



Patterns of marijuana and tobacco use associated with suboptimal self-rated health among US adult ever users of marijuana

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ABSTRACT

The purpose of this study was to examine the patterns of marijuana and tobacco use and their associations with suboptimal self-rated health (SRH) among US adults who reported “ever, even once, using marijuana or hashish.” Data came from the 2009–2012 National Health and Nutrition Examination Survey, restricting to respondents aged 20 years and older who reported using marijuana at least once in their lifetime ($n = 3,210$). We assessed the age-adjusted prevalence of mutually exclusive groups of regular (at least once a month for more than one year) and non-regular marijuana smoking by current (serum cotinine ≥ 3.08 ng/mL) and not current use of tobacco. Suboptimal SRH status was defined as “fair” or “poor” in response to the question “Would you say that in general your health is excellent, very good, good, fair, or poor?” We produced prevalence ratios with multivariable log-linear regression models.

Among ever users of marijuana, the age-adjusted prevalence of regular marijuana smoking with current tobacco use, non-regular marijuana smoking with current tobacco use, and regular marijuana smoking without current tobacco use was 24.7%, 15.2%, and 21.1%, respectively. When compared to non-regular marijuana smokers without current tobacco use, the adjusted prevalence ratio for reporting suboptimal SRH was 1.98 (95% CI: 1.50–2.61), 1.82 (95% CI: 1.40–2.37), and 1.34 (95% CI: 1.05–1.69), respectively.

In conclusion, among adult ever users of marijuana, current tobacco use is high and strongly associated with suboptimal SRH; regular marijuana smoking with or without current tobacco use is significantly associated with suboptimal SRH.

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1. Introduction

Tobacco use is the leading cause of preventable morbidity and mortality in the US (DHHS, 2016). Cannabis (hereinafter referred to as marijuana) is the most prevalent and increasingly used illicit drug in the United States (SAMHSA, 2014). Accumulating evidence consistently demonstrates that heavy or habitual marijuana use is associated with numerous short- and long-term deleterious health consequences (NIDA, 2015; Volkow et al., 2014), including but not limited to addiction (Lopez-Quintero et al., 2011), altered brain structure and connectivity (Batalla et al., 2013; Zalesky et al., 2012), impaired memory and neuropsychological decline (Meier et al., 2012; Riba et al., 2015), psychosis (Di Forti et al., 2015; Radhakrishnan et al., 2014), poor educational attainment (Chatterji, 2006; Stiby et al., 2015), symptoms of chronic

bronchitis (Joshi et al., 2014; Tashkin, 2013), impaired motor coordination and traffic collisions (Asbridge et al., 2014; Hartman and Huestis, 2013), and diminished life satisfaction (Fergusson and Boden, 2008).

Marijuana and tobacco use share potential common environmental influences (e.g., peer influences), common mode of use (e.g., smoked), and are frequently used together (e.g., blunts and spliffs) (Agrawal et al., 2012; Agrawal et al., 2010; Rabin and George, 2015). One study suggested that, during a lifetime period, 57.9% of those who ever used tobacco reported ever using marijuana and 90% of those who ever used marijuana reported ever using tobacco (Agrawal et al., 2012). Another study showed that, during the past month, the prevalence of marijuana use was 17.8% among past-month tobacco users and the prevalence of tobacco use was 69.6% among past-month marijuana users (Schauer et al., 2015). Across the lifespan, either concurrently or at different times, prior use of either tobacco or marijuana substantially elevates the risk of subsequent initiation of the other and is associated with the progression to tobacco and marijuana dependence (Agrawal et al., 2011; Patton et al., 2005; Patton et al., 2006; Ream et al., 2008; Timberlake et al., 2007). Heightened susceptibility has been linked to

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genetic predispositions and putative neurobiological mechanisms that may facilitate increased urge and intensity of using each substance (Ramo et al., 2013b), promote progression to other types of illicit drugs (Fergusson et al., 2006; Secades-Villa et al., 2015), and precipitate relapse or hamper the success of quitting use of either substance (Ford et al., 2002; Haney et al., 2013; Ramo et al., 2013a).

Self-rated health (SRH) is a brief, validated proxy measure of overall health status (DeSalvo et al., 2006; Idler and Benyamini, 1997; Jylha, 2009). Among a variety of populations, SRH is strongly predictive of future morbidity and mortality, even after extensive adjustment for many covariates such as illness, depression status, functional and cognitive decline, and health care utilization (Cesari et al., 2008; DeSalvo et al., 2006; DeSalvo et al., 2005; Idler and Benyamini, 1997; Idler et al., 2000; Jylha, 2009; Kawada, 2003; Lee, 2000; Molarius and Janson, 2002). Although SRH is generated through a subjective, contextual, and non-arbitrary process, research shows that individuals with “poor” SRH have a two-fold higher mortality risk than that of those with “excellent” SRH (DeSalvo et al., 2006). SRH has been adopted as a chronic disease indicator for overarching conditions and as a Foundation Health Measure for the *Healthy People 2020* objectives that monitor progress toward promoting health, preventing disease and disability, eliminating disparities, and improving quality of life (CDC, 2015a; DHHS, 2015).

Although epidemiologic studies have evaluated effects of marijuana and tobacco use on many health outcomes, combined patterns of marijuana and tobacco use and their impact on overall health are uncertain. To our knowledge, no study has assessed regular marijuana smoking, with and without current tobacco use, in relation to suboptimal SRH among US adult ever users of marijuana. Ever users of marijuana are an important population of concern. Given that habitual marijuana use may affect health outcomes, and that tobacco use is a serious public health problem (Jamal et al., 2014; Ramo et al., 2013a), such a study may provide observational evidence to inform prevention efforts. Therefore, we sought to examine patterns of regular marijuana smoking and current tobacco use and their associations with suboptimal SRH among a nationally representative household-based survey sample of US adult ever users of marijuana by analyzing data from the 2009–2012 National Health and Nutrition Examination Survey (NHANES).

2. Methods

2.1. Participants

The NHANES is a program of studies designed to assess the health and nutritional status of adults and children in the US. NHANES participants were recruited using a household-based, multistage, stratified sampling designed to represent the noninstitutionalized civilian US population. The response rates for 2009–2012 ranged from 69.5% to 77.2% (CDC, 2013). We limited this analysis to men and nonpregnant women aged 20–59 years who attended the medical examination and provided information on their lifetime marijuana use in the Mobile Examination Center (MEC) interview ($n = 6342$). Of the participants who attended the MEC and reported marijuana use at least once during their lifetime ($n = 3370$), 3253 adults (96.5%) provided blood by venipuncture for measurement of serum cotinine. After excluding participants with missing covariate values, 3210 participants remained as ever users of marijuana for our analyses. All procedures involving human participants and confidentiality were reviewed and approved by the Research Ethics Review Board of the National Center for Health Statistics (CDC, 2015b).

2.2. Measures

2.2.1. Marijuana use

We defined ever users of marijuana as those participants who said yes to the question “Have you ever, even once, used marijuana or

hashish?” We further classified ever users of marijuana into subgroups of regular and non-regular marijuana smokers based on their responses to the question “Have you ever smoked marijuana or hashish at least once a month for more than one year?” Respondents who reported “yes” were considered regular marijuana smokers.

2.2.2. Current tobacco use

Cotinine is a metabolite of nicotine and a biomarker for both active and passive tobacco exposure (Benowitz et al., 2009b; CDC, 2015c). Previous studies have identified a nearly identical optimal cutpoint of using serum cotinine (≥ 3.08 ng/mL) to distinguish tobacco users from non-tobacco users (Agaku and King, 2014; Benowitz et al., 2009a; Flouris et al., 2013). Because recent use of other tobacco products (e.g., cigars, pipes, smokeless tobacco, nicotine patch, nicotine gum, e-cigarette, and any products containing nicotine) would be reflected in the measure of serum cotinine, and because non-tobacco users with exposures to secondhand smoking typically have serum cotinine below the cutpoint (Baltar et al., 2011; Chiu et al., 2011; Matsunaga et al., 2014), we defined current tobacco use as having serum cotinine values ≥ 3.08 ng/mL in this study.

2.2.3. Patterns of regular marijuana smoking with and without current tobacco use

Based on the status of regular marijuana smoking (yes/no) and current tobacco use (serum cotinine ≥ 3.08 ng/mL), we created four mutually exclusive groups: (1) non-regular marijuana smoking without current tobacco use; (2) regular marijuana smoking without current tobacco use; (3) non-regular marijuana smoking with current tobacco use; and (4) regular marijuana smoking with current tobacco use. Based on the response to the question, “How long has it been since you last smoked marijuana or hashish at least once a month for one year?”, we considered those who reported ≤ 30 days and ≤ 60 days as recent regular marijuana smokers for the periods of past 30-day and 60-day, respectively.

2.2.4. Suboptimal self-rated health

SRH is validated measure across various population and subgroups, although there are many different biological, physiological, psychological, behavioral (e.g., cigarette smoking, alcohol use, and physical activity), and health underpinnings for SRH (Emmelin et al., 2003; Jylha, 2009; Jylha et al., 2006; Tsai et al., 2010a; Tsai et al., 2010b; Tsai et al., 2010c). The NHANES survey asked participants to rate their overall health by answering the question: “Would you say that in general your health is excellent, very good, good, fair, or poor?” We dichotomized these responses into the categories of optimal (excellent, very good, or good) and suboptimal (fair or poor) SRH.

2.2.5. Behavioral and health-related risk factors

In addition to sociodemographic variables such as age, sex, race or ethnicity, education, and marital status, we also assessed behavioral and health-related risk factors. Specifically, we included alcohol use, physical activity, body mass index (BMI), health care access, and a self-reported history of cardiovascular diseases (CVD), diabetes, arthritis, and cancer. For alcohol use, we classified participants into: (1) lifetime abstainers— <12 drinks ever; (2) former drinkers—12 or more drinks during their lifetime but none during the past year; (3) non-excessive current drinkers—an average of up to 14 drinks per week for men or up to 7 drinks per week for women and never 5 drinks (men)/4 drinks (women) or more in a single day during the past year; and (4) excessive current drinkers—an average of >14 drinks per week for men or >7 drinks per week for women, or ≥ 5 (men)/ ≥ 4 (women) drinks in a single day once or more during the past year. BMI was calculated as measured weight in kg divided by the square of height in m and categorized as: (1) normal or underweight (<25 kg/m²); (2) overweight (25–29.9 kg/m²); and (3) obese (≥ 30 kg/m²). We summed and classified weekly hours of Metabolic Equivalent of Task (MET) for

transportation, household, and leisure time physical activity into the following groups: (1) inactive (MET hour/week = 0); (2) insufficiently active (MET hour/week >0–<7.5); and (3) active (MET hour/week ≥7.5) (Lee et al., 2010). Participants who said “yes” to the question, “Is there a place that you usually go when you are sick or you need advice about your health?” were considered to have access to health care. Participants were asked whether a doctor or other health professional had ever told them that they had the following: (1) coronary heart disease; (2) angina (i.e., angina pectoris); (3) a heart attack (i.e., myocardial infarction); or (4) a stroke. Respondents who answered “yes” to any of these questions were classified as having a history of CVD. Similarly, respondents who answered affirmatively to the questions, “Have you ever been told by a doctor or health professional that you have diabetes?” “Has a doctor or other health professional ever told you that you had arthritis?” “Have you ever been told by a doctor or other health professional that you had cancer or a malignancy of any kind?” were classified as having a history of diabetes, arthritis, and cancer, respectively.

2.3. Statistical analysis

We estimated the crude prevalence for the four mutually exclusive groups of regular marijuana use and current tobacco use, both overall and among age subgroups. We also calculated the age-adjusted prevalence by the direct method to the year 2000 Census population for these patterns among participants and subgroups stratified by sex, race or ethnicity, education, marital status, alcohol use, physical activity, BMI, health care access, and a history of cardiovascular diseases, diabetes, arthritis, and cancer (CDC, 2011). We produced unadjusted and adjusted prevalence ratios with multivariable generalized linear models for survey data (Poisson regression models with a log link). We used the variable for patterns of regular marijuana smoking and current tobacco use as the predictor and suboptimal SRH as the outcome while adjusting for sociodemographic, behavioral, and health-related risk factors. To obtain additional information on current regular marijuana smoking, we estimated the prevalence for reporting suboptimal SRH by status of previous 30-day and 60-day regular marijuana smoking among regular marijuana smokers with and without current tobacco use ($n = 1538$). To estimate relative excess risk due to interaction (RERI) between current tobacco use and regular marijuana smoking (Richardson and Kaufman, 2009), additional analyses were performed by using current tobacco use and regular marijuana smoking as two independent variables with their interaction term in regression models. Weighted analyses were performed to account for the complex sampling design to provide nationally representative estimates.

3. Results

Among ever users of marijuana, the age-adjusted prevalence for the 3 usage patterns of regular marijuana smoking without current tobacco use, non-regular marijuana smoking with current tobacco use, and regular marijuana smoking with current tobacco use was 21.1%, 15.2%, and 24.7%, respectively (Table 1). Prevalence for non-regular marijuana smoking without current tobacco use was 39.0% (100% - sum of percentages for the other 3 usage patterns, not shown). The prevalence for each of the 3 usage patterns varied significantly ($P < 0.05$ with non-overlapping 95% CI) across some demographic and health-related risk factors subgroups. For example, the prevalence for regular marijuana smoking without current tobacco use was greater among corresponding subgroups of participants who were 50–59 years of age (28.0%), were Hispanic (24.7%), had some college or higher education (23.1%), or were obese (23.9%), when compared to participants who were 20–39 years of age (17.2–18.5%), were non-Hispanic black (15.7%), had less than a high school education (14.9%), or were normal or underweight (17.1%) (Table 1). In addition, the prevalence for non-regular marijuana smoking with current tobacco use was higher

among participants had less than a high school education (21.9%), or were physically inactive (24.4%) than among participants had some college or higher education (12.2%), were physically active (13.9%) or insufficiently active (12.5%). The prevalence for regular marijuana smoking with current tobacco use was greater among participants who were 20–29 years of age (30.8%), were non-Hispanic black (38.5%), had less than a high school education (43.5%), were unmarried (30.0%), or had no access to health care (32.4%) than among participants who were 50–59 years of age (18.8%), were non-Hispanic white (23.4%) or Hispanic (19.7%), had some college or higher education (16.6%), were married (22.4%), or had access to health care (23.6%) (Table 1). Furthermore, the prevalence for reporting suboptimal SRH was higher among regular marijuana smokers with current tobacco use (ranged 21.1–23.1%) than among those without (ranged 12.8–15.6%) (Figs. 1 and 2). Among regular marijuana smokers with and without current tobacco use, the prevalence did not change significantly by whether they had smoked marijuana in the previous 30-day or 60-day (Figs. 1 and 2). We did not find any significant relative excess risk due to interaction (RERI = -0.20 ; 95% CI: -2.16 – 1.76).

When compared to non-regular marijuana smokers without current tobacco use, the prevalence ratios for reporting suboptimal SRH from log-linear regression models with adjustment for all study covariates were 1.98 (95% CI: 1.50–2.61), 1.82 (95% CI: 1.40–2.37), and 1.34 (95% CI: 1.05–1.69) among participants who reported regular marijuana smoking with current tobacco use, non-regular marijuana smoking with current tobacco use, and regular marijuana smoking without current tobacco use, respectively (Table 2).

4. Discussion

Consistent with previous studies, our results show that approximately 40% of ever users of marijuana were currently using tobacco. Our findings further indicate that, when compared to non-regular marijuana smoking without current tobacco use, regular marijuana smoking without current tobacco use was significantly associated with a 34% increased prevalence ratio of reporting suboptimal SRH. A greater prevalence ratio was observed for current tobacco use and regular marijuana smoking (98%), as well as current tobacco use and non-regular marijuana smoking (82%). Results from previous research on effects of marijuana use are inconclusive. One study reported an improvement in capacity for recall of information was associated with cessation of marijuana use (Tait et al., 2011). Other studies showed persistent marijuana use was associated with long-lasting cognitive impairment, and that cessation of marijuana use does not fully restore neuropsychological functioning, especially among those marijuana users of adolescent-onset (Meier et al., 2012; Riba et al., 2015). Another study found that marijuana use for up to 20 years was associated with periodontal disease but not with other physical health measures in early midlife (Meier et al., 2016). In this study, we did not detect any appreciable difference in reporting suboptimal SRH among regular marijuana smokers with and without current tobacco stratified by status of their past 30- or 60-day regular marijuana smoking. Moreover, the results from this and previous studies show that many unhealthy lifestyle health behaviors (e.g., tobacco use and excessive drinking) are interrelated. Such behaviors frequently co-occur and are often associated with worse health outcomes (Prochaska and Prochaska, 2011).

The findings of our study have a number of important public health implications. First, SRH is included in the public health key metrics such as *Healthy People 2020* and *CDC Healthy Day* for guiding disease prevention and health promotion and for measuring health-related quality of life in the US population (Barile et al., 2013). Second, reducing tobacco use and initiation among youth and adults is an important public health goal (DHHS, 2014). Given a high rate of overlap between marijuana and tobacco use among the participants, our study findings provide further support for implementing comprehensive tobacco control programs and underscore the importance of target interventions among high-

Table 1
Age-adjusted prevalence for patterns of regular marijuana smoking and current tobacco use among US adult ever users of marijuana, NHANES, 2009–2012.

Characteristics	n	Regular marijuana smoking without current tobacco use ^a		Non-regular marijuana smoking with current tobacco use ^b		Regular marijuana smoking with current tobacco use ^c	
		%	(95% CI ^d) P-value ^e	%	(95% CI) P-value	%	(95% CI) P-value
Unadjusted (overall)	3210	21.6	(20.1, 23.2)	15.0	(13.2, 16.9)	24.4	(22.3, 26.6)
Age-adjusted (overall)	3210	21.1	(19.5, 22.7)	15.2	(13.4, 17.2)	24.7	(22.4, 27.1)
Age (years)			= 0.001		= 0.400		= 0.001
20–29	927	17.2	(13.9, 21.2)	14.4	(11.3, 18.1)	30.8	(26.2, 35.9)
30–39	754	18.5	(15.3, 22.1)	16.6	(13.2, 20.6)	25.9	(22.1, 30.0)
40–49	812	21.8	(18.4, 25.7)	16.3	(12.4, 22.2)	22.6	(18.5, 27.3)
50–59	717	28.0	(24.0, 32.4)	12.9	(10.4, 15.9)	18.8	(15.3, 22.8)
Sex			= 0.147		= 0.089		< 0.001
Male	1815	22.6	(20.1, 25.3)	14.0	(12.2, 16.2)	28.5	(24.9, 32.5)
Female	1395	19.1	(16.5, 22.1)	16.7	(14.0, 19.8)	19.9	(17.7, 32.5)
Race or ethnicity			= 0.022		= 0.129		< 0.001
Non-Hispanic white	1687	21.4	(19.4, 23.6)	15.8	(13.5, 18.3)	23.4	(20.8, 26.3)
Non-Hispanic black	750	15.7	(13.0, 18.9)	14.1	(11.4, 17.3)	38.5	(33.8, 43.4)
Hispanic	538	24.7	(20.6, 29.4)	11.4	(9.2, 14.0)	19.7	(15.5, 24.6)
Other	235	16.0	(10.2, 24.2)	20.5	(12.6, 31.7)	24.8	(16.5, 35.5)
Education			= 0.003		= 0.002		< 0.001
< High school	546	14.9	(11.1, 19.6)	21.9	(16.4, 28.6)	43.5	(36.9, 50.3)
High school or GED	757	17.9	(15.1, 21.1)	18.7	(15.0, 23.0)	38.7	(32.8, 44.9)
≥ Some college	1907	23.1	(20.9, 25.6)	12.2	(11.0, 14.9)	16.6	(14.6, 18.7)
Marital status			= 0.198		= 0.038		< 0.001
Married or live with partner	1760	21.8	(19.7, 24.0)	14.2	(12.0, 16.6)	22.4	(20.4, 24.5)
Unmarried ^f	1450	20.2	(17.3, 23.5)	17.3	(14.9, 20.0)	30.0	(26.3, 34.1)
Alcohol use ^g			= 0.272		= 0.285		= 0.004
Lifetime abstainer	63	15.5	(6.6, 32.3)	27.5	(12.7, 49.9)	15.6	(7.0, 31.2)
Former drinker	394	18.9	(13.8, 25.5)	16.2	(10.5, 24.0)	26.4	(19.8, 34.4)
Non-excessive drinker	1139	18.2	(15.6, 21.0)	15.0	(12.7, 17.7)	20.7	(17.1, 24.9)
Excessive drinker	1614	23.6	(20.7, 26.6)	15.2	(13.3, 17.4)	27.5	(24.6, 30.5)
Physical activity			= 0.425		< 0.001		= 0.922
Inactive (MET ^h = 0)	538	17.3	(13.0, 22.8)	24.4	(20.1, 29.3)	25.6	(21.4, 30.3)
Insufficiently active (0 < MET ≤ 7.5)	268	17.1	(11.0, 25.5)	12.5	(7.8, 19.5)	27.5	(19.7, 37.0)
Active (MET ≥ 7.5)	2404	22.1	(20.0, 24.4)	13.9	(12.1, 16.0)	24.3	(21.9, 26.9)
Body mass index (kg/m ²)			= 0.011		= 0.322		= 0.007
Normal or underweight (<25)	1024	17.1	(13.6, 21.2)	14.8	(12.0, 18.1)	29.2	(25.3, 33.4)
Overweight (25–29.9)	1024	21.5	(18.7, 24.6)	13.9	(11.5, 16.6)	23.0	(19.8, 26.6)
Obese (≥30)	1162	23.9	(21.3, 26.7)	16.9	(14.0, 20.3)	23.1	(19.8, 26.7)
Have access to health care			= 0.474		= 0.266		< 0.001
Yes	2578	21.1	(19.4, 22.8)	14.9	(12.8, 17.2)	23.6	(21.4, 26.0)
No	632	19.8	(16.0, 24.3)	18.0	(14.2, 22.5)	32.4	(27.6, 37.7)
History of cardiovascular diseases			= 0.260		= 0.944		= 0.475
Yes	132	28.2	(19.6, 38.8)	16.1	(9.6, 25.8)	25.8	(17.3, 36.7)
No	3078	21.0	(19.4, 22.6)	15.2	(13.4, 17.3)	24.5	(22.1, 26.9)
History of diabetes			= 0.010		= 0.444		= 0.215
Yes	182	26.6	(18.5, 36.6)	12.5	(7.2, 20.8)	24.7	(16.4, 35.4)
No	3028	20.6	(19.0, 22.4)	15.3	(13.5, 17.4)	24.7	(22.4, 27.3)
History of arthritis			= 0.168		= 0.424		= 0.124
Yes	535	16.8	(13.3, 20.9)	17.9	(11.7, 26.4)	32.5	(26.1, 39.6)
No	2675	20.8	(19.0, 22.7)	14.9	(13.1, 16.8)	23.4	(20.9, 26.1)
History of cancer			= 0.081		= 0.637		= 0.620
Yes	142	22.8	(15.9, 31.6)	14.8	(8.9, 23.6)	28.2	(18.9, 39.8)
No	3068	20.9	(19.4, 22.4)	15.3	(13.5, 17.3)	24.7	(22.2, 27.4)

^a Reported smoking marijuana or hashish at least once a month for more than one year and serum cotinine values <3.08 ng/mL.

^b Did not report smoking marijuana or hashish at least once a month for more than one year and serum cotinine values ≥3.08 ng/mL.

^c Reported smoking marijuana or hashish at least once a month for more than one year and serum cotinine values ≥3.08 ng/mL.

^d Confidence interval.

^e P-value for Pearson chi-square test.

^f Sex-specific question “how many days did you have 4 (women)/5 (men) or more drinks of any alcoholic beverage?” was used in 2011–2012.

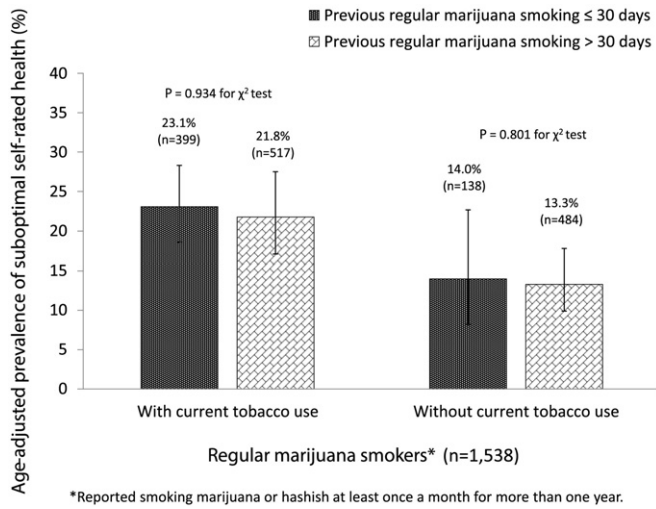
^g Included widowed, divorced, separated, or never married.

^h Metabolic equivalent of task (hours/week).

risk populations, including those using marijuana, in order to enhance the reach and effectiveness of prevention. Third, multiple unhealthy behaviors tend to co-occur but they are amenable to concurrent or sequential interventions. A successful change in one unhealthy behavior may lead to increased self-efficacy to modify other co-occurring unhealthy behaviors for which individuals may have low motivation to change (Prochaska and Prochaska, 2011). Finally, the difference in the prevalence of unhealthy behaviors (e.g., current tobacco use) across a number of sociodemographic subgroups highlights the need for evidence-based research to identify interdisciplinary intervention

strategies that integrate science, practice, and policy to address health disparities among the population.

Our study results also have several important clinical implications. SRH is an assessment tool for *Patient-Reported Outcomes Measurement Information System (PROMIS)* that measures patient-reported health status for physical, mental, and social well-being (Barile et al., 2013). In light of the legalization of medical and recreational marijuana use in some US states, patients may be more likely to ask their healthcare providers about potential health effects of marijuana use. Many of the proposed health benefits and unintended consequences of marijuana



Figs. 1 and 2. Estimated prevalence for reporting suboptimal self-rated health by status of previous 30-day and 60-day regular marijuana smoking among US adult regular marijuana smokers with and without current tobacco use, NHANES, 2009–2012.

use have not been fully explored. The findings of our study suggest that, in addition to receiving counseling about marijuana, patients with a history of marijuana use should obtain firm advice and support for not using tobacco. For those who plan to quit, evidence suggests that simultaneously quitting both tobacco and marijuana may yield important psychological and neurobiological benefits (Rabin and George, 2015). Until more results from experimental research are forthcoming to provide guidance, it is important to encourage dual cessation.

Our study has several limitations. It was cross-sectional and cannot establish cause and effect. With the ongoing changes in medical marijuana law in a growing number of states, people with certain health conditions might be drawn into marijuana use. It might be possible that poor perceived health resulted in marijuana use rather than marijuana use caused poor perceived health. Research shows that the predictive power of SRH for mortality is robust across many subgroups of country of origin even after extensively controlling for numerous covariates. However, validation study has not been conducted among the population of US adult ever users of marijuana. We adopted serum cotinine as a biomarker to define current tobacco use, occasional tobacco users who had used tobacco beyond 3–5 days prior to examination may be included as non-current tobacco users. In addition, data on marijuana use were self-reported and were subject to potential recall bias or

under-reporting of less socially desirable behaviors. Our study did not identify the use of specific tobacco products, including electronic cigarettes or electronic nicotine delivery systems that have been gaining popularity in recent years. Due to data constraints, we were unable to account for several potential confounders such as medication use, drug abuse, and other co-morbid conditions, as well as the difference in patterns of recreational versus medical marijuana use that might have had an effect on suboptimal SRH. Regular marijuana users may include both current and former marijuana users. In the present study, we assessed the impact of recent 30-day and 60-day regular marijuana use on suboptimal SRH among regular marijuana smokers. Because of the limited analytical sample size, we could not explore additional harmful marijuana and tobacco usage patterns related to quantity, frequency, timing, and duration of usage. It is worth noting that although several subgroups of the adult population (e.g., women of childbearing age, younger and older adults) were not evaluated in the current study due to a limited sample size, such adults are especially vulnerable to a multitude of health consequences associated with unhealthy behaviors even at low threshold levels for exposure. Long-term change of unhealthy behaviors is challenging and may require multifaceted efforts to effectively address the interplay of behaviors with biological, health, and social factors across various subgroups and environmental settings over persons' life course (Geronimus et al., 2006; IOM, 2001).

5. Conclusions

The results of this study indicate that, among adult ever users of marijuana in the US, current tobacco use is high and strongly associated with suboptimal SRH; ever smoking marijuana regularly with or without current tobacco use is significantly associated with suboptimal SRH. Our study findings underscore the importance of identifying and implementing clinical and population-based interventions that integrate proven tobacco control strategies among adults who may have such co-occurring risk factors.

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Competing Interests

The authors have declared that no competing interests exist.

Table 2

Estimated prevalence and prevalence ratios for reporting suboptimal self-rated health by patterns of regular marijuana smoking and current tobacco use among US adult ever users of marijuana, NHANES, 2009–2012.

Pattern (n = 3210)	Outcome								
	Suboptimal SRH ^a			Unadjusted model		Adjusted model 1 ^b		Adjusted model 2 ^c	
	n	%	CI ^d	PR ^e	CI	PR	CI	PR	CI
Non-regular marijuana smoking without current tobacco use ^f	1145	8.9	7.2–10.9	1.00	Referent	1.00	Referent	1.00	Referent
Regular marijuana smoking without current tobacco use ^g	636	14.1	10.8–18.1	1.59	1.21–2.08	1.46	1.13–1.88	1.34	1.05–1.69
Non-regular marijuana smoking with current tobacco use ^h	504	19.1	16.2–22.3	2.16	1.67–2.79	1.89	1.43–2.49	1.82	1.40–2.37
Regular marijuana smoking with current tobacco use ⁱ	925	21.7	18.7–25.1	2.45	1.90–3.16	2.00	1.48–2.72	1.98	1.50–2.61

^a Self-rated health reported as "fair" or "poor."
^b Adjusted for age, sex, race or ethnicity, education, and marital status.
^c Adjusted for age, sex, race or ethnicity, education, marital status, alcohol use, physical activity, BMI, health care access, and a history of cardiovascular diseases, diabetes, arthritis, and cancer.
^d Confidence interval.
^e Prevalence ratio.
^f Did not report smoking marijuana or hashish at least once a month for more than one year and serum cotinine values <3.08 ng/mL.
^g Reported smoking marijuana or hashish at least once a month for more than one year and serum cotinine values <3.08 ng/mL.
^h Did not report smoking marijuana or hashish at least once a month for more than one year and serum cotinine values ≥3.08 ng/mL.
ⁱ Reported smoking marijuana or hashish at least once a month for more than one year and serum cotinine values ≥3.08 ng/mL.

Disclaimer

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

Transparency document

The Transparency document associated with this article can be found in the online version.

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