

# Marijuana and Tobacco Co-Use in Young Adults: Patterns and Thoughts About Use

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**ABSTRACT. Objective:** We examined the frequency and intensity of tobacco use and thoughts about abstinence among young adults in the United States as a function of their use of marijuana. We hypothesized that heavier marijuana use would be associated with heavier tobacco use and fewer attempts to quit smoking, and we explored relationships between marijuana use and ratings of intentions and thoughts related to quitting tobacco. **Method:** This was a cross-sectional survey consisting of online recruitment and anonymous self-report. Participants were English literate, were between the ages of 18 and 25 years, and reported past-month tobacco use. More than half (53%) had smoked marijuana in the past 30 days. Tobacco use (quantity/frequency, Heavy Smoking Index, past-year quit attempt), thoughts about tobacco use (outcome expectancies, desire, self-efficacy, difficulty of quitting, abstinence goal, pros and cons, stage of change), alcohol use, and other drug use were

assessed. **Results:** Compared with those who smoked only tobacco, co-users were younger and had smoked for fewer years; had higher household income; were more likely to be male, multiethnic, and nondaily smokers; and reported greater alcohol and other drug use. The variable of days using marijuana in the past 30 days was associated with multiple measures of tobacco use intensity/frequency. Only one association was significant between marijuana use and tobacco-related cognitions: Co-users had a lower likelihood of planning to quit tobacco for good (odds ratio = 0.75, 95% CI [0.58, 0.98]). **Conclusions:** Findings support the association between tobacco and marijuana use among young people but speak to the importance of addressing tobacco cognitions in young adult smokers regardless of level of marijuana use. (*J. Stud. Alcohol Drugs*, 74, 301–310, 2013)

**T**OBACCO USE, INCLUDING CIGARETTE smoking, remains the single most preventable cause of morbidity and mortality in the United States, accounting for approximately one in five deaths, or 440,000 deaths per year (Centers for Disease Control and Prevention, 2008; Mokdad et al., 2004). In the United States, the prevalence of cigarette smoking has declined among adults since 1983. However, the cigarette smoking prevalence among young adults ages 18–25 years has remained stable, with 34% reporting having smoked in the past month in 2010 (Substance Abuse and Mental Health Services Administration [SAMHSA], 2011a). More than 90% of cigarette smokers become regular users before age 18 (U.S. Department of Health and Human Services, 1994). Tobacco industry documents reveal that young adults ages 18–24 years constitute the largest segment of targeted tobacco-marketing efforts (Biener and Albers, 2004; Katz and Lavack, 2002; Ling and Glantz, 2002a, 2002b; Sepe et al., 2002), which are associated with smoking initiation (Gilpin et al., 1997, 2005; Pierce et al., 1994). Compared with other age groups, young adults are

less likely to use behavioral or pharmacotherapy interventions for smoking cessation (Curry et al., 2007).

Marijuana is the most commonly used illicit substance among young adults, with approximately 19% of those ages 18–25 reporting marijuana use in the past month (SAMHSA, 2011b). Rates of marijuana use among young adults have increased since 2008 and are highest among those ages 18–25, compared with any other age group. Young adulthood is an important developmental stage for understanding use patterns of cigarettes and marijuana (Ramo et al., 2012).

## *Association between tobacco and marijuana use in young adulthood*

Tobacco and marijuana use commonly co-occur among young people (Ramo et al., 2012). In 2009, 35% of cigarette smokers ages 18–25 had used marijuana in the past month, almost three times the rate of the general adult population (SAMHSA, 2010). Tobacco use has been implicated as a gateway drug to the use of marijuana and other illicit drugs

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(Beenstock and Rahav, 2002; Bentler et al., 2002). Cigarette smoking is associated with the initiation (Agrawal et al., 2007; Lai et al., 2000) and the extent (Kapusta et al., 2007; Leatherdale et al., 2007) of marijuana use in young adulthood. One study demonstrated that young adults ages 18–25 are 10 times more likely to have ever used marijuana if they also have a history of smoking cigarettes (Lai et al., 2000). Research also documents a reverse gateway effect, whereby those who smoke marijuana in early young adulthood are more likely to initiate tobacco use and to have a greater likelihood of developing nicotine dependence than their nonsmoking peers (Agrawal et al., 2008; Behrendt et al., 2009; Okoli et al., 2008; Timberlake et al., 2007; Tullis et al., 2003). Those who go on to have problems with the use of illicit drugs, including but not limited to marijuana, are more likely to be heavy smokers, to be nicotine dependent, and to experience greater difficulty with quitting smoking (e.g., Richter et al., 2002).

The mechanisms by which tobacco and marijuana use are related include shared genetic factors, a similar route of administration (i.e., smoking), and co-administration (e.g., “blunts,” marijuana wrapped in a cigar shell; Agrawal et al., 2012). Possible manifestations of such commonalities in use are a substitution effect, whereby using marijuana causes smokers to smoke fewer cigarettes than they otherwise would have, or a facilitation effect, whereby smoking marijuana increases the intensity of use and is associated with reduced motivation, reduced abstinence goals, and increased barriers to quitting tobacco. For example, in one study among college students who reported smoking both marijuana and tobacco, 65% had smoked tobacco and marijuana in the same hour, and 31% reported that tobacco prolonged and sustained the effects of marijuana (Tullis et al., 2003). Additionally, a qualitative study reported that youth were most likely to relapse to tobacco use while smoking marijuana (Amos et al., 2004). A recent review of clinical outcomes of tobacco and marijuana co-use found that, relative to tobacco use only, co-occurring use was not associated with a greater likelihood of tobacco use disorder, psychosocial problems, or poorer tobacco-cessation outcomes (Peters et al., 2012). However, many of the studies reviewed included marijuana use as a dichotomous variable (use/no use), limiting the ability to detect a relationship between heavier marijuana use and tobacco use outcomes.

As others have noted, most substance use interventions target risk behaviors individually (Prochaska and Prochaska, 2011). However, interventions that have targeted tobacco use in the context of treatment for other substance dependence have demonstrated significant posttreatment effects on tobacco use and even improved long-term sobriety (Myers and Prochaska, 2008; Prochaska et al., 2004). Given the high rate of tobacco and marijuana co-use among young people, information is needed on patterns and processes of tobacco

and marijuana use to determine the best way to tailor interventions to this population.

To characterize the relationship between marijuana and tobacco use among young adults, the present study used a national online survey to examine whether heavier marijuana use was associated with greater cigarette use (quantity/frequency of use). We also sought to examine whether marijuana use was associated with differences in the likelihood of a past-year tobacco quit attempt. Furthermore, while controlling for smoking severity, we sought to examine whether marijuana use was associated with differences in smoking-related cognitions, including tobacco-related expectancies, desire and self-efficacy for quitting, abstinence goals, pros and cons for quitting (i.e., decisional balance), and readiness to quit (i.e., stage of change).

## Method

### *Participants and procedure*

Participants were young adults between ages 18 and 25 years who were English literate and reported having smoked at least one cigarette in the past 30 days. Marijuana use was not an inclusion criterion. This cross-sectional survey used three Internet-based recruitment methods described previously (Ramo et al., 2010; Ramo and Prochaska, 2012): (a) a paid advertisement campaign on Facebook, (b) a free campaign on Craigslist, and (c) a paid email advertising campaign through a survey sampling company. Advertisements on the three Internet-based channels invited young adults to participate in a 20-minute online survey with a chance to win a prize in a drawing (worth either \$25 or \$400). Advertisements were targeted to tobacco smokers (e.g., a picture of a pack of cigarettes) and/or both tobacco and marijuana use (e.g., a picture of a pack of cigarettes and a marijuana plant). The campaign ran for 18 consecutive months, between April 1, 2009, and December 31, 2010. Advertisements contained a hyperlink that directed potential participants to (a) the study's University of California Institutional Review Board–approved consent form that included verification questions to determine understanding of the consent process and (b) a screener for determining initial eligibility, including English literacy. Screening questions assessed age and past-month use of tobacco and other substances, including alcohol and marijuana (yes/no).

Participants who consented and were deemed eligible (reported age 18–25 and past-month cigarette use) were asked to complete a demographic questionnaire and measures of tobacco, marijuana, and other substance use and thoughts about tobacco use. The survey was anonymous, and data were encrypted for added security protection. Participants were required to answer all questions before they could continue to the next page of the survey but could quit and return to the survey at any time. Computer Internet Protocol (IP) addresses

were tracked, and only one entry was allowed from a single computer to prevent duplicate entries from the same person; however, multiple entries were allowed from the same Internet connection (dormitories, apartment buildings). Eligibility checks excluded respondents who (a) had discrepant data on similar demographic questions (e.g., date of birth and age, indicating that they were either too young or too old to participate) or grossly discrepant data on substance use measures (e.g., indicating that they had used tobacco daily in the past month on one measure and not at all on another item), (b) reported the same email address across multiple survey entries, and (c) had clearly invalid data (e.g., every entry was the same across the entire survey). Respondents found to be ineligible based on initial screening questions or the above criteria were considered invalid, and data were not analyzed.

### Measures

The measures used in the current study had been previously analyzed with anonymous online survey methods and demonstrated good reliability and validity with young adults (Ramo et al., 2011a, 2011b).

*Sociodemographics.* Gender, age, race/ethnicity, student status, employment status, years of education, annual personal and family income, and highest parental level of education were assessed. Residential zip codes were used to categorize participants as residing in (a) one of four U.S. Census Regions: Northeast, Midwest, South, and West (U. S. Census Bureau, 2010); (b) an urban or rural area, using zip code approximations of Rural–Urban commuting area data from the 2000 census in a coding system made public by the University of Washington Rural Health Research Center (2011); and (c) one of the 16 states or Washington, D.C., in which there was an active medical marijuana program at the time of data collection. The MacArthur Scale of Subjective Social Status (Adler et al., 2000) presented a “social ladder” and asked individuals to place an “X” on the rung reflecting their standing in terms of occupation, income, and social status, with values ranging from 1 to 10. All sociodemographic variables were used in propensity scoring analyses.

*Cigarette smoking behavior.* Timeline Followback (TLFB) procedures (Brown et al., 1998) assessed the number of cigarettes smoked each day in the past 30 days. The average number of cigarettes smoked per day and the number of days when the respondent smoked any cigarettes in the past 30 days were calculated. A smoking questionnaire assessed participants’ years of smoking, prior quit attempts (lifetime and past year), and the longest period of abstinence in a prior quit attempt (Hall et al., 2006). The Heavy Smoking Index (HSI; Heatherton et al., 1989), which combines the number of cigarettes per day (scored between 0 and 3) and the time to the first cigarette in a day (scored between 0 and 3), was used as a measure of dependence. This measure performs as well as or better than the Fagerström Test of Nicotine

Dependence (e.g., Kozlowski et al., 1994), which was found to be invalid in this sample (Ramo et al., 2011a).

*Thoughts about smoking.* The 21-item Smoking Consequences Questionnaire—short form (S-SCQ; Myers et al., 2003; Ramo et al., 2011a) measured smoking-related outcome expectancies (range: 0–189; Cronbach’s  $\alpha = .90$ ). Responses were scored on a 10-point Likert scale (0 = *completely unlikely* to 9 = *completely likely*) to rate the likelihood of occurrence of each smoking consequence. The Thoughts about Abstinence form (Hall et al., 1990) assessed the desire to quit, abstinence self-efficacy, and perceived difficulty of quitting (each scored on a scale from 1 to 10). Abstinence goals for cigarettes were categorized as total abstinence or nonabstinence. Smoking Decisional Balance (Velicer et al., 1985) assessed the pros (Cronbach’s  $\alpha = .80$ ) and cons (Cronbach’s  $\alpha = .73$ ) of smoking. Raw scores were converted to *t* scores and summed for pro and con scales consistent with previous literature. The Smoking Stages of Change Questionnaire assessed motivation to quit (Prochaska and DiClemente, 1983), categorizing smokers into one of three pre-action stages of change (precontemplation [no intention to quit within the next 6 months], contemplation [intention to quit within the next 6 months but no 24-hour quit attempt in the past year] and preparation [intention to quit within the next month and a 24-hour quit attempt in the past year]).

*Marijuana use.* The TLFB for marijuana (Sobell and Sobell, 1996) assessed the number of days using marijuana in the past 30 days. This measure has been shown previously to have high reliability for the full sample across almost all demographic groups (Ramo et al., 2011b) and was corroborated with responses to a single screening item (“Have you used marijuana in the past month [30 days]? [yes/no]”) and responses on the 2007 National Survey on Drug Use and Health marijuana use items (SAMHSA, 2008). Participants were considered marijuana users only if they reported past-month use on all three measures. Because it was a skewed variable, days using marijuana in the past 30 days required log-transformation.

*Alcohol and other drug use.* TLFB procedures for alcohol (Sobell et al., 1996a) assessed the number of drinks per day in the past 30 days. Composite variables used in generating propensity scores included the presence or absence of past-30-day drinking, the total number of drinks in the past 30 days, the number of days drinking, the average number of drinks per drinking day, the number of heavy drinking days, the greatest number of drinks in a day, and the average number of drinks per week. TLFB procedures for other drug use (Sobell et al., 1996b) assessed days using any drug other than tobacco, alcohol, or marijuana in the past 30 days. Composite variables used in generating propensity scores included the presence or absence of other drug use, the total number of days using other drugs in the past 30 days, and the average number of days per week using other drugs.

### *Analyses*

Chi-squares and *t* tests were used to compare tobacco smokers who did and did not use marijuana on demographic, tobacco use, alcohol use, and other drug use characteristics. Nonparametric Mann–Whitney *U* tests were used to test for differences in variables that were skewed. Analyses of study aims consisted of estimating and testing multivariate regression and logistic regression models. Because this was an observational study comparing self-selected groups, propensity scoring was used to help account for differences between marijuana users and nonusers that could lead to biased estimates of smoking patterns and cognitions. This method, widely used in observational studies, incorporates a scalar summary of covariate information to be included in the study design (D'Agostino, 1998). For each participant, sociodemographic, alcohol, and other drug use variables thought to be related to marijuana use were entered in a logistic regression analysis to generate a propensity score. Propensity scores were then entered as independent variables in all analyses testing the effect of marijuana use (log-transformed days using in the past 30 days) on tobacco use and thoughts about use. In addition to propensity scores, the total number of cigarettes smoked in the past month was included as a control variable in all analyses of thoughts about tobacco use.

Given the possibility that equating groups on alcohol and other substance use may overly correct for risk taking or substance problems in the marijuana use groups, all analyses were rerun with a modified version of propensity scores that did not include alcohol or other drug use variables. Given that propensity scoring is typically used when making causal inferences (e.g., with longitudinal data), we also reran any models in which propensity scores were significant, using only those individual covariates that were significant in analyses comparing marijuana users with nonusers (Table 1). All findings were consistent with those described below.

## **Results**

### *Sample characteristics*

The online survey received more than 7,567 hits, and 7,260 people gave online consent to determine eligibility to complete the survey. Of those, 4,242 (58%) met criteria and 494 (7%) were deemed invalid, leaving 3,748 (52%) eligible and valid cases. Of those, 3,379 (90%) completed the demographic items, and 1,987 (53%) completed the entire survey. The completion rate was consistent with other online smoking studies (Cobb et al., 2005; McKay et al., 2008; Swartz et al., 2006). Survey completers differed significantly from those who completed demographic information only ( $n = 369$ ) on several variables, but the differences were of small magnitude (e.g., the complete group had a mean age of 20.6

years, compared with a mean age of 20.1 years for the incomplete group). Because significant differences were more likely attributable to the large sample size than to meaningful group differences, we used only the completed cases ( $N = 1,987$ ) in analyses for the present study.

More than half of the sample (53%) reported marijuana use in the past month. The proportion of marijuana users was identical to that in a subsample of respondents who were recruited from advertisements targeted to tobacco use only. Table 1 presents comparisons between marijuana users and nonusers on sociodemographic, tobacco, alcohol, and other drug use variables. Compared with those who smoked only cigarettes, those who also used marijuana were slightly younger, were more likely to be male, were more likely to be multiethnic, and had higher household incomes. Marijuana users were more likely to have used alcohol or illicit drugs in the past month, and those who did so had used them more often and in greater amounts. Without controlling for demographic differences, we found that marijuana users had fewer total years of smoking, were less likely to be daily smokers, reported fewer pros of smoking, and were less likely to endorse a goal of abstinence from smoking.

### *Tobacco use*

Demographic, alcohol, and other drug use variables were included in propensity score computations. Regression analyses tested whether marijuana use frequency was associated with cigarette use. Use was examined as the number of days smoking in the past 30 days, the total number of cigarettes smoked in the past 30 days, the average number of cigarettes smoked per day, daily smoking status [yes/no; logistic regression], nicotine dependence (HSI), and the total number of years smoking.

Model fit statistics are summarized for multiple regression models (Table 2) and logistic regression models (Table 3) testing the relationships between marijuana use (log days using in the past 30 days) and tobacco use variables. Models with propensity scores added first indicated that propensity scores were associated with the number of days smoking in the past 30 days (Table 2, Model 1), the total number of cigarettes smoked in the past 30 days (Model 2), the average number of cigarettes smoked per day (Model 3), nicotine dependence (HSI; Model 4), the total number of years smoking (Model 5), and daily smoking status (Table 3, Model 1). Controlling for propensity scores, we found that there were significant associations between the number of days using marijuana and the number of days smoking in the past 30 days (Table 2, Model 1), the number of cigarettes smoked in the past 30 days (Model 2), and the average number of cigarettes per smoking day (Model 3). There were no significant relationships between marijuana use and nicotine dependence (HSI; Model 4), the total number of years smoking (Model 5), or daily smoking status (Table 3, Model 1).

TABLE 1. Descriptive statistics and comparisons of marijuana users versus marijuana nonusers ( $n = 1,987$ )

| Variable  | Marijuana nonusers<br>( $n = 930$ ) |                 | Marijuana users<br>( $n = 1,057$ ) |                 | Total<br>( $n = 1,987$ ) |                 | $\chi^2/t/U$ | $p$   |
|---|-------------------------------------|-----------------|------------------------------------|-----------------|--------------------------|-----------------|--------------|-------|
|   | <i>M/Mdn/%<sup>a</sup></i>          | <i>SD/IR</i>    | <i>M/Mdn/%</i>                     | <i>SD/IR</i>    | <i>M/Mdn/%</i>           | <i>SD/IR</i>    |              |       |
| Age   | 20.8                                | 2.1             | 20.4                               | 2.1             | 20.6                     | 2.1             | -4.59        | <.001 |
| Sex, <sup>b</sup> % female                          | 41.2                                |                 | 33.1                               |                 | 36.9                     |                 | 13.69        | <.001 |
| Ethnicity, %  |                                     |                 |                                    |                 |                          |                 | 11.90        | .036  |
| African American                                    | 2.8                                 |                 | 3.3                                |                 | 3.1                      |                 |              |       |
| Asian American/Pacific Islander                     | 4.9                                 |                 | 3.2                                |                 | 4.0                      |                 |              |       |
| White   | 72.0                                |                 | 70.5                               |                 | 71.2                     |                 |              |       |
| Hispanic/Latino                                     | 6.1                                 |                 | 6.4                                |                 | 6.3                      |                 |              |       |
| Multiethnic   | 8.0                                 |                 | 11.5                               |                 | 9.9                      |                 |              |       |
| Other   | 6.1                                 |                 | 5.0                                |                 | 5.5                      |                 |              |       |
| Years of education                                  | 13.1                                | 2.3             | 13.2                               | 2.1             | 13.2                     | 2.2             | 0.73         | .468  |
| Subjective social status                            | 5.2                                 | 1.8             | 5.3                                | 1.9             | 5.2                      | 1.9             | 0.94         | .350  |
| Household income                                    |                                     |                 |                                    |                 |                          |                 | 17.93        | <.000 |
| <\$20,000   | 29.7                                |                 | 24.9                               |                 | 27.1                     |                 |              |       |
| \$20,000–\$60,000                                   | 38.5                                |                 | 34.6                               |                 | 36.4                     |                 |              |       |
| \$60,000–\$100,000                                  | 17.6                                |                 | 20.5                               |                 | 19.2                     |                 |              |       |
| >\$100,000  | 14.2                                |                 | 20.0                               |                 | 17.3                     |                 |              |       |
| Smoking days, <i>M (SD)</i>                         | 22.72                               | 11.50           | 22.57                              | 11.22           | 22.64                    | 11.34           | -0.29        | .769  |
| Cigarettes smoked                                   |                                     |                 |                                    |                 |                          |                 |              |       |
| in the past 30 days, <i>Mdn</i>                     | 164.03                              | (39.44, 347.90) | 166.45                             | (36.77, 340.65) | 165.48                   | (37.74, 343.55) | 484,108.00   | .562  |
| Average cigarettes per day, <i>Mdn</i>              | 5.47                                | (1.31, 11.60)   | 5.55                               | (1.23, 11.35)   | 5.52                     | (1.26, 11.45)   | 455,831.00   | .005  |
| % Daily smoker                                      | 70.9                                |                 | 65.2                               |                 | 67.8                     |                 | 7.31         | .007  |
| Total years smoking                                 | 4.27                                | 3.06            | 3.88                               | 3.09            | 4.06                     | 3.08            | -2.83        | .005  |
| HSI score   | 2.25                                | 0.96            | 2.31                               | 0.96            | 2.28                     | 0.96            | 1.44         | .150  |
| Past-year quit attempt, % yes                       | 62.2                                |                 | 61.8                               |                 | 61.9                     |                 | 0.03         | .860  |
| S-SCQ   | 143.99                              | 31.95           | 141.64                             | 32.73           | 142.73                   | 32.38           | -1.50        | .133  |
| Desire to stop smoking                              | 5.21                                | 3.05            | 5.29                               | 3.00            | 5.25                     | 3.02            | 0.57         | .567  |
| Expected success for quitting                       | 5.77                                | 2.89            | 5.97                               | 2.91            | 5.88                     | 2.99            | 1.47         | .141  |
| Expected difficulty for quitting                    | 6.50                                | 2.84            | 6.50                               | 2.80            | 6.50                     | 2.82            | -0.04        | .966  |
| Smoking goal, % abstinence                          | 13.5                                |                 | 7.7                                |                 | 10.4                     |                 | 18.36        | <.001 |
| Smoking decisional balance                          |                                     |                 |                                    |                 |                          |                 |              |       |
| Pros  | 9.40                                | 3.42            | 8.96                               | 3.39            | 9.16                     | 3.41            | -2.77        | .006  |
| Cons  | 7.49                                | 3.45            | 7.28                               | 3.41            | 7.38                     | 3.43            | -1.30        | .193  |
| Smoking stage of change, %                          |                                     |                 |                                    |                 |                          |                 | 0.239        | .887  |
| Precontemplation                                    | 47.1                                |                 | 47.5                               |                 | 47.3                     |                 |              |       |
| Contemplation                                       | 30.9                                |                 | 29.9                               |                 | 30.3                     |                 |              |       |
| Preparation   | 22.0                                |                 | 22.6                               |                 | 22.3                     |                 |              |       |
| % Used alcohol, past 30 days                        | 68.3                                |                 | 87.4                               |                 | 78.5                     |                 | 107.2        | <.001 |
| Total number of drinks, <sup>c</sup> <i>Mdn</i>     | 17.00                               | (6.00, 41.00)   | 26.00                              | (9.00, 57.00)   | 22.00                    | (8.00, 52.00)   | 241,438.00   | <.001 |
| Drinking days, <i>Mdn</i>                           | 4.00                                | (2.00, 9.00)    | 6.00                               | (3.00, 12.00)   | 5.00                     | (2.00, 10.00)   | 248,828.50   | <.001 |
| Average drinks per drinking day, <i>Mdn</i>         | 3.60                                | (2.00, 5.83)    | 4.33                               | (2.70, 6.56)    | 4.00                     | (2.50, 6.17)    | 257,170.00   | .004  |
| Heavy drinking days, <i>Mdn</i>                     | 1.00                                | (0.00, 4.00)    | 2.00                               | (1.00, 6.00)    | 2.00                     | (0.00, 5.00)    | 244,556.50   | <.001 |
| Greatest number of drinks/day, <i>Mdn</i>           | 6.00                                | (3.00, 10.00)   | 7.00                               | (4.00, 11.00)   | 6.00                     | (4.00, 10.00)   | 243,696.00   | <.001 |
| Average drinks per week, <i>Mdn</i>                 | 3.84                                | (1.35, 9.26)    | 5.87                               | (2.03, 12.87)   | 4.97                     | (1.81, 11.74)   | 241,438.00   | <.001 |
| % Used other drugs, past 30 days                    | 4.0                                 |                 | 31.5                               |                 | 18.6                     |                 | 247.4        | <.001 |
| Days using other drugs, <sup>d</sup> <i>Mdn</i>     | 2.00                                | (1.00, 8.00)    | 3.00                               | (1.00, 6.00)    | 3.00                     | (1.00, 6.00)    | 5,649.00     | .398  |
| Average days using other drugs per week, <i>Mdn</i> | 0.45                                | (0.23, 1.81)    | 0.68                               | (0.23, 1.35)    | 0.68                     | (0.23, 1.35)    | 5,649.00     | .398  |

Notes: IR = interquartile range; HSI = Heavy Smoking Index; S-SCQ = Smoking Consequences Questionnaire—short form. <sup>a</sup>Means/standard deviations are reported for continuous variables, medians/interquartile ranges reported for skewed variables, and percentages for nominal variables (indicated in first data column); <sup>b</sup>nine transgendered participants were not included in gender difference analyses because of the small  $n$ ; <sup>c</sup>analyses of drinking variables excluded participants who did not drink in the past 30 days ( $n = 428$ ); <sup>d</sup>days using other drugs analyses excluded participants who did not use other drugs in the past 30 days ( $n = 1,617$ ).

### Tobacco quit attempt

Logistic regression was used to examine whether marijuana use was associated with a past-year quit attempt (yes/no) and, in addition to propensity scores, controlled for cigarettes smoked in the past 30 days. Tobacco use (the number of cigarettes smoked in the past 30 days) significantly predicted the likelihood of making a past-year

tobacco quit attempt, but marijuana use did not (Table 3, Model 2).

### Thoughts about smoking

Regression analysis tested whether, when we controlled for propensity scores and the number of cigarettes smoked in the past 30 days, past-30-day marijuana use was associated

TABLE 2. Multiple regression models using marijuana use group to model tobacco use and thoughts about smoking

| Variable   | Standardized $\beta$ | $p$   | Model $p$ | $R^2$ |
|--|----------------------|-------|-----------|-------|
| Model 1: Predicting days smoking, past 30 days                       |                      |       | <.001     | .01   |
| Propensity score   | -.05                 | .032  |           |       |
| Log days marijuana use <sup>a</sup>                                  | .11                  | <.001 |           |       |
| Model 2: Predicting cigarettes smoked, past 30 days                  |                      |       | .003      | .01   |
| Propensity score   | -.07                 | .007  |           |       |
| Log days marijuana use   | .08                  | .002  |           |       |
| Model 3: Predicting average cigarettes per day                       |                      |       | .003      | .01   |
| Propensity score   | -.07                 | .007  |           |       |
| Log days marijuana use   | .08                  | .002  |           |       |
| Model 4: Predicting HSI  |                      |       | <.001     | .01   |
| Propensity score   | .11                  | <.001 |           |       |
| Log days marijuana use   | -.03                 | .228  |           |       |
| Model 5: Predicting total years smoking                              |                      |       | <.001     | .01   |
| Propensity score   | -.11                 | <.001 |           |       |
| Log days marijuana use   | .01                  | .654  |           |       |
| Model 6: Predicting tobacco outcome expectancies (S-SCQ total score) |                      |       | <.001     | .08   |
| Propensity score   | -.03                 | .187  |           |       |
| Cigarettes smoked, past 30 days                                      | .27                  | <.001 |           |       |
| Log days marijuana use   | -.02                 | .477  |           |       |
| Model 7: Predicting desire to quit smoking cigarettes                |                      |       | <.001     | .01   |
| Propensity score   | -.07                 | .003  |           |       |
| Cigarettes smoked, past 30 days                                      | -.10                 | .000  |           |       |
| Log days marijuana use   | .04                  | .089  |           |       |
| Model 8: Predicting expected success                                 |                      |       | <.001     | .14   |
| Propensity score   | .04                  | .064  |           |       |
| Cigarettes smoked, past 30 days                                      | -.37                 | <.001 |           |       |
| Log days marijuana use   | .01                  | .781  |           |       |
| Model 9: Predicting difficulty staying quit                          |                      |       | <.001     | .12   |
| Propensity score   | -.00                 | .871  |           |       |
| Cigarettes smoked, past 30 days                                      | .34                  | <.001 |           |       |
| Log days marijuana use   | .01                  | .616  |           |       |
| Model 10: Predicting pros of tobacco use                             |                      |       | <.001     | .09   |
| Propensity score   | -.07                 | .003  |           |       |
| Cigarettes smoked, past 30 days                                      | .28                  | <.001 |           |       |
| Log days marijuana use   | -.05                 | .068  |           |       |
| Model 11: Predicting cons of tobacco use                             |                      |       | .007      | .01   |
| Propensity score   | -.05                 | .066  |           |       |
| Cigarettes smoked, past 30 days                                      | -.04                 | .069  |           |       |
| Log days marijuana use   | -.03                 | .198  |           |       |

Notes: HSI = Heavy Smoking Index; S-SCQ = Smoking Consequences Questionnaire—short form. <sup>a</sup>Versus marijuana nonuse.

with smoking-related outcome expectancies (S-SCQ total score), the desire to quit smoking, self-efficacy for smoking cessation, expected difficulty with staying quit, pros and cons for smoking, the stage of change for tobacco use (precontemplation, contemplation, or preparation; logistic regression) or having a goal of abstinence (yes/no; logistic regression).

Propensity scores were associated with the desire to quit smoking (Table 2, Model 6) and the pros of tobacco use (Model 10). A greater number of cigarettes smoked in the past 30 days was associated with more positive tobacco outcome expectancies (Model 6), a lower desire to quit (Model 7), lower self-efficacy for quitting (Model 8), greater perceived difficulty with staying quit (Model 9), more pros of smoking (Model 10), and an earlier stage of change for tobacco (Table 3, Model 4).

Compared with marijuana nonusers, marijuana users were three fourths as likely to endorse a goal of complete, sustained abstinence from tobacco use (odds ratio = 0.75, 95% CI [0.58, 0.98],  $p = .036$ ; Table 3, Model 3). Given the large number of comparisons made for this study (15 models), if we controlled for type I error using a Šidák correction, the adjusted  $p$  value threshold would be .003, and the  $p$  value for marijuana use in this model would not be significant either.

Marijuana use was not significantly associated with tobacco outcome expectancies (S-SCQ total score; Table 2, Model 6), thoughts about tobacco abstinence (desire, self-efficacy, perceived difficulty; Models 7–9), or the pros or cons of smoking (Models 10 and 11). Marijuana use did not differentiate stages of change for quitting tobacco use (Table 3, Model 4).

TABLE 3. Logistic regression models testing relationships between marijuana use group and smoking behavior and thoughts about smoking

| Variable   | Yes <sup>a</sup>  |                               | Model $\chi^2$ | Model <i>p</i> | Cox & Snell <i>R</i> <sup>2</sup> |                                   |
|--|-------------------|-------------------------------|----------------|----------------|-----------------------------------|-----------------------------------|
|  | OR [95% CI]       | <i>p</i>                      |                |                |                                   |                                   |
| Model 1: Predicting daily smoking status                 |                   |                               |                |                |                                   |                                   |
| Propensity score   | 0.39 [0.24, 0.62] | <.001                         | 16.23          | <.001          | .01                               |                                   |
| Log days marijuana use <sup>e</sup>                      | 1.18 [1.00, 1.39] | .057                          |                |                |                                   |                                   |
| Model 2: Predicting likelihood of past-year quit attempt |                   |                               |                |                |                                   |                                   |
|  |                   | Yes <sup>b</sup>              |                | Model $\chi^2$ | Model <i>p</i>                    | Cox & Snell <i>R</i> <sup>2</sup> |
|  |                   | OR [95% CI]                   | <i>p</i>       |                |                                   |                                   |
| Propensity score   |                   | 1.31 [0.84, 2.05]             | .231           | 23.71          | <.001                             | .01                               |
| Cigarettes smoked, past 30 days                          |                   | 1.00 [1.00, 1.00]             | <.001          |                |                                   |                                   |
| Log days marijuana use <sup>e</sup>                      |                   | 0.87 [0.74, 1.02]             | .649           |                |                                   |                                   |
| Model 3: Predicting TOB abstinence goal                  |                   |                               |                |                |                                   |                                   |
|  |                   | Abstinence <sup>c</sup>       |                | Model $\chi^2$ | Model <i>p</i>                    | Cox & Snell <i>R</i> <sup>2</sup> |
|  |                   | OR [95% CI]                   | <i>p</i>       |                |                                   |                                   |
| Propensity score   |                   | 0.31 [0.15, 0.66]             | .006           | 25.86          | <.001                             | .01                               |
| Cigarettes smoked, past 30 days                          |                   | 1.00 [1.00, 1.00]             | .209           |                |                                   |                                   |
| Log days marijuana use <sup>e</sup>                      |                   | 0.75 [0.58, 0.98]             | .036           |                |                                   |                                   |
| Model 4: Predicting TOB stage of change                  |                   |                               |                |                |                                   |                                   |
|  |                   | Precontemplation <sup>d</sup> |                | Model $\chi^2$ | Model <i>p</i>                    | Cox & Snell <i>R</i> <sup>2</sup> |
|  |                   | OR [95% CI]                   | <i>p</i>       |                |                                   |                                   |
| Propensity score   |                   | 1.63 [0.93, 2.85]             | .088           | 37.24          | <.001                             | .02                               |
| Cigarettes smoked, past 30 days                          |                   | 1.00 [1.00, 1.00]             | <.001          |                |                                   |                                   |
| Log days marijuana use <sup>e</sup>                      |                   | 0.94 [0.77, 1.15]             | .57            |                |                                   |                                   |
|  |                   | Contemplation <sup>d</sup>    |                |                |                                   |                                   |
|  |                   | OR [95% CI]                   | <i>p</i>       |                |                                   |                                   |
| Propensity score   |                   | 1.46 [0.80, 2.69]             | .22            |                |                                   |                                   |
| Cigarettes smoked, past 30 days                          |                   | 1.002 [1.001, 1.002]          | <.001          |                |                                   |                                   |
| Log days marijuana use <sup>e</sup>                      |                   | 0.92 [0.74, 1.15]             | .47            |                |                                   |                                   |

Notes: OR = odds ratio; CI = confidence interval; TOB = tobacco. <sup>a</sup>Reference group is nondaily smoker; <sup>b</sup>reference group is no past-year quit attempt; <sup>c</sup>reference group category is nonabstinence; <sup>d</sup>reference group category is preparation; <sup>e</sup>reference group category is marijuana nonuse.

## Discussion

The present study tested whether marijuana use had an effect on tobacco use and associated cognitions among young adult smokers. A high proportion of the sample reported marijuana use in the past 30 days (53%). Although this study did use some recruitment advertisements targeted to both tobacco and marijuana users, the proportion of marijuana users was identical regardless of recruitment strategy. The anonymity of the online environment may have provided for reduced bias in reporting of illegal or stigmatized activity.

Consistent with much work on the relationship between tobacco and marijuana use, we found that heavier marijuana use was associated with heavier tobacco use when groups were equated on demographic and substance use characteristics. This is consistent with the large body of work demonstrating that tobacco use is associated with the use of marijuana among young people (Ramo et al., 2012) and that prior cannabis use increases the risk for later smoking and developing nicotine dependence among adolescents (Patton et al., 2005; Timberlake et al., 2007; Tullis et al., 2003).

The present study stands out in that it used a continuous measure of marijuana use, making it possible to assess the relationship between tobacco and marijuana use at all levels of marijuana use severity. A recent review of clinical outcomes of tobacco and marijuana co-use found that, relative to tobacco use only, co-occurring use was not associated with a greater likelihood of tobacco use disorder, psychosocial problems, or poorer tobacco-cessation outcomes (Peters et al., 2012). However, most of the studies reviewed measured marijuana use as a dichotomous variable (use/no use). The present study suggests that contributions to tobacco-related use and problems are likely seen at higher levels of marijuana use.

Thoughts about tobacco use and quitting were not associated with past-month marijuana use. This speaks to the importance of addressing tobacco cessation with a similar effort in those who use marijuana compared with those who do not (e.g., working to increase motivation, reduce positive smoking expectancies, decrease pros, and increase cons of smoking). A notable exception was that marijuana users were less likely to select a complete abstinence goal for tobacco

use, yet associations with the desire to quit smoking and the stage of change for smoking were not significant. Perhaps marijuana use hinders their ability to follow through with complete abstinence from tobacco. Future research should examine co-users' thoughts about tobacco in relation to their thoughts about marijuana to clarify this issue.

This national online survey was a convenience rather than a representative sample of young adult smokers, and thus findings may differ from previous work because of differences in survey methodology. Marijuana users and nonusers were naturally occurring groups (nonrandomized) and differed on a number of characteristics, which were statistically controlled for through the use of propensity scores and by controlling for tobacco use (the number of cigarettes smoked in the past 30 days) in all analyses of the effect of marijuana use on tobacco-related cognitions. Statistically adjusting for group differences may have discounted true differences in the population. Effect sizes for most of the models tested were relatively low ( $R^2$  values ranged from .01 to .26), suggesting that there are additional variables not controlled for in these analyses that could account for the differences between marijuana users and nonusers. The data were self-reported; however, previous reports have demonstrated good reliability and validity of tobacco (Ramo et al., 2011a) and marijuana (Ramo et al., 2011b) reports compared with multiple measures of these behaviors and national epidemiological data. Only 52% of the entire eligible sample completed the survey; however, this completion rate is consistent with other online survey studies with young adults (e.g., McCabe et al., 2002), and methods of tracking participants beyond what were used here would have compromised participant anonymity. Although we did use propensity scoring to control for preexisting differences between marijuana use groups on variables that were thought to differentiate the groups, we did not account for other important variables that likely differ between marijuana users and nonusers (e.g., personality characteristics) that may have been related to tobacco use and thoughts about use.

### Conclusions

The current study contributes to the literature in its evaluation of marijuana use in relation to patterns of tobacco use and thoughts about use in young adult smokers. Data were collected by online survey anonymously. Importantly, the study examined associations across multiple constructs and showed that marijuana use had little effect on tobacco use behaviors and cognitions. Given that the co-use of tobacco and marijuana is so common among young people (Ramo et al., 2012), a next step in this line of investigation should seek to understand the relationship between tobacco and marijuana cognitions in young people who use both substances. The promise of addressing tobacco use in the context of treatment for substance use disorders

(Prochaska et al., 2004) suggests that it will be important to understand how co-use of tobacco and marijuana can be harnessed to help reduce the burden of tobacco use on the health of young people.

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