Published OnlineFirst August 4, 2021; DOI: 10.1158/1055-9965.EPI-20-1810

Association between Smoking Cannabis and Quitting Cigarettes in a Large American Cancer Society Cohort

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ABSTRACT

Background: Cannabis use is increasing, including among smokers, an at-risk population for cancer. Research is equivocal on whether using cannabis inhibits quitting cigarettes. The current longitudinal study investigated associations between smoking cannabis and subsequently quitting cigarettes.

Methods: Participants were 4,535 adult cigarette smokers from a cohort enrolled in the American Cancer Society's Cancer Prevention Study-3 in 2009–2013. Cigarette quitting was assessed on a follow-up survey in 2015–2017, an average of 3.1 years later. Rates of quitting cigarettes at follow-up were examined by retrospectively assessed baseline cannabis smoking status (*never, former, recent*), and by frequency of cannabis smoking among recent cannabis smokers (*low*: ≤3 days/month; *medium*: 4–19 days/month; *high*: ≥20 days/month). Logistic regression models adjusted for sociodemographic factors, smoking- and health-related behaviors, and time between baseline and follow-up.

Results: Adjusted cigarette quitting rates at follow-up did not differ significantly by baseline cannabis smoking status [never 36.2%, 95% confidence interval (CI), 34.5–37.8; former 34.1%, CI, 31.4–37.0; recent 33.6%, CI, 30.1–37.3], nor by frequency of cannabis smoking (low 31.4%, CI, 25.6–37.3; moderate 36.7%, CI, 30.7–42.3; high 34.4%, CI, 28.3–40.2) among recent baseline cannabis smokers. In cross-sectional analyses conducted at follow-up, the proportion of cigarette smokers intending to quit smoking cigarettes in the next 30 days did not differ by cannabis smoking status ($P = 0.83$).

Conclusions: Results do not support the hypothesis that cannabis smoking inhibits quitting cigarette smoking among adults.

Impact: Future longitudinal research should include follow-ups of >1 year, and assess effects of intensity/frequency of cannabis use and motivation to quit on smoking cessation.

Introduction

Legal and societal restraints against cannabis use have recently become more relaxed across the United States, and the prevalence of cannabis use is increasing, including among tobacco smokers (1–5). Despite an increase in new routes of cannabis administration, including vaping, edibles, and topicals, smoking is still the most prevalent form of cannabis use (6).

Cigarette smoking remains a major health problem, causing at least 12 types of cancers and an estimated 480,000 deaths each year in the U.S. alone (7, 8). People who smoke cigarettes are also much more likely to use cannabis than people who do not smoke cigarettes (4, 9, 10).

Recent studies have raised concerns that using cannabis may hinder cigarette smokers' motivation or ability to quit cigarettes (11–15). There are important implications if cannabis use hinders quitting cigarette smoking. First, increases in cannabis smoking may put at risk recent decreasing trends in the prevalence of cigarette smoking. Second, clinical guidelines would need to consider whether cigarette smokers should be advised to cut down or stop cannabis use when attempting to quit cigarettes, similar to recommendations regarding alcohol use when quitting cigarettes (16). In addition, some patients with cancer use cannabis to alleviate pain, nausea, or other symptoms caused by cancer or its treatment (17–19) but may simultaneously need to quit cigarette smoking to improve their prognosis and reduce their risk or recurrence (20–22).

Cannabis use and smoking cessation

It is behaviorally and biologically plausible that cannabis use could hinder quitting cigarettes. Smoking cannabis and smoking cigarettes share a common route of administration (inhalation) so smoking cannabis could act as a behavioral cue for smoking cigarettes. Synergistic effects have also been hypothesized wherein use of one substance enhances or sensitizes the user to the effects of the other (10, 23).

Only a small number of community or epidemiologic studies have examined cannabis use and subsequent cessation of cigarette smoking and these studies have produced mixed results. An early study of 431 adults in the Baltimore area in 1981 found that compared with never use, past 30-day use of cannabis at baseline, and ever-daily cannabis use, predicted continued cigarette smoking 13 years later (24). The National Epidemiologic Survey on Alcohol and Related Conditions (NESARC), however, found that among 4,071 U.S. adults diagnosed with past-year nicotine dependence at baseline (2001–2002), a lifetime history of cannabis use was not associated with continued nicotine dependence [based on DSM criteria (25)] at follow-up (2004–2005; ref. 26). Subsequent analyses of the same NESARC dataset indicated that while cannabis use at baseline (any in the past year) was associated with decreased cigarette smoking cessation at follow-up among 6,911 daily smokers, the association was not significant after adjustment for

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Note: Supplementary data for this article are available at Cancer Epidemiology, Biomarkers & Prevention Online (http://cebp.aacrjournals.org/).

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Cancer Epidemiol Biomarkers Prev 2021;XX:XX–XX

doi: 10.1158/1055-9965.EPI-20-1810

Published OnlineFirst August 4, 2021; DOI: 10.1158/1055-9965.EPI-20-1810

demographic factors, psychiatric disorders, and alcohol and other drug use disorders (13). Moreover, among 1,419 nondaily smokers of cigarettes in the study, baseline cannabis use was not associated with quitting at follow-up.

Two more recent studies examined associations between cannabis use and the likelihood of subsequently quitting cigarettes. A cohort study (the Population Assessment of Tobacco and Health Study; PATH) found that "any past-year use of cannabis" at baseline predicted decreased odds of quitting cigarettes 1 year later among 7,378 daily smokers, though not among 1,906 nondaily smokers of cigarettes (14). These analyses did not, however, adjust for other substance use or psychiatric variables (14).

Several secondary analyses of clinical trials of smoking cessation interventions have also examined cannabis use as a predictor of subsequent smoking cessation. Most of these studies found no association (27–32), but cannabis use was associated with less cigarette smoking cessation in an Australian study (33), and in a U.S. study of young adults (34). A more recent study of youth ages 14–21 found no differences in quitting cigarettes at a 26-week follow-up between dual users (of cannabis and cigarettes) versus nonusers of cannabis (35); however, during the 12-week varenicline-treatment period, more frequent cannabis use (vs. nonuse) was associated with decreased cigarette abstinence (35). Overall, these clinical studies had relatively small sample sizes, short-term follow-ups, and by design were limited to smokers who were actively engaged in an organized quit attempt as part of a smoking cessation trial.

To date, epidemiologic studies have not investigated whether *frequency* of cannabis use among users is important. The definition of "any past-year use of cannabis" in prior epidemiologic studies could include both occasional/recreational use as well as heavier use. It seems plausible that heavier (vs. occasional) cannabis users would have more difficulty quitting cigarettes if cannabis use is a deterrent to quitting.

It may also be illuminating to investigate differences in *motivation* to quit cigarettes between users and nonusers of cannabis, as this might explain why cannabis use might be associated with a lower likelihood of subsequently quitting cigarettes.

The current study investigated whether smoking cannabis was associated with subsequently quitting cigarettes among adult cigarette smokers in the longitudinal American Cancer Society's (ACS) Cancer Prevention Study 3 (CPS-3). We also examined (at a follow-up only) cross-sectional associations between cannabis smoking and intent to quit cigarettes. The CPS-3 cohort is well suited for this analysis because of its longitudinal assessment, large size, collection of detailed information on potential confounders not included in other studies but linked to smoking cessation [e.g., cancer diagnosis (36), past quit attempts, use of other tobacco products, etc.], its repeated assessments of cigarette smoking and cessation, and measurement of cannabis smoking.

Materials and Methods

Participants and procedure

CPS-3 is a large prospective cohort study of 303,682 cancer-free individuals recruited from 35 states, Puerto Rico, and the District of Columbia, designed to investigate lifestyle and other risk factors in cancer and chronic diseases (37). Participants were enrolled at two major annual fundraising events: Relay for Life and Making Strides Against Breast Cancer (although participation in the event was not required), and through community enrollment drives such as at local YMCA's, hospitals, worksites, churches, etc. and in rural and urban areas. Further details on recruitment, included measures, and ethics approval, are provided elsewhere (37). This analysis selected participants from the cohort who were cigarette smokers at the time they completed the baseline survey (2006–2013), and who also completed a follow-up survey (2015–2017). The follow-up survey assessed lifetime cannabis use and updated cigarette smoking status. Lifetime cannabis smoking reported at the follow-up was used to retrospectively estimate cannabis smoking status and frequency at the time the baseline survey was completed. Participants were not compensated for completing surveys.

The number of cigarette smokers identified at baseline was 12,498. Of these, we excluded those who had enrolled early between 2006 and 2009 because only limited covariate information was collected at that time (1,845; 14.8%). We further excluded those who did not complete the follow-up questionnaire (4,541; 36.3%), whose cigarette smoking status could not be determined from the follow-up survey (48; 0.4%), who did not provide complete information on cannabis smoking on the follow-up questionnaire (65; 0.5%), and those who were missing data on any covariate on their baseline questionnaire (1,464; 11.7%), for a final analytic sample of 4,535 baseline cigarette smokers (Supplementary Table S1). Though percent differences between nonresponders and the final analytic sample on some variables were small (reported below) results were stratified by these variables (Supplementary Tables S2 and S3).

Measures

Cigarette smoking–related behavior

Cigarette smoking status. Respondents completed standard measures of smoking behavior at baseline and follow-up. Current smokers at baseline were defined as those who reported having smoked at least 100 cigarettes in their lifetime, and current daily or nondaily smoking. Daily smokers provided the number of cigarettes per day (cpd) they smoked, and nondaily smokers the number of days they smoked per month and how much they smoked on those days. Quitting at follow-up was defined as reporting no current cigarette smoking.

Intent to quit. On the follow-up survey, respondents reporting current daily or nondaily smoking were asked "What best describes your intentions about quitting smoking cigarettes (not including e-cigarettes)?" Response options were "never expect to quit," "may quit in the future but not in the next 6 months," "will quit in the next 6 months," "will quit in the next month," and "don't know."

Other cigarette smoking behavior–related variables. Years smoked, number of quit attempts, and use of other tobacco products were assessed at baseline. Use of other tobacco products and electronic cigarettes were assessed at follow-up.

Cannabis smoking

Baseline. Because the baseline questionnaire did not ask about cannabis smoking, we used detailed information collected on the follow-up survey about cannabis smoking at various ages to estimate each participant's cannabis smoking status and frequency at the age they were when they completed their baseline survey.

On the follow-up survey, participants reported lifetime cannabis smoking by responding to "*Have you ever smoked marijuana at least once a month for more than one year?* (*yes*/*no*)." Those answering "yes" reported the average number of days per month they smoked cannabis, both *in the last 12 months* and during previous consecutive age ranges: 14 to 17; 18 to 24; 25 to 29; 30–39; 40 to 49; 50 to 59; and 60+. Frequency of use was characterized by terciles; low: <3 days/month; medium: 4–19 days/month; high: >20 days/month.

Published OnlineFirst August 4, 2021; DOI: 10.1158/1055-9965.EPI-20-1810

Never cannabis smokers at baseline reported no monthly cannabis smoking ever in their lifetime, or no monthly cannabis smoking during their baseline age range or before. A sensitivity analysis, however, excluded any of these individuals who initiated cannabis smoking for the first time subsequent to completing their baseline survey (described in Results).

Both former and recent cannabis smokers reported *lifetime monthly* cannabis smoking for more than 1 year. Former cannabis smokers were further defined as reporting no monthly cannabis smoking during their baseline age range, but reporting monthly cannabis smoking during age range(s) *prior* to their baseline age range. In contrast, recent cannabis smokers reported monthly cannabis smoking that included their baseline age range. Because some "recent" baseline cannabis smokers may have stopped smoking cannabis sometime within their baseline age range, the sensitivity analysis included only recent cannabis smokers who also reported cannabis smoking subsequent to their baseline age range; these individuals can reasonably be characterized in the sensitivity analysis as committed cannabis smokers. The sensitivity analysis, which aimed to be conservative in its restrictions, also limited former cannabis smokers to those who did not report smoking cannabis subsequent to their baseline age range.

Follow-up. Participants who on their follow-up questionnaire reported monthly cannabis smoking in the last 12 months were designated as current cannabis smokers at follow-up. Former cannabis smokers at follow-up were defined as not having smoked in the last 12 months but had smoked cannabis during a prior age range. Never cannabis smokers at follow-up were defined as not ever having smoked cannabis at least once a month for more than 1 year, or did not report smoking cannabis in any of the age ranges, including in the last 12 months.

Sociodemographic and health-related variables

Sociodemographic variables assessed at baseline were age, sex, marital status, household income, education, race/ethnicity, and medical insurance status. Health-related variables were ever use of medication for depression or anxiety, physical activity in the past 2 years (in metabolic equivalents; MET), and meeting ACS guidelines for alcohol use (≤1 drink/day for women, and ≤2 drinks/day for men).

A dichotomous variable was created indicating whether or not the respondent had been diagnosed with cancer by the time of the follow-up questionnaire. Respondents were considered diagnosed with cancer if they reported ever having been treated or diagnosed with cancer on their follow-up questionnaire, or if a cancer diagnosis before the date of their follow-up questionnaire had been identified through linkage with a state cancer registry.

We created a proxy measure of likelihood of quitting based on geographic location, which could influence quit rates due to regional variation in the restrictiveness of smoking policies. To do this, we first computed, in our sample, rates of quitting stratified by state. We then categorized states' quit rates as low, medium, or high based on terciles. We also calculated length of time in years between completion of the baseline and follow-up surveys.

Statistical analyses

Multivariable logistic regression models were conducted with cannabis smoking status or frequency as the independent variable; the dependent variable was having quit cigarette smoking or not at follow-up (2015–2017). All models, including tests for confounders and effect modifiers, adjusted for age, sex, and length of follow-up. Reference groups in regressions were *never* cannabis smokers for cannabis use status, and *low* cannabis smoking for frequency analyses. SAS statistical software was used for all analyses.

To identify possible confounders, models were conducted with each of the sociodemographic and other smoking behavior–related and health-related variables added separately as an independent variable. Variables that resulted in a 5% or greater change in ORs for the relationship between cannabis smoking status or frequency with quitting at follow-up were designated as confounders and included in final adjusted models as covariates. These were gender, age, education, income, daily versus nondaily smoking, cpd, physical activity, number of quit attempts, state quit rate, and follow-up time.

To identify potential modifiers, covariate-adjusted regression models examined the significance of interaction terms between cannabis smoking status or frequency with each of the sociodemographic and other smoking behavior–related and health-related variables in predicting cigarette quitting. None of the interactions were significant, however, indicating an absence of effect modification by any of these variables. Notably, cancer diagnosis was not a significant confounder nor an effect modifier of the relationship between baseline cannabis smoking status and cigarette quit rates (there were insufficient cancer cases to determine confounder or modifier effects for frequency of cannabis smoking).

Cigarette quit rates [and confidence intervals (CI)] at follow-up, by cannabis smoking status and frequency, were calculated on the basis of final adjusted models using an algorithm described elsewhere (38). Adjusted cigarette quit rates were also calculated stratified by each sociodemographic and other smoking behavior–related and health-related variable.

The sensitivity analysis excluded 6 never cannabis smokers who initiated cannabis smoking subsequent to baseline, excluded 44 former cannabis smokers who resumed cannabis smoking subsequent to baseline, and restricted recent cannabis smokers to the 560 individuals who also reported cannabis smoking during age ranges after their baseline age range and/or in the 12 months prior to completion of the follow-up survey (suggesting committed use).

A χ^2 test investigated the cross-sectional association at follow-up between cannabis smoking status at follow-up with intent to quit cigarette smoking among respondents reporting current cigarette smoking at follow-up. Percentages were standardized on the basis of the age, sex, and income distribution of the cohort. A follow-up test examined effect modification by cpd.

Results

Comparison of nonresponders to analytic sample

Among nonresponders at follow-up 53.6% were younger than 40 years of age versus 45.7% of the analytic sample. Nonresponders (vs. included participants) were also more likely to be male (26.1% vs. 20.7%), non-Hispanic White (20.7% vs. 12.4%), unmarried (41.2% vs. 39.7%), to report education level of high school or less (24.6% vs. 15.7%), a household income below $50,000 (48.8% vs. 38.6%), to not have medical insurance (16.4% vs. 10.4%), to be daily smokers (66.8% vs. 63.2%), and to smoke 20 or more cpd (30.9% vs. 25.4%). Among nonresponders at follow-up, a smaller proportion (40.5%) had smoked cigarettes for 30 or more years versus 48.9% of included participants. More nonresponders met ACS guidelines for alcohol use (91.2% vs. 87.6%, respectively). The largest difference in proportions between nonresponders and the analytic sample on the above variables was 10.2%.

Published OnlineFirst August 4, 2021; DOI: 10.1158/1055-9965.EPI-20-1810

Participant characteristics

The proportions of the sample who at baseline were never, former, and recent cannabis smokers were 61.6% (n = 2,794), 22.9% (n = 1,040), and 15.5% (n = 701), respectively (**Table 1**). The sample was predominantly female (79.3%), and non-Hispanic White (87.6%). Mean age at baseline was 46 years and mean time between baseline and follow-up questionnaires was 3.1 years.

Among *recent* smokers of cannabis at baseline, the average monthly frequency of smoking cannabis was 1.7 for low-frequency cannabis smokers, 8.7 for medium frequency cannabis smokers, and 26.7 for high-frequency cannabis smokers.

The overall unadjusted rate of quitting cigarette smoking by follow-up was 35.3%; 95% CI, 33.9–36.7.

By the time of the follow-up assessment, 174 of baseline cigarette smokers had been diagnosed with cancer. Among these individuals, 59.8%, 22.4%, and 17.8% were never, former, and recent cannabis smokers at baseline. Proportions were similar among the never diagnosed (61.7%, 23.0%, and 15.4%, respectively).

Among those still smoking cigarettes at follow-up (n = 2,933), 60.3% were never cannabis smokers, 26.2% were former cannabis smokers, and 13.5% were recent cannabis smokers. After excluding 23 respondents who did not complete the intent to quit cigarettes section, 3.6% of those still smoking cigarettes at follow-up reported that they never intended to quit cigarette smoking, 11.6% intended to quit in the next month, 23% in less than 6 months, 32% planned to quit in the future but not in the next 6 months, and 29.9% did not know.

Cannabis smoking and quitting cigarettes

Adjusted cigarette quit rates for baseline *never* cannabis smokers (36.2%, 95% CI, 34.5–37.8%) did not differ significantly from quit rates of *former* (34.1%, 95% CI, 31.4–37.0) or *recent* (33.6%, 95% CI, 30.1–37.3) cannabis smokers (**Fig. 1**; also see Supplementary Table S2 for quit rates by cannabis smoking status stratified by sociodemographic and other smoking-related and health behavior–related variables).

Among *recent* baseline cannabis smokers, cigarette quit rates for *low*-frequency cannabis smokers (31.4%, 95% CI, 25.6–37.3) did not differ significantly from quit rates of *medium* (36.7%, 95% CI, 30.7–42.3) or *high*-frequency cannabis smokers (34.4%, 95% CI, 28.3–40.2; **Fig. 2**; also see Supplementary Table S3 for cannabis smoking frequency stratified by sociodemographic and other smoking-related and health behavior–related variables).

Similar results were obtained from the sensitivity analyses in which baseline never and former cannabis smokers were restricted to those not smoking or resuming cannabis smoking subsequent to baseline, and in which recent cannabis smokers were restricted to those who also reported subsequent monthly cannabis smoking after baseline (suggesting committed use). This sensitivity analysis (Supplementary Table S4) indicated that adjusted quit rates of baseline never cannabis smokers (36.3%, 95% CI, 34.6–37.9) did not differ significantly from quit rates of former (34.3%, 95% CI, 31.5–37.1) or recent cannabis smokers (32.8%, 95% CI, 29.0–36.6). Among recent baseline cannabis smokers (Supplementary Table S5), cigarette quit rates for low-frequency cannabis smokers (31.2%, 95% CI, 24.0–38.7) did not differ significantly from quit rates for medium (35.8%, 95% CI, 28.9–42.5) or high-frequency cannabis smokers (34.5%, 95% CI, 28.3–41.1).

Cross-sectional association between cannabis smoking at follow-up and intent to quit cigarettes

The unadjusted χ^2 test found no significant association between cannabis smoking status at follow-up and intent to quit cigarettes (P = 0.83). For example, 10.9% of *current* cannabis smokers planned to quit in the next month, 10.4% of *former* cannabis smokers, and 12.1% of *never* cannabis smokers (percentages standardized by age, sex, and income; **Table 2**).

An analysis of subgroups based on cpd observed no significant association between cannabis smoking status and intent to quit cigarettes among those smoking less than 20 cpd (P = 0.38). Among those smoking 20 or more cpd, the association was only marginally significant (P = 0.08).

Discussion

Our study of adult cigarette smokers investigated whether smoking cannabis at baseline was associated with the likelihood of quitting cigarettes after approximately 3 years. Neither cannabis smoking status, nor frequency of cannabis smoking among recent cannabis smokers, were associated with subsequently quitting cigarettes. Results were confirmed in sensitivity analysis with more conservative criteria for defining baseline cannabis smoking status. Moreover, in cross-sectional analyses at follow-up, current cannabis smoking was not associated with the intent to quit cigarettes.

Our results are consistent with trials of treatments for cigarette cessation, the majority of which have found no association between cannabis use and smoking cessation (27–32, 35). A recent 21-day diary study of 62 smokers not seeking treatment for cessation also found no association between past-year cannabis use and cessation (though their romantic partners' cannabis use was linked to their own cigarette smoking; ref. 39). Other cohort studies of adults have also not observed associations between measures of cannabis use and likelihood of quitting cigarettes after controlling for psychiatric disorders, and alcohol and other drug use disorders (13, 26). The current study included a measure of alcohol use, and use of medications for anxiety or depression, but neither of these were sources of confounding or effect modifiers and were therefore not included in final models.

Our results contrast with those from the nationally representative PATH cohort study which found that "any past-year use of cannabis" at baseline was associated with considerably decreased odds of quitting cigarettes 1 year later among 7,378 daily smokers (14). Reasons for differences in results between PATH and CPS-3 are not clear. However, the PATH and CPS-3 study populations were demographically different; daily smokers in the PATH cohort were notably younger (nearly 25% under 30) and of lower income (median family income < $25,000), whereas smokers in our CPS-3 analysis were all age 30 or older at baseline and typically middle or higher income (median household income >$50,000). These sociodemographic differences may also plausibly explain the higher rates of cannabis use among cigarette smokers in the PATH (26% and 30% for daily and nondaily smokers, respectively; 14) compared with the current study (15.5%), as cannabis smoking is less prevalent among older age groups (40) and among higher income individuals (which we also observed in our study; ref. 41).

Another possibility for differences in results between PATH and CPS-3 could be greater confounding by psychiatric or substance use problems in the PATH study population than in CPS-3. This could have occurred if, among cigarette smokers in the PATH cohort, those who used cannabis were more likely than those who did not use cannabis to have psychological or substance use problems that made it more difficult to quit cigarettes; the same may not be true among cigarette smokers in CPS-3. Neither study adjusted for psychiatric or substance use disorders. We assessed history of anxiety or depression, but differences by cannabis smoking status were not found. Cannabis smokers reported modestly higher alcohol use, but this was not a

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Table 1. Baseline characteristics of smokers in CPS-3 by baseline cannabis use status.

		Cannabis smoking status		
	Total (*N* = 4,535) *N* (%)	**Never (*N* = 2,794) *N* (%)**	**Former (*N* = 1,040) *N* (%)**	**Recent (*N* = 701) *N* (%)**
Sociodemographic Variables				
Age, years				
25–<35	811 (17.9)	474 (17)	175 (16.8)	162 (23.1)
35–<45	1,262 (27.8)	824 (29.5)	234 (22.5)	204 (29.1)
45–<55	1,478 (32.6)	872 (31.2)	399 (38.4)	207 (29.5)
≥55	984 (21.7)	624 (22.3)	232 (22.3)	128 (18.3)
Gender				
Female	3,597 (79.3)	2,358 (84.4)	779 (74.9)	460 (65.6)
Male	938 (20.7)	436 (15.6)	261 (25.1)	241 (34.4)
Marital status				
Not married	1,797 (39.7)	1,091 (39.1)	407 (39.2)	299 (42.7)
Married/living as married	2,733 (60.3)	1,701 (60.9)	631 (60.8)	401 (57.3)
Income				
<$50,000	1,752 (38.6)	1,044 (37.4)	388 (37.3)	320 (45.6)
≥$50,000	2,783 (61.4)	1,750 (62.6)	652 (62.7)	381 (54.4)
Education				
High school or less	712 (15.7)	437 (15.6)	177 (17.0)	98 (14.0)
Postsecondary	3,823 (84.3)	2,357 (84.4)	863 (83.0)	603 (86.0)
Race				
White	3,973 (87.6)	2,465 (88.3)	920 (88.5)	588 (83.9)
Non-White	560 (12.4)	328 (11.7)	119 (11.5)	113 (16.1)
Medical insurance				
No	472 (10.4)	263 (9.4)	101 (9.7)	108 (15.4)
Yes	4,053 (89.6)	2,525 (90.6)	935 (90.3)	593 (84.6)
Cigarette smoking–related behavior				
Smoking status				
Daily	2,864 (63.2)	1,761 (63.0)	658 (63.3)	445 (63.5)
Nondaily	1,671 (36.8)	1,033 (37.0)	382 (36.7)	256 (36.5)
Cigarettes per day[a]				
<20	3,383 (74.6)	2,119 (75.8)	741 (71.3)	523 (74.6)
≥20	1,152 (25.4)	675 (24.2)	299 (28.8)	178 (25.4)
Years smoked				
<30	2,310 (51.1)	1,481 (53.3)	441 (42.5)	388 (55.4)
30+	2,209 (48.9)	1,300 (46.7)	597 (57.5)	312 (44.6)
Number of quit attempts				
0	363 (8.0)	229 (8.2)	78 (7.5)	56 (8.0)
1–5	2,499 (55.1)	1,578 (56.5)	548 (52.7)	373 (53.2)
6–10	976 (21.5)	584 (20.9)	235 (22.6)	157 (22.4)
11+	697 (15.4)	403 (14.4)	179 (17.2)	115 (16.4)
Use other tobacco products (baseline)				
No	3,946 (87.6)	2,503 (90.0)	890 (86.2)	553 (79.9)
Yes	558 (12.4)	277 (10.0)	142 (13.8)	139 (20.1)
Use other tobacco products (at follow-up)				
No	4,127 (93.7)	2,576 (94.7)	950 (94.2)	601 (89.0)
Yes	277 (6.3)	145 (5.3)	58 (5.8)	74 (11.0)
E-cigarette use				
No	3,825 (84.6)	2,404 (86.3)	874 (84.4)	547 (78.4)
Yes	696 (15.4)	383 (13.7)	162 (15.6)	151 (21.6)
State quit rate				
Low	1,606 (35.4)	1,016 (36.4)	362 (34.8)	228 (32.5)
Medium	1,907 (42.1)	1,139 (40.8)	452 (43.5)	316 (45.1)
High	1,022 (22.5)	639 (22.9)	226 (21.7)	157 (22.4)
Health-related variables				
Depression or anxiety medication				
No	3,199 (71.5)	1,976 (71.6)	719 (70.5)	504 (72.7)
Yes	1,274 (28.5)	784 (28.4)	301 (29.5)	189 (27.3)
Physical activity (MET hours/week)				
<7.5	1,021 (22.5)	670 (24.0)	222 (21.3)	129 (18.4)
≥7.5	3,514 (77.5)	2,124 (76.0)	818 (78.7)	572 (81.6)

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Published OnlineFirst August 4, 2021; DOI: 10.1158/1055-9965.EPI-20-1810

Table 1. Baseline characteristics of smokers in CPS-3 by baseline cannabis use status. (Cont'd)

	Total (*N* = 4,535) *N* (%)	Cannabis smoking status		
		Never (*N* = 2,794) *N* (%)	Former (*N* = 1,040) *N* (%)	Recent (*N* = 701) *N* (%)
Meets ACS alcohol guidelines				
No	549 (12.4)	303 (11.2)	137 (13.4)	109 (15.8)
Yes	3,873 (87.6)	2,405 (88.8)	886 (86.6)	582 (84.2)
History of cancer diagnosis				
Never diagnosed	4,361 (96.2)	2,690 (96.3)	1,001 (96.2)	670 (95.6)
Ever diagnosed (by follow-up)	174 (3.8)	104 (3.7)	39 (3.8)	31 (4.4)
Length of follow-up (years)				
<2	943 (20.8)	553 (19.8)	236 (22.7)	154 (22.0)
2–3	1,807 (39.8)	1,090 (39.0)	427 (41.1)	290 (41.4)
3–4	802 (17.7)	507 (18.1)	175 (16.8)	120 (17.1)
≥4	983 (21.7)	644 (23.0)	202 (19.4)	137 (19.5)

[a]Includes both daily and nondaily smokers (for nondaily smokers, cpd calculated by multiplying number of smoking days per month by cigarettes smoked per day on those days and dividing the result by 30).

source of confounding. Prior research using the NESARC dataset found that after adjustment for demographic factors, psychiatric disorders, and alcohol and other drug use disorders, baseline cannabis use was not associated with decreased cigarette smoking cessation at follow-up among daily cigarette smokers (13), suggesting that mental health conditions and substance use disorders should be assessed and adjusted for in future investigations.

Limitations

We explicitly asked about "smoking marijuana." Therefore, our results should not be generalized to other forms of cannabis use; however, previous epidemiologic studies most likely also captured cannabis smoking as opposed to other forms of use. Although edibles and electronic delivery systems appear to be increasing in popularity for consuming cannabis, their use at the time of our study and previous studies was likely to be low (42).

A considerable number of baseline cigarette smokers did not complete the follow-up survey and were excluded. *Post hoc* analyses suggested differences between these individuals and our analytic sample on some characteristics; however, our analyses tested for confounding by these variables and included them as covariates as

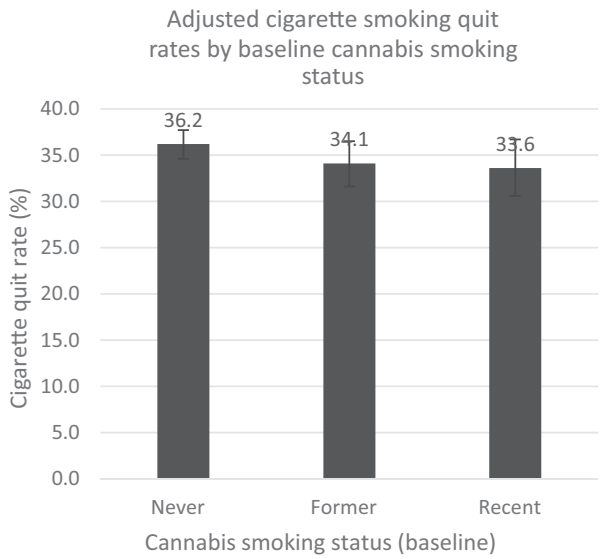

Figure 1.
Results of logistic regression model indicating no difference in cigarette smoking quit rates at follow-up by baseline cannabis smoking status, adjusted for gender, age, education, income, daily versus nondaily smoking, cpd, physical activity, number of quit attempts, state quit rate, and follow-up time.

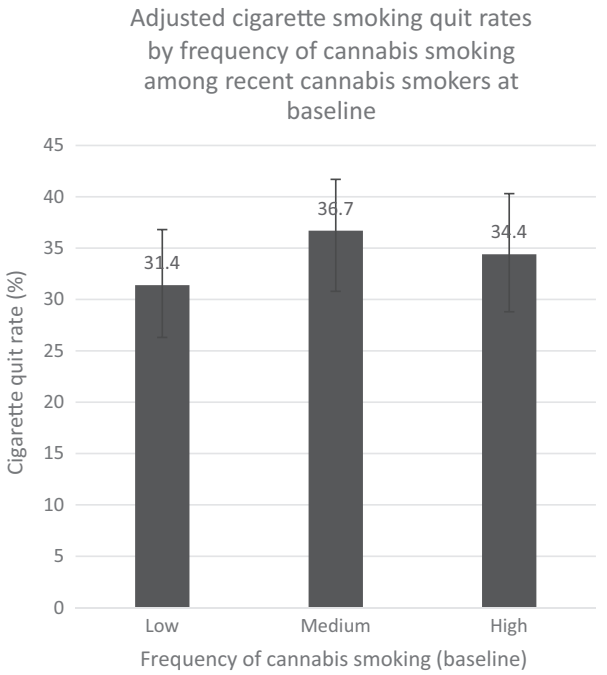

Figure 2.
Results of logistic regression model indicating no difference in cigarette smoking quit rates at follow-up by baseline frequency of cannabis smoking among recent cannabis smokers, adjusted for gender, age, education, income, daily versus nondaily smoking, cpd, physical activity, number of quit attempts, state quit rate, and follow-up time; low = ≤3 days/month; medium = 4–19 days/month; high: ≥20 days/month.

Published OnlineFirst August 4, 2021; DOI: 10.1158/1055-9965.EPI-20-1810

Table 2. Intent to quit cigarette smoking by cannabis smoking status at follow-up ($N = 2{,}910$).

		Cannabis smoking status[a]		
	Total	Never	Former	Current
	2,910	1,753	763	394
Intent to quit	*N* (%)[b]	*N* (%)[b]	*N* (%)[b]	*N* (%)[b]
Never expect to quit	104 (3.6)	62 (3.6)	30 (3.8)	12 (3.4)
May quit in the future but not in the next 6 months	931 (32.0)	568 (32.2)	240 (31.5)	123 (31.9)
Will quit in the next 6 months	669 (23.0)	392 (22.4)	177 (23.2)	100 (23.7)
Will quit in the next month	336 (11.5)	214 (12.1)	79 (10.4)	43 (10.9)
Don't know	870 (29.9)	517 (29.6)	237 (31.2)	116 (30.1)

[a]χ^2 model (unadjusted), $P = 0.083$.
[b]Standardized by age, sex, and income.

necessary. In addition, none of those characteristics were found to be effect modifiers of the relationship between cannabis smoking status or frequency at baseline and quitting at follow-up.

Our measure of baseline cannabis smoking required recall of cannabis smoking during specific age ranges which were then used to estimate baseline cannabis smoking status and frequency. One potential bias is that individuals who had quit smoking cigarettes by follow-up might be more biased toward misreporting (by minimizing) their cannabis smoking. If this were the case, however, higher cigarette quit rates would be associated with being a former or never cannabis smoker; yet we found no differences in cigarette quit rates by baseline cannabis smoking status. In a similar vein, individuals who had failed to quit smoking cigarettes at follow-up might be more biased toward recalling greater cannabis smoking, especially as cannabis use is more prevalent among cigarette smokers than among never smokers (4, 9, 10), and smoking cannabis might be a reason to blame not being able to quit cigarette smoking. If this were the case, however, lower quit rates would be associated with being a recent cannabis smoker; again, this was not what we observed. Rather, cigarette quit rates did not differ as a function of baseline cannabis smoking status. The consistency of our results indicating no differences in cigarette quit rates by baseline cannabis smoking status, cannabis smoking frequency, as well as no differences at follow-up among current cigarette smokers in intention to quit cigarettes as a function of cannabis smoking status or frequency, suggest that recall bias may not have been a significant factor in the results we observed.

Our measure of frequency assessed days per month of cannabis smoking. Future studies should include more precise estimates of intensity of cannabis use by asking about quantity of use on days when cannabis is used.

We had estimated the likelihood of quitting based on geographic location by categorizing states as low, medium, or high based on our sample's cigarette quit rates at follow-up. We believe this measure most likely captured the combined influence of multiple geographically associated factors, including unmeasured factors, that may have affected quitting among our study population. Nonetheless, we conducted *post hoc* analyses in which we substituted this variable with a measure of states' 2016 per-capita expenditures of tobacco cessation best practices (43), or the percent of a state's population in December 2015 covered by comprehensive smoke-free laws for worksites, restaurants, and bars (44). Substituting either of these variables, however, made no significant difference to our findings for cigarette quitting rates either by cannabis smoking status or frequency (all $P > 0.18$).

Results of the current study may not be generalizable to the general population of cannabis smokers or users, as our sample included more women, a higher percentage of Whites, and older individuals compared with the U.S. population or other study samples. Our models, however, controlled for race/ethnicity, income, education, age, and sex, Nonetheless, individuals for whom cannabis smoking is more strongly linked with a failure to quit cigarette smoking (e.g., daily heavy cannabis users, those with psychiatric comorbidity) may be more prevalent in the general population or in samples that include more individuals who are younger or report lower education or income.

Implications and conclusions

Our results do not support the hypothesis that cannabis smoking in adults inherently inhibits quitting cigarette smoking, including among those who had been diagnosed with a cancer by the time of follow-up. Additional studies are needed to confirm this finding. In some populations, confounding of cannabis use by prior mental health conditions and/or substance use could result in observing a noncausal association between cannabis use and lower quitting rates. Therefore, we believe additional studies should carefully measure and attempt to control for mental health conditions and substance use disorders. If cannabis smoking does not influence quitting cigarettes, as suggested by our results, then cigarette smokers attempting to quit cigarettes, as well as the clinicians supporting them, could reasonably focus their efforts more narrowly on quitting cigarettes, rather than attempting to simultaneously address cannabis smoking. Among those with comorbid psychiatric and/or substance disorders, however, the treatment of these conditions, including how cannabis use might be contributing to them, should be of primary concern.

Some patients with cancer may use cannabis to alleviate symptoms from cancer or its treatment; however, there may be potential harms for this population. For example, smoking cannabis may result in exposure to some of the same carcinogens and other toxicants in tobacco smoke, (17, 42, 45) or interact with medications used in cancer treatments. The continuing evolution of cannabis delivery methods (e.g., vaporizing products, edibles), chemical extracts, and potencies, may complicate future research efforts investigating the effects of cannabis use on quitting cigarettes. With increased acceptance of cannabis and continued legalization, however, more research on its potential short- and long-term harms will be feasible. Results of such research can be used to identify how best to minimize harms from both tobacco and cannabis use among those who use both substances.

Published OnlineFirst August 4, 2021; DOI: 10.1158/1055-9965.EPI-20-1810

Authors' Disclosures

W.D. Flanders reports ownership in Epidemiologic Research & Methods, LLC, which does consulting work for clients. There are no recognized conflicts with this work. J. Thrul reports membership on the scientific advisory board of MindCotine, Inc., which offers a smoking cessation program. This arrangement has been reviewed and approved by the Johns Hopkins University in accordance with its conflicts of interest policies. No disclosures were reported by the other authors.

Disclaimer

The study protocol was approved by the Institutional Review Boards of Emory University, and those of participating registries as required. The authors assume full responsibility for all analyses and interpretation of results. The views expressed here are those of the authors and do not necessarily represent the American Cancer Society or the American Cancer Society Cancer Action Network.

Authors' Contributions

J.L. Westmaas: Conceptualization, supervision, methodology, writing–original draft, writing–review and editing. **S.E. Strollo:** Data curation, software, formal analysis, methodology, writing–review and editing. **C.C. Newton:** Supervision, writing–review and editing. **B.D. Carter:** Methodology, writing–review and editing. **W.R. Diver:** Data curation, software, writing–review and editing. **W.D. Flanders:** Formal analysis, supervision, writing–review and editing. **V.L. Stevens:** Writing–review and editing. **A.V. Patel:** Conceptualization, resources, methodology, writing–review and editing. **K.I. Alcaraz:** formal analysis, writing–review and editing. **J. Thrul:** Writing-review and editing. **E.J. Jacobs:** Conceptualization, data curation, formal analysis, supervision, methodology, writing–original draft, writing–review and editing.

Acknowledgments

The authors express sincere appreciation to all CPS-3 participants, and to each member of the study and biospecimen management group. The authors would like to acknowledge the contribution to this study from central cancer registries supported through the Centers for Disease Control and Prevention's National Program of Cancer Registries and cancer registries supported by the NCI's Surveillance Epidemiology and End Results Program.

The ACS funds the creation, maintenance, and updating of the Cancer Prevention Study-II cohort (and/or CPS-3).

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Received December 22, 2020; revised April 19, 2021; accepted July 30, 2021; published first August 4, 2021.

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Published OnlineFirst August 4, 2021; DOI: 10.1158/1055-9965.EPI-20-1810

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Cancer Epidemiol Biomarkers Prev Published OnlineFirst August 4, 2021.