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Brief report

Cannabis Use Is Associated With Increased Risk of Cigarette Smoking Initiation, Persistence, and Relapse Among Adults in the United States

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Abstract

Introduction: Despite increasing use of cannabis, it is unclear how cannabis use is related to cigarette transitions. This study examined cannabis use and smoking initiation, persistence, and relapse over 1 year among a nationally representative sample of US adults.

Methods: Data were from US adults (≥18 years) who completed two waves of longitudinal data from the Population Assessment of Tobacco and Health Study (Wave 1, 2013–2014; Wave 2, 2014–2015; $n = 26\,341$). Logistic regression models were used to calculate the risk of Wave 2 incident smoking among Wave 1 never-smokers, smoking cessation among Wave 1 smokers, and smoking relapse among Wave 1 former smokers by Wave 1 cannabis use. Analyses were adjusted for age, gender, race/ethnicity, income, and education.

Results: Among Wave 1 never-smokers, cannabis use was associated with increased odds of initiation of nondaily (adjusted odds ratio [AOR] = 5.50, 95% confidence limits [CL] = 4.02–7.55) and daily cigarette smoking (AOR = 6.70, 95% CL = 4.75–9.46) 1 year later. Among Wave 1 daily smokers, cannabis use was associated with reduced odds of smoking cessation (AOR = 0.36, 95% CL = 0.20–0.65). Among Wave 1 former smokers, cannabis use was associated with increased odds of relapse to daily and nondaily cigarette smoking (daily AOR = 1.90, 95% CL = 1.11–3.26; nondaily AOR = 2.33, 95% CL = 1.61–3.39).

Conclusions: Cannabis use was associated with increased cigarette smoking initiation, decreased smoking cessation, and increased smoking relapse among adults in the United States. Increased public education about the relationship between cannabis use and cigarette smoking transitions may be needed as cannabis use becomes more common among US adults.

Implications: As cannabis use increases in the United States and other countries, an evaluation of the relationships of cannabis use to other health-related behaviors (eg, cigarette smoking) is

needed to understand the population-level impact of legalization. Little is known about associations between cannabis use and cigarette smoking transitions (1) using recent longitudinal data, (2) among adults, and (3) examining transitions other than smoking initiation (eg, smoking relapse). Our results suggest that among US adults, cannabis use was associated with increased cigarette smoking initiation among never-smokers, decreased cigarette smoking cessation among current smokers, and increased cigarette smoking relapse among former smokers.

Introduction

Cigarettes are a leading cause of mortality and morbidity in the United States and globally.^{1,2} Although the prevalence of smoking has decreased over time,^{2,3} some subgroups of smokers continue to exhibit disproportionately high prevalences of smoking. People who use cannabis are one such group.⁴

A strong relationship between cannabis and cigarette use has been documented. In the United States, any cannabis use and daily cannabis use have increased significantly among both cigarette smokers and nonsmokers over the past decade.⁵ Adults who use cannabis are more likely to report cigarette use,^{4,6} and conversely, cigarette smokers are more likely to report cannabis use.^{5,7}

Despite the increasing use of cannabis, changes in cannabis-related legislation in the United States and other countries, and the relationship between cannabis and cigarettes, it is unclear whether and how cannabis use may be associated with cigarette use among current, former, and lifetime nonsmoking adults in the United States. There is evidence for a “reverse gateway effect” where cannabis use leads to cigarette use among adolescents.^{8,9} Less is known about smoking initiation among adults who use cannabis or the relationship between cannabis use and other smoking transitions (eg, cessation, relapse). One study of US adults found that cannabis use was associated with increased risk of onset and persistence of smoking,¹⁰ but these data are now 10 years old. Determining whether these relationships remain generalizable with the continuing changes in the social and legal climate related to cannabis use in the United States is a critical first step toward examining whether cannabis use may interfere with clinical and public health efforts to reduce cigarette use.

The current study used two waves of longitudinal data collected 1 year apart (2013–2014 and 2014–2015) among US adults to investigate whether cannabis use among (1) nonsmokers was associated with increased odds of incident daily and nondaily cigarette smoking, (2) current (daily or nondaily) cigarette smokers was associated with decreased odds of quitting and/or decreased cigarette smoking (ie, from daily to nondaily smoking), and (3) former smokers was associated with increased odds of relapse to cigarette smoking. We hypothesized that cannabis use would be associated with increased likelihood of cigarette smoking initiation, maintenance, and relapse, relative to no use of cannabis.

Methods

Data Source and Study Population

The Population Assessment of Tobacco and Health (PATH) Study is a nationally representative, longitudinal cohort study focused on assessing tobacco use and health behavior in a population representative sample of civilian, noninstitutionalized US adults (18 years and older) and youth (12 years and older). The PATH study oversampled adult tobacco users, young adults (ages 18–24), and non-Hispanic black adults. The PATH study is sponsored by the National Institute on Drug Abuse and the Food and Drug Administration’s Center for Tobacco Products with data collected by Westat. Additional

details about the PATH study design and methods can be found elsewhere.^{11,12}

The current study used two waves of PATH Study data (Wave 1, 2013–2014; Wave 2, 2014–2015). Our full analytic sample included respondents who were adults age 18 years and older, completed both waves of data collection, responded to questions about cannabis use at Wave 1, and responded to the question about smoking status at both Wave 1 and Wave 2 ($n = 26\,341$; 82% of the original Wave 1 adult sample).

Measurements

Smoking status: Cigarette smoking status was classified using data from the Wave 1 and Wave 2 assessments and definitions from the US Department of Health and Human Service’s Centers for Disease Control and Prevention¹³ similar to our previous investigation of cannabis use and smoking behavior using the National Epidemiologic Survey on Alcohol and Related Conditions.¹⁰ At Wave 1, respondents were classified into four smoking statuses. Wave 1 nonsmokers were defined as adults who reported smoking fewer than 100 lifetime cigarettes. Wave 1 daily and nondaily cigarette smokers were defined as adults who reported smoking 100 or more lifetime cigarettes and reported smoking all (daily smoking) or some (nondaily smoking) days at the time of the Wave 1 assessment. Wave 1 former cigarette smokers were defined as adults who reported smoking 100 or more lifetime cigarettes and no smoking at the time of the Wave 1 assessment.

At Wave 2, respondents were classified into four smoking groups: nonsmoking (ie, fewer than 100 lifetime cigarettes and did not smoke in past 12 months at Wave 2), former smoking (ie, 100 or more lifetime cigarettes and did not smoke in past 12 months at Wave 2), daily smoking (ie, 100 or more lifetime cigarettes and currently smoking every day at Wave 2), or nondaily smoking (ie, 100 or more lifetime cigarettes and currently smoking some days at Wave 2).

Cannabis use: Cannabis use was defined as any past-year use of cannabis reported at Wave 1.

Demographic covariates: Demographics included age (a continuous variable), gender (male, female), race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, non-Hispanic all other races or more than one race), total annual family income (<\$25 000, \$25 000–\$49 999, \$50 000–\$74 999, ≥\$75 000), and education (less than high school, high school degree, more than high school degree).

Statistical Analysis

Regression modeling: A series of logistic regression models were run to model the odds of Wave 1 past-year cannabis use and Wave 2 smoking status for the four Wave 1 smoking status groups: Wave 1 nonsmokers, Wave 1 daily smokers, Wave 1 nondaily smokers, and Wave 1 former smokers. For each of the four smoking groups, a crude model was run first to determine the unadjusted odds ratio (OR) of smoking status by past-year cannabis use status. Then an additional model was run to control for potential confounders and covariates measured at Wave 1. The adjusted model controlled for

demographic covariates (ie, age, gender, race/ethnicity, income, education). All analyses were performed using SAS-callable SUDAAN, version 11.0.1 (RTI International, Research Triangle Park, NC; <http://www.rti.org/sudaan/>), incorporated the PATH sampling weights, which adjusted for nonresponse and oversampling, and controlled for complex clustered sampling using the balanced repeated replication method with Fay's adjustment and replicate weights supplied by Westat.¹¹

Results

Sample Characteristics

Overall, the analytic sample was approximately half female (52.11%, standard error [SE] = 0.05) and two-thirds non-Hispanic white (66.03%, SE = 0.07). Approximately 11% of respondents (11.22%, SE = 0.34) reported past-year cannabis use at Wave 1 with higher prevalences of cannabis use among Wave 1 current daily smokers (26.36%, SE = 0.75) and nondaily smokers (30.30%, SE = 1.18) compared to former smokers (9.78%, SE = 0.61) and never-smokers (7.03%, SE = 0.32). See [Supplementary Table 1](#) for demographic characteristics of the full analytic sample and by Wave 1 smoking status.

Wave 2 Smoking Initiation Among Wave 1 Nonsmokers

Among Wave 1 nonsmokers, Wave 1 cannabis use was associated with seven times greater odds of nondaily cigarette smoking (OR = 7.06, 95% confidence limits (CL) = 5.06–9.85) and 6.5 times greater odds of daily cigarette smoking at Wave 2 (OR = 6.56, 95% CL = 5.08–8.47; see [Table 1](#)). After controlling for demographics, the odds of nondaily smoking were somewhat attenuated (adjusted odds ratio [AOR] = 5.5, 95% CL = 4.02–7.55) whereas the odds of daily smoking did not change notably (AOR = 6.70, 95% CL = 4.75–9.46).

Wave 2 Smoking Cessation Among Wave 1 Daily and Nondaily Smokers

Among Wave 1 daily cigarette smokers, cannabis use was associated with significantly lower odds of quitting smoking at Wave 2 in unadjusted and adjusted analyses (OR = 0.42, 95% CL = 0.26–0.66; AOR = 0.36, 95% CL = 0.20–0.65; see [Table 1](#)). Among Wave 1 daily cigarette smokers, there was no significant association between cannabis use at Wave 1 and Wave 2 nondaily smoking in unadjusted or adjusted analyses (see [Table 1](#)). Among Wave 1 nondaily cigarette smokers, there was no association between cannabis use at Wave 1 and daily smoking at Wave 2 or a decrease to nonsmoking at Wave 2 in unadjusted or adjusted analyses (see [Table 1](#)).

Wave 2 Smoking Relapse Among Wave 1 Former Smokers

Cannabis use was associated with more than three times greater odds of Wave 2 daily smoking (OR = 3.35, 95% CL = 2.11–5.30) and nearly four times greater odds of Wave 2 nondaily smoking (OR = 3.90, 95% CL = 2.78–5.46), relative to those who did not use cannabis, among Wave 1 former smokers (see [Table 1](#)). These odds were attenuated but remained statistically significant after adjusting for demographics (daily smoking AOR = 1.90, 95% CL = 1.11–3.26; nondaily smoking AOR = 2.33, 95% CL = 1.61–3.39).

Discussion

In recent longitudinal data from a nationally representative sample of US adults, cannabis use was associated with increased odds of nondaily and daily cigarette smoking initiation among nonsmokers, decreased odds of smoking cessation among daily cigarette smokers, and increased odds of smoking relapse among former cigarette smokers. There are a number of possible explanations for the observed relationships between cannabis use and cigarette smoking. Causal relationships are possible, in either direction, and there is also substantial evidence suggesting that the use of both tobacco and cannabis may be driven by common individual, social, and environmental risk factors as well as shared genetic vulnerabilities (eg, see refs^{9,14–16}). In addition, the neurobiological systems involved with nicotine and cannabis (ie, the nicotinic and endocannabinoid systems) overlap.^{9,14} Cigarettes and cannabis are used to enhance the effects or relieve withdrawal symptoms of the other^{17,18} and prior studies suggest that co-use of both cannabis and cigarettes, versus cigarette use alone, is associated with greater smoking quantity and greater nicotine dependence symptoms¹⁹ which may in turn make it more difficult to quit smoking. Future research is needed to clarify how these different mechanisms relate to smoking initiation, cessation, and relapse and how prevention and intervention efforts might best work with cannabis users to reduce cigarette smoking-related behavior and harm.

On the basis of the substantial overlap of cannabis and cigarette use, it may be beneficial for professionals to simultaneously target cannabis use and cigarette smoking with their patients or in secondary prevention settings. Although few studies have examined treatments for both cannabis and cigarette users, a web-based intervention targeting both drugs increased readiness to quit cigarettes and cannabis,²⁰ and there is preliminary evidence that pharmacological and behavioral treatments for cannabis and cigarettes are feasible and have promising outcomes.²¹ Importantly, research has shown that simultaneous treatment of smoking and other drugs does not result in poorer drug treatment outcomes,²² and that continued cigarette use may in fact lead to poorer long-term substance use disorder outcomes.²³

In concert with other recent findings that cannabis use is increasing among current smokers, nonsmokers, and former smokers,⁵ our results suggest that public health efforts to both maintain current progress and achieve further goals in cigarette reduction may benefit from the adoption of screening for and/or education on cannabis use as a potential vulnerability factor for cigarette use relapse among some former smokers. The speed with which cannabis use is increasing in the US suggests that additional, more detailed information on the potential pathways between cannabis and cigarette transitions as well as how to best communicate that information to the public is urgently needed.

With regard to limitations, these results may not generalize to persons outside of the United States. The study included adults 18 years and older, and because many smokers initiate cigarette use prior to 18 years old, it is important to separately examine the relationship between cannabis use and smoking initiation among youth. Information about cannabis use and smoking was collected via self-report and may have been subject to underreporting or reporting errors. The definition of cannabis use was broad and future studies should investigate the relationship between cigarette use transitions and cannabis use taking into account various characteristics of cannabis use (eg, frequency, quantity, mixing, various types of coadministration) including simultaneous use (ie, use of both

Table 1. Odds of Wave 2 Cigarette Smoking Among Wave 1 Non-Smokers, Wave 1 Daily Cigarette Smokers, Wave 1 Nondaily Cigarette Smokers, and Wave 1 Former Cigarette Smokers by Wave 1 Past-Year Cannabis Use (US Adults Age 18 Years and Older; Population Assessment of Tobacco and Health (PATH) Study; Wave 1, 2013–2014 and Wave 2, 2014–2015)

Wave 1 nonsmokers	Nondaily cigarette smoking at Wave 2 (<i>n</i> = 2173)			Daily cigarette smoking at Wave 2 (<i>n</i> = 7332)			Current cigarette smoking at Wave 2 (<i>n</i> = 9505)		
	OR	95% CL	<i>p</i> value	OR	95% CL	<i>p</i> value	OR	95% CL	<i>p</i> value
Model 1 ^a									
No Wave 1 past-year cannabis use	1.00	—		1.00	—		1.00	—	
Wave 1 past-year cannabis use	7.06	5.06–9.85	<.0001	6.56	5.08–8.47	<.0001	6.77	5.50–8.33	<.0001
Model 2 ^b									
No Wave 1 past-year cannabis use	1.00	—		1.00	—		1.00	—	
Wave 1 past-year cannabis use	5.5	4.02–7.55	<.001	6.7	4.75–9.46	<.0001	6.18	4.85–7.87	<.0001
	Nondaily cigarette smoking at Wave 2 (<i>n</i> = 2173)			Former cigarette smoking at Wave 2 (<i>n</i> = 3757)					
Wave 1 daily cigarette smokers	OR	95% CL	<i>p</i> value	OR	95% CL	<i>p</i> value			
Model 1 ^a									
No Wave 1 past-year cannabis use	1.00	—		1.00	—				
Wave 1 past-year cannabis use	1.14	0.93–1.39	.20	0.42	0.26–0.66	.0003			
Model 2 ^b									
No Wave 1 past-year cannabis use	1.00	—		1.00	—				
Wave 1 past-year cannabis use	0.96	0.77–1.19	.68	0.36	0.20–0.65	.0007			
	Daily cigarette smoking at Wave 2 (<i>n</i> = 7332)			Former cigarette smoking at Wave 2 (<i>n</i> = 3757)					
Wave 1 non-daily cigarette smokers	OR	95% CL	<i>p</i> value	OR	95% CL	<i>p</i> value			
Model 1 ^a									
No Wave 1 past-year cannabis use	1.00	—		1.00	—				
Wave 1 past-year cannabis use	0.83	0.63–1.09	.17	0.64	0.40–1.02	.06			
Model 2 ^b									
No Wave 1 past-year cannabis use	1.00	—		1.00	—				
Wave 1 past-year cannabis use	0.93	0.67–1.29	0.68	0.73	0.39–1.34	.30			
	Nondaily cigarette smoking at Wave 2 (<i>n</i> = 2173)			Daily cigarette smoking at Wave 2 (<i>n</i> = 7332)			Current cigarette smoking at Wave 2 (<i>n</i> = 9505)		
Wave 1 former cigarette smokers	OR	95% CL	<i>p</i> value	OR	95% CL	<i>p</i> value	OR	95% CL	<i>p</i> value
Model 1 ^a									
No Wave 1 past-year cannabis use	1.00	—		1.00	—		1.00	—	
Wave 1 past-year cannabis use	3.90	2.78–5.46	<.0001	3.35	2.11–5.30	<.0001	3.68	2.74–4.95	<.0001
Model 2 ^b									
No Wave 1 past-year cannabis use	1.00	—		1.00	—		1.00	—	
Wave 1 past-year cannabis use	2.33	1.61–3.39	<.0001	1.9	1.11–3.26	.0202	2.15	1.53–3.01	<.0001
							1.97	1.26–3.07	.0032

CL = confidence limits; OR = odds ratio. ORs compared with nonsmokers at Wave 2. Bolding indicates statistical significance.

^aUnadjusted.^bAdjusted for age, gender, race/ethnicity, income, and education.

cigarettes and cannabis during the same session) which is common⁹ and associated with cannabis use disorders.²⁴ There are a number of potentially important confounders (eg, parental cigarette or cannabis use, personality variables such as impulsivity) that could not be included in the current analyses and should be considered in future research. Finally, as there are reciprocal relationships between cannabis and cigarette use,²⁵ future studies should examine the relationship of cigarette use to cannabis transitions to better understand all potential relationships between cigarettes and cannabis.

As tobacco policies and laws become more restrictive over time in some areas of the country, the same regions are often simultaneously, and ironically, relaxing cannabis restrictions, including legalization for recreational purposes.²⁶ As such, Although cigarette use has decreased over time due to enduring efforts of tobacco control, cannabis use trends are now moving in the opposite upward direction. A better understanding of the potential myriad pathways through which cannabis and cigarette use are linked will allow us to be better equipped with knowledge to inform the public of the risks and benefits of use of each and the potential risks of co-use through public health interventions and clinical efforts to reduce smoking prevalence and the health-related consequences of cigarettes.

Supplementary Material

Supplementary data are available at *Nicotine and Tobacco Research* online.

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Declaration of Interests

The authors report no financial or other relationship relevant to the subject of this article.

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