

Association between use of marijuana and time to pregnancy in men and women: findings from the National Survey of Family Growth

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Objective: To determine if regular use of marijuana has an impact on time to pregnancy.

Design: Retrospective review of cross-sectional survey data from male and female respondents aged 15–44 years who participated in the 2002, 2006–2010, and 2011–2015 National Survey of Family Growth.

Setting: Not applicable.

Participant(s): The National Survey of Family Growth is a nationally representative population-based sample derived from stratified multistage area probability sampling of 121 geographic areas in the U.S. Our analytic sample was participants who were actively trying to conceive.

Intervention(s): Exposure status was based on the respondents' answers regarding their marijuana use in the preceding 12 months.

Main Outcome Measure(s): The main outcome was estimated time to pregnancy, which was hypothesized before analysis to be delayed by regular marijuana use.

Result(s): A total of 758 male and 1,076 female participants responded that they were actively trying to conceive. Overall, 16.5% of men reported using any marijuana while attempting to conceive, versus 11.5% of women. The time ratio to pregnancy for never smokers versus daily users of marijuana in men was 1.08 (95% confidence interval 0.79–1.47) and in women 0.92 (0.43–1.95), demonstrating no statistically significant impact of marijuana use on time to pregnancy.

Conclusion(s): Our study suggests that neither marijuana use nor frequency of marijuana use was associated with time to pregnancy for men and women. (Fertil Steril® 2018; ■: ■–■. ©2018 by American Society for Reproductive Medicine.)

Key Words: Fertility, infertility, marijuana

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About 15% of couples are unable to conceive after 1 year of trying and are labeled infertile (1, 2). Although many lifestyle factors including alcohol use, psychosocial stress, Western dietary preference, higher body mass index (BMI) and waist circumference, and smoking have all been associated with delayed pregnancy, marijuana use has been relatively understudied (3–7).

Marijuana is the most commonly used recreational drug in the United States today, with an estimated 22.2 million people using it within the preceding month and 117 million lifetime users (8–10). It is also the fastest growing recreational drug, with an increase in uptake of 4% from 2002 to 2015. Interestingly, there is a widening gender gap in the use of marijuana, with an increasingly higher prevalence

among men than women (8). Twenty-six states and the District of Columbia currently have laws that have broadened legalization of medical marijuana and seven states and the District of Columbia have laws permitting recreational use (11).

To date, there are limited data regarding the impact of marijuana use on fertility. Plowden et al. performed a small secondary analysis of a randomized controlled trial that had a total of 1,228 enrolled subjects, examining time-to-pregnancy (TTP) effect of alcohol, tobacco, and marijuana and finding that marijuana use in the preceding year led to delayed TTP (12). Wesselink et al., in an internet-based

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prospective study, found that in a study of 510 couples, women who smoked marijuana at least once a week had reduced fecundability whereas men who smoked marijuana at least once a week had increased fecundability (13). Gundersen et al. studied a cohort of Danish men and reported reduced sperm concentration and total sperm count in weekly users of marijuana (14). Mueller et al. in 1990 found that women who used marijuana within the year preceding attempted pregnancy were twice as likely to have ovulatory infertility (15). Since 2002, the prevalence of pregnant women using marijuana has increased 62%, with the highest percentage of women using marijuana during pregnancy being 18–25 years of age (16, 17). Although the prenatal impact of marijuana ranges from fetal growth restriction to placental resistance to preterm birth, the clinical impact on the ability to conceive remains unknown (18, 19). Given increased legalization of both recreational and medical marijuana in the United States, the highest rates of marijuana use being among the reproductive ages, and limited knowledge regarding its effects on infertility, the present study sought to determine the association between marijuana use and TTP among men and women.

METHODS

Design and Study Population

The study population was composed of 758 male and 1,076 female respondents aged 15–44 years who participated in the 2002, 2006–2010, and 2011–2015 National Survey of Family Growth (NSFG; www.cdc.gov/nchs/nsfg) and were actively trying to become pregnant. The target population for this survey was all reproductive-age men and women in the United States; to obtain a nationally representative sample, the participants were derived via stratified multistage area probability sampling of 121 geographic areas in the United States. Selection was random, but sampling was done at higher rates for certain subgroups, such as Hispanic men and women, non-Hispanic black men and women, and teenagers (15–19 y). The overall response rate was 78% for men and 80% for women for 2002, 75% men and 78% women for 2006–2010, and 72% men and 73% women for 2011–2015. The NSFG survey was reviewed and approved by Research Ethics Review Board of the Centers for Disease Control and Prevention and National Center for Statistics and the University of Michigan.

Data Collection

Data for the NSFG were collected through questionnaires distributed to households across the United States by trained interviewers using computer-assisted interviewing techniques. Information was collected on sociodemographic characteristics, health history, sexual behaviors and attitudes, fatherhood, drug use, birth expectations, and characteristics of current and former partners or cohabiting partners. Only one individual per household was surveyed, and given the nature of the survey, information on motherhood was not collected from women who were currently trying to conceive.

For the current-duration approach, we used methods that have been previously described and applied to NSFG data (20–24). Briefly, two questions in the NSFG directly assessed the duration of the respondent's current pregnancy attempt. Women who were not using a method of contraception nor pregnant but were sexually active at the time of interview ($n = 1,078$ potentially eligible respondents) were asked, "Is the reason you are not using a method of birth control now because you, yourself, want to become pregnant as soon as possible?" Women who responded "Yes" were then asked, "How long have you been trying to become pregnant? (number of months or years)," which was used to determine their current duration of pregnancy attempt ("current duration") in months. Regardless of pregnancy intentions, women were not considered to be at risk for pregnancy if they had a live birth or stillbirth within the past 3 months, reported one or more months without intercourse in the past 3 months, or if their current partner had a vasectomy. Women were not included in the current-duration analysis if they were not at risk of pregnancy (i.e., using contraception, pregnant, or not sexually active) or were at risk but not currently trying to become pregnant. Similarly, men were asked if they were married, cohabiting, or in a sexually active relationship with at least one partner in the last year. Men who were with a female partner within the past year who was not known to be physically unable to have a child were asked about their partner's current pregnancy status. Men/couples considered to be "at risk for pregnancy" were sexually active in the past year, reported that they or their partner was not using contraception, and had a partner who was not currently pregnant. Similarly to women, men's current duration values were derived from two questions: "Are you and your wife/partner currently trying to get pregnant?" and if so, "How long have you been trying to become pregnant? (number of months or years)?" In survey years 2006–2015, men and women who reported that it was impossible for them or their partner to have a baby for reasons other than surgical sterilization were not included in the current-duration sample.

The current-duration approach was developed to improve the study of fecundity because it can be challenging to measure the length of pregnancy attempts, i.e., TTP. Retrospective and prospective TTP study designs can miss certain aspects that contribute to pregnancy (25). For example, some women never get pregnant and may be missed by retrospective studies among pregnant women, thereby biasing results. Furthermore, women who do not plan their pregnancies can be missed in prospective studies because women must join the studies before the start of their pregnancy attempt (26–29). The current-duration approach is a recent method that uses cross-sectional data to estimate fecundity and infertility rates. Unlike retrospective and prospective TTP studies, the current-duration approach uses cross-sectional design (used by many existing population-based surveys) and includes couples who do not plan their pregnancies and couples that will never get pregnant.

We censored attempts >36 months to control for measurement error in longer attempts. Recall for TTP has been shown to be acceptable for shorter periods, so we censored

to use only values that have acceptable validity (30). The methods used here require the distribution of TTP to be independent from calendar time. If there was a time trend in the distribution of TTP and a time trend in marijuana use it could bias results. We did, however, run sensitivity analysis that controlled for cycle, and it did not alter the results.

For the purpose of our study we then focused on the respondents' answers regarding marijuana use. The participants were asked about their habits regarding smoking marijuana in the past 12 months. They were able to answer either never, once or twice, several times, about once a month, or about once a week. Analysis of variance was used to compare continuous variables, and chi-square test was used for categorical variables. Variables included in the multivariable model were age, marital status, previous children, partner age (for men), previous fertility evaluation/treatment, year of survey, income (percentage of poverty level), race, and education.

Statistical Analysis

All analyses accounted for the complex survey design of the NSFG with the use of the weighting provided. We used a current-duration approach to examine the relationship between marijuana use and TTP. The current-duration approach refers to a statistical method of estimating the distribution of the (unobserved) total duration of pregnancy attempt (i.e., TTP) according to the (observed) current duration of pregnancy attempt at the time of the survey. Using the survey weighting, the average trying times were calculated. Because the current-duration sample evaluates only those at risk of pregnancy at the time of the cross-sectional survey, there is an inherent overrepresentation of couples who take longer to become pregnant (i.e., length-biased sampling). This issue is handled in the statistical methods used to implement this approach. The statistical methods require two assumptions: that the starts of pregnancy attempts are uniform over time, and that the distribution of TTP is independent over time. With the use of these assumptions and backward-recurrence time-survival methods, the current-duration data can be used to provide inference on the relationship between marijuana use and TTP. This approach has previously been described by Gasbarra and Scheike (25, 31).

Weighted accelerated-failure-time (AFT) gamma regression models were used to estimate time ratios to evaluate the impact of marijuana on TTP. The ratio of the median values of the total duration of pregnancy attempt was estimated by exponentiated coefficients of the AFT model across characteristics. As such, a ratio >1 indicates a longer estimated median TTP. The AFT model has been previously applied to current-duration data (28, 32, 33). To assess for interactions, a stratified analysis was performed for all covariables, and no meaningful changes were noted. The complex survey design was used to determine the weighted percentage of marijuana use among survey participants who reported they were trying to conceive. Tests for temporal trend were performed by treating year as a continuous variable in the regression model. In addition, year was treated as a categorical variable, with no significant differences identified. All tests were two sided, and a

P value of <.05 was considered to be statistically significant. All calculations were performed with the use of Stata 10 (Statacorp).

RESULTS

Our study population consisted of 758 men and 1,076 women who were actively trying to conceive. Within the study population, the demographics between men in women were similar regarding age, BMI, race, education, and income. More men than women had previous children (58% men and 49% women). Similar numbers of men and women in the study population were married (70% men and 68% women) and cohabiting (16% men and 18% women; Table 1).

Overall, 16.5% of men reported using marijuana while attempting to conceive, versus 11.5% of women (Table 2). More men reported use of marijuana at least monthly while trying to conceive: 8% versus 5% of women. Of note, 5% of men reported at least daily use of marijuana while trying to conceive, versus 3% of women. The use of marijuana while trying to conceive in men and women was stable over the past 10 years.

The average current durations of pregnancy attempt for those that never used marijuana was 13.7 months for men and 20.1 months for women. The average current duration of pregnancy attempt for daily users of marijuana was 12.2 months in men and 15.9 months in women (Table 3). After adjustment for age, marital status, previous children, partner age (for men), previous fertility evaluation/treatment, year of survey, income, race, and education, there was no significant association between marijuana use and TTP, as demonstrated by time ratios of 1.08 (95% confidence interval [CI] 0.79–1.47; *P*=.65) in men and 0.92 (0.43–1.95) in women for daily users of marijuana compared with never smokers. Similarly, there were no statistically significant differences in TTP for weekly and monthly marijuana users compared with never users in men and women. For nonusers versus any user, the time ratios were 0.96 (95% CI 0.76–1.20) for men and 1.03 (0.80–1.31) for women. We did not identify any significant interactions with respondent age, race/ethnicity, income, marital status, those seeking infertility care, or previous maternity/paternity.

DISCUSSION

With the use of nationally representative data, the present report found that 16.6% of men and 12.5% of women smoked marijuana in the preceding 12 months while attempting to conceive. Importantly, we found no association between the use of marijuana, or frequency of use, and TTP among men and women. We found little change in rates of use among pregnancy planners over the past decade. Despite the increasing trend of legalization both medically and recreationally across the United States, the use of marijuana while trying to conceive appears to have stayed relatively steady from 2002 to 2015.

To date, there are scant data on the clinical impact of regular marijuana use on fertility in both men and women. A study by Mueller et al. found a trend of increased ovulatory infertility and tubal infertility in women who used marijuana in the preceding year, but there was insufficient evidence in

TABLE 1

Demographics of male and female participants in the National Survey of Family Growth who were actively trying to conceive at the time of the survey, and comparison of never versus ever smokers of marijuana (weighted %).

Variable	All (n = 758)	Male		P value	All (n = 1,076)	Female		P value
		Never	Ever			Never	Ever	
Race								
Nonhispanic white	353 (56.5%)	56.2%	57.9%	< .01	538 (61.6%)	61.7%	60.9%	.31
Nonhispanic black	174 (16.6%)	14.4%	27.2%		194 (11.2%)	10.5%	16.6%	
Nonhispanic other	178 (18.8%)	19.7%	14.0%		82 (8.5%)	8.7%	7.3%	
Hispanic	53 (8.2%)	9.6%	0.9%		262 (18.7%)	19.2%	15.2%	
Education, y								
0–11	195 (30.9%)	14.9%	22.7%	.03	340 (39.1%)	41.3%	22.5%	< .01
12	205 (27.1%)	43.4%	53.5%		284 (25%)	24.5%	28.7%	
13–15	175 (20.7%)	30.1%	15.9%		247 (21%)	20.3%	26.2%	
≥ 16	183 (21.2%)	11.5%	7.9%		205 (14.9%)	13.9%	22.6%	
% of Federal Poverty Level								
≥ 300	363 (52.4%)	54.9%	40.1%	< .01	475 (51.1%)	52.9%	37.7%	.04
150–299	178 (23.5%)	23.9%	21.4%		264 (22.3%)	21.7%	26.9%	
< 150	217 (24.1%)	21.2%	38.5%		337 (26.6%)	25.4%	35.4%	
Fertility treatment								
Never	615 (78.4%)	76.4%	88.3%	< .01	847 (78.7%)	78.1%	83.5%	.51
Yes—currently	67 (9.7%)	11.2%	2.5%		99 (8.7%)	9.0%	6.7%	
Yes—not currently	76 (11.9%)	12.4%	9.2%		130 (12.5%)	12.9%	9.9%	
Children								
No	377 (48.7%)	49.6%	44.0%	.34	541 (49.9%)	52.8%	29.5%	< .01
Yes	381 (51.3%)	50.4%	56.0%		535 (50.1%)	47.2%	70.6%	
Marital status								
Married	533 (79%)	83.6%	55.3%	< .01	741 (72.1%)	74.8%	51.6%	< .01
Cohabiting	123 (13.8%)	10.6%	30.2%		193 (20%)	18.4%	32.1%	
Neither	102 (7.2%)	5.8%	14.5%		142 (7.9%)	6.8%	16.4%	
Age, y								
15–24	83 (10.9%)	9.0%	20.7%	.03	149 (13.8%)	11.3%	33.5%	< .01
25–29	170 (22.4%)	22.8%	20.5%		268 (24.9%)	25.7%	18.4%	
30–34	220 (29%)	28.9%	29.5%		269 (25%)	24.5%	28.9%	
35–39	187 (24.7%)	26.3%	16.8%		234 (21.8%)	23.5%	8.9%	
40–44	98 (13%)	13.1%	12.5%		156 (14.5%)	15.1%	10.2%	
Body mass index, kg/m ²								
< 19	5 (0.7%)	0.6%	0.0%	.18	33 (3.1%)	2.9%	4.4%	.58
18–25	183 (24.1%)	23.3%	33.1%		428 (39.8%)	40.7%	32.4%	
25–30	268 (35.4%)	37.7%	37.4%		270 (25.1%)	24.4%	31.2%	
30–35	179 (23.6%)	24.9%	22.2%		145 (13.5%)	13.6%	12.4%	
≥ 35	100 (13.2%)	13.5%	7.2%		199 (18.5%)	18.4%	19.6%	

Kasman. Marijuana and infertility. Fertil Steril 2018.

the groups to show statistical significance (15). Ness et al. found that in a cohort of women who suffered spontaneous abortions, there was no association with marijuana use (34).

TABLE 2

Weighted percentages of male and female participants in the survey reporting marijuana use while trying to conceive.

Marijuana use	2002	2006	2011	2013	Total
Male					
Never	86.8%	82.3%	80.9%	83.0%	83.5%
<1× per mo	7.8%	9.0%	8.8%	8.0%	8.4%
Monthly	0.4%	2.2%	2.3%	0.4%	1.3%
Weekly	2.3%	1.3%	0.3%	1.8%	1.5%
Daily	2.7%	5.3%	7.6%	6.8%	5.4%
Female					
Never	89.8%	84.9%	91.0%	88.0%	88.5%
<1× per mo	7.3%	8.3%	4.9%	5.4%	6.4%
Monthly	0.5%	1.7%	0.3%	1.1%	0.9%
Weekly	1.2%	2.0%	1.4%	1.4%	1.5%
Daily	1.1%	3.1%	2.4%	4.0%	2.7%

Kasman. Marijuana and infertility. Fertil Steril 2018.

Thus, while the literature is reassuring on the effect of marijuana use on female fertility, the existing data are limited. An earlier study examined chronic marijuana users who, for the purposes of the study, were abstinent for 4 weeks and then smoked 8–20 marijuana-containing joints a week for 4 weeks (35). The authors reported a decreased sperm count after this time period, which persisted for 4 weeks afterward, during which time they were not using marijuana. It is possible that marijuana use in our population did not affect TIP because of a dose-dependent effect. The marijuana use of our population was specified only as none, less than once, more than once a month, or weekly over the past 12 months, whereas the participants in the Hembree et al. study (35) were using at least eight marijuana-containing joints per week.

Another study of six chronic (>10 y) hashish users examined sperm morphology under electron microscopy and found multiple defects across the spermatozoa anatomy, including in the head, tail, and nucleus (36). However, the subjects did not define the amount of hashish used over the past 10 years, they were simultaneous users of opium and heroin, and they

TABLE 3

Mean time reported trying to conceive or current duration and time ratio (TR) of time to conceive for increasing marijuana levels for both men and women.

Marijuana use	Months trying to conceive	Adjusted TR	P value (TR)	Unadjusted TR	P value (TR)
Male					
Never	13.7 (11.3–15.9)	Reference		Reference	
<1× per mo	8.4 (4.3–12.6)	0.9 (0.7–1.2)	.43	0.8 (0.7–1.1)	.14
Monthly	4.9 (0.3–9.5)	0.9 (0.5–1.8)	.73	0.7 (0.4–1.4)	.32
Weekly	10.4 (2.6–18.3)	1.0 (0.3–2.9)	1.00	0.9 (0.5–1.9)	.85
Daily	12.2 (5.6–18.8)	1.1 (0.79–1.5)	.65	0.8 (0.6–1.1)	.26
Female					
Never	20.1 (17.9–22.3)	Reference		Reference	
<1× per mo	18.5 (11.9–25.0)	1.0 (0.7–1.3)	.77	1.0 (0.7–1.3)	.73
Monthly	17.2 (5.3–28.9)	1.1 (0.6–2.2)	.78	0.8 (0.4–1.7)	.57
Weekly	21.9 (13.0–30.9)	1.7 (0.9–3.3)	.10	1.4 (0.9–2.4)	.17
Daily	15.7 (8.2–23.5)	0.9 (0.4–2.0)	.83	0.8 (0.4–1.5)	.49

Note: Values in parentheses are 95% confidence intervals. Time ratio was adjusted per variables discussed in the Methods section.

Kasman. Marijuana and infertility. *Fertil Steril* 2018.

were all malnourished, making the data difficult to apply to our study population. A large study of Danish military conscripts identified an association between regular use of marijuana, as well as it in combination to other recreational drugs, and semen quality (14). That Danish cohort of 1,215 men showed a statistically significant impact of marijuana use of more than once a week on sperm concentration and sperm count, lowering them by 28% and 29%, respectively. In contrast, the present report found no association between marijuana use and TTP for men. Although previous reports have examined semen quality, to our knowledge, ours is the first to examine TTP. Given that semen quality can be a poor metric of male fertility, an examination of TTP represents an important clinical end point for patients and clinicians (37, 38).

Studies of the health effects of marijuana usage in other organ systems have been reported. Investigators have demonstrated improved or minimal impact on pulmonary function in marijuana smokers (39). In addition, data from National Health and Nutrition Examination Survey (NHANES) suggest that marijuana users display improved insulin resistance, lower fasting insulin levels, smaller waist circumference, and lower prevalence of diabetes (40, 41). Moreover, Gunderson et al. (14) demonstrated higher testosterone levels among marijuana users, and Thistle et al. (42) demonstrated higher testosterone levels in recent users. Although we did not identify a benefit of use, the present report supports the safety of marijuana regarding TTP. Importantly, health effects on the offspring were not assessed and remain a key consideration.

Few studies in the literature have examined the effect of marijuana's active ingredients in vivo on sperm, oogenesis, and embryogenesis. However, two main receptors in the body for tetrahydrocannabinol (THC), brain-type (CB1) and spleen-type (CB2) endocannabinoid receptors, have been found to be expressed in the oviduct, uterus, anterior pituitary, embryos, and spermatozoa (43–45). It has been demonstrated that knockout mice for these receptors show defects in embryogenesis, fertilization, and implantation (45–47).

The present study is limited in the fact that it is a retrospective review of survey data relying on participant reporting of both marijuana use and TTP, which could be subject to recall bias. The analysis is limited to men and women who reported that they were attempting pregnancy, which may not represent all those at risk for pregnancy. Individuals may be affected by social pressures that lead to underreporting of drug use in the survey. Furthermore, certain populations are not represented in the survey, such as homeless individuals not in shelters and incarcerated individuals. The population of men and women reporting daily use of marijuana while trying to conceive was quite small. A further limitation of this study is due to a question asked in the NSFG, where a man who reported that his wife/partner was unable to achieve a pregnancy was not asked if they were trying. And before 2002, the NSFG surveyed women who said they were not surgically sterile but were reported to be physically unable to have children. However, from 2006 on, women in this category were not asked the current duration questions, making comparisons between time periods imperfect.

In conclusion, to our knowledge this is the first nationally representative survey to examine the clinical effect of regular marijuana use in the reproductive-age population of both men and women. Even though previous studies have suggested that marijuana decreased measurable surrogates of fertility, this study failed to identify an effect on TTP. However, we would caution clinicians from advising that marijuana is safe while trying to conceive, because it may have other deleterious health effects on both user and fetus. Further studies are necessary to fully understand the association between marijuana use and reproductive function.

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