" (*n*=490), or "would try" (*n*=469, as they had indicated prior use). We excluded those who answered that they would use "less

often" (*n*=152) because the number of these cases was small and led to poor model fit. In addition, we conducted supplementary analyses focusing only on those who had used within the last 12-months and the last 30-days.

We first compared sample characteristics across the five cohorts for each subsample. Rao-Scott χ^2 tests for homogeneity (Rao & Scott, 1984) were computed to determine whether there were differences between cohorts on each covariate, while correcting for the complex study design. We then aggregated the data from all five cohorts and estimated the proportion of those with intentions to try (among non-lifetime-users) and the proportion of those with intentions to use the same amount or more (among lifetime users) for each level of each covariate, separately. Using data from the full 2011 dataset containing data from all survey forms (*N*=14,855) we estimated and report the following for each level of each covariate: 1) prevalence of lifetime cannabis use; 2) expected increase in prevalence of lifetime use if cannabis were legalized (derived from intent to use among never-users); 3) expected rates of lifetime use in the case of legalization, which was the sum of the prevalence in 2011 and the expected increase in prevalence, and 4) the relative increase in prevalence as a ratio of the expected increase prevalence of use and the 2011 prevalence of lifetime use. Prevalence estimate computations were based on the assumption that those who reported they would use if legal would do so before or during senior year.

We then performed design-based analyses for survey data (Heeringa, West & Berglund, 2010). Multiple logistic regression was used to estimate conditional associations, producing adjusted odds ratios (AORs) for each covariate. Binary logistic regression was used for analyses of intentions to initiate among non-users. Multinomial logistic regression was used for analyses of intentions to continue or increase use among those who had already initiated use. Potential cohort effects/secular trends were controlled by entering indicators for each year (with 2007 as the comparison) in all models (Wray-Lake et al., 2012). To explore whether the effect of covariates on the outcome changed over time, we fitted additional models that included interactions between the cohort variable with those covariates that showed non-homogeneous distributions across cohorts. Cohort was treated as a continuous variable in these models to assess possible monotone trends in the relationships of the outcome to those covariates over time. We also performed two additional supplemental analyses on the cannabis-using sample. Specifically, in order to examine whether the associations found in the model examining lifetime users are comparable to more recent users, we also computed models separately for last 12-month and last 30-day users. All analyses were weighted according to the survey's sampling scheme. Goodness-of-fit is reported in terms of Nagelkerke R^2 and Correct Classification Rate.

For multivariable models, we first examined the two subsamples with only case-complete data (*N* for non-user sample=3,435, *N* for lifetime user sample=1,976). Consistent with previous MTF publications (e.g., Terry-McElrath, O'Malley, & Johnston, 2013), we re-analyzed the two full subsamples with missing data coded as another level of the respective predictors (*N* for non-user sample=6,116, *N* for lifetime user sample=3,828), thus utilizing all available data. This was done because 48.3% of the case-complete dataset for non-lifetime-users had missing data and 48.4% of the case-complete dataset for lifetime users had missing data, which would have resulted in deletion of nearly half of each subsample.

The variables with the most missing data were religiosity (28.6%), race/ethnicity (13.9%), and friends' disapproval of cannabis use (10.2%).

Results of case-complete and full analytic (with missing data indicators) samples were similar with respect to the direction of the associations. With regard to statistical significance, some variables (e.g., that approached significance) in the case-complete samples tended to become significant in the full sample models as the addition of thousands of students added power to detect the associations. We present outcomes from the full subsamples (that included missing data indicators) as the rates most accurately reflect rates published by MTF (Johnston et al., 2013a), and we are confident that inferential statistics are more likely to be generalizable to US high school seniors, as multivariable results reasonably match across samples with and without missing data. All models were computed using SAS 9.3 software with weighted data to adjust for differential probability of selection of schools and students (Johnston et al., 2013a).

For validity purposes, we also examined correlates of students providing inconsistent survey responses to help determine if there was self-report bias. As discussed above, 93 students had never used cannabis said they would use as often, more often or less often if legal. Likewise, 469 students who had previously initiated cannabis use said they would try cannabis if legal. Using multiple logistic regression models, utilizing the same covariates we analyzed in the previous models, we delineated predictors of inconsistent responses for data we did not include in the main models.

Results

Intention to Use Cannabis among Non-Lifetime Cannabis Users

Characteristics of the non-cannabis-using sample are presented in Table 1, stratified by survey year and for all respondents collectively. The sample was 54.1% female and 60.0% white. With respect to substance use, 18.8% reported smoking cigarettes in their lifetime, the majority (71.8%) indicated that their friends disapproved or strongly disapproved of cannabis use, and 10.3% indicated they would try cannabis if legal to use and legally available. Student characteristics were relatively stable across cohorts; however, rates of lifetime cigarette use decreased every cohort. There were also differences between cohorts with respect to race/ethnicity, plans to graduate from college, and friend disapproval towards cannabis use, but no systematic changes were evident.

Table 2 presents raw proportions, estimates of expected prevalence change if legal, and model-based estimates with regard to intention to use if legal. While controlling for all other covariates, females (vs. males), and blacks and Hispanics (vs. white students) had lower odds for intention to use cannabis if legal, while residing in a small MSA increased the odds for intention to use in comparison to those residing in non-MSAs. Students of parents with higher educational attainment or who definitely planned to graduate from college had increased odds for intention to use and students who are highly religious had lower odds. Lifetime cigarette smokers and those who had used alcohol in the last 12 months had about two and a half times the odds of reporting intention to use in comparison to non-smokers and non-recent-alcohol users, respectively. Finally, students whose friends disapprove of

cannabis use were at low odds, and those with friends who strongly disapprove had only 19% the odds for cannabis initiation intentions, compared to those whose friends do not disapprove of cannabis use. In a separate model we explored whether the relationship of covariates with non-homogenous distributions over time interacted with cohort in their effect on intent to use. No interaction term was significant.

The 2011 prevalence of lifetime cannabis use among high school seniors was 45.6%. With computations based on the assumption that those who state that they intend to use if legal would initiate while still in high school, an estimated additional 5.6% (0.544*.103 = 0.056) of high school senior non-lifetime users would use if legal, which constitutes a 12.3% relative increase in prevalence (relative to current prevalence; 5.6/45.6). Therefore, if those who reported intention to use did engage in use, lifetime prevalence in senior year would be expected to increase from 45.6% to 51.2%. With regard to subgroups, as shown in Table 2, the absolute increase in prevalence of use among males is estimated to be 6.5%, with an increase from 48.7% to 55.2% if legal, which constitutes a relative 13.5% increase. The absolute increase among black students is estimated to be 3.9%, from 42.4% to 46.3%, which constitutes a relative 9.2% increase. The largest absolute increase in prevalence would be expected to be among those whose friends disapprove of cannabis use, but do not strongly disapprove (8.9%) (Column 6, Table 2). The highest relative increases would be among students who have not drunk alcohol in the last 12 months (33.0%), students who have friends who strongly disapprove (25.4%) or disapprove (24.0%) of cannabis use, and non-lifetime cigarette smokers (24.8%) (last column, Table 2).

Intentions to Increase Cannabis Use among Lifetime Cannabis Users

The sample of students who reported lifetime cannabis use (Table 3) was 45.5% female and 62.7% white. Of lifetime users, 74.8% had smoked cigarettes in their lifetime, the majority (62.0%) indicated that their friends did not disapprove of cannabis use, and 46.0% indicated they would use cannabis as often and 18.1% indicated they would use more often if legal to use and legally available. Race/ethnicity, population density, evenings out per week, cigarette use and friend disapproval significantly varied across cohorts. There were no clear upward or downward trends regarding race/ethnicity or population density of students' residency; however, similar to the non-user sample, cigarette smoking decreased across cohorts. In addition, there was a trend for students reporting that they would use as often or more often if legalized, across cohorts.

Adjusted results from the multinomial logistic regression model suggest that older (vs. younger) students were at lower odds for reporting that they would use as often if legal, and females (vs. males) and Hispanics (vs. whites) had lower odds for reporting intent to use cannabis as often or more often if legal (Table 4). Students with parents of high educational attainment (vs. parents of low educational attainment) were at increased odds for reporting intent to use cannabis as often or more often if legal, and highly religious students were at low odds for both outcomes (with moderately religious students also at decreased odds for reporting they would use as often) if legal. Students who go out 4–7 nights for fun or recreation were at increased odds for using more often (but not as often) if legal and students who were lifetime cigarette smokers (vs. non-smokers) were at increased odds for reporting

intent to use cannabis as often or more often if legal. Past 30-day cannabis use robustly increased the odds for both outcomes in comparison to lifetime users who had not recently used, and alcohol use increased the odds for reporting that they would use as often if legal. Finally, students who had friends who disapprove of cannabis use had lower odds for both outcomes. In a separate model we explored whether the relationship of covariates with non-homogenous distributions interacted with cohort in their effect on the outcomes. No interaction term was significant.

Table 5 presents supplementary analyses on the cannabis-using sample to examine associations more specifically in recent cannabis users. Results in the subsample of last 12-month users and last 30-day users were comparable to the full lifetime cannabis user sample, although the reader should be reminded that the model examining lifetime users controlled for use of cannabis in the last 30 days. The age association did not hold in either recent-using subsample and the decreased odds for females appeared to decrease as use was more recent. The "protective" association for Hispanic ethnicity (compared to white race) fluctuated across samples, but the association was most robust in the 30-day users. Population density associations were no longer present in the recent-using subsamples, and the reduced odds for high religiosity were more robust in the sample of last 30-day users. The associations of number of evenings spent out for fun or recreation were inconsistent across samples, but stronger in the last 12-month using subsample. The significant association for last 12-month alcohol use was lost in the two subsamples, but the associations of lifetime cigarette smoking were more robust in the subsamples, especially among last 30-day cannabis users. Finally, the associations of friend disapproval were much stronger in the recent using samples, particularly among last 30-day users.

Since recent cannabis use was such a robust explanatory variable in the lifetime cannabis using sample, we also present the prevalence of responding "would not use," "would use as often" and "would use more often" among users by type of use (lifetime, last 12-month and last 30-day use) and number of occasions used (Table 6). The majority of non-frequent users reported that they would not use again if legalized; the more recent and frequent users, however, tended to report that they would use as often or more often if legalized.

Analyses of Inconsistent Survey Responses

Finally, for validity purposes, we examined correlates of students providing inconsistent survey responses. As discussed in the Methods section, 93 students who reported non-lifetime use said they would use as often, more often or less often if legal to use and legally available and 469 lifetime cannabis using students said they would try cannabis if legal. With regard to non-cannabis users who reported that they would use as often, more often or less often if legal, females were at lower odds for providing a discrepant response (AOR=0.46, 95% CI=0.27, 0.76, p=.003), particularly with regard to using less often. Black students (compared to white students) were at triple the odds for providing a discrepant response (AOR=2.99, 95% CI=1.55, 5.75, p=.001); specifically, they were at increased odds for reporting that they would use less often. Lifetime cigarette smokers were at increased odds for providing a discrepant response (AOR=3.59, 95% CI=2.20, 5.88, p<.001); specifically, they were at higher odds for reporting that they would use both as often and less

often. Finally, friend disapproval (AOR=0.33, 95% CI=0.18, 0.63, *p*<.001) and high friend disapproval (AOR=0.19, 95% CI=0.10, 0.36, *p*<.001) decreased the odds for reporting a discrepancy. More specifically, students with friends who disapprove were at low odds for reporting that they would use more often, and those with friends who highly disapprove were at decreased odds for reporting that they would use as often or more often.

With regard to lifetime cannabis users who said they would try cannabis if legal, older students were at higher odds for reporting that they intended to try cannabis if legal (AOR=1.42, 95% CI=1.12, 1.78, *p*=.003), and students who reported going out 4–7 evenings per week for fun or recreation (AOR=0.60, 95% CI=0.43, 0.84, *p*=.003) and those who smoked cigarettes in their lifetime (AOR=0.71, 95% CI=0.56, 0.92, *p*=.008) were at lower odds for reporting intention to use. Students reporting friend disapproval were at high odds for reporting intention to use (AOR=1.58, 95% CI=1.20, 2.10, *p*=.001); however, those reporting high friend disapproval were at low odds for reporting intention to use (AOR=0.41, 95% CI=0.26, 0.66, *p*<.001).

Discussion

Rates of cannabis use are increasing and attitudes toward use among adolescents and young adults are shifting, yet little is known about whether prevalence of use would increase substantially in light of legalization. Likewise, little is known about risk factors for initiation and continued use within the context of legalization. With an absence of data that would allow us to examine how prevalence changes in relation to enactment of more liberal cannabis laws, we utilized national survey data of US high school seniors to examine cannabis use intentions if cannabis was legal to use and legally available.

Ten percent of non-lifetime cannabis users surveyed by MTF reported that they would try cannabis if legal. Assuming that onset would occur before or during the senior year, results suggest that we could expect an increase in lifetime prevalence in this age group to rise from 45.6% to 51.2%. Lifetime prevalence increases as adolescents age into adulthood; for example, by age 25–26, 64% of young adults in the US are expected to use cannabis in their lifetime (Johnston et al., 2013b) in the current policy context. It is unknown whether the students who reported intention to use if legal are those who would have become users a later age if not legalized. If this is the case, then more liberal cannabis policy may accelerate initiation. If not, then students who otherwise would not have initiated would add to the current prevalence of older young adults. To help deduce who is at greatest risk for initiation or continued use in the case of legalization we examined numerous covariates.

It is not surprising that many characteristics associated with intention to use are also correlates of lifetime cannabis use (Johnston et al., 2012). For example, males and white students had higher odds for intention to use, which is consistent with other national studies (Degenhardt, Chiu, Sampson, Kessler & Anthony, 2007). We found that females are at lower odds for initiation as well as continued use. However, although females are somewhat "protected" against use even in the case of legalization, if cannabis were legalized, a small percentage of females could be expected to initiate who likely would not have otherwise used (at that age). Likewise, racial minority students were less likely to report intention to

use, with blacks and Hispanics having lower odds for intention to initiate use relative to whites. Hispanic students who were lifetime or recent users, however, were at lower odds for reporting they would use cannabis as often or more often if legal, but blacks were not. It is not clear why black lifetime users were not also at lower odds, but we do know that there are racial disparities with respect to criminal justice involvement. Blacks who are stopped by police are more likely to be arrested (Gelman, Fagan & Kiss, 2007) and blacks are more likely to experience cannabis arrests, pre-trial detentions, detainment, convictions and sentencing related to cannabis in plain view arrests, compared to their white counterparts (Golub, Johnson & Dunlop, 2007). Thus, cannabis use may have more legal repercussions for black adolescents when it is not legalized. Even though racial minorities would still be at lower odds for use in comparison to whites in the case of legalization, the prevalence among racial and ethnic minorities would be expected to increase.

Interestingly, while according to MTF, cannabis use is slightly higher in large MSAs relative to small and non-MSAs (Johnston et al., 2012a), results from this study suggest that high school seniors residing in a small MSA had increased odds of intention to try cannabis if legal relative to non-MSAs. The reason for this association is unclear, although a similar observation was made in a German study (Kuepper, van Lieb, Wittchen & Henquet, 2011). This could reflect students in small- to mid-size cities "catching up" to those in larger cities (Johnston et al., 2012). However, residing in MSAs was not significantly associated with intention to use as often or more often if legal among lifetime users. Results also suggest that students whose parents attained higher levels of education attainment had higher odds for intention to try cannabis if legal and to use as often or more often among lifetime users if legal. Lifetime prevalence among this group would be expected to increase more than many other demographic subgroups if legal. Likewise, students who report that they definitely expect to graduate from a four-year college are at increased odds for initiation if legal. These findings add to previous studies in the US (Humensky, 2010; Johnston et al., 2012) and Europe (Legleye, Janssen, Beck, Chau & Khlat, 2011) that have found that students from higher SES families are more likely to report cannabis use.

Not surprisingly, highly religious students were at low odds for intention to initiate or continue to use cannabis use if legal to use. This is consistent with many other studies suggesting that religious individuals tend to be at low odds for use (Bachman, Johnston, & O'Malley, 1998; Degenhardt et al., 2007; Palamar, Kiang, & Halkitis, 2012), in part, due to higher disapproval or stigma toward use as well as lack of (known) exposure to users (Palamar, Kiang, & Halkitis, 2011; Palamar, 2013). Proscriptions against psychoactive drug use vary by religious affiliation and denomination, and such data were not available to be examined in this study. However, among those who identified as highly religious, we would expect the number of initiates in this group to increase if cannabis were to be legalized. This may be because fewer Americans now feel that cannabis use is no longer a moral issue. Specifically, according to the recent Pew Research Center survey, only 32% of adults surveyed felt use was "morally wrong" in 2013 (compared to 50% in 2006; Pew Research Center, 2013). This decrease occurred across most demographic and political groups and younger respondents were most likely to feel that use is not a moral issue (Pew Research Center, 2013). It is likely that many religious individuals would consider use even less of a moral issue if use became legal.

Substance use variables were among the strongest correlates of intention to use cannabis. Students who used alcohol or cigarettes were at more than double the odds of reporting that they intended to try cannabis if legal than those who did not use these legal, yet age-restricted drugs. Cigarette smoking also increased the odds for reporting intent to use as often and more often among lifetime cannabis users, and the odds were nearly three to four times higher for these outcomes among those who reported using cannabis in the last 30 days. Recent alcohol use was associated with intention to use as often, but not more often, among lifetime cannabis users. Recent alcohol use, however, was not related to intention to use among recent cannabis users. It is likely that once tobacco and alcohol is initiated, attitudes towards drugs such as cannabis become more favorable, but the association between cigarette use and intention to use cannabis is more robust. Cigarette use has been found to be a strong risk factor in lowering disapproval towards use of various other illicit drugs so it is not surprising that it is a strong predictor of intention to use cannabis in the case of legalization, especially since cigarette use is now more disapproved than cannabis use (Palamar, 2013). But alarmingly, the lifetime prevalence of cannabis use among students who report no recent use of alcohol would be expected to increase about 33% if legal. Recent cannabis use robustly increased the odds for intention to use as often or more often if legal among lifetime users. Analyses further revealed that the recent and frequent users were most likely to report intentions to continue or increase use if cannabis were legal and that lifetime use itself was not as important.

Finally, with regard to attitudes toward use, perception of friends' disapproval towards cannabis use was a robust protective factor against intention to use among both non-users and lifetime users. Results suggest that the higher the level of perceived friend disapproval, the lower the odds of intention to use if legal. This finding adds to recent research suggesting that attitudes of peers can strongly predict one's own use, perhaps even above and beyond one's personal level of disapproval (Keyes et al., 2011). However, a major finding of this study is that despite friend disapproval serving as one of the most robust protective factors against intention to use, we would expect students with friends who disapprove (or strongly disapprove) to increase in lifetime prevalence more than other subgroups examined in this study. This may suggest that friend disapproval or influence of friend disapproval is contingent on the legal status of cannabis.

Limitations

Studies have found that rates of cannabis use differ according to state medical cannabis laws (Cerdá et al., 2012; Wall et al., 2011) so intention to use may differ by state; however, state-level MTF data were not available. Although cannabis is illegal at the federal level, we could not account for states with more liberal cannabis laws (e.g., medical cannabis, decriminalization). Cannabis was not legal in any state during the time period of this study (2007–2011), but it is possible that students' awareness of their state-level policy may have influenced their responses. Thus, in 16 states and the District of Columbia (where medical cannabis laws were in effect during the study period), we might underestimate the likelihoods of both intention to initiate and intention to increase cannabis use among non-users and users, respectively. Conversely, we may overestimate these likelihoods in states without pro-medical cannabis policies. MTF legalization questions are only asked of one-

sixth of the high school senior sample (through survey form 4) and MTF does not administer questions about legalization to their eighth or tenth grade samples. We also could not include other commonly assessed attitudinal and belief variables (e.g., perceived risk, perception of use by friends, easiness to get) in analyses as they were not assessed in the survey form that asked about legalization. Results cannot be fully generalized to all individuals in the age group assessed as some students were not in school the days of assessment and others had dropped out of school.

There were some inconsistencies or confusion among students regarding the legalization question. For example, 93 cannabis users (removed from analytic sample) reported that they would try cannabis if legal. It is possible that such issues with the validity of self-report are related to under- or over-reporting of cannabis use, or it may also be that some students were confused about the term "legalization," ignored skip patterns, or misunderstood the question. For example, MTF did not specify under which (if any) regulatory conditions cannabis would be used (e.g., sold in stores, age restrictions), which may add to confusion. We carefully cleaned the data in order to remove such inconsistent responses. A secondary analysis of inconsistent responses revealed the potential for some systematic bias. Response bias needs to be further explored in future studies, but given the potential confusion regarding the legalization question (e.g., some students might have answered as if they would be more likely to use "in general," whether or not they were users), we feel our results are reliable given our approach to data cleaning.

Missing data, particularly for religiosity and race/ethnicity, was also problematic. However, we addressed this by computing all statistics using both case-complete and full samples (including missing data indicators in the models). Similar methods for handling missing data have been used by MTF investigators (e.g., Terry-McElrath et al., 2013). Results were reasonably similar across models, giving us confidence in reporting results from the larger dataset including missing data indicators. Cohort data also had to be aggregated to provide adequate sample size. We thoroughly tested differences between cohorts (including interactions) and results from sensitivity analyses suggest comparable results across cohorts giving us confidence in combining cohorts. We also included results from supplementary analyses to report the associations within the smaller subsamples of last 12-month and 30-day users. These subsamples are smaller, leading to larger standard errors so results should be viewed with some caution. Finally, it is important to note that intentions to use do not always predict use as attitudes may shift over time. Life events or the emergence of new information over time can produce changes in intentions and the opportunity must arise in order for an individual to engage in use (Ajzen, 1985, 1987). Thus, our computations of expected increases in lifetime prevalence if cannabis was legal were held under the assumption that students who reported intention to use actually used.

Conclusion

Ten percent of non-cannabis-using high school seniors reported the intention to initiate use if cannabis was legally available. Among lifetime users, recent and frequent users were more likely to report intentions to use as often or more often if legalized. This study delineated specific risk factors predicting intentions to use. Cannabis use and support for legalization

are increasing while disapproval towards use is decreasing. Initiation of cannabis use by some individuals appears to be inevitable, whether or not use is legalized. Results from this analysis suggest that legalization may become associated with increased rates of initiation and use among specific subsets of high school seniors in the US. However, the reader should be reminded that rates of lifetime use among these high school seniors are expected to rise over time so it is unknown whether the same students who reported intention to use if legal are the same students who will initiate use during adulthood regardless of legal status. However, our analyses of subgroups did identify those with an increased likelihood for use in the case of legalization. While those already at risk for use were found to be more likely to report intention to use, these analyses did reveal increased likelihood of subgroups normally not at risk for use as being at increased risk for use if legal to use and if cannabis was legally available. As cannabis use increases, regardless of legal status, it has become increasingly important to prevent the adverse consequences that can be associated with use. Public health practitioners must continue to educate cannabis users and those at risk for initiation and/or continued use about the potential harms associated with use.

Acknowledgments

References

Australian Institute of Health and Welfare. 2010 National Drug Strategy Household Survey report. Canberra: AIHW; 2011. Drug statistics series no. 25. Cat. no. PHE 145Retrieved from: http://www.aihw.gov.au/WorkArea/DownloadAsset.aspx?id=10737421314

Azjen, I. From intentions to actions: A theory of planned behavior. In: Kuhl, J.; Beckmann, J., editors. Action-control: From cognition to behavior. London: Springer; 1985. p. 11-39.

Ajzen I. Attitudes, traits, and actions: Dispositional prediction of behavior in personality and social psychology. Advances in Experimental Social Psychology. 1987; 20:1–63.

Bachman JG, Johnston LD, O'Malley PM. Explaining recent increases in students' marijuana use: Impacts of perceived risks and disapproval, 1976 through 1996. American Journal of Public Health. 1998; 88(6):887–892. [PubMed: 9618614]

Bauer UE, Johnson TM, Hopkins RS, Brooks RG. Changes in youth cigarette use and intentions following implementation of a tobacco control program: Findings from the Florida Youth Tobacco Survey, 1998–2000. Journal of the American Medical Association. 2000; 284(6):723–728. [PubMed: 10927781]

Caulkins, JP.; Hawken, A.; Kilmer, B.; Kleiman, MAR. Cannabis Legalization: What Everyone Needs to Know. New York: Oxford University Press; 2012.

Cerdá M, Wall M, Keyes KM, Galea S, Hasin D. Medical cannabis laws in 50 states: Investigating the relationship between state legalization of medical cannabis and cannabis use, abuse and dependence. Drug and Alcohol Dependence. 2012; 120(1–3):22–27. [PubMed: 22099393]

CIFRA. Telemundo, 29 July, 2013. Montevideo: CIFRA/González, Raga & Asociados; 2013. La regulación del cultivo y consumo de marihuana y el impacto esperado en el narcotráfico. Retrieved from: http://www.cifra.com.uy/novedades.php?idNoticia=201

Degenhardt L, Chiu WT, Sampson N, Kessler RC, Anthony JC. Epidemiological patterns of extra-medical drug use in the United States: Evidence from the National Comorbidity Survey Replication, 2001–2003. Drug and Alcohol Dependence. 2007; 90(2–3):210–223. [PubMed: 17481828]

Gelman A, Fagan J, Kiss A. An analysis of the New York City Police Department's "Stop-and-Frisk" policy in the context of claims of racial bias. Journal of the American Statistical Association. 2007; 102(479):813–823.

Golub A, Johnson BD, Dunlop E. The race/ethnicity disparity in misdemeanor cannabis arrests in New York City. Criminology & Public Policy. 2007; 6(1):131–164. [PubMed: 18841246]

Greenwald, G. Drug decriminalization in Portugal: Lessons for creating fair and successful drug policies. The Cato Institute; 2009. Retrieved from: http://www.cato.org/sites/cato.org/files/pubs/pdf/greenwald_whitepaper.pdf

Harper S, Strumpf EC, Kaufman JS. Do medical cannabis laws increase cannabis use? Replication study and extension. Annals of Epidemiology. 2012; 22(3):207–212. [PubMed: 22285867]

Hawken A, Caulkins J, Kilmer B, Kleiman M. Quasi-legal cannabis in Colorado and Washington: Local and national implications. Addiction. 2013; 108:837–838. [PubMed: 23587071]

Healy J. Voters ease cannabis laws in 2 states, but legal questions remain. New York Times. 2012 Nov 8.:15.

Heeringa, SG.; West, BT.; Berglund, PA. Applied Survey Data Analysis. London: Chapman and Hall; 2010.

Hughes CE, Stevens A. What can we learn from The Portuguese decriminalization of illicit drugs? British Journal of Criminology. 2010; 50:999–1022.

Humensky JL. Are adolescents with high socioeconomic status more likely to engage in alcohol and illicit drug use in early adulthood? Substance Abuse Treatment, Prevention & Policy. 2010; 5:19.

Kleiman, MAR.; Caulkins, JP.; Hawken, A. Drugs and Drug Policy: What Everyone Needs to Know. New York: Oxford University Press; 2011.

Johnston, LD.; O'Malley, PM.; Bachman, JG.; Schulenberg, JE. Demographic subgroup trends for various licit and illicit drugs, 1975–2011. Institute for Social Research, University of Michigan; 2012. Retrieved from: http://www.monitoringthefuture.org/pubs/occpapers/mtf-occ77.pdf

Johnston, LD.; O'Malley, PM.; Bachman, JG.; Schulenberg, JE. Monitoring the Future national survey results on drug use, 1975–2012: Volume I, Secondary school students. Ann Arbor: Institute for Social Research, The University of Michigan; 2013a. Retrieved from: http://www.monitoringthefuture.org/pubs/monographs/mtf-vol1_2012.pdf

Johnston, LD.; O'Malley, PM.; Bachman, JG.; Schulenberg, JE. Monitoring the Future national survey results on drug use, 1975–2012: Volume 2, College students and adults ages 19–50. Ann Arbor: Institute for Social Research, The University of Michigan; 2013b. Retrieved from: http://www.monitoringthefuture.org/pubs/monographs/mtf-vol2_2012.pdf

Keyes KM, Schulenberg JE, O'Malley PM, Johnston LD, Bachman JG, Li G, Hasin D. The social norms of birth cohorts and adolescent cannabis use in the United States, 1976–2007. Addiction. 2011; 106(10):1790–1800. [PubMed: 21545669]

Kilmer, B.; Caulkins, JP.; Pacula, RL.; MacCoun, RJ.; Reuter, PH. Altered state? Assessing how cannabis legalization in California could influence cannabis consumption and public budget.

RAND Occasional Paper. 2010. Retrived from: http://www.rand.org/content/dam/rand/pubs/occasional_papers/2010/RAND_OP315.pdf

Kuepper R, van OJ, Lieb R, Wittchen HU, Henquet C. Do cannabis and urbanicity co-participate in causing psychosis? Evidence from a 10-year follow-up cohort study. Psychological Medicine. 2011; 41(10):2121–2129. [PubMed: 21466750]

Legleye S, Janssen E, Beck F, Chau N, Khlat M. Social gradient in initiation and transition to daily use of tobacco and cannabis during adolescence: A retrospective cohort study. Addiction. 2011; 106(8):1520–1531. [PubMed: 21631617]

MacCoun, RJ. Estimating the non-price effects of legalization on cannabis consumption. RAND Working Paper, WR-767-RC. 2010a. Retrieved from: http://www.rand.org/content/dam/rand/pubs/working_papers/2010/RAND_WR767.pdf

MacCoun, RJ. What can we learn from the Dutch cannabis coffeeshop experience?. RAND Working Paper: WR-768-RC. 2010b. Retrieved from: http://www.rand.org/content/dam/rand/pubs/working_papers/2010/RAND_WR768.pdf

MacCoun RJ, Reuter P. Assessing drug prohibition and its alternatives: A guide for agnostics. Annual Review of Law and Social Science. 2011; 7:61–78.

Newport, F. Americans want federal gov't out of state cannabis laws. 2012. Retrieved from: http://www.gallup.com/poll/159152/americans-federal-gov-state-cannabis-laws.aspx

Palamar JJ, Kiang MV, Halkitis PN. Development and psychometric evaluation of scales that assess stigma associated with illicit drug use. Substance Use & Misuse. 2011; 46:1457–1467. [PubMed: 21767076]

Palamar JJ, Kiang MV, Halkitis PN. Religiosity and exposure to users in explaining illicit drug use among emerging adults. Journal of Religion and Health. 2012 Epub ahead of print.

Palamar JJ. Predictors of disapproval toward "hard drug" use among high school seniors in the US. Prevention Science. 2013 Epub ahead of print.

Pew Research Center. Majority now supports legalizing cannabis. 2013. Retrieved from: http://www.people-press.org/files/legacy-pdf/4-4-13%20Cannabis%20Release.pdf

Rao JNK, Scott AJ. On chi-squared tests for multi-way tables with cell proportions estimated from survey data. Annals of Statistics. 1984; 12:46–60.

Romero S. Uruguay acts to legalize marijuana. The New York Times. Dec 10.:A8.

Room, R. Legalizing a market for cannabis for pleasure. Colorado, Washington: Uruguay and beyond. Addiction; 2013. Epub ahead of print

Swift, A. For first time, Americans favor legalizing marijuana: Support surged 10 percentage points in past year, to 58%. 2013. Retrieved from: http://www.gallup.com/poll/165539/first-time-americans-favor-legalizing-marijuana.aspx

Substance Abuse and Mental Health Services Administration, SAMHSA. Results from the 2011 NationalSurvey on Drug Use and Health: Summary of National Findings. Rockville, MD: Substance Abuse and Mental Health Services Administration; 2012. NSDUH Series H-44, HHSPublication No. (SMA) 12-4713Retrieved from: http://www.samhsa.gov/data/NSDUH/2k11Results/NSDUHresults2011.pdf

Terry-McElrath YM, O'Malley PM, Johnston LD. Simultaneous alcohol and marijuana use among US high school seniors from 1976 to 2011: Trends, reasons, and situations. Drug and Alcohol Dependence. 2013 Epub ahead of print.

United Nations Office on Drugs and Crime, UNODC. World Drug Report 2013. 2013. (United Nations publication, Sales No. E.13.XI.6). http://www.unodc.org/unodc/secured/wdr/wdr2013/World_Drug_Report_2013.pdf

Vuolo M. National-level drug policy and young people's illicit drug use: A multilevel analysis of the European Union. Drug Alcohol Dependence. 2013; 131(1–2):149–156. [PubMed: 23298650]

Wakefield M, Kloska DD, O'Malley PM, Johnston LD, Chaloupka F, Pierce J, Giovino G, Ruel E, Flay BR. The role of smokingintentions in predictingfuturesmoking among youth: Findings from Monitoring the Futuredata. Addiction. 2004; 99(7):914–922. [PubMed: 15200587]

Wall MM, Poh E, Cerda M, Keyes KM, Galea S, Hasin DS. Adolescent cannabis use from 2002 to 2008: Higher in states with medical cannabis laws, cause still unclear. Annals of Epidemiology. 2011; 21(9):714–716. [PubMed: 21820632]

Wallace JM Jr, Vaughn MG, Bachman JG, O'Malley PM, Johnston LD, Schulenberg JE. Race/ethnicity, socioeconomic factors, and smoking among early adolescent girls in the United States. Drug and Alcohol Dependence. 2009; 104(Suppl 1):S42–S49. [PubMed: 19628345]

Wray-Lake L, Maggs JL, Johnston LD, Bachman JG, O'Malley PM, Schulenberg JE. Associations between community attachments and adolescent substance use in nationally representative samples. Journal of Adolescent Health. 2012; 51(4):325–331. [PubMed: 22999832]

Table 1

Sample characteristics of non-cannabis users by cohort, 2007–2011 (Weighted N= 6,116).

Predictor	2007 $N = 1,296$	2008 $N = 1,230$	2009 $N = 1,236$	2010 $N = 1,222$	2011 $N = 1,132$	χ^2(df)	Combined $N = 6,116$
Age							
<18	41.9	42.1	44.8	43.8	45.3	5.56(8)	43.5
18	57.2	57.3	54.2	55.0	53.8		55.5
Missing Data	1.0	0.6	1.1	1.1	0.9		0.9
Sex							
Male	40.3	41.2	40.5	43.4	43.3	6.16(8)	41.7
Female	55.7	55.4	54.8	52.0	52.5		54.1
Missing Data	4.0	3.4	4.7	4.5	4.2		4.2
Race/Ethnicity							
White	62.4	59.4	60.9	60.5	56.5	30.20(12)**	60.0
Black	10.8	11.8	9.6	11.7	12.1		11.2
Hispanic	14.1	16.2	16.4	15.3	12.5		14.9
Missing Data	12.6	12.6	13.1	12.6	18.9		13.9
Population Density[+]							
Non-MSA	23.9	22.4	22.1	23.2	22.0	9.94(8)	22.7
Small MSA	45.6	50.7	51.6	47.0	48.7		48.7
Large MSA	30.5	26.9	26.3	29.8	29.3		28.6
Parent Education							
Low Education	29.8	29.2	28.8	27.1	24.5	14.22(12)	27.9
Medium Education	27.3	29.7	28.3	26.8	28.1		28.0
High Education	39.2	37.7	38.6	41.2	43.4		39.9
Missing Data	3.8	3.4	4.3	5.0	3.9		4.1
Religiosity							
Low	23.4	25.0	27.0	25.3	27.6	14.62(12)	25.6
Medium	21.5	19.2	20.3	21.2	22.5		20.9

Predictor	2007 N = 1,296	2008 N = 1,230	2009 N = 1,236	2010 N = 1,222	2011 N = 1,132	χ^2(df)	Combined N = 6,116
High	31.1	31.3	31.4	31.8	26.6		30.5
Missing Data	24.1	24.5	21.3	21.7	23.4		23.0
Plan to Graduate College							
Definitely Not or Probably Not	13.6	12.4	12.0	11.1	11.3	24.30(12)*	12.1
Probably	21.9	20.1	17.0	18.6	23.5		20.2
Definitely	60.9	63.2	65.6	65.3	62.2		63.4
Missing Data	3.5	4.3	5.4	5.0	3.0		4.2
Evenings Out Per Week for Fun							
0–1	31.0	30.6	31.5	30.4	37.9	19.95(12)	32.2
2–3	49.6	50.2	49.0	51.0	47.1		49.4
4–7	15.2	15.6	15.6	14.7	12.5		14.8
Missing Data	4.3	3.5	3.9	3.8	2.4		3.6
Lifetime Cigarette Use							
No	75.6	77.5	80.8	84.1	85.7	41.09(8)***	80.8
Yes	23.1	22.1	18.6	15.6	14.1		18.8
Missing Data	0.3	0.4	0.5	0.3	0.1		0.3
Alcohol Use in Last 12 Months							
No	51.9	50.3	50.9	54.1	54.3	6.11(8)	52.3
Yes	45.2	45.9	46.1	43.0	42.4		44.6
Missing Data	2.9	3.8	3.0	2.9	3.3		3.2
Friends Disapprove of Cannabis Use							
Don't Disapprove	14.7	15.9	16.6	21.5	21.9	35.61(12)***	18.0
Disapprove	22.3	22.0	23.3	21.3	21.2		22.0
Strongly Disapprove	52.6	53.1	49.9	45.1	47.8		49.8
Missing Data	10.5	9.0	10.1	12.1	9.1		10.2
Would Try Cannabis if Legal to Use							
No	91.0	90.4	89.9	88.2	89.1	4.55(4)	89.7

Predictor	2007 N = 1,296	2008 N = 1,230	2009 N = 1,236	2010 N = 1,222	2011 N = 1,132	χ^2(df)	Combined N = 6,116
Yes	9.0	9.6	10.1	11.8	10.9		10.3

Note. Rao-Scott Chi-squares (χ^2) are design-based to correct for the complex survey design. Weighted percentages are rounded so they do not always add up to exactly 100%.

[+] Population density had no missing data so no missing data category was considered in chi-square analysis. MSA = metropolitan statistical area.

[**] *p* < 0.01,

[***] *p* < 0.001

Table 2

Variables explaining intention to try cannabis among non-users (Weighted *N*= 6,116).

Predictor	Raw proportions		Model-based estimates		Current 2011 Prevalence (45.6%) (%) (a)	Expected change in lifetime prevalence†		
	Would Not Try %	Would Try %	AOR	(95% CI)		Expected Absolute Increase in Prevalence (%) (b)	Expected Prevalence (51.2%) (%) (a + b)	Expected Relative Increase in Prevalence (%) (b/a)
Age								
<18	89.2	10.8	1.00		44.5	6.0	50.5	13.5
18	90.2	9.8	0.84	(0.68, 1.03)	46.0	5.3	51.3	11.5
Sex								
Male	87.3	12.7	1.00		48.7	6.5	55.2	13.4
Female	91.8	8.2	0.61***	(0.49, 0.76)	41.9	4.8	46.7	11.4
Race/Ethnicity								
White	88.3	11.7	1.00		45.9	6.3	52.2	13.8
Black	93.2	6.8	0.66*	(0.43, 0.99)	42.4	3.9	46.3	9.2
Hispanic	92.8	7.2	0.62**	(0.44, 0.87)	47.6	3.8	51.4	7.9
Population Density								
Non-MSA	90.9	9.1	1.00		40.5	5.4	45.9	13.4
Small MSA	89.1	10.9	1.38*	(1.05, 1.81)	46.3	5.9	52.2	12.6
Large MSA	89.9	10.1	1.19	(0.88, 1.62)	47.9	5.3	53.2	11.0
Parent Education								
Low Education	93.1	6.9	1.00		48.5	3.6	52.1	7.3
Medium Education	90.7	9.3	1.32	(0.98, 1.77)	47.4	4.9	52.3	10.3
High Education	86.8	13.2	1.94***	(1.48, 2.56)	41.8	7.7	49.5	18.4
Religiosity								
Low	85.3	14.7	1.00		53.0	6.9	59.9	13.0
Medium	89.6	10.4	0.75	(0.57, 1.01)	45.4	5.7	51.1	12.5
High	92.6	7.4	0.65**	(0.49, 0.85)	29.0	5.3	34.3	18.1

Predictor	Raw proportions		Model-based estimates		Current 2011 Prevalence (45.6%) (%) (a)	Expected change in lifetime prevalence[†]		
	Would Not Try %	Would Try %	AOR	(95% CI)		Expected Absolute Increase in Prevalence (%) (b)	Expected Prevalence (51.2%) (%) (a + b)	Expected Relative Increase in Prevalence (%) (b/a)
Plan to Graduate College								
Definitely Not or Probably Not	91.0	9.0	1.00		52.9	4.2	57.1	8.0
Probably	89.8	10.2	1.47	(0.97, 2.21)	49.6	5.1	54.7	10.4
Definitely	89.4	10.6	1.50*	(1.03, 2.18)	41.2	6.2	47.4	15.1
Evenings Out Per Week for Fun								
0–1	91.5	8.5	1.00		32.6	5.7	38.3	17.6
2–3	89.1	10.9	1.02	(0.79, 1.31)	46.3	5.9	52.2	12.6
4–7	88.1	11.9	0.98	(0.72, 1.34)	59.8	4.8	64.6	8.0
Lifetime Cigarette Use								
No	92.0	8.0	1.00		24.4	6.1	30.5	24.8
Yes	80.0	20.0	2.45***	(1.94, 3.10)	77.9	4.4	82.3	5.7
Alcohol Use in Last 12 Months								
No	94.5	5.5	1.00		14.3	4.7	19.0	33.0
Yes	83.9	16.1	2.42***	(1.90, 3.08)	63.7	5.8	69.5	9.2
Friends Disapproval of Cannabis Use								
Don't Disapprove	77.0	23.0	1.00		71.5	6.6	78.1	9.2
Disapprove	85.8	14.2	0.60***	(0.47, 0.77)	37.2	8.9	46.1	24.0
Strongly Disapprove	95.9	4.1	0.19***	(0.14, 0.25)	13.9	3.5	17.4	25.4
NagelkerkeR2			22%					
Correct Classification Rate			90%					

Note. Adjusted Odds Ratios (AORs) were adjusted for all other covariates. We adjusted for cohort when computing AORs. Results from missing data indicators not presented. Weighted percentages are rounded so they do not always add up to exactly 100%. MSA = metropolitan statistical area.

[†]Lifetime prevalence was computed using the full 2011 MTF dataset (*N*=14,855).

*
p< 0.05,

**

$p < 0.01$,

***

$p < 0.001$.

NIH-PA Author Manuscript NIH-PA Author Manuscript NIH-PA Author Manuscript

Table 3

Sample characteristics of cannabis users by cohort, 2007–2011 (Weighted *N*= 3,828).

Predictor	2007 *N* = 774	2008 *N* = 755	2009 *N* = 699	2010 *N* = 780	2011 *N* = 820	χ^2(df)	Combined *N* = 3,828
Age							
<18	43.1	40.3	41.5	46.1	44.6	8.05(8)	43.2
18	55.8	58.6	57.9	53.2	53.8		55.8
Missing Data	1.1	1.1	0.6	0.7	1.6		1.1
Sex							
Male	44.7	49.3	50.3	55.1	48.7	13.92(8)	49.6
Female	49.6	46.1	45.0	40.2	46.2		45.5
Missing Data	5.7	4.5	4.7	4.6	5.1		4.9
Race/Ethnicity							
White	66.2	63.1	62.5	63.0	58.7	37.84(12)[***]	62.7
Black	10.8	12.7	6.7	7.5	12.6		10.1
Hispanic	11.5	13.3	16.8	14.0	12.3		13.5
Missing Data	11.4	11.0	13.9	15.5	16.4		13.7
Population Density[+]							
Non-MSA	19.8	21.7	21.0	16.5	17.6	26.15(8)[**]	19.2
Small MSA	44.4	52.0	47.8	56.3	51.4		50.5
Large MSA	35.8	26.4	31.2	27.2	31.0		30.3
Parent Education							
Low Education	30.7	28.4	32.9	30.6	30.3	17.35(12)	30.5
Medium Education	31.0	28.7	26.8	31.9	26.6		29.0
High Education	35.2	37.0	36.6	35.1	38.7		36.5
Missing Data	3.2	5.9	3.7	2.5	4.4		3.9
Religiosity							
Low	40.1	38.1	40.5	36.5	38.7	12.98(12)	38.8

Predictor	2007 N = 774	2008 N = 755	2009 N = 699	2010 N = 780	2011 N = 820	χ^2(df)	Combined N = 3,828
Medium	23.2	20.4	21.4	21.2	19.6		21.1
High	14.3	15.3	14.7	15.7	12.5		14.5
Missing Data	22.3	26.1	23.4	26.6	29.3		25.6
Plan to Graduate College							
Definitely Not or Probably Not	19.4	22.0	18.1	17.8	19.5	12.92(12)	19.4
Probably	23.8	22.5	17.8	23.4	22.5		22.1
Definitely	51.4	50.0	58.2	52.9	52.5		52.9
Missing Data	5.5	5.6	5.9	5.9	5.5		5.7
Evenings Out Per Week for Fun							
0–1	16.0	16.2	18.8	16.8	21.9	30.40(12) **	18.0
2–3	47.8	46.4	48.7	44.4	50.0		47.5
4–7	33.5	32.4	28.7	33.5	23.6		30.3
Missing Data	2.7	5.0	3.8	5.3	4.6		4.3
Lifetime Cigarette Use$^+$							
No	20.4	22.0	24.9	25.1	32.2	25.77(4) ***	25.0
Yes	79.5	77.6	75.1	74.8	67.7		74.8
Missing Data	0.1	0.4	0.0	0.1	0.2		0.2
Alcohol Use in Last 12 Months							
No	8.5	10.4	7.6	9.1	13.0	15.34(8)	9.8
Yes	90.0	87.2	89.5	89.2	84.9		88.1
Missing Data	1.5	2.4	2.9	1.7	2.1		2.1
Cannabis Use in Last 30 Days							
No	50.6	53.0	49.5	46.7	47.4	6.02(4)	49.4
Yes	49.4	47.0	50.5	53.3	52.6		50.6
Friends Disapproval of Cannabis Use							
Don't Disapprove	62.8	58.1	59.3	62.4	66.8	21.67(12) *	62.0
Disapprove	16.4	15.1	16.5	16.9	13.3		15.6

Predictor	2007 N = 774	2008 N = 755	2009 N = 699	2010 N = 780	2011 N = 820	χ^2(df)	Combined N = 3,828
Strongly Disapprove	9.4	12.2	10.1	7.0	9.3		9.6
Missing Data	11.4	14.6	14.1	13.8	10.6		12.8
Use if Legal							
Would Not Use	39.0	40.1	36.8	32.0	32.1	17.58(8)[*]	35.9
Would Use as Often	45.2	44.1	45.5	47.3	47.9		46.0
Would Use More Often	15.8	15.8	17.6	20.8	20.0		18.1

Note. Rao-Scott Chi-squares (χ^2) are design-based to correct for the complex survey design. Weighted percentages are rounded so they do not always add up to exactly 100%. Cannabis use and the "Use if Legal" variables were not missing any data in the analyses.

[+] Since there were cells in the missing data row with zero-counts for lifetime smoking we removed the missing subgroup for chi-square analysis. Likewise, population density had no missing data so no missing data category was considered in chi-square analysis. MSA = metropolitan statistical area.

[*]
p < 0.05,

[**]
p < 0.01,

[***]
p < 0.001

Table 4

Variables explaining intention to use cannabis among lifetime users (Weighted *N* = 3,828).

	Raw proportions			Model-based estimates			
				Would Use as Often (N = 1,763)		Would Use More Often (N = 691)	
	Would Not Use %	Would Use as Often %	Would Use More Often %	AOR	(95% CI)	AOR	(95% CI)
Age							
<18	33.4	48.4	18.3	1.00		1.00	
18	37.9	44.2	17.9	0.76*	(0.61, 0.95)	0.78	(0.60, 1.01)
Sex							
Male	30.5	48.8	20.7	1.00		1.00	
Female	42.4	42.7	14.9	0.71**	(0.56, 0.89)	0.56***	(0.43, 0.74)
Race/Ethnicity							
White	31.3	49.7	19.1	1.00		1.00	
Black	44.0	39.0	17.0	0.84	(0.58, 1.22)	1.00	(0.64, 1.57)
Hispanic	50.9	37.0	12.1	0.50***	(0.35, 0.71)	0.47***	(0.31, 0.71)
Population Density							
Non-MSA	40.7	41.0	18.3	1.00		1.00	
Small MSA	35.1	46.5	18.4	1.14	(0.85, 1.52)	1.08	(0.77, 1.51)
Large MSA	34.2	48.5	17.3	1.10	(0.79, 1.52)	1.01	(0.69, 1.46)
Parent Education							
Low Education	44.2	39.9	15.9	1.00		1.00	
Medium Education	38.1	43.6	18.3	0.95	(0.71, 1.26)	1.02	(0.73, 1.43)
High Education	27.1	52.7	20.2	1.57**	(1.18, 2.08)	1.55**	(1.12, 2.14)
Religiosity							
Low	29.3	50.1	20.7	1.00		1.00	
Medium	36.8	42.8	20.4	0.71*	(0.53, 0.94)	0.82	(0.59, 1.14)
High	49.2	34.7	16.1	0.57**	(0.40, 0.80)	0.61*	(0.41, 0.91)

	Raw proportions			Model-based estimates			
				Would Use as Often (N = 1,763)		Would Use More Often (N = 691)	
	Would Not Use %	Would Use as Often %	Would Use More Often %	AOR	(95% CI)	AOR	(95% CI)
Plan to Graduate College							
Definitely Not or Probably Not	34.2	44.8	20.9	1.00		1.00	
Probably	35.1	46.8	18.1	1.05	(0.75, 1.49)	0.87	(0.59, 1.29)
Definitely	37.3	45.3	17.4	1.03	(0.75, 1.41)	0.89	(0.63, 1.27)
Evenings Out Per Week for Fun							
0–1	49.4	35.7	14.9	1.00		1.00	
2–3	36.7	46.2	17.1	1.29	(0.95, 1.74)	1.17	(0.82, 1.66)
4–7	27.4	49.9	22.6	1.39	(1.00, 1.94)	1.53[*]	(1.05, 2.23)
Lifetime Cigarette Use							
No	46.4	41.7	12.0	1.00		1.00	
Yes	32.4	47.5	20.1	1.49[**]	(1.15, 1.93)	2.25[***]	(1.65, 3.06)
Alcohol Use in Last 12 Months							
No	58.1	28.0	13.9	1.00		1.00	
Yes	32.9	48.5	18.6	1.72[**]	(1.21, 2.43)	1.22	(0.79, 1.89)
Cannabis Use in Last 30 Days							
No	87.2	8.4	4.4	1.00		1.00	
Yes	22.3	56.0	21.7	14.70[***]	(11.51, 18.77)	15.40[***]	(11.59, 20.47)
Friends Disapproval of Cannabis Use							
Don't Disapprove	20.8	56.2	23.0	1.00		1.00	
Disapprove	65.9	24.0	10.1	0.23[***]	(0.17, 0.31)	0.23[***]	(0.16, 0.31)
Strongly Disapprove	79.8	12.8	7.4	0.11[***]	(0.07, 0.17)	0.15[***]	(0.10, 0.24)
NagelkerkeR^2				47%			
Correct Classification Rate				66%			

Note. The comparison group is "Would Not Use" (*N* = 1,375). Adjusted Odds Ratios (AORs) were adjusted for all other covariates. We adjusted for cohort when computing both ORs and AORs. Results from missing data indicators not presented. Weighted percentages are rounded so they do not always add up to exactly 100%. MSA = metropolitan statistical area.

*
p < 0.05,

**
p < 0.01,

***
p < 0.001

Table 5

Supplementary analyses: model-based estimates of variables explaining intention to use cannabis among recent users.

	Last 12 Month Users Weighted *N* = 3,025				Last 30 Day Users Weighted *N* = 1,937			
	Would Use as Often (N = 1,695)		Would Use More Often (N = 656)		Would Use as Often (N = 1,267)		Would Use More Often (N = 506)	
	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI
Age								
<18	1.00		1.00		1.00		1.00	
18	0.80	(0.63, 1.01)	0.80	(0.60, 1.06)	0.99	(0.64, 1.53)	0.91	(0.57, 1.46)
Sex								
Male	1.00		1.00		1.00		1.00	
Female	0.69**	(0.54, 0.88)	0.57***	(0.42, 0.76)	0.54**	(0.34, 0.85)	0.49***	(0.30, 0.80)
Race/Ethnicity								
White	1.00		1.00		1.00		1.00	
Black	1.00	(0.66, 1.52)	1.16	(0.70, 1.91)	1.25	(0.61, 2.55)	1.63	(0.75, 3.55)
Hispanic	0.56**	(0.39, 0.80)	0.53**	(0.34, 0.84)	0.33***	(0.18, 0.62)	0.31**	(0.20, 0.77)
Population Density								
Non-MSA	1.00		1.00		1.00		1.00	
Small MSA	1.22	(0.89, 1.68)	1.15	(0.80, 1.67)	1.55	(0.87, 2.76)	1.22	(0.66, 2.26)
Large MSA	1.12	(0.80, 1.58)	1.02	(0.68, 1.53)	1.11	(0.62, 2.00)	0.95	(0.50, 1.80)
Parent Education								
Low Education	1.00		1.00		1.00		1.00	
Medium Education	0.88	(0.65, 1.20)	0.91	(0.63, 1.30)	0.87	(0.50, 1.52)	0.98	(0.53, 1.78)
High Education	1.47*	(1.08, 2.00)	1.45*	(1.01, 2.09)	1.44	(0.78, 2.63)	1.67	(0.87, 3.19)
Religiosity								
Low	1.00		1.00		1.00		1.00	
Medium	0.61**	(0.45, 0.84)	0.72	(0.50, 1.03)	0.94	(0.51, 1.70)	1.09	(0.58, 2.07)
High	0.45***	(0.31, 0.64)	0.50**	(0.33, 0.77)	0.37**	(0.20, 0.68)	0.39**	(0.20, 0.78)

| | Last 12 Month Users Weighted N = 3,025 | | | | Last 30 Day Users Weighted N = 1,937 | | | |
| | Would Use as Often (N = 1,695) | | Would Use More Often (N = 656) | | Would Use as Often (N = 1,267) | | Would Use More Often (N = 506) | |
	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI
Plan to Graduate College								
Definitely Not or Probably Not	1.00		1.00		1.00		1.00	
Probably	1.10	(0.77, 1.57)	0.91	(0.60, 1.38)	1.36	(0.71, 2.59)	1.08	(0.54, 2.14)
Definitely	0.86	(0.62, 1.19)	0.75	(0.51, 1.09)	0.95	(0.54, 1.66)	0.74	(0.41, 1.35)
Evenings Out Per Week for Fun								
0–1	1.00		1.00		1.00		1.00	
2–3	1.43*	(1.02, 2.00)	1.20	(0.81, 1.79)	1.85	(0.99, 3.46)	1.60	(0.82, 3.13)
4–7	1.59*	(1.11, 2.28)	1.70*	(1.12, 2.58)	1.47	(0.77, 2.81)	1.49	(0.75, 2.95)
Lifetime Cigarette Use								
No	1.00		1.00		1.00		1.00	
Yes	1.83***	(1.41, 2.38)	2.25***	(1.65, 3.06)	2.97***	(1.86, 4.76)	3.90***	(2.31, 6.60)
Alcohol Use in Last 12 Months								
No	1.00		1.00		1.00		1.00	
Yes	1.01	(0.63, 1.62)	0.81	(0.47, 1.41)	0.63	(0.23, 1.74)	0.63	(0.22, 1.84)
Friends Disapproval of Cannabis Use								
Don't Disapprove	1.00		1.00		1.00		1.00	
Disapprove	0.18***	(0.13, 0.25)	0.19***	(0.12, 0.29)	0.12***	(0.07, 0.22)	0.17***	(0.09, 0.34)
Strongly Disapprove	0.10***	(0.06, 0.16)	0.12***	(0.07, 0.20)	0.09***	(0.04, 0.20)	0.17***	(0.08, 0.35)
NagelkerkeR²	21%				17%			
Correct Classification Rate	60%				66%			

Note. The comparison group is "Would Not Use;" (*N* for 12 Month Users = 674 and *N* for 30 Day Users = 164). Adjusted Odds Ratios (AORs) were adjusted for all other covariates. We adjusted for cohort when computing both ORs and AORs. Results from missing data indicators not presented. Weighted percentages are rounded so they do not always add up to exactly 100%. MSA = metropolitan statistical area.

*
$p < 0.05$,

**

$p < 0.01$,

***

$p < 0.001$

Table 6

Prevalence of responses "would not use," "would use as often" and "would use more often" among users, broken down by number of occasions of use by A) lifetime use, B) last year use, and C) last 30-day use (Weighted N = 3,828).

	0 Occasions	1–2 Occasions	3–5 Occasions	6–9 Occasions	10–19 Occasions	20–39 Occasions	40+ Occasions
A) Lifetime Use (n=3,828)	$n = 0$	$n = 732$	$n = 499$	$n = 324$	$n = 467$	$n = 376$	$n = 1,430$
Would Not Use (%)	0.0	79.6	56.1	39.2	26.0	25.7	11.6
Would Use as Often (%)	0.0	13.4	33.4	44.8	52.0	48.6	64.8
Would Use More Often (%)	0.0	6.9	10.5	15.9	22.0	25.7	23.5
B) Use in Last 12 Months (n=3,025)	$n = 803$	$n = 745$	$n = 486$	$n = 338$	$n = 336$	$n = 315$	$n = 807$
Would Not Use (%)	87.2	58.0	25.8	14.7	8.2	7.9	2.0
Would Use as Often (%)	8.4	29.9	56.6	62.4	60.2	63.6	72.5
Would Use More Often (%)	4.4	12.2	17.7	22.9	31.6	28.5	25.5
C) Use in Last 30 Days (n=1,937)	$n = 1,891$	$n = 650$	$n = 285$	$n = 207$	$n = 241$	$n = 197$	$n = 358$
Would Not Use (%)	64.0	19.1	6.4	2.7	3.2	1.6	1.6
Would Use as Often (%)	26.2	55.0	67.4	66.3	68.4	78.1	71.3
Would Use More Often (%)	9.8	24.9	26.3	30.9	28.4	20.3	27.1

Note: Number of occasions used was assessed separately for lifetime, annual (12-month) and recent (30-day) use so number of reported occasions used was reported for lifetime, the last year and last 30 days, separately. Weighted percentages and frequencies are rounded so they do not always add up to exactly 100%.