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Cigarette Use and Cannabis Use Disorder Onset, Persistence, and Relapse: Longitudinal Data From a Representative Sample of US Adults

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ABSTRACT

Objective: The current study prospectively investigated the relationship between cigarette use and the onset of, persistence of, and relapse to cannabis use disorder (CUD) 3 years later among adults in the United States.

Methods: Analyses included respondents who completed Waves 1 and 2 of the National Epidemiologic Survey on Alcohol and Related Conditions (2001–2002 and 2004–2005, respectively) and responded to questions about cigarette use, cannabis use, and CUD ($n = 34,653$). CUDs were defined by *DSM-IV* criteria using the Alcohol Use Disorder and Associated Disabilities Interview Schedule–Diagnostic Version IV. Multivariable logistic regression models were used to calculate the odds of CUD onset, persistence, and relapse at Wave 2 by Wave 1 cigarette use status. Analyses were adjusted for sociodemographics, psychiatric disorders, nicotine dependence, and alcohol and other substance use disorders.

Results: Cigarette use at Wave 1 was associated with onset of CUD at Wave 2 among those without Wave 1 cannabis use (adjusted odds ratio [AOR] = 1.62; 95% CI, 1.35–1.94) but not among those with Wave 1 cannabis use (AOR = 1.00; 95% CI, 0.83–1.19). Cigarette use at Wave 1 was also associated with persistence of CUD at Wave 2 among those with CUD at Wave 1 (AOR = 1.63; 95% CI, 1.30–2.00) and relapse to CUD at Wave 2 among those with remitted CUD at Wave 1 (AOR = 1.23; 95% CI, 1.09–1.45).

Conclusions: Among adults, cigarette use is associated with increased onset and persistence of and relapse to CUD 3 years later. Additional attention to cigarette use in community prevention and clinical treatment efforts aimed at reducing CUD may be warranted.

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Cannabis is the most commonly used drug in the United States after alcohol and one of the most commonly used drugs around the world.^{1,2} An estimated 43.5 million Americans (aged 12 and older) report having used cannabis in the past year, and 8,400 Americans initiate cannabis daily.³ Past-year cannabis use has also increased in the United States from 17.8% in 2015 to 19.4% in 2018, driven by increased use among both young adults (aged 18–25 years) and adults (aged 26 years and older).³

Cannabis use disorders (CUDs) are defined by problems related to cannabis use (eg, work, home, or relationship problems; withdrawal symptoms).⁴ While there are mixed data from national US samples regarding whether the prevalence of CUD is increasing, remaining steady, or decreasing, with more evidence for increases among adults compared to younger people,^{4–8} a large number of US individuals are impacted by CUD. Recent US national data show that 3 of 10 of those who use cannabis develop CUD⁵ and approximately 6 million US individuals reported CUDs in 2018.³ CUD is associated with increased risk of unemployment, emergency department visits, and hospitalizations^{9,10} as well as comorbid psychiatric disorders that can lead to worse prognoses and health outcomes.^{11–13} Preventing CUD onset and relapse reduces potential negative consequences, yet 6.63% of US adults with past CUD relapsed to CUD an average of 3.6 years later.¹⁴ The identification of potentially modifiable vulnerability factors for CUD onset and relapse may reduce CUD and CUD-related harm.

Tobacco is one of the most frequently used substances and is often co-used with cannabis.^{15,16} There has been an increase in current (ie, past-month) cannabis use, daily cannabis use, and CUD among individuals using cigarettes in the United States.¹⁵ The majority of cannabis use and CUDs occur among people who use cigarettes, and frequent (ie, daily) cannabis use increased over recent years among those with daily and non-daily (ie, smoking fewer than 30 days in a month) cigarette use while CUDs increased among non-daily cigarette users.^{17,18} Cigarette use has well-known health consequences,^{19,20} and the co-use of cannabis and cigarettes is associated with poorer physical, psychological, and behavioral outcomes as well as detrimental effects on brain functions.^{21–23} Additionally, tobacco and cannabis co-use is associated with greater risk of CUD.^{21,24–26}

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Clinical Points

- Cannabis use is increasing over time in the United States, especially among individuals using cigarettes. Little is known about the relationship between cigarette use and cannabis use disorder (CUD).
- Among adults in the United States, cigarette use is associated with increased onset and persistence of and relapse to CUD. Clinical and public health efforts that reduce tobacco use may ultimately contribute to lowering the incidence, prevalence, and negative consequences of CUD.

Beyond understanding that an association exists between cigarette use and CUD, little is known about the role of cigarette use in transitions in CUD status over time (eg, onset, persistence, relapse). In prospective longitudinal studies, earlier nicotine use onset was correlated with earlier cannabis initiation among those aged 14–24 years in Germany,²⁷ while earlier cigarette use onset predicted incident CUD in young adulthood among US adolescents.²⁸ Similarly, repeated cross-sectional data from US youth and young adults (aged 12–21 years) found that nicotine dependence was associated with earlier onset of cannabis use, heavier cannabis use, and more symptoms of CUDs.²⁹ Further, adolescents who initiate cigarette use before use of other drugs (eg, cannabis) are significantly more likely to develop CUD.³⁰ Studies of cigarettes and transitions in CUD status have focused primarily on adolescents and CUD onset. Less is known about the relationship of cigarette use to CUD onset among adults or to transitions in CUD status other than onset (eg, persistence, relapse).

Obtaining a more in-depth understanding of the relationship between cigarette use and CUD is timely. As legalization of cannabis for medicinal and recreational purposes continues to grow across US states and in other countries (eg, Canada),^{31,32} cannabis use and CUD are likely to continue to increase among adults.^{6,33} The primary aim of the current study was to estimate the relationship between cigarette use and transitions in CUD status over a 3-year period using 2 waves of longitudinal data from US adults. Specifically, the study examined the following questions: (1) Is cigarette use among individuals without CUD associated with CUD onset 3 years later? (2) Is cigarette use among individuals with current CUD associated with CUD persistence 3 years later? (3) Is cigarette use among individuals with remitted CUD associated with CUD relapse 3 years later? (4) Do these relationships persist after adjusting for sociodemographics, psychiatric disorders, nicotine dependence, and alcohol/other substance use disorders?

METHODS

Data Source and Study Population

Data for this study came from 2 waves of the NESARC (Wave 1, 2001–2002, $n = 43,093$; Wave 2, 2004–2005, $n = 34,653$). The NESARC surveyed a population-representative sample

of civilian, non-institutionalized adults in the United States and used a 2-wave multistage stratified design in which primary sampling units, housing units, and group-quarter units were stratified to oversample non-Hispanic Black and Hispanic adults as well as adults aged 18–24 years to have appropriate representation of these subgroups for statistical analyses (see Grant et al³⁴ and Grant and Kaplan³⁵ for more details). The original NESARC data sets were obtained from the National Institute on Alcohol Abuse and Alcoholism (NIAAA, <http://www.niaaa.nih.gov>). All analyses were completed in SAS v9.4 (2013; SAS, Inc) using weighted analysis to account for nonresponse, sample attrition, and residual differences between the sample and the population profile according to the 2000 US Population Census. Analysis of deidentified data from the survey is exempt from the federal regulations for the protection of human research participants.

Measures

Cigarette use status. Respondents were asked if they ever used cigarettes, and those who reported ever using cigarettes were asked if they used cigarettes in the past year. They were subsequently classified into 2 mutually exclusive groups based on their past-year cigarette use status at Wave 1: those who reported smoking cigarettes in the past year were classified as having Wave 1 cigarette use, and those who reported no past-year smoking were classified as having Wave 1 no cigarette use.

Cannabis use. Respondents were asked if they ever used cannabis, and those who reported ever using cannabis were asked if they used cannabis in the past year. Respondents were classified into 2 mutually exclusive groups based on their past-year cannabis use status at Wave 1: those who reported past-year cannabis use were classified as having Wave 1 cannabis use, and those who reported no past-year cannabis use were classified as having Wave 1 no cannabis use.

Cannabis use disorder. CUDs were defined at Wave 1 and Wave 2 using the Alcohol Use Disorder and Associated Disabilities Interview Schedule–Diagnostic Version IV (AUDADIS-IV), a fully structured diagnostic interview instrument³⁶ with good to excellent reliability and validity.³⁷ The AUDADIS-IV assessed CUDs (ie, cannabis dependence and cannabis abuse) according to *DSM-IV* criteria.³⁸ Cannabis dependence was defined by the report of 3 or more of the following 6 criteria: (1) a great deal of time spent getting, using, or getting over the effects of cannabis; (2) using more cannabis or using cannabis more often than intended; (3) tolerance (ie, needing to use more cannabis over time to get the same effects or feeling less effect over time from the same amount); (4) being unable to cut down or stop using cannabis; (5) continuing to use cannabis even though it was causing mental health or physical problems; and (6) reducing or giving up participation in important activities due to cannabis use. Cannabis abuse was defined by the report of 1 or more of the following 4 criteria: (1) serious work, home, or school problems due to cannabis use;

Table 1. Sociodemographic Characteristics for the Full Analytic Sample and by Wave 1 (2001–2002) Cigarette Use Status in NESARC

Variable	Total Wave 1 Sample by Wave 1 Cigarette Use Status						P Value
	Total Wave 1 Sample		Wave 1 No Cigarette Use		Wave 1 Cigarette Use		
	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	
	n	%	n	%	n	%	
Total	34,653	...	25,753	72.5	8,900	27.5	<.0001
Gender							<.0001
Men	14,564	47.2	9,909	43.2	4,655	57.7	
Women	20,089	52.8	15,844	56.8	4,245	42.3	
Age, y							<.0001
18–29	6,719	21.1	4,697	19.6	2,022	25.1	
30–44	11,013	31.4	7,867	29.9	3,146	35.1	
45–64	10,917	32.7	7,965	32.7	2,952	32.8	
65+	6,004	14.8	5,224	17.7	780	7.0	
Race/ethnicity							<.0001
Non-Hispanic White	20,174	72.7	14,448	70.9	5,726	77.6	
Non-Hispanic Black	6,577	10.8	5,003	11.2	1,574	9.5	
Non-Hispanic Native American/Alaskan Native	580	2.2	346	1.8	234	3.3	
Non-Hispanic Asian/Pacific Islander	966	3.9	817	4.6	149	2.1	
Hispanic	6,356	10.4	5,139	11.5	1,217	7.5	
Marital status							<.0001
Currently married	18,413	63.5	14,247	65.7	4,166	57.7	
Widowed, separated, or divorced	8,564	16.4	6,083	15.2	2,481	19.7	
Never married	7,676	20.0	5,423	19.1	2,253	22.6	
Income, \$							<.0001
0–19,999	16,385	45.6	12,109	45.2	4,276	46.6	
20,000–34,999	8,093	22.9	5,869	22.1	2,224	24.9	
35,000–69,999	7,647	23.0	5,758	23.4	1,889	21.8	
70,000+	2,528	8.6	2,017	9.4	511	6.7	
Education							<.0001
Less than high school degree	5,744	14.1	4,068	12.9	1,676	17.2	
High school degree	17,289	50.6	12,272	47.8	5,017	57.9	
More than high school degree	11,620	35.4	9,413	39.4	2,207	24.8	
Psychiatric and substance use disorders							
Lifetime mood disorder	3,378	9.5	2,091	7.8	1,287	14.0	<.0001
Lifetime anxiety disorder	8,406	24.3	5,544	21.4	2,862	32.0	<.0001
Past-year alcohol use disorder	2,694	8.4	1,252	5.1	1,442	17.2	<.0001
Past-year nicotine dependence	4,017	12.8	0	...	4,017	46.7	...
Past-year substance use disorder	265	0.9	79	0.3	186	2.2	<.0001
Past-year cannabis use	1,279	4.0	437	1.8	842	9.8	<.0001
Past-year cannabis use disorder	444	1.5	120	0.5	324	3.9	<.0001

Abbreviation: NESARC = National Epidemiologic Survey on Alcohol and Related Conditions.

(2) using cannabis in a situation when use might have put them in physical danger; (3) cannabis-related trouble with the law; and (4) cannabis-related problems with family or friends and continued cannabis use despite these problems. Respondents were classified as having a CUD at Wave 1 and Wave 2 if they met criteria for either cannabis abuse or cannabis dependence at that respective wave.

Sociodemographic, psychiatric disorder, and substance use disorder covariates. Sociodemographic variables included gender (male, female), age (18–29, 30–44, 45–64, 65+ years), race/ethnicity (non-Hispanic White, non-Hispanic Black, non-Hispanic Native American/Alaskan Native, non-Hispanic Asian/Pacific Islander, Hispanic), marital status (currently married, widowed/separated/divorced, never married), annual income ($\leq \$19,999$, $\$20,000$ – $\$34,999$, $\$35,000$ – $\$69,999$, $\geq \$70,000$), and education (less than high school degree, high school degree, more than high school degree).

Psychiatric and alcohol/substance use diagnoses were determined using the AUDADIS-IV. A summary

dichotomous variable was created for the presence of lifetime mood and anxiety disorders (yes/no) as measured at Wave 1, including major depressive disorder, bipolar disorder, dysthymia, mania, hypomania, panic disorder with/without agoraphobia, agoraphobia, social and specific phobia, generalized anxiety disorder, posttraumatic stress disorder, and attention-deficit/hyperactivity disorder. Also, dichotomous variables (yes/no) were created for past-year nicotine dependence, alcohol use disorders, and other substance use disorders (ie, meeting criteria for dependence or abuse for sedatives, tranquilizers, opioids, heroin, amphetamines, cocaine, hallucinogens, inhalants/solvents, or other drugs).

Statistical Analysis

Analytic sample. Our full analytic sample included respondents who completed both waves of data collection, had valid survey weights, responded to questions about cigarette smoking status and cannabis use at Wave 1, and responded to questions about CUD at both Wave 1 and

Table 2. Odds of Wave 2 (2004–2005) Incident Cannabis Use Disorder by Wave 1 (2001–2002) Cigarette Use Status for the Full Analytic Sample and Stratified by Wave 1 Past-Year Cannabis Use in NESARC

Wave 1 Cigarette Use Versus Wave 1 No Cigarette use	Total Sample (n = 34,653) ^a		Wave 1 No Cannabis Use (n = 33,374)		Wave 1 Cannabis Use (n = 1,279)	
	OR	95% CI	OR	95% CI	OR	95% CI
Model 1 ^b	3.89	3.54–4.28	2.60	2.29–2.96	1.11	0.99–1.24
Model 2 ^c	2.72	2.45–3.01	1.90	1.64–2.20	1.04	0.92–1.17
Model 3 ^d	2.43	2.21–2.68	1.81	1.57–2.09	1.00	0.88–1.14
Model 4 ^e	1.79	1.57–2.04	1.62	1.35–1.94	1.00	0.83–1.19

^aAnalyses were conducted on the total sample of respondents who completed Wave 1 and Wave 2.

^bModel 1 was unadjusted for covariates.

^cModel 2 was adjusted for sociodemographic covariates.

^dModel 3 was adjusted for Model 2 covariates and Wave 1 mood and anxiety disorders.

^eModel 4 was adjusted for Model 3 covariates as well as Wave 1 nicotine dependence, alcohol use disorders, and other substance use disorders.

Abbreviations: NESARC = National Epidemiologic Survey on Alcohol and Related Conditions, OR = odds ratio.

Table 3. Odds of Wave 2 (2004–2005) Persistent Cannabis Use Disorder Among Those With Wave 1 (2001–2002) Cannabis Use Disorder by Wave 1 Cigarette Use in NESARC

Wave 1 Cigarette Use Versus Wave 1 No Cigarette Use	Wave 2 Persistent Cannabis Use Disorder ^a	
	OR	95% CI
Model 1 ^b	3.19	2.82–3.62
Model 2 ^c	2.28	2.00–2.61
Model 3 ^d	2.13	1.87–2.41
Model 4 ^e	1.63	1.30–2.00

^aAnalyses were conducted among the sample of respondents with Wave 1 cannabis use disorder (n = 444).

^bModel 1 was unadjusted for covariates.

^cModel 2 was adjusted for sociodemographic covariates.

^dModel 3 was adjusted for Model 2 covariates and Wave 1 mood and anxiety disorders.

^eModel 4 was adjusted for Model 3 covariates as well as Wave 1 nicotine dependence, alcohol use disorders, and other substance use disorders.

Abbreviations: NESARC = National Epidemiologic Survey on Alcohol and Related Conditions, OR = odds ratio.

Table 4. Odds of Wave 2 (2004–2005) Cannabis Use Disorder Relapse Among Those With Wave 1 (2001–2002) Remitted Cannabis Use Disorder by Wave 1 Cigarette Use Status in NESARC

Wave 1 Cigarette Use Versus Wave 1 No Cigarette use	Wave 2 Cannabis Use Disorder Relapse ^a	
	OR	95% CI
Model 1 ^b	1.75	1.57–1.96
Model 2 ^c	1.25	1.10–1.41
Model 3 ^d	1.22	1.08–1.39
Model 4 ^e	1.23	1.09–1.45

^aAnalyses were conducted among the sample of respondents with remitted cannabis use disorder at Wave 1 (n = 3,210).

^bModel 1 was unadjusted for covariates.

^cModel 2 was adjusted for sociodemographic covariates.

^dModel 3 was adjusted for Model 2 covariates and Wave 1 mood and anxiety disorders.

^eModel 4 was adjusted for Model 3 covariates as well as Wave 1 nicotine dependence, alcohol use disorders, and other substance use disorders.

Abbreviations: NESARC = National Epidemiologic Survey on Alcohol and Related Conditions, OR = odds ratio.

Wave 2 (unweighted n = 34,653; weighted percentage = 82.7% of the original Wave 1 sample).

Sample frequencies. Sociodemographic distributions were compared between those with and those without Wave 1 cigarette use. Standard errors were computed using Taylor series linearization, and frequency differences were tested using Rao Scott χ^2 tests to account for complex survey design.

Regression modeling. A series of logistic regression models were run to model the odds of (1) Wave 2 incident CUD among those without CUD at Wave 1, (2) Wave 2 persistent CUD among those with CUD at Wave 1, and (3) Wave 2 CUD relapse among those with remitted CUD at Wave 1 by Wave 1 past-year cigarette use status. For each transition, unadjusted odds ratios (ORs) were estimated (Model 1), and then 3 additional models were run to adjust for potential confounding measured at Wave 1. Model 2 controlled for sociodemographic confounders. Model 3 controlled for Model 2 confounders plus a lifetime history of mood and anxiety disorders. Model 4 controlled for Model 3 confounders plus past-year nicotine dependence, alcohol use disorders, and other substance use disorders.

RESULTS

Sample Characteristics

See Table 1 for sociodemographics of the full analytic sample and by Wave 1 cigarette use status. All sociodemographic variables differed among those with versus without Wave 1 cigarette use. Those with Wave 1 cigarette use (compared with Wave 1 no cigarette use) were more likely to be male, younger, non-Hispanic White, and never married and have lower income and lower education. Among those who used cannabis, the cigarette smoking weighted prevalence was 9.8%, compared with 1.8% among cannabis non-users.

Wave 1 Past-Year Cigarette Use and CUD Transitions From Wave 1 to Wave 2

Incidence of CUD at Wave 2. Among the full analytic sample, Wave 1 cigarette use was associated with a nearly 4 times greater odds of incident Wave 2 CUD (odds ratio [OR] = 3.89; 95% CI, 3.54–4.28; see Table 2). The fully adjusted odds of incident Wave 2 CUD were 1.79 times

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higher among those with Wave 1 cigarette use compared with those with Wave 1 no cigarette use (95% CI, 1.57–2.04). The relationship between cigarette use and incident CUD differed by Wave 1 cannabis use status. Among those with Wave 1 no cannabis use, cigarette use was associated with 1.62 times higher odds of incident CUD at Wave 2 (95% CI, 1.35–1.94), while among those with Wave 1 cannabis use, cigarette use was not associated with higher odds of Wave 2 incident CUD (adjusted OR [AOR] = 1.00; 95% CI, 0.83–1.19).

Persistence of CUD at Wave 2. Among respondents with CUD at Wave 1, Wave 1 cigarette use, compared with Wave 1 no cigarette use, was associated with more than 3 times greater odds of persistent CUD at Wave 2 (OR = 3.19; 95% CI, 2.82–3.62; see Table 3). After controlling for sociodemographic, psychiatric disorder, nicotine dependence, and substance use covariates, the odds of Wave 2 persistent CUD were attenuated but remained significant (AOR = 1.63; 95% CI, 1.30–2.00).

Relapse to CUD at Wave 2. Among respondents with remitted CUD at Wave 1, Wave 1 cigarette use, compared with Wave 1 no cigarette use, was associated with greater odds of relapse to CUD at Wave 2 (OR = 1.75; 95% CI, 1.57–1.96; see Table 4). After controlling for demographic, psychiatric disorder, nicotine dependence, and substance use covariates, the odds of Wave 2 CUD relapse were slightly attenuated but remained significant (AOR = 1.23; 95% CI, 1.09–1.45).

DISCUSSION

The current study prospectively examined the relationship between cigarette use and transitions in CUD status over a 3-year period among adults in the United States. Wave 1 cigarette use, compared with no cigarette use, was associated with increased odds of CUD onset, persistence, and relapse 3 years later at Wave 2. In further examining incident CUD, cigarette use was associated with Wave 2 CUD onset for those not using cannabis at Wave 1 but not for those using cannabis at Wave 1. These relationships remained significant after adjusting for sociodemographics and psychiatric/substance use comorbidities.

While cigarette use has declined among US adults,³⁹ cigarette use remains common among those with substance use disorders, including CUDs.^{40,41} In the current study, cigarette use was associated with incident CUD among those without cannabis use but not among those with cannabis use. These results are consistent with past literature in which cigarette use was associated with a faster transition from cannabis use to cannabis dependence among 3,824 Australian adult twins and siblings,⁴² while in contrast, cigarette use was not associated with the transition to cannabis dependence among 600 Dutch adults reporting frequent (ie, ≥ 3 days per week) cannabis use at baseline.⁴³ It may be that cigarettes exert a greater influence on the transition from no cannabis use to CUD than the transition from cannabis use to CUD. If so, clinical efforts to reduce

CUD onset by targeting cigarette use may be more beneficial if they focus on the general population of adults rather than adults who already report use of cannabis. Further, the transition from cannabis use to CUD may be more strongly related than the transition from no cannabis use to CUD to factors other than cigarette use. For example, one study⁴³ reported that living alone and negative life events (eg, financial problems) predicted the transition from cannabis use to cannabis dependence, while a second study⁴⁴ found that the use of drugs other than cannabis, anxiety disorders, and depression (for women) were associated with incident CUD. Future research should examine potential reasons for the difference in the relationship of cigarettes and onset of CUD by cannabis status.

There are a range of potential neurologic, psychosocial, individual, environmental, genetic, and other (eg, marketing tactics by tobacco manufacturers in targeted communities) factors, including common liability risk factors and social determinants of health,⁴⁵ that influence the co-use of nicotine and cannabis.^{16,21,22,46} The roles these factors play with regard to the potentially detrimental impact of cigarettes or nicotine on CUD transitions need to be clarified through additional research. For example, the most common route of administration (ie, inhalation) is the same for both cannabis and nicotine. Products like blunts, spliffs, and mulled cigarettes involve the simultaneous use of cannabis and nicotine⁴⁷ and are associated with a greater number of symptoms of cannabis dependence⁴⁸ and more cannabis-related problems.⁴⁹ Further, cannabis users report vaping cannabis through e-cigarette devices.⁵⁰ In addition, there are common neurobiological systems involved with nicotine and cannabis (see Rabin and George¹⁶ and Subramaniam et al²²). Simultaneous users of cannabis and nicotine who try to stop using cannabis, or who have stopped using cannabis, may experience cue-induced cravings for cannabis when using nicotine, making it difficult to sustain abstinence and not relapse to cannabis. A laboratory study of individuals with daily cannabis use found that cigarette use was related to cannabis relapse and that cigarette use was a stronger predictor of relapse than mood and cannabis withdrawal symptoms.⁵¹

The role of cigarettes in transitions in CUD status can inform interventions to reduce CUD incidence, improve CUD treatment outcomes, and prevent CUD relapse. Such CUD-focused prevention and intervention efforts may need to address cigarette use to produce optimal outcomes. There is evidence that never use or quitting cigarettes is associated with more successful cannabis treatment outcomes than among those who smoke cigarettes, although research is mixed (see Lemyre et al⁴⁶ for a review). Initial studies of treatments that target both cannabis and cigarette use^{52–58} demonstrate feasibility and promising preliminary outcomes. CUD treatment programs may benefit from assessing cigarette use, incorporating cigarette treatment, and examining CUD outcomes by cigarette smoking status.

One limitation of the current study is that data on cannabis and cigarette use were collected by self-report,

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which can be subject to biases and errors in memory, and thus cigarette and cannabis use may be underreported.^{59,60} Second, this study focused on one tobacco product, cigarettes. There are relationships between cannabis use and other tobacco products such as cigars⁴⁷ and e-cigarettes,^{50,61} and co-use of cannabis with tobacco products is associated with greater CUD and negative consequences.⁶² Importantly, the landscape of tobacco use has changed since these data were collected (eg, increasing availability and popularity of e-cigarette products⁶³). Future research examining the relationship between other tobacco products and other tobacco-related variables (eg, nicotine dependence, increasing levels of nicotine over time^{64,65}) and changes in CUD status would be informative. Similarly, considering changes in the cannabis use landscape would also be important. The increasing legalization of cannabis in US states and other countries^{31,32} is a critical change along with other changes such as an increase in tetrahydrocannabinol (THC) over

time⁶⁶ as greater THC levels are associated with greater risk of CUD.⁶⁷ Third, we were not able to examine variables related to changes in CUD such as substance use treatment or context of changes in CUDs (eg, environment- and person-related factors related to CUD relapse). Fourth, cannabis and cigarette use were assessed as past-year use, and future research should examine the relationship between cigarettes and CUDs with shorter periods of time (eg, past-month use) when data are available. Fifth, results may not generalize to other groups not included in the NESARC sample (eg, adults outside of the United States, institutionalized US individuals [eg, incarcerated persons], persons under the age of 18 years, who make up a large proportion of smoking initiators^{68,69}).

In sum, cigarette use was associated with increased odds of CUD onset, CUD persistence, and CUD relapse over a 3-year period among US adults. Attention to tobacco use is warranted in clinical and public health efforts to reduce the incidence, prevalence, and negative consequences of CUDs.

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