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Frequent Marijuana Use is Associated with Greater Nicotine Addiction in Adolescent Smokers

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Abstract

BACKGROUND—Marijuana and tobacco are the substances used most commonly by adolescents and co-occurring use is common. Use of one substance may potentiate the addictive properties of the other. The current study examined the severity of nicotine addiction among teen smokers as a function of co-occurring marijuana use.

METHODS—Participants were 165 adolescents (13–17 years old) who reported smoking at least 1 cigarette per day (CPD) in the past 30 days. General linear models examined the association of marijuana use with multiple measures of nicotine addiction including the Modified Fagerström Tolerance Questionnaire (mFTQ), Hooked on Nicotine Checklist (HONC), ICD-10, and the Nicotine Dependence Syndrome Scale (NDSS).

RESULTS—The adolescent sample (mean age=16.1 years, SD=0.95) averaged 3.0 CPD (SD=3.0) for 1.98 years (SD=1.5). Most (79.5%) also smoked marijuana in the past 30 days. In models controlling for age, daily smoking status, and years of tobacco smoking, frequency of marijuana use accounted for 25–44% of the variance for all four measures of adolescent nicotine dependence.

CONCLUSIONS—Marijuana use was associated with greater reported nicotine addiction among adolescent smokers. The findings suggest a role of marijuana in potentiating nicotine addiction and underscore the need for treatments that address both smoked substances.

Keywords

adolescent; marijuana; cannabis; tobacco; nicotine addiction

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1. BACKGROUND

Marijuana is the most widely used illicit substance worldwide (UNDOC, 2010). In 2010, more US high school students used marijuana in the prior 30 days than tobacco (Johnston et al., 2011). Co-use with tobacco is of increasing interest (Akre et al., 2010; Ramo et al., 2012; Soldz et al., 2003). Smoking marijuana with tobacco, either in a tobacco leaf (i.e. blunt) or mixed with tobacco, is an increasingly common practice among adolescents (Golub et al., 2005) thought by some users to prolong the effects (Tullis et al., 2003) and/or increase the high from marijuana (Cooper and Haney, 2009). A recent national online, anonymous survey of young smokers reported that roughly half also smoked marijuana in the past 30 days (Ramo et al., 2013). Co-use of marijuana and tobacco may contribute to the development of nicotine dependence (Agrawal et al., 2012; Ramo et al., 2012) and thus, is an important area of research for the investigation.

Adult co-users of tobacco and marijuana have an increased risk of developing nicotine dependence (Agrawal et al., 2012; Behrendt et al., 2009; Okoli et al., 2008; Timberlake et al., 2007; Tullis et al., 2003) and have worse tobacco cessation outcomes (Agrawal et al., 2012; Gourlay et al., 1994; Humfleet et al., 1999; Richter et al., 2002; Stapleton et al., 2009). While overall rates of tobacco use and co-use with marijuana are lower in adolescents compared with adults (Ramo et al., 2013), most addicted adults develop nicotine dependence during adolescence. Therefore, adolescence is a critical period to study the effects of marijuana on tobacco.

Although the transition from experimentation with tobacco to addiction is likely multifactorial, marijuana use may play a role for some adolescents and has been identified as a risk for nicotine addiction in a study of young adults (Patton et al., 2005). Possible mechanisms of action include common routes of administration (e.g., smoking being the most common route for both); hence, one behavior may reinforce the other. Furthermore, both nicotine and cannabis affect similar pathways within the mesolimbic addiction pathways, suggesting similar and overlapping mechanisms for addiction (Filbey et al., 2009; Goldman et al., 2013). Finally, smoking cues are also similar between the two substances, which may contribute to the poorer tobacco cessation outcomes observed in adult co-users of marijuana (Agrawal et al., 2012; Gourlay et al., 1994; Humfleet et al., 1999; Stapleton et al., 2009).

Despite the increasing prevalence of marijuana use in adolescents, particularly among smokers, and evidence of harm from marijuana-tobacco co-use in adults, little is known about the interaction between marijuana and tobacco in adolescents. The goal of this study was to examine the severity of nicotine addiction among teen smokers as a function of co-occurring marijuana use. Given the literature on adult smokers, we hypothesized marijuana would contribute to symptoms of nicotine dependence among adolescents.

2. METHODS

2.1 Participants

Adolescents between the ages of 13–17 from the San Francisco Bay Area who smoked at least 1 cigarette in the past 30 days were recruited as part of an ongoing smoking trajectory study detailed elsewhere (Rubinstein et al., 2013). Adolescents responding to online, school and clinic-based advertising were invited to complete the study visit. Participants were screened to exclude those who had used any form of nicotine replacement in the prior month. Females with positive pregnancy tests were excluded from the study.

2.2 Informed Consent

The research design and procedures were reviewed and approved by the University of California, San Francisco Institutional Review Board. Informed, written assent from the adolescent subject and consent from one parent were obtained for each subject before data collection.

2.3 Measures

Adolescent tobacco smokers completed in-person surveys of smoking behaviors and dependence scales. Tobacco use was measured by asking adolescents how many cigarettes they smoked on each day of the week. Participants who reported smoking on fewer than 30 of the previous 30 days were considered intermittent smokers (DiFranza et al., 2007; Husten, 2009; Lindstrom and Isacsson, 2002). Given the lack of consensus regarding optimal measurement of nicotine dependence in adolescents, (Colby et al., 2000a, b) the study administered the following four measures at study entry: (1) the modified Fagerström Tolerance Questionnaire (mFTQ) (Prokhorov et al., 1996), (2) the Hooked on Nicotine Checklist (HONC) (O'Loughlin et al., 2002), (3) the Nicotine Dependence Syndrome Scale (NDSS) (Shiffman and Sayette, 2005), and (4) the *International statistical classification of diseases and related health problems*, 10th revision (ICD-10) criteria for nicotine dependence (Orginization, 1992). All of the nicotine dependence measures were scored continuously with the total score on each measure used to quantify nicotine addiction.

Participants were also queried about their alcohol, smoked marijuana, and other drug use during the past 3 months, with possible responses of “Never”, “Not in last 3 months,” “Once a month or less,” “More than once a month, but less than once a week,” “One or more times a week but not every day,” “Every day,” and “I don’t want to answer.” Those who declined to answer (n=5) were not included in the current analyses. For the purposes of analyses, possible responses were collapsed into four categories (1= never to less than once every 3 months, 2= monthly to quarterly, 3= weekly, and 4= daily). Symptoms of depression were measured using the Center for Epidemiologic Studies Depression Scale (CESD; Faulstich, 1986).

2.4 Data Analyses

Frequency of marijuana use was categorized as: 1) never or no use in past 3 months, 2) Once a month or less plus once a week or less, 3) one or more times a week, and 4) every day. Spearman’s rho correlations examined associations between frequency of our ordinal

measure of marijuana use with demographic variables, cigarettes per day and alcohol use. To examine the association between marijuana and measures of nicotine addiction (mFTQ, HONC, NDSS, ICD-10), we ran general linear models with key variables that in the literature have been associated with nicotine addiction (i.e., age, gender, years of smoking, daily/nondaily smoker) and marijuana use (i.e., race and alcohol use).

3. RESULTS

Two hundred adolescents were consented into the study and completed the baseline visit. Of those, 28 denied smoking cigarettes in the past 30 days and 7 declined to answer the question about marijuana use and were thus excluded from the analysis. The resulting sample (N=165, 64% female) had a mean age of 16.1 years (SD=0.95) and was racially diverse, with 28% participants identifying as White, 19% African American, 19% Hispanic and 34% other. Participants averaged 3.01 CPD (SD=3.0) for a duration of 1.98 years (SD=1.49). Fifty-one participants (31.5%) reported daily cigarette smoking and 111 (68.5%) reported non-daily smoking (i.e., smoking cigarettes on fewer than 30 days in the past month). Mean scores were 2.56 on the mFTQ (SD=1.42), 4.52 on the HONC (SD=3.24), −1.75 on the NDSS (SD=1.39), and 10.13 on the ICD-10 (SD= 6.21).

Most participants (79.5%) reported marijuana use in the past 30 days with 43 (26.1%) using weekly, and 62 (37.6%) reporting daily use. Frequency of marijuana use was correlated with CPD (r=0.16, p=0.04), but not with the frequency of alcohol use (r<-0.01, p=0.99). Participant CESD scores were not associated with frequency of marijuana use (r=.06, p=.44) or cigarette use (CPD; r=.04, p=.65).

In general linear models controlling for age, years of smoking, and daily versus non-daily smoking, frequency of marijuana use was significantly and positively associated with nicotine addiction (Table 1). The findings were consistent across all four measures of dependence and remained significant for the mFTQ after removing the question on CPD. When examining the NDSS subscales, only the drive and priority subscales were significantly associated with marijuana frequency. Older age, more years smoking, and daily smoking were associated with greater nicotine dependence in all models. The total percent of variance predicted ranged from 25% for the HONC to 44% for the mFTQ and NDSS.

Illicit drug use may co-occur across substances, and follow-up analyses sought to examine whether the finding of an association with nicotine dependence was specific to marijuana. Therefore, we also assessed co-use with other illicit substances. In the past 3 months, 40 participants (24%) reported ecstasy use. A small number of participants reported use of cocaine/crack (7 users), methamphetamine (6 users), mushrooms/ mescaline (6 users), heroin (5 users), Percocet/Vicodin (4 users), or LSD (2 users), preventing inclusion in analyses. Ecstasy, included as a covariate in the fully adjusted general linear models, was not a significant contributor with p-values ranging from .24-.99 and the effects for marijuana remained largely unchanged.

4. DISCUSSION

Marijuana smoking was prevalent in this adolescent sample of tobacco smokers: 80% reported past month marijuana use and more than a third smoked marijuana daily. Notably, among adolescent tobacco smokers who also smoked marijuana, the frequency of marijuana use was associated with greater levels of nicotine addiction on all three major scales used in studies with adolescents plus the ICD-10. Moreover, models incorporating age, frequency and years of tobacco smoking with marijuana accounted for 25–44% of variance in adolescent nicotine dependence. Interestingly, CPD was only minimally associated with the frequency of marijuana use and made minimal contribution to the model since associations with the mFTQ were similar after removing the question about CPD.

The finding that with the exception of drive and priority, the other subscales of the NDSS were not significantly associated with marijuana frequency was not surprising since most of these adolescent smokers were light and intermittent tobacco users and dimensions of dependence such as stereotypy and tolerance become more prominent as teens develop more regular and established patterns of smoking (Sterling et al., 2009). However, despite relatively light tobacco use, the drive subscale, which measures the compulsion to smoke, and the priority subscale, which measures the preference of smoking over other reinforcers, were associated with marijuana use. It is possible that since both marijuana and tobacco share common pathways of use, smoking cues for one substance may trigger craving for the other, and thus reinforce patterns of use. As such, tobacco and marijuana may serve as reciprocal reinforcers.

Some limitations of this brief include the relatively small sample size and the lack of detailed information on the timing of the initiation of marijuana use with regard to cigarette smoking. Future studies will need to examine how the proximity of marijuana use to cigarette smoking affects the degree of nicotine addiction. For example, examining whether concomitant use (e.g., blunt smoking or mixing tobacco with marijuana) impacts the level of nicotine addiction more than smoking marijuana separately from tobacco. The sample largely consisted of light smokers, which reflects adolescent smoking in the US. That we found such a strong association between marijuana use and nicotine addiction in this group of relatively light tobacco smokers is notable, and reinforces the relevance of the association.

5. CONCLUSIONS

Marijuana use was associated with greater reported nicotine addiction among adolescents. The findings suggest a role of marijuana in potentiating nicotine addiction and underscore the need for treatments that address use of both smoked substances.

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TABLE 1

General Linear Models of Adolescent Nicotine Dependence (values shown are the % variance accounted for by each variable in the model)

	mFTQ N=159	**mFTQ' N=159**	**HONC N=156**	**NDSS N=144**	**ICD-10 N=123**
Age	.059**	.059**	.033*	.064**	.046*
Sex	.002	.002	.013	.001	.013
Race/Ethnicity	.018	.017	.031	.024	.023
Years of smoking[1]	.029*	.032*	.067**	.150**	.038*
Daily/Intermittent[2]	.328**	.321**	.105**	.210**	.116**
Alcohol[3]	.006	.005	.004	.003	.012
Marijuana[3]	.049**	.047**	.035*	.039*	.048*
Full Model	Adj-R^2=.44**	adj-R^2= .44**	adj-R^2=.25**	adj-R^2=.44	adj-R^2=.27

mFTQ' does not include the item on cigarettes per day

*p<.05

**p<.001

[1]number of years since first cigarette smoked

[2]daily versus intermittent smoking

[3]frequency of use in past 3 months