Letters

RESEARCH LETTER

Trends in Marijuana Use Among Pregnant and Nonpregnant Reproductive-Aged Women, 2002-2014

Between 2001 and 2013, marijuana use among US adults more than doubled, many states legalized marijuana use, and attitudes toward marijuana became more permissive.[1] In aggregated 2007-2012 data, 3.9% of pregnant women and 7.6% of nonpregnant reproductive-aged women reported past-month marijuana use.[2] Although the evidence is mixed, human and animal studies suggest that prenatal marijuana exposure may be associated with poor offspring outcomes (eg, low birth weight, impaired neurodevelopment).[3] The American College of Obstetricians and Gynecologists recommends that pregnant women and women contemplating pregnancy be screened for and discouraged from using marijuana and other substances.[4] Whether marijuana use has changed over time among pregnant and nonpregnant reproductive-aged women is unknown.

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Methods | The Columbia University Medical Center institutional review board waived review of this study. Informed oral consent was obtained from each participant. Data from women aged 18 through 44 years from the annual National Survey on Drug Use and Health (NSDUH) from 2002 through 2014 were analyzed. The surveys used in-person audio computer-assisted self-interviews (ACASI) about substance use and other behaviors in nationally representative samples of the noninstitutionalized US population; average response rates since 2002 were 75%.[5] Among participants reporting lifetime use of marijuana or hashish, recency of use was assessed with the question: "How long has it been since you last used marijuana or hashish?" Responses included "within the past 30 days," "more than 30 days ago but within the past 12 months," and "more than 12 months ago."[5] Among pregnant and nonpregnant women, log-Poisson regression (SUDAAN [RTI International], version 11.0.1) was used to estimate and test trends in the adjusted prevalences of past-month and past-year marijuana use over time, controlling for complex survey design, age, race/ethnicity, family income, and education. Differences in trends over time were examined by pregnancy status and age (18-25 years and 26-44 years). Results were considered statistically significant at a *P* value of less than .05 (2-sided).

Results | Of the 200 510 women analyzed, 29.5% were aged 18 through 25 years and 70.5% were aged 26 through 44 years; 61.0% were white, 13.7% black, 17.2% Hispanic, and 8.1% other race/ethnicity; 59.2% had some college education; 55.9% had annual family incomes less than $50 000; and 5.3% (n = 10 587) were pregnant.

Among all pregnant women, the adjusted prevalence of past-month marijuana use increased from 2.37% (95% CI, 1.85%-3.04%) in 2002 to 3.85% (95% CI, 2.87%-5.18%) in 2014 (prevalence ratio [PR], 1.62 [95% CI, 1.09-2.43]) (**Table**). The adjusted prevalence of past-month marijuana use was

Table. Trends in Prevalence of Marijuana Use in Pregnant and Nonpregnant Women, 2002-2014[a]

Marijuana Use Among Women	Adjusted Prevalence, No. (%) [95% CI][b] 2002 (n = 15 284)[c]	2014 (n = 15 318)[d]	Prevalence Ratio (95% CI)[e]	*P* Value for Difference in Prevalence Ratios[f]
Past month[g]				
Pregnant	40 (2.37) [1.85-3.04]	43 (3.85) [2.87-5.18]	1.62 (1.09-2.43)	.64
Nonpregnant	1531 (6.29) [6.02-6.57]	1673 (9.27) [8.90-9.65]	1.47 (1.38-1.58)	
Past year				
Pregnant	134 (8.64) [7.32-10.19]	115 (11.63) [9.78-13.82]	1.35 (1.05-1.72)	.73
Nonpregnant	2809 (12.37) [12.05-12.70]	2824 (15.93) [15.48-16.40]	1.29 (1.23-1.35)	

[a] Data were from the US National Survey on Drug Use and Health (NSDUH).

[b] Adjusted prevalence estimates are from the linear predicted prevalence model described in footnote *a* of the Figure.

[c] Sample sizes in 2002: pregnant women, n = 797; nonpregnant women, n = 14 487.

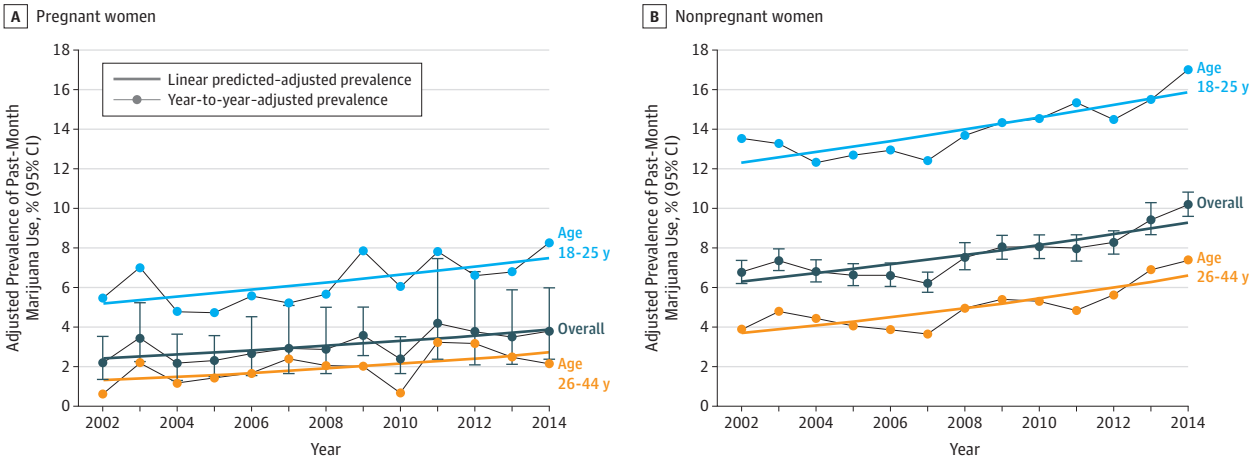
[d] Sample sizes in 2014: pregnant women, n = 735: nonpregnant women, n = 14 583.

[e] Prevalence ratios were the ratio of the adjusted prevalence estimates from 2014 divided by the adjusted prevalence estimates from 2002; ratios and 95% CIs were from log-Poisson regressions. CIs for prevalence ratios that did not include 1.00 within the lower and upper levels indicated statistically significant increasing trends in marijuana use.

[f] The test for difference in prevalence ratios was the *P* value of the pregnancy × year interaction in the log-Poisson regression. This test indicated whether the ratio of the prevalence ratios for pregnant vs nonpregnant women differed significantly from 1.00. Nonsignificant *P* values ($P \geq .05$) indicated insufficient evidence to conclude that the prevalence ratios differ.

[g] Past-month marijuana use was defined as responding "within the past 30 days" to the question, "How long has it been since you last used marijuana or hashish?" Past-year marijuana use was defined as responses of "within the past 30 days" or "more than 30 days ago but within the past 12 months" to the aforementioned question. Preprocessing of missing variables by predictive mean neighborhood imputation and recoding was done prior to public release of the NSDUH data sets.[5] Because the analyses used the imputed variables of NSDUH, there were no missing data.

Figure. Year-to-Year Prevalence[a] of Past-Month Marijuana Use[b] Among Pregnant and Nonpregnant Women, Overall and by Age, 2002-2014[c]



[a] Year-to-year–adjusted and linear predicted–adjusted prevalence estimates were from log-Poisson regressions. Models controlled for race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, and other non-Hispanic minorities), family income ($0-$19 999, $20 000-$49 999, $50 000-$74 999, ≥$75 000), age (18-25 years, 26-34 years, 35-44 years), education (<high school, high school, some college), year (year was categorical in the year-to-year model, and continuous in the linear predicted model), pregnancy status, pregnancy × year interaction, covariate × pregnancy interactions, and complex survey design. Error bars indicate 95% CIs and are only shown for overall year-to-year–adjusted prevalence estimates. Percentage of variability in dichotomous marijuana use explained by the model with year as a continuous variable was 6% (McFadden pseudo-R^2); the ratio of the pseudo-R^2 statistics for the models with year as a continuous vs categorical variable was 0.98, indicating strong evidence for a linear trend.

[b] Past-month marijuana use was defined as responding "within the past 30 days" to the question, "How long has it been since you last used marijuana or hashish?"

[c] Data were from the US National Survey on Drug Use and Health. Sample size across all years combined: pregnant women (n = 10 587), nonpregnant women (n = 189 923).

highest among those aged 18 to 25 years, reaching 7.47% (95% CI, 4.67%-11.93%) in 2014 (**Figure**), significantly higher (P = .02) than among those aged 26 to 44 years (2.12% [95% CI, 0.74%-6.09%]). However, increases over time did not differ by age (P = .76). Past-year use was higher overall, reaching 11.63% (95% CI, 9.78%-13.82%) in 2014, with similar trends over time.

In nonpregnant women, prevalences of past-month use (2014: 9.27% [95% CI, 8.90%-9.65%]) and past-year use (2014: 15.93% [95% CI, 15.48%-16.40%]) were higher overall, with similar trends over time. Increases over time in past-month marijuana use did not differ by pregnancy status (P = .64).

Discussion | Among pregnant women, the prevalence of past-month marijuana use increased 62% from 2002 through 2014. Prevalence was highest among women aged 18 to 25 years, indicating that young women are at greater risk for prenatal marijuana use. Study limitations are noted. Self-reported marijuana use may lead to underreporting due to social desirability and recall biases. However, use of ACASI helps reduce such biases,[5] and the increases over time observed in this study are consistent with increases over time in marijuana-related outcomes shown in other studies that did not rely on self-reports, supporting the validity of the findings.[6] Additionally, future studies should address dose, frequency of use, and clinical outcomes.

These results offer an important step toward understanding trends in marijuana use among women of reproductive age. Although the prevalence of past-month use among pregnant women (3.85%) is not high, the increases over time and potential adverse consequences of prenatal marijuana exposure[3] suggest further monitoring and research are warranted. To ensure optimal maternal and child health, practitioners should screen and counsel pregnant women and women contemplating pregnancy about prenatal marijuana use.

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Drafting of the manuscript: Brown, Martins, Hasin.
Critical revision of the manuscript for important intellectual content: All authors.
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Administrative, technical, or material support: Brown, Hasin.

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Use of Marijuana for Medical Purposes Among Adults in the United States

By 2014, 23 states and the District of Columbia had legalized medical marijuana use, suggesting a need for information about national rates of marijuana use for medical purposes.[1]

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Although 17% of past-year marijuana users reported use for medical purposes in states with medical marijuana legalization,[2] physicians might recommend medical marijuana use to patients regardless of their residing states.[3] Therefore, we examined differences between medical and nonmedical marijuana users across all US states.

Methods | Data were from adults 18 years and older who participated in the 2013-2014 National Survey on Drug Use and Health (NSDUH), providing representative data on marijuana and other substance use among the US civilian, noninstitutionalized population.[4] NSDUH data collection was approved by the institutional review board at RTI International. Verbal informed consent was received from each study participant. Data were collected by interviewers in personal visits, using audio computer-assisted self-administered interviews. The annual mean response rate for the 2013-2014 NSDUH was 59.3%.

In addition to sociodemographic and mental and physical health characteristics, NSDUH collected data on substance use and use disorders, age of onset for each specific substance used, perceived risk of harm from marijuana use, perceived legalization of medical marijuana use in residing state, and perceived marijuana availability. To classify medical marijuana use, those reporting past-year marijuana use were asked if any marijuana use was recommended by health care professionals and, if yes, whether all marijuana use was recommended.

We estimated the 12-month prevalence of medical marijuana use only, nonmedical marijuana use only, and combined medical and nonmedical use (combined use; 2-sided *t* test with a significance level of .05). We used multinomial logistic regressions to examine characteristics distinguishing the 3 groups. Our analyses used SUDAAN software (RTI International), version 11.0.1, to account for the complex sample design and sampling weights of NSDUH data.

Results | Based on 96 100 respondents, 12.9% (95% CI, 12.6%-13.2%) of US adults had past-year marijuana use (nonmedical use only, 11.6% [95% CI, 11.3%-11.8%], medical use only, 0.8% [95% CI, 0.7%-0.9%], combined use, 0.5% [95% CI, 0.4%-0.5%]). Among past-year adult marijuana users, 90.2% (95% CI, 89.5%-91.0%) used nonmedically only, 6.2% (95% CI, 5.6%-6.9%) used medically only, and 3.6% (95% CI, 3.1%-4.0%) used medically and nonmedically. Of medical marijuana users, 78.8% (95% CI, 75.7%-81.9%) resided in states where medical marijuana was legal, and 21.2% (95% CI, 18.1%-24.3%) resided in other states.

Prevalence patterns among adults were similar across medical use only, nonmedical use only, and combined user groups with few exceptions (eTable in Supplement): compared with the West region, medical use only and combined use was less common in other regions, and nonmedical use only was more common in the Northeast. Medical use only was more common among those reporting fair or poor health than better health and among those with stroke; the opposite was found for nonmedical use only. Compared with full-time employed adults, nonmedical use only was less common and medical use only was more common among disabled adults.

Compared with nonmedical use only, medical use only was directly associated with older age, older marijuana initiation age, disability, Medicaid status, stroke diagnosis, poor self-rated health, anxiety disorder, daily or near daily marijuana use, residing in a medical marijuana legalization state, and perceived state legalization of medical marijuana, but was inversely associated with heavy alcohol use and nonmedical use of prescription stimulants and analgesics (**Table**).

Discussion | Using nationally representative data, 9.8% of adult marijuana users in the United States reported use for medical purposes. Although the prevalence of medical use was higher in states that had legalized medical marijuana, 21.2% of medical marijuana users resided in states that had not, suggesting physicians might recommend medical marijuana use regardless of legalization.[3]

Similarities in correlates of medical and nonmedical users, especially co-occurrence with psychiatric conditions and other substance use, suggest that some marijuana users may access medical marijuana without medical need.[5] However, medical-only marijuana users differed from nonmedical-only users in ways that are consistent with use to address medical problems.[6] Limitations of this study include lower response rates compared with prior years, which increases the

Table. Comparison of Characteristics of Adults With 12-Month Medical Marijuana Use Only vs Those With Nonmedical Marijuana Use Only and vs Those With Medical and Nonmedical Marijuana Use[a]

Characteristics	Medical Use Only vs Nonmedical Use Only, AOR (95% CI)[b]	Medical Use Only vs Medical and Nonmedical Use, AOR (95% CI)[b]
Age, y		
18-29	0.6 (0.41-0.92)[c]	0.6 (0.36-1.15)
30-49	1.2 (0.80-1.70)	0.9 (0.50-1.55)
≥50	1 [Reference]	1 [Reference]
Employment status		
Full-time	1 [Reference]	1 [Reference]
Part-time	1.2 (0.81-1.64)	1.3 (0.81-2.09)
Disabled for work	3.1 (1.96-4.81)[c]	2.5 (1.31-4.88)[c]
Unemployed	0.9 (0.61-1.35)	1.1 (0.65-1.94)
Health insurance		
Private only	1 [Reference]	1 [Reference]
No insurance coverage	1.4 (1.02-1.99)[c]	1.0 (0.66-1.60)
Medicaid	1.5 (1.05-2.19)[c]	1.1 (0.66-1.80)
Other	1.5 (0.98-2.41)	1.0 (0.56-1.79)
Metropolitan statistical area		
Large	1.5 (1.04-2.16)[c]	1.6 (1.00-2.61)
Small	1.4 (0.98-2.13)	1.5 (0.94-2.51)
Nonmetropolitan	1 [Reference]	1 [Reference]
Region		
Northeast	0.2 (0.14-0.29)[c]	0.4 (0.25-0.73)[c]
Midwest	0.4 (0.27-0.52)[c]	0.7 (0.46-1.15)
South	0.3 (0.14-0.42)[c]	0.4 (0.20-0.76)[c]
West	1 [Reference]	1 [Reference]
Self-rated health		
Excellent	0.5 (0.32-0.74)[c]	1.3 (0.72-2.46)
Very good	0.3 (0.23-0.50)[c]	0.9 (0.53-1.50)
Good	0.6 (0.44-0.90)[c]	1.0 (0.63-1.68)
Fair or poor	1 [Reference]	1 [Reference]
Stroke	2.8 (1.16-6.94)[c]	0.6 (0.19-2.00)
Diagnosed anxiety disorder	2.1 (1.50-3.01)[c]	1.1 (0.66-1.71)
Heavy alcohol use	0.6 (0.40-0.78)[c]	0.7 (0.44-1.03)
Nonmedical use of prescription pain relievers	0.7 (0.46-0.98)[c]	0.8 (0.47-1.36)
Nonmedical use of prescription stimulants	0.5 (0.23-0.85)[c]	0.8 (0.36-1.54)
Daily/near daily marijuana use	3.5 (2.75-4.52)[c]	1.8 (1.27-2.47)
Age of first marijuana use		
<18	1.1 (0.81-1.46)	1.0 (0.64-1.43)
18-29	1 [Reference]	1 [Reference]
≥30	2.5 (1.15-5.55)[c]	3.0 (0.96-9.38)
Residing in a state that legalized medical marijuana	1.8 (1.21-2.80)[c]	1.1 (0.63-2.03)
Perceived state legalization of medical marijuana use		
Yes	3.0 (2.08-4.36)[c]	2.1 (1.27-3.43)[c]
Not sure/unknown	1.0 (0.42-2.60)	1.7 (0.54-5.45)
No	1 [Reference]	1 [Reference]
Perceived risk of smoking marijuana 1-2 times/wk		
Slight	0.6 (0.45-0.76)[c]	0.9 (0.61-1.27)
Moderate	0.4 (0.21-0.58)[c]	0.8 (0.39-1.53)
Great	0.7 (0.26-1.95)	1.4 (0.32-5.88)
No	1 [Reference]	1 [Reference]

Abbreviation: AOR, adjusted odds ratio.

[a] Data were obtained from the 2013-2014 National Survey on Drug Use and Health (NSDUH). This analysis used SUDAAN software to account for the complex sample design and sampling weights of NSDUH data. The Substance Abuse and Mental Health Services Administration requires that any description of overall sample sizes based on the restricted-use data files has to be rounded to the nearest 100 to minimize potential disclosure risk. In addition to the variables shown, the multivariable model also controlled for survey year, sex, race/ethnicity, education, number of past-year emergency department visit, heart disease, hypertension, diabetes, asthma, hepatitis, HIV/AIDS, past-year major depressive episode, suicidal ideation, tobacco use, cocaine use, hallucinogen use, heroin use, inhalant use, nonmedical use of prescription sedatives, marijuana use disorders, nonmarijuana illicit drug use disorders, and perceived marijuana availability, which did not significantly distinguish the 3 examined groups. Multicollinearity (using variance inflation factors) and potential interaction effects between examined factors were assessed and were not identified in the final multivariable model.

[b] The sample size for medical use only vs nonmedical use only was 18 200. The sample size for medical use only vs medical and nonmedical use was 1300.

[c] Value was a significant difference ($P < .05$) from the corresponding reference group.

potential for nonresponse bias, and limited questions about medical marijuana use.

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Author Contributions: Dr Han had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Concept and design: Compton, Han, Hughes, Jones.
Acquisition, analysis, or interpretation of data: All authors.
Drafting of the manuscript: Compton, Han.
Critical revision of the manuscript for important intellectual content: All authors.
Statistical analysis: Han, Hughes, Jones.
Administrative, technical, or material support: Han.
Supervision: Han.

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Disclaimer: The findings and conclusions of this study are those of the authors and do not necessarily reflect the views of the National Institute on Drug Abuse of the National Institutes of Health, the Substance Abuse and Mental Health Services Administration, or the US Department of Health and Human Services.

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COMMENT & RESPONSE

Alternatives in the Evaluation of Suspected Coronary Heart Disease

To the Editor The study by Dr Greenwood and colleagues[1] supports cardiovascular magnetic resonance (CMR) as an alternative for the investigation of suspected stable coronary heart disease (CHD), concluding that CMR led to a lower probability of unnecessary invasive angiography compared with the National Institute for Health and Care Excellence (NICE) guidelines, with no effect on major adverse cardiovascular events (MACE).

However, the lower rate of unnecessary invasive angiography was driven by the inadequate pretest probability score used in the NICE guidelines. Both the Duke and Diamond-Forester scores used in the NICE guidelines are known to overestimate the prevalence of obstructive CHD.[2] The effect of newer, better-calibrated scores such as the Coronary Artery Disease Consortium scores[3] may lead to an increase in the proportion of individuals with a low pretest probability that would not require further testing. Moreover, the proportion of individuals with a greater than 70% pretest probability would be reduced, leading to a reduction in the rate of invasive angiography. Therefore, an estimate of the pretest probability of patients in the trial according to the Coronary Artery Disease Consortium scores and the reduction in angiography would be of particular interest.

Regarding the conclusion of no significant difference in the rates of MACE across groups, the authors did not specify the power required to detect differences in the secondary outcomes. The adjusted hazard ratio for MACE was 1.37 (95% CI, 0.52-3.57; P = .52) in the CMR group vs the NICE guideline group, which, although not statistically significant, would be of clinical significance if corroborated by adequately powered studies. This 30% relative difference in event rates between groups is comparable with the difference between placebo and statins in primary prevention trials, for example.[4] By presenting those results as not statistically significant, the authors failed to acknowledge that this result may be caused by a type I error, with insufficient power to detect a clinically meaningful difference in events.

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To the Editor In the Clinical Evaluation of Magnetic Resonance Imaging in Coronary Heart Disease 2 (CE-MARC 2) trial, Dr Greenwood and colleagues[1] addressed the question of whether CMR can reduce the number of unnecessary invasive coronary angiographies in patients with suspected CHD compared with a myocardial perfusion scintigraphy (MPS)-guided approach and with the NICE guidelines, which also integrate cardiac computed tomography in the evaluation of lower-risk patients. However, I was concerned that per protocol, inconclusive and negative noninvasive imaging test results (which should not be followed by invasive angiography) could