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Associations Between Monthly Cannabis Use and Myocardial Infarction in Middle-Aged Adults: NHANES 2009 to 2018

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Abstract

Mechanistic research suggests using *Cannabis sativa* L. (cannabis or marijuana) may increase the risk of cardiometabolic disease, but observational studies investigating associations between cannabis use and myocardial infarction (MI) have reported inconsistent results. Cross-sectional National Health and Nutrition Examination Survey data from five 2-year cycles between 2009 and 2018 and representing 9,769 middle-aged adults (35 to 59 years old) were analyzed. Multivariable logistic regression models accounting for sampling weights and adjusting for cardiovascular risk factors were used to assess associations between a history of monthly cannabis use before MI and a subsequent MI. A quarter of respondents (n = 2,220) reported a history of monthly use >1 year before an MI. A history of MI was reported by 2.1% of all respondents and 3.2% of those who reported a history of monthly use. In fully adjusted multivariable models, and compared with never use, a history of monthly cannabis use preceding an MI was not associated with an MI (odds ratio [OR] 0.78, 95% confidence interval [CI] 0.35 to 1.71). However, when stratified by recent use, the odds of MI were threefold greater (OR 2.98, 95% CI 1.08 to 8.60) when no use was reported within the past month than when use was reported within the past month. Duration of monthly use was also not significantly associated with MI, including monthly use >10 years (OR 0.78, 95% CI 0.30 to 2.01). In conclusion, in a representative sample of middle-aged US adults, a history of monthly cannabis use >1 year before an MI was not associated with a subsequent physician-diagnosed MI, except for threefold greater odds when cannabis was not used within the past month.

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Declaration of Competing Interest

Dr. Corroon is a member of the Board of Directors of CV Sciences Inc., a manufacturer of hemp-derived cannabidiol products. The remaining authors have no competing interests to declare.

Supplementary materials

Supplementary material associated with this article can be found in the online version at <https://doi.org/10.1016/j.amjcard.2023.07.065>.

Keywords

myocardial infarction; cardiovascular disease; cannabis; marijuana

Changing societal attitudes toward *Cannabis sativa* L. (cannabis or marijuana), including consideration of its therapeutic utility,¹ have led to changing regulations and increased access in the United States and around the world.² Therefore, there is greater interest in the long-term effects of cannabis use, including concerns of cardiovascular disease (CVD).

Cardiovascular effects are mediated through cannabinoid receptors, namely, CB1R and CB2R, located in the central nervous and cardiovascular systems. Chronic CB1R activation has been linked with mechanisms of cardiometabolic disease, including profibrotic and proatherogenic effects, whereas CB2R activation has shown anti-inflammatory and antioxidant effects.³ Acute effects include dose-dependent increases in heart rate and cardiac contractility, elevations in myocardial oxygen demand, and alterations in vascular resistance and blood pressure.⁴

Epidemiologic studies investigating the relation between cannabis use and myocardial infarction (MI) have yielded conflicting results, depending on the study design, population, and measure of cannabis exposure. More specifically, cross-sectional studies have found associations with MI,^{5,6} coronary artery disease,⁷ stroke,^{6,8} and CVD mortality,⁹ whereas longitudinal studies have shown no association with these outcomes¹⁰ or with markers of systemic inflammation,¹¹ CVD risk factors,¹² carotid intima-media thickness,¹³ coronary artery and abdominal artery calcium,¹⁴ or abdominal adiposity.¹⁵

Previous cross-sectional studies have investigated recency (past month use) and frequency of recent use (days used in the past month), but not duration and timing of use beyond the past month. Thus, we conducted an analysis of National Health and Nutrition Examination Survey (NHANES) data to assess the relation between a history of monthly cannabis use preceding an MI (i.e., long-term use preceding an MI) and self-reported history of physician-diagnosed MI in a nationally representative sample of middle-aged adults in the United States.

Methods

The NHANES is a series of nationally representative, cross-sectional examinations designed to monitor the health of the US population. Participants are selected from the noninstitutionalized, civilian population using a complex, stratified, multistage probability-cluster sampling design for in-home interviews and visits to a mobile examination center.¹⁶ Weights in NHANES are formulated to address the survey's intricate design elements, such as oversampling, nonresponses, and poststratification adjustments to align with the Census Bureau's total population figures.¹⁷

The analytic sample was limited to middle-aged adults (35 to 59 years old) who participated in both the interview and mobile NHANES examinations during 5 2-year cycles between 2009 to 2018. This included 9,769 (unweighted)/91,860,164 (weighted) respondents who

answered questions about their cannabis use using the Drug Use Questionnaire (DUQ) and history of physician-diagnosed MI (n = 232) using the Medical Conditions Questionnaire (MCQ). Respondents with relevant missing data from both the DUQ and the MCQ were excluded.

Cannabis use was defined using questions from the DUQ, which surveyed respondents between 18 and 69 years of age (age 59 years for cannabis use).¹⁸ Classifications for the primary analysis included “never use,” “no history of monthly use,” or “history of monthly use” (i.e., a history of monthly use >1 year), as outlined in Figure 1. A secondary exposure variable was calculated to measure duration of monthly cannabis use before an MI (Figure 1).

For recent use (i.e., within the past month), a categorical variable was created to summarize the frequency of use within the month. Respondents reporting <10 days of use were categorized as “Recent, light” users, 10 to 20 days as “Recent, moderate” users, and >20 days as “Recent, heavy” users.¹⁹

Covariates were obtained through self-report and included age, gender, race/ethnicity, education, household income, physical activity, cigarette smoking status, and alcohol use. Age was self-reported in years. Gender was self-reported as male or female. Race/ethnicity was categorized as non-Hispanic White, non-Hispanic Black, Asian and other, or Hispanic (inclusive of Mexican American and Other Hispanic). Height and weight were obtained by trained examiners and were used to compute body mass index (BMI). Comprehensive information on covariates is available in Supplementary Methods and Results.

Biomarkers (total cholesterol [mg/100 ml], high-density lipoprotein [HDL] cholesterol [mg/100 ml], fasting blood glucose [mg/d], HbA1c [%]) were objectively measured by American Society of Clinical Pathologists-certified medical technologists or medical laboratory technicians at the University of Minnesota, Minneapolis, Minnesota. Dyslipidemia was defined as a total cholesterol/HDL ratio >5.0 or use of lipid-lowering medication. Prediabetes was defined as fasting blood glucose \geq 100 or HbA1c \geq 5.7%. Diabetes was defined as fasting blood glucose \geq 126 or HbA1c >6.4% or use of antidiabetic medication.

The 10-year atherosclerotic CVD (ASCVD) risk was calculated using the race- and gender-specific Pooled Cohort Risk Equations developed by the American College of Cardiology (ACC) and American Heart Association (AHA).²⁰ Given that the 10-year ASCVD risk score is only validated in non-Hispanic White and Black subjects, men and women reporting other races/ethnicities were treated as non-Hispanic White (per the equations). Parameters included the natural log of age, age squared, total cholesterol, HDL cholesterol, treated or untreated systolic blood pressure, smoking status, and diabetes status. A unique set of parameters was used for each race- and gender-specific equation, as specified by the ACC/AHA.

Cardiovascular-related medical conditions were defined by questions from the MCQ. Eligible respondents were aged between 20 and 150 years. A self-reported history of MI was determined by response to the following question: “Has a doctor or other health

professional ever told you that you...had a heart attack (also called myocardial infarction)?" ("Yes," "No"). Respondents reporting "Yes" were categorized as having history of MI. The age of the heart attack was determined by response to the following question: "How old were you when you were first told you had a heart attack (also called myocardial infarction)?" The age of the MI was used to determine the years of monthly cannabis use before MI (Figure 1).

NHANES data are weighted using a complex sampling design, so the population provides a representation of the population of the United States for each 2-year survey cycle. Per the guidelines provided by NHANES, weights were used for the smallest subsample used in this study.²¹ The analytic sample combines data from multiple survey cycles; the weights were adjusted per the instructions provided by NHANES.¹⁷

Descriptive statistics were used to characterize the sample (mean and standard error, or median and interquartile range, for continuous variables and unweighted counts and weighted percentages for nominal variables). Multicollinearity between independent variables was assessed in the final multivariable adjusted model using Variance Inflation Factor and Tolerance. Trend analyses were conducted for cannabis use across time using simple linear regression. Data management and statistical analyses were performed using SAS On-Demand for Academics (Copyright 2014 SAS Institute Inc., Cary, North Carolina).

The primary analysis tested the association between a history of monthly cannabis use (> 1 year) preceding an MI and a history of a subsequent MI. Secondary analyses included duration of monthly use preceding an MI, both as a continuous and a categorical measure (<5 years, 5 to 10 years, and >10 years). Weighted multivariable logistic regression models were used to estimate adjusted odds ratios (ORs) and 95% confidence intervals (CIs), controlling for potential confounders. Variables considered potential confounders in the multivariable analyses were sociodemographic variables (model 1); cigarette and alcohol use and physical activity (model 2); and BMI and the 10-year ASCVD risk (model 3).

Multiplicative, first-order interactions were examined in the multivariable adjusted regression models between history of monthly use and gender, race/ethnicity, cigarette smoking status, recency of use, and age of first use (separately). Interaction terms were considered significant in the final multivariable adjusted model if $p < 0.10$. A $p < 0.05$ was considered significant for all other analyses.

Results

The sample comprised 9,769 respondents, of whom 24.9% ($n = 2,220$) reported a history of monthly use >1 year (Table 1). A history of MI infarction was reported by 2.1% of all respondents, 1.5% of those who reported never using cannabis, 2.2% of those who denied a history of monthly use, and 3.2.% of those who reported a history of monthly use.

Those with a history of monthly use > 1 year were more likely than were never users to be non-Hispanic White men with less education, lower household income, and more days of alcohol use per week. Notably, subjects with a history of monthly use had a higher prevalence of current cigarette smoking than did those without a history of monthly use, and

almost double the median number of pack-years. Despite this, the former reported engaging in more minutes of physical activity per week. Finally, median 10-year ASCVD risk score was significantly higher for those with a history of monthly use than for those without a history of monthly use and those who reported never using cannabis at all. This difference was statistically significant (Tukey adjusted $p < 0.0001$ for both).

Between 2009 and 2018, the percentage of respondents reporting a history of monthly cannabis use fluctuated around 25%, without a statistically significant trend over time (p for trend = 0.69). However, a significant upward trend was seen in recent cannabis use (past month) from 9.0% (95% CI 7.0 to 11.1) in 2009 to 13.5% (95% CI 10.9 to 16.2) in 2017 to 2018 (p for trend < 0.01), and in recent use by those with a history of monthly use from 7.6% (95% CI 5.7 to 9.6) in 2009 to 11.4% (95% CI 8.7 to 14.1) in 2017 to 2018 (p for trend = 0.03). Conversely, the percentage reporting a history of MI decreased from 2.5% (SE 0.4) in 2009 to 2.2% (SE 0.7) in 2017 to 2018. This trend was not significant (p for trend = 0.931).

Detailed characteristics of respondents reporting ever using cannabis ($n = 4,780$, 57.2%) are reported in Table 2. Almost 44% of those who reported ever using cannabis also reported a history of monthly use > 1 year. Of these, approximately 38% reported recent use (past month).

Frequencies and percentages of MI history are reported according to cannabis use characteristics in Table 3. Those with a history of monthly cannabis use had the greatest percentage of MIs ($n = 81$, 3.2%), which was largely driven by those with a history of 5 to 10 years of monthly use before their MI ($n = 14$, 3.7%).

The odds of MI by cannabis use status are reported in Table 4. In multivariable logistic regression models adjusted for sociodemographic variables, the odds of reporting a history of a MI were significantly greater among those with and without a history of monthly cannabis use (OR 1.69, 95% CI 1.17 to 2.45 and 1.58, 95% CI 1.08 to 2.30), respectively, than among those who reported never using cannabis. After adjusting for cigarette smoking, alcohol use, and physical activity, the odds became nonsignificant for both groups (no history of monthly use: OR 0.81, 95% CI 0.41 to 1.60 and history of monthly use: OR 0.78, 95% CI 0.35 to 1.71). After adjusting for cardiovascular risk factors, the odds remained nonsignificant for both groups.

A secondary analysis was performed to investigate the duration of monthly use preceding the MI as both a categorical and continuous measure (years of monthly use before MI). No association was found between years of monthly use and history of MI in the fully adjusted multivariable logistic regression model at any of the 3 levels of the categorical measure (< 5 years, 5 to 10 years, > 10 years) or for the continuous measure expressed in decades of use (10 years).

Models exploring potential effect modification by gender, race/ethnicity, cigarette smoking status, and age of first cannabis use were all nonsignificant (Supplementary Table 1). However, a significant interaction was found between a history of monthly cannabis use and recency of use for self-reported MI. Specifically, a history of monthly use among those

denying use in the past month was associated with threefold greater odds of MI than among those with no history of monthly use (OR 2.98, 95% CI 1.08 to 8.60, $p < 0.03$).

Discussion

In a nationally representative sample of middle-aged US adults, a history of monthly cannabis use (>1 year) before experiencing an MI was not associated with a history of self-reported physician-diagnosed MI after adjusting for sociodemographic characteristics, alcohol and cigarette use, physical activity, BMI, and cardiovascular risk factors, except when stratified by use within in the past month. In the latter case, the odds were threefold greater when use was not reported within the past month. Duration of monthly use preceding the MI was also not associated, including monthly use >10 years.

The lack of association in our study may be unexpected given the observation that those with a history of cannabis use were more likely to be male, smoke more cigarettes, drink more alcohol, and have a greater 10-year ASCVD risk. In contrast, they were also found to engage in more physical activity. Other observational studies, including other studies using NHANES data, have reported that cannabis users engage in more physical activity²² and have more favorable BMI profiles,^{12,23} lower concentrations of selected lipid biomarkers,^{8,12} and better glycemic parameters.²³ It remains unclear whether these favorable factors counterbalance potential risks.

Our results diverge from previous research in the Behavioral Risk Factor Surveillance System survey in US adults, which reported elevated odds of MI among young adults (18 to 44 years old),⁵ and those of Shah et al,⁶ who reported increased odds of MI or coronary artery disease (CAD) among adults (18 to 74 years old) naive to cigarette smoking. Importantly, both studies investigated recent use (30 days before survey administration), including frequency of recent use, but did not assess long-term use or discriminate between cannabis use before or after the MI.

The greater odds of MI or CAD reported by Shah et al⁶ were driven by a single method of cannabis use (smoking), which, if causative, may be attributable to increases in oxidative stress, carbon monoxide, and other byproducts of cannabis combustion.²⁴ This finding holds implications for future investigations, given the range of cannabis products accessible to consumers where cannabis has been legalized and regulated. Unfortunately for our study, the method of cannabis use was not available because it was only recently added to the NHANES DUQ in the 2019-to-2020 survey cycle.²⁵

The finding that respondents with a history of monthly cannabis use, but no recent use, had significantly greater odds of MI is somewhat unexpected given the known acute cardiovascular effects of cannabis,^{26,27} other studies reporting associations with recent use, and the shorter duration of exposure in this group (average years of use before MI: 11.9 years vs 23.9 years for those who reported past month use). One might hypothesize smaller odds of MI owing to less cumulative exposure.

It is conceivable that subjects with a history of monthly cannabis use may have ceased usage earlier owing to health-related concerns that may have otherwise contributed to an increased

risk of CVD. If this phenomenon exists, it may be comparable to the “smoker’s paradox” evident in tobacco research, in which cigarette smokers may receive more intensive medical interventions at a younger age and consequently exhibit better outcomes than do current smokers or never smokers.²⁸ This finding warrants further investigation.

Study strengths include using a nationally representative sample and a relatively large sample size, which was balanced across sociodemographic and other characteristics. Another strength is the focus on a history of monthly use (long-term) as a measure of duration of exposure (preceding the reported MI) as opposed to recency of cannabis use (past month use) and frequency of recent use (days used in the past month), which fail to account for both the duration and timing of the exposure beyond the past month.

Limitations include a cross-sectional design, the age limit of the NHANES Drug Use Questionnaire (59 years old for cannabis use), and cannabis use and MI being based on self-report. Finally, and despite attempts to account for the magnitude of use (days of use per month, years of monthly use, joints or pipes per day), the actual amount of cannabis (grams of dried flower or extracted oil), and/or cannabinoids (milligrams of phytocannabinoids such as tetrahydrocannabinol, cannabidiol, and so on), and the method of use (e.g., inhalation, ingestion, and so on) were not available.

In conclusions, in a representative sample of middle-aged US adults, a history of monthly cannabis use for more than a year before an MI was not linked to a subsequent physician-diagnosed MI, after accounting for cardiovascular risk factors. However, when considering recent use, the odds were 3 times greater if no use was reported in the past month. The length of monthly use before the MI, including use >10 years, also showed no association. The evidence base for cardiovascular harms is conflicting and limited by the ability to accurately quantify use, especially the method of use, dose, and potency. Given the expanding access to cannabis products in the United States and around the world, more research, particularly longitudinal and experimental studies, is needed.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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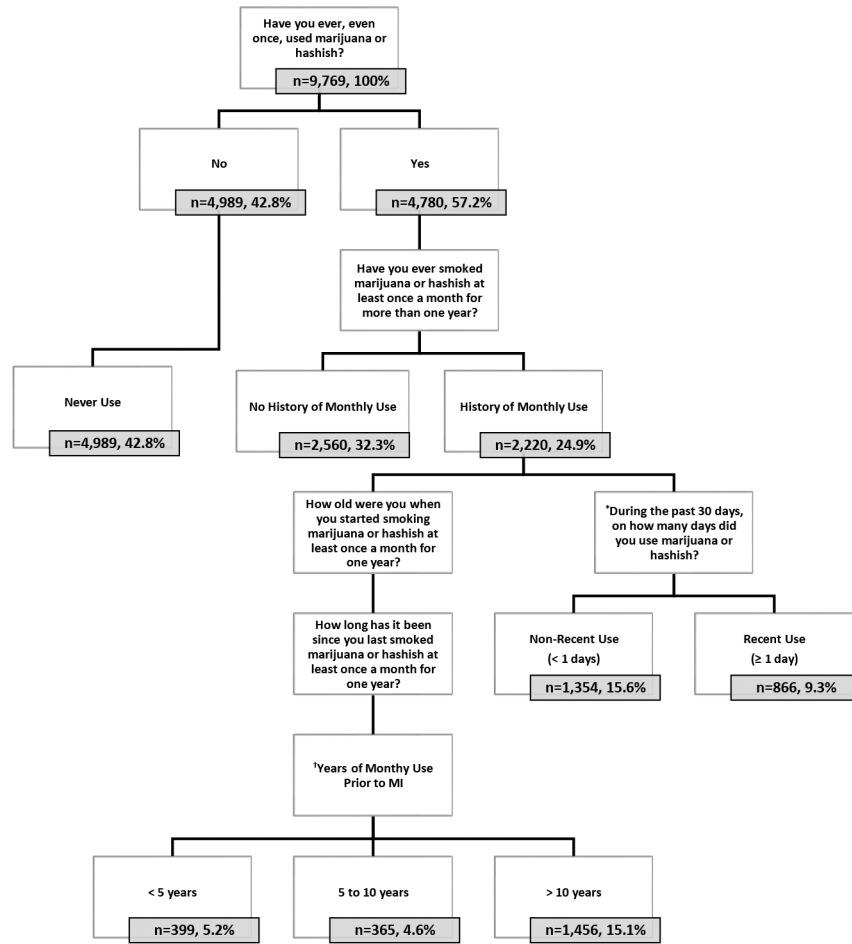


Figure 1. Flowchart of the analytic sample (unweighted).

Notes: subgroups are represented by unweighted frequencies and weighted percentages.

*This question was administered to all respondents reporting ever using marijuana or hashish. Only responses from those with a history of monthly use >1 year were analyzed.

†Years of monthly cannabis use before MI was determined by responses to the following questions: “How old were you when you started smoking marijuana or hashish at least once a month for one year?” (age in years) and “How long has it been since you last smoked marijuana or hashish at least once a month for one year?” Years of monthly use were calculated by subtracting the number of years since using it monthly for a year from a respondent’s current age and then subtracting the age at which they reported starting using it monthly for a year. If the number of years since a reported MI was greater than the number of years since monthly use, the difference was subtracted from the number of years of monthly use, resulting in years of monthly use before the MI.

Table 1
 Characteristics of Middle-Aged Adults (35–59 YOA) by Cannabis Use Status, 2009–2018 (n=9,769)

	Overall Sample (n=9,769, 100.0%)	Never (n=4,989, 42.8%)	No History of Monthly Use n=2,560 (32.3%)	History of Monthly Use (n=2,220, 24.9%)
Socio-demographics, n (%)				
Sex				
Male	4705 (49.3)	2120 (43.6)	1240 (47.8)	1345 (61.0)
Age (YOA), mean (SE)	47.3 (0.1)	46.9 (0.2)	47.1 (0.2)	48.1 (0.2)
Race/Ethnicity				
Non-Hispanic White	3708 (65.5)	1234 (52.2)	1327 (76.3)	1147 (74.6)
Non-Hispanic Black, Asian, Other	3383 (18.0)	1805 (20.9)	806 (14.5)	772 (17.6)
Hispanic	2678 (16.4)	1950 (26.9)	427 (9.3)	301 (7.8)
Education				
High school or less	4222 (35.7)	2328 (39.2)	826 (26.5)	1068 (41.7)
Some college	2924 (31.0)	1238 (27.2)	904 (32.7)	782 (35.2)
College graduate or above	2617 (33.3)	1418 (33.6)	829 (40.8)	370 (23.0)
Household income, annual \$				
\$0 to 44,999	4029 (32.1)	1997 (34.1)	929 (25.1)	1103 (37.7)
\$45,000 to \$99,999	2775 (34.4)	1439 (35.2)	728 (33.0)	608 (34.8)
\$100,000	2093 (33.6)	997 (30.7)	746 (41.8)	350 (27.6)
Cigarette smoking status				
Never	5514 (55.4)	3779 (78.2)	1269 (51.3)	466 (21.4)
Former	1959 (23.0)	619 (11.3)	647 (27.4)	693 (37.6)
Current	2293 (21.6)	589 (10.5)	643 (21.3)	1061 (40.9)
Pack-years, median (IQR)	6.8 (0.2)	2.8 (0.2)	7.0 (0.4)	13.7 (0.5)
Alcohol use, n (%)				
No days/week	1536 (15.5)	786 (17.3)	380 (12.8)	370 (16.3)
2 days/week	5577 (63.9)	2725 (70.6)	1610 (64.2)	1242 (53.9)
> 2 days/week	1468 (20.7)	383 (12.1)	501 (23.0)	584 (29.8)
Phys. Act. Min./wk., median (IQR)	339.7 (7.5)	339.8 (10.0)	311.6 (11.8)	378.0 (13.8)
BMI, kg/m², mean (SE)	29.8 (0.1)	30.0 (0.2)	29.7 (0.2)	29.5 (0.2)
Cardio-Metabolic Medical history, n (%)				

	Overall Sample (n=9,769, 100.0%)	Never (n=4,989, 42.8%)	No History of Monthly Use n=2,560 (32.3%)	History of Monthly Use (n=2,220, 24.9%)
Myocardial infarction	232 (2.1)	81 (1.5)	70 (2.2)	81 (3.2)
Coronary heart disease	160 (1.5)	53 (0.9)	56 (1.6)	51 (2.3)
Angina	152 (1.5)	58 (1.2)	37 (1.2)	57 (2.4)
Stroke	221 (1.7)	93 (1.8)	63 (1.6)	65 (1.8)
Heart failure	163 (1.2)	72 (1.2)	40 (0.9)	51 (1.7)
Hypertension	4822 (47.6)	2367 (47.0)	1270 (46.1)	1185 (50.5)
Dyslipidemia	3140 (32.3)	1586 (31.0)	834 (31.8)	720 (35.1)
Diabetes or Pre-diabetes	4928 (45.6)	2610 (48.0)	1199 (40.8)	1119 (47.8)
10-year ASCVD Risk Score, median (IQR)	4.6 (0.1)	4.1 (0.1)	4.2 (0.2)	5.8 (0.2)
Laboratory measures, mean (SE)				
Total cholesterol, mg/dL	201.1 (0.7)	199.2 (0.8)	203.3 (1.3)	201.3 (1.4)
HDL, mg/dL	53.3 (0.3)	52.6 (0.4)	54.9 (0.4)	52.4 (0.5)
LDL, mg/dL	120.8 (0.6)	121.0 (0.9)	120.3 (1.2)	121.3 (1.7)
Triglycerides, mg/dL	131.0 (2.5)	132.2 (3.5)	122.6 (3.6)	139.2 (4.1)
Hemoglobin A1c, %	5.7 (0.0)	5.7 (0.0)	5.6 (0.0)	5.7 (0.0)
Medication use, n (%)				
Antihypertensive (incl. comb.)	2115 (36.5)	1025 (39.9)	567 (33.7)	523 (35.1)
Antilipidemic	1298 (24.7)	633 (24.5)	369 (23.8)	296 (26.2)
Antidiabetic	895 (13.7)	504 (17.0)	218 (11.6)	173 (11.4)

Notes: Subgroup sizes represent unweighted frequencies. All other numbers are weighted column percentages, means (with standard errors) or medians (with IQR). Physical activity includes the following domains: Walk/bike for transportation, vigorous recreational activity, moderate recreational activity, moderate recreational activity.

Table 2
Cannabis Use Characteristics by Cannabis Use Status, 2009–2018 (4,780, 57.2%)

Cannabis Use	No History of Monthly Use (n=2,560, 32.3%)	History of Monthly Use (n=2,220, 24.9%)
Years of monthly use prior to MI, n (%)		
< 5 yrs.	NA	399 (21.0)
5 to 10 yrs.	NA	365 (18.6)
> 10 yrs.	NA	1456 (60.4)
Years of monthly use prior to MI, mean (SE)	0 (0.0)	16.5 (0.4)
Onset of use, mean (SE)		
Age of first use	18.9 (0.1)	16.0 (0.1)
Age started monthly use	NA	18.7 (0.2)
Recency of use, n (%)		
Past month	162 (5.1)	866 (37.5)
> Past month	2398 (94.9)	1354 (62.5)
Frequency of Recent Use		
Days of use, past month, mean (SE)	3.0 (0.3)	15.3 (0.6)
Days of use, past month, n (%)		
Light (< 10 days/past mo.)	144 (91.8)	380 (41.1)
Moderate (10-20 days /past mo.)	15 (7.0)	175 (19.8)
Heavy (> 20 days/past mo.)	3 (1.2)	311 (39.1)

Notes: Subgroup sizes represent unweighted frequencies. All other numbers are weighted column percentages, means (with standard errors) or medians (with IQR). Cannabis use variables are all standard NHANES variables, other than “Years of monthly use prior to MI”, which is a calculation.

Table 3

Cannabis Use Characteristics by Myocardial Infarction Status, 2009–2018 (n=9,769)

Cannabis Use	MI (n=232, 2.1%)	No MI (n=9,537, 97.9%)
Never	81 (1.5)	4908 (98.5)
No History of Monthly Use	70 (2.2)	2490 (97.8)
History of Monthly Use	81 (3.2)	2139 (96.8)
Duration of monthly use		
< 5 yrs.	13 (2.5)	386 (97.5)
5 to 10 yrs.	14 (3.7)	351 (96.3)
> 10 yrs.	54 (3.3)	1402 (96.7)
Years of monthly use prior to MI, mean (SE)	18.9 (2.2)	16.4 (0.4)
Onset of use, mean (SE)		
Age of first use	17.3 (0.5)	17.7 (0.1)
Age started monthly use	17.4 (0.7)	18.7 (0.2)
Recency of use, n (%)		
Past month	35 (2.7)	993 (97.3)
> Past month	116 (2.6)	3636 (97.4)
Frequency of Recent Use		
Days of use, past month, mean (SE)	14.0 (2.2)	13.5 (0.6)
Days of use, past month, n (%)		
Light (< 10 days/past mo.)	15 (2.4)	509 (97.6)
Moderate (10-20 days /past mo.)	7 (4.7)	183 (95.3)
Heavy (> 20 days/past mo.)	13 (2.2)	301 (97.8)
Years since monthly use, n (%)		
< 5 yrs.	35 (2.9)	992 (97.1)
5 to 10 yrs.	10 (3.3)	242 (96.7)
> 10 yrs.	36 (3.5)	905 (96.5)
Frequency of Monthly Use		
Time per Month		
Once/month	7 (3.4)	152 (96.6)
2-3 times/month	8 (1.2)	313 (98.8)
4-8 times/month	19 (2.7)	543 (97.3)
9-24 times/month	22 (4.3)	514 (95.7)
25-30 times/month	25 (3.7)	613 (96.3)
Joints or Pipes per Day		
1 joint or pipe/day	29 (2.3)	921 (97.7)
2 joints or pipes/day	24 (3.6)	657 (96.4)
3-5 joints or pipes/day	21 (3.3)	432 (96.7)
6 joints or pipes/day	6 (7.2)	116 (92.8)

Notes: Subgroup sizes represent unweighted frequencies. All other numbers in the table are weighted column percentages.

Table 4

Adjusted Odds Ratios for MI by Cannabis Use Status, 2009-2018

	OR (95% CI)
Unadjusted (n=9,769)	
Never	1.00 Reference
No History of Monthly Use	1.50 (1.06-2.13)*
History of Monthly Use	2.23 (1.56-3.20)*
Duration of monthly	
< 5 yrs.	1.71 (0.84-3.45)
5 to 10 yrs.	2.60 (1.24-5.42)*
> 10 yrs.	2.31 (1.48-3.59)*
Model 1 (M1)*: Adjusted for socio-demographic variables (n=8,893)	
Never	1.00 Reference
No History of Monthly Use	1.58 (1.08-2.30)*
History of Monthly Use	1.69 (1.17-2.45)*
Duration of monthly	
< 5 yrs.	1.83 (0.89-3.76)
5 to 10 yrs.	2.48 (1.15-5.35)*
> 10 yrs.	1.49 (0.95-2.34)
Model 2 (M2)**: Adjusted for cigarette, alcohol use & physical activity (n=4,584)	
Never	1.00 Reference
No History of Monthly Use	0.81 (0.41-1.60)
History of Monthly Use	0.78 (0.35-1.71)
Duration of monthly	
< 5 yrs.	0.81 (0.26-2.55)
5 to 10 yrs.	0.91 (0.26-3.14)
> 10 yrs.	0.74 (0.29-1.91)
Model 3 (M3)***: Adjusted for CVD risk factors (n=2,238)	
Never	1.00 Reference
No History of Monthly Use	0.52 (0.21-1.29)
History of Monthly Use	0.75 (0.34-1.64)
Duration of monthly	
< 5 yrs.	0.67 (0.22-2.06)
5 to 10 yrs.	0.72 (0.17-3.01)
> 10 yrs.	0.78 (0.30-2.01)

Notes: Odds ratios and 95% CI for reporting a prior MI by cannabis use status. Unweighted frequencies and weighted percentages reported.* Socio-demographic variables: age, sex, race/ethnicity, education, and household income.** All variables in M1 plus cigarette and alcohol use and physical activity.*** ASCVD risk and BMI.