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Original Contribution

Obesity and Cannabis Use: Results From 2 Representative National Surveys

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The role of cannabis and endocannabinoids in appetite regulation has been extensively studied, but the association of cannabis use with weight in the general population is not known. The authors used data from 2 representative epidemiologic studies of US adults aged 18 years or older, the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC; 2001–2002) and the National Comorbidity Survey–Replication (NCS-R; 2001–2003), to estimate the prevalence of obesity as a function of cannabis use. The adjusted prevalences of obesity in the NESARC and the NCS-R were 22.0% and 25.3%, respectively, among participants reporting no use of cannabis in the past 12 months and 14.3% and 17.2%, respectively, among participants reporting the use of cannabis at least 3 days per week. These differences were not accounted for by tobacco smoking status. Additionally, after adjustment for sex and age, the use of cannabis was associated with body mass index differences in both samples. The authors conclude that the prevalence of obesity is lower in cannabis users than in nonusers.

appetite; body mass index; body weight; cannabis; obesity

Abbreviations: BMI, body mass index; NCS-R, National Comorbidity Survey–Replication; NESARC, National Epidemiologic Survey on Alcohol and Related Conditions.

In 2007–2008, the prevalence of obesity was 33.9% among adults in the United States (1), contributing to 13% of total US mortality (2). Clinical guidelines for obesity treatment recommend lifestyle approaches, including the promotion of physical activity and a healthy diet (3). Pharmacologic treatment may be appropriate to facilitate weight loss in patients with a body mass index (BMI; weight (kg)/height $(m)^2$) greater than 30 or patients with a BMI greater than 27 in the presence of coexisting conditions. Seven drugs are currently approved for the treatment of obesity in the United States. Their mechanisms of action are based on elevating monoamine levels or lipase inhibition in the gastrointestinal tract.

The role of cannabis and endocannabinoids in appetite regulation has been extensively studied in the past 10 years (4). Rimonabant, a selective antagonist/inverse agonist of the cannabinoid CB1 receptor, was approved in more than 30 countries for the treatment of obesity in 2006 but was withdrawn several years later because of safety concerns. Thereafter, the commercial development of other cannabinoid CB1 receptor antagonists was stopped (5, 6). Based on the fact that cannabis use increases appetite, clinical trials have suggested that cannabis derivatives may be a useful treatment for anorexia and weight loss associated with human immunodeficiency virus infection (7, 8).

Tobacco use and smoking cessation have been associated with weight loss (9) and weight gain (10), respectively. Although some investigators have examined the relation between cannabis use and obesity in small samples, no large-scale study has evaluated the association of cannabis use with weight in the general adult population. Therefore, we estimated the prevalence of obesity as a function of cannabis use in 2 representative national epidemiologic studies: the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC) (11) and the National Comorbidity Survey–Replication (NCS-R) (12). We hypothesized that the prevalence of obesity would be higher in cannabis users than in nonusers.

MATERIALS AND METHODS

Data sources

We analyzed cross-sectional data on 2 population-based nationally representative samples, the NESARC participants (11) and the NCS-R participants (12). These studies have been described extensively in previous reports (11–14). Both studies involved face-to-face surveys of US residents aged 18 years or older from the civilian, noninstitutionalized population.

The NESARC was a survey of 43,093 respondents (response rate = 81%) conducted by the National Institute on Alcohol Abuse and Alcoholism from 2001 to 2002. The NCS-R was an independent survey of 9,282 respondents (response rate = 73.0%) conducted by the National Institute of Mental Health (Collaborative Psychiatric Epidemiology Surveys) from 2001 to 2003.

Measures

Current cannabis use. In the NESARC, the frequency of cannabis use in the preceding 12 months among users was assessed with the question, ''During the last 12 months, about how often did you use marijuana?'' There were 7 possible answers: 1) every day; 2) 5–6 days per week; 3) 3–4 days per week; 4) 1–2 days per week; 5) 2–3 days per month; 6) once a month or less; and 7) no use in the past 12 months.

In the NCS-R, the frequency of cannabis use in the preceding 12 months among users was assessed with the question, ''On average, how often in the past 12 months have you used marijuana or hashish?'' There were 9 possible answers: 1) daily; 2) almost daily (3–6 times per week); 3) 1–2 days per week; 4) several times per month (25–51 days per year); 5) 1–2 times per month (12–24 days per year); 6) every other month or so (6–11 days per year); 7) 3–5 days in the past 12 months; 8) 1–2 days in the past 12 months; and 9) no use in the past 12 months.

On the basis of responses to these 2 similar questions, respondents were grouped into 4 categories of cannabis use to increase consistency across the 2 studies: 1) no use in the last 12 months; 2) at least once a year but less than once a month; 3) from once a month or more to twice per week; and 4) from 3 days per week to every day.

BMI and obesity. Data on self-reported height and weight were available from 41,654 respondents in the NESARC and from 9,106 respondents in the NCS-R. BMI was calculated by dividing weight in kilograms by the square of height in meters. Participants were considered obese if their BMI was 30.0 or greater ($n = 9{,}879$ in the NESARC; $n = 2{,}283$ in the NCS-R). We used BMI as a continuous outcome for the linear regression analysis examining the relation between frequency of cannabis use and BMI. For all other analyses, we considered obesity as a categorical outcome ($\geq$30 vs. $<$30).

Tobacco smoking. For both study samples, cigarette smoking in the past 12 months was coded into 3 categories: 1) current smoker, defined as someone who currently smoked cigarettes daily or occasionally; 2) ex-smoker, defined as a tobacco nonuser who previously was a daily or occasional smoker; and 3) never smoker, defined as a nonuser who had never used any tobacco.

Other measures. We also considered sociodemographic characteristics, including age, race/ethnicity, educational level, and marital status, as well as the use of other drugs in the past 12 months.

In both the NESARC and the NCS-R, age at interview was categorized into 4 groups: 18–29, 30–44, 45–64, and $\geq$65 years. Marital status was classified as married/common-law married; widowed, divorced, or separated; or never married. Educational level was classified as less than high school, high school graduate, or some college or higher. Region of residence was classified as Northeast, Midwest, South, or West.

Coding of race/ethnicity differed between the 2 samples. In the NESARC, race/ethnicity was categorized as white, black, Asian/Native Hawaiian/Pacific Islander, Hispanic/Latino, or American Indian/Alaska Native. In the NCS-R, race/ethnicity was categorized as white, black, Asian, Hispanic/Latino, or other (including American Indian/Pacific Islander).

In the NESARC, participants were asked whether they had used sedatives, tranquilizers, opiates, heroin, amphetamine, cocaine/crack, hallucinogens, or an inhaler in the past 12 months. In the NCS-R, participants were asked whether they had used cocaine/crack or any other drug in the past 12 months. In both samples, drug use in the past 12 months was categorized as either no use of other drugs (except tobacco and alcohol) or use of other drugs.

Statistical analyses

We first conducted univariate descriptive analyses for the cohorts' characteristics across the 4 groups defined according to the frequency of cannabis use in the past year (no use in the last 12 months, at least once a year but less than once a month, at least once a month to twice per week, and 3 days per week to every day). We used the Cochran-Mantel-Haenszel χ^2 statistic to examine the statistical significance of differences observed with categorical dependent variables. The threshold for statistical significance was $P < 0.05$. This analysis was repeated including only the participants who had never smoked tobacco.

We then fitted a logistic regression model with obesity as a categorical outcome and the frequency of cannabis use in the past year as the primary association of interest. We adjusted for sex and age in our first model and for sex, age, race/ethnicity, educational level, marital status, region of residence, and smoking status in our second model. These covariates were chosen because they were associated with the dependent variable in the bivariate analysis. Goodness of fit was determined by means of the Hosmer-Lemeshow statistic. We fitted a linear regression model with BMI as the outcome; use of cannabis, as well as frequency of cannabis use in the past year, was the primary association of interest, adjusting for sex and age.

For all analyses, data were weighted to reflect national population estimates. Results were analyzed using SUDAAN software, version 10.01 (Research Triangle Institute, Research Triangle Park, North Carolina), to adjust for the complex sampling design.

Table 1. Characteristics (%) of Participants From the National Epidemiologic Survey on Alcohol and Related Conditions ($n = 41,633$), 2001–2002[a,b]

	No. of Persons	Frequency of Cannabis Use			
		No Use in the Past 12 Months	More Than Once a Year, Less Than Once a Month	Once a Month to 2 Days Per Week	3 Days Per Week to Every Day
Sex					
Male	18,149	94.3 (0.2)[c]	2.0 (0.1)	1.9 (0.1)	1.8 (0.1)
Female	23,484	97.3 (0.1)	1.2 (0.1)	0.8 (0.1)	0.7 (0.1)
Race/ethnicity					
White	23,701	95.8 (0.2)	1.7 (0.1)	1.3 (0.1)	1.1 (0.1)
Black	7,901	95.2 (0.4)	1.5 (0.2)	1.6 (0.2)	1.8 (0.2)
American Indian/Alaska Native	679	92.8 (0.5)	1.4 (0.5)	2.2 (0.6)	3.6 (1.0)
Asian/native Hawaiian/Pacific Islander	1,282	96.8 (0.5)	1.4 (0.4)	1.0 (0.3)	0.8 (0.3)
Hispanic	8,070	96.6 (0.3)	1.0 (0.1)	1.4 (0.2)	1.0 (0.1)
Age, years					
18–29	8,405	89.3 (0.5)	4.0 (0.3)	3.3 (0.2)	3.4 (0.3)
30–44	12,928	95.7 (0.2)	1.7 (0.1)	1.4 (0.1)	1.1 (0.1)
45–64	12,355	98.4 (0.1)	0.5 (0.1)	0.6 (0.1)	0.5 (0.1)
≥65	7,945	99.9 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Educational level					
Less than high school	3,192	99.1 (0.2)	0.4 (0.2)	0.4 (0.1)	0.2 (0.1)
High school graduate	16,479	95.2 (0.2)	1.4 (0.1)	1.5 (0.1)	1.9 (0.2)
Some college or higher	21,962	95.9 (0.2)	1.8 (0.1)	1.4 (0.1)	0.9 (0.1)
Marital status					
Married/common-law married	21,431	97.8 (0.1)	0.8 (0.1)	0.6 (0.1)	0.7 (0.1)
Widowed, divorced, or separated	10,764	96.6 (0.3)	1.3 (0.2)	1.3 (0.2)	0.8 (0.1)
Never married	9,468	89.2 (0.4)	4.0 (0.3)	3.5 (0.2)	3.2 (0.2)
Region of residence					
Northeast	7,901	95.6 (0.3)	1.5 (0.2)	1.5 (0.2)	1.3 (0.1)
Midwest	8,697	95.8 (0.3)	1.7 (0.2)	1.5 (0.1)	1.0 (0.1)
South	15,579	97.0 (0.2)	1.1 (0.1)	0.9 (0.1)	1.0 (0.1)
West	9,456	94.3 (0.5)	2.0 (0.2)	1.9 (0.2)	1.8 (0.3)
Tobacco use					
Current user of tobacco	10,873	90.1 (0.4)	3.2 (0.2)	3.4 (0.2)	3.4 (0.3)
Ex-user of tobacco	7,874	98.3 (0.2)	0.6 (0.1)	0.6 (0.1)	0.4 (0.1)
Lifetime nonsmoker	22,886	98.1 (0.1)	1.0 (0.1)	0.5 (0.1)	0.3 (0.0)

[a] All analyses were weighted to reflect national population estimates. Sample sizes are unweighted values; percentages are weighted values. Percentages may not total 100 because of rounding.

[b] χ^2 statistics were used to compare respondent characteristics among the 4 subgroups defined by cannabis use ($P < 0.001$ for all comparisons).

[c] Numbers in parentheses, standard error.

RESULTS

Of the 50,736 eligible respondents (41,633 in the NESARC; 9,103 in the NCS-R), 4.0% of the participants in the NESARC and 7.3% of the participants in the NCS-R reported having used cannabis at least once in the past 12 months (see Table 1 and Web Table 1 (http://aje.oxfordjournals.org/)). The prevalence of obesity was significantly lower in cannabis users than in nonusers (16.1% vs. 22.0% in the NESARC ($P < 0.001$) and 17.2% vs. 25.3% in the NCS-R ($P < 0.001$)).

The proportion of obese participants decreased with the frequency of cannabis use (Cochran-Mantel-Haenszel χ^2 test: $P < 0.001$ in both samples). The prevalence of obesity in NESARC participants who reported no cannabis use in the past 12 months was 22.0%, but it was only 14.3% in participants who used cannabis "3 days per week or more" (percentages are weighted and adjusted for the survey design). Similarly, the prevalence of obesity in NCS-R participants who reported no cannabis use in the past 12 months was 25.3%, but it was only 17.2% in participants who used cannabis "3 days per week or more." In both samples, the odds

Table 2. Association Between Cannabis Use and Obesity in Multivariate Analyses in Samples of Participants From the National Epidemiologic Survey on Alcohol and Related Conditions (2001–2002) and the National Comorbidity Survey–Replication (2001–2003)[a]

Frequency of Cannabis Use	National Epidemiologic Survey on Alcohol and Related Conditions (n = 41,633)						National Comorbidity Survey–Replication (n = 9,103)					
	Crude OR	95% CI	Adjusted OR_1[b]	95% CI	Adjusted OR_2[c]	95% CI	Crude OR	95% CI	Adjusted OR_1[b]	95% CI	Adjusted OR_2[c]	95% CI
No use in the past 12 months	1	Reference	1	Reference	1	Reference	1	Reference	1	Reference	1	Reference
More than once a year, less than once a month	0.71	0.54, 0.92	0.76	0.58, 0.98	0.82	0.63, 1.05	0.56	0.36, 0.86	0.61	0.38, 0.96	0.70	0.44, 1.11
Once a month to 2 days per week	0.73	0.57, 0.93	0.77	0.60, 0.98	0.79	0.62, 1.01	0.69	0.44, 1.07	0.75	0.49, 1.14	0.84	0.54, 1.31
3 days per week to every day	0.59	0.44, 0.79	0.63	0.47, 0.84	0.61	0.46, 0.82	0.61	0.38, 0.99	0.67	0.40, 1.10	0.73	0.43, 1.23

Abbreviations: CI, confidence interval; OR, odds ratio.
[a] All analyses were weighted to reflect national population estimates.
[b] Adjusted for sex and age.
[c] Adjusted for sex, age, race/ethnicity, educational level, marital status, region, and tobacco smoking status.

ratio for obesity was significantly lower for all groups of cannabis users than for persons who had not used cannabis in the last 12 months, except for the subgroup of NCS-R participants who used cannabis "once a month to 2 days per week" (Table 2).

When a regression analysis was used to control for the confounding effects of age and sex, the odds ratio for obesity in the NESARC sample was significantly lower for all groups of cannabis users than for participants who had not smoked cannabis in the last 12 months (Table 2). The same regression analysis in the NCS-R sample showed that when controlling for the confounding effects of sex and age, the odds ratio for obesity was significantly lower in the group of participants using cannabis "more than once a year but less than once a month" than in those who had not used cannabis in the last 12 months.

Given that tobacco smoking affects weight, we conducted supplementary analysis taking into account this effect. These analyses did not affect the significance of the results (see Web Appendix). We also took pregnancy into account, without any effect on the results (Web Appendix).

DISCUSSION

This cross-sectional analysis indicated that despite the evidence that cannabis use stimulates appetite in clinical trials and laboratory studies, cannabis users are actually less likely to be obese than nonusers in the general population.

Numerous cross-sectional and prospective studies have examined the association between BMI or obesity and the use of several substances of abuse, including alcohol (15–18), tobacco (10, 19, 20), and illegal substances (21–24). The only clear (and negative) relation between the frequency of use of a substance and body weight that has emerged so far has been for tobacco.

Three studies have specifically examined the relation between cannabis use and obesity (25–27). A study of 297 females suggested that the rate of cannabis use in the last 12 months is lower in obese subjects than in subjects with a lower BMI (25). A second study showed that frequent use of cannabis was associated with obesity in girls in a nationally representative sample of 7,885 adolescents (26). A third study showed that use of cannabis is associated with a higher caloric intake but is not associated with a higher BMI (27).

Our results should be interpreted in the context of several limitations. Firstly, information on cannabis use, height, and weight was based on self-reports and was not confirmed by direct measurement. Self-reports tend to underestimate BMI (28, 29) but are unlikely to influence conclusions about associations, since they are unlikely to be related to cannabis use. Furthermore, the adjustments made for sociodemographic characteristics in our study further decreased the risk of misclassification (29, 30). Secondly, physical activity and diet are 2 major risk factors for obesity but were not taken into account in this study. Despite these limitations, this analysis showed that even if cannabis consumption increases appetite, people using cannabis are less likely to be obese than people who do not use cannabis.

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Both authors had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

A patent application entitled "Use of Marihuana and Compounds Therein for Treating Obesity" has been filed in Canada by Dr. Bernard Le Foll.

Conflict of interest: none declared.

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