2023QualifyingCondition

Upon petition, the State Medical Board of Ohio has the authority to approve and designate conditions or diseases as qualifying medical conditions for treatment with medical marijuana. For the calendar year of 2023, the board will accept petitions for consideration between November 1, 2023 and December 31, 2023.

The following conditions are already part of the program: AIDS, amyotrophic lateral sclerosis, Alzheimer's disease, cachexia, cancer, chronic traumatic encephalopathy, Crohn's disease, epilepsy or another seizure disorder, fibromyalgia, glaucoma, hepatitis C, Huntington's disease, inflammatory bowel disease, irritable bowel syndrome, multiple sclerosis, pain that is either chronic and severe or intractable, Parkinson's disease, positive status for HIV, post-traumatic stress disorder, sickle cell anemia, spasticity, spinal cord disease or injury, terminal illness, Tourette syndrome, traumatic brain injury, and ulcerative colitis.

The board's Medical Marijuana Committee determined that the following are considered to be covered by an existing qualifying condition.

- Arthritis (determined to be covered by pain that is either chronic or intractable, February 2021)
- Chronic Migraines (determined to be covered by pain that is either chronic or intractable, February 2021)
- Complex Regional Pain Syndrome (determined to be covered by pain that is either chronic or intractable, February 2021)
- Degenerative Disc Disease (determined to be covered by pain that is either chronic or intractable, February 2022)
- Lupus where pain is present (determined to be covered by pain that is either chronic or intractable, February 2022)

You do not need to submit a petition for any of these conditions. Click here to read the board's position statement.

The petition will not be considered if:

- Received after December 31, 2023
- It seeks to add a broad category of diseases or conditions
- The condition that has been previously reviewed by the board and rejected unless new scientific research that supports the request is offered

If you are petitioning for a previously considered condition:

- Do not resubmit documents which have already been reviewed by the board
- Only new scientific research should be submitted for previously rejected petitions
- A catalogue of submitted research and documents can be found here

Most information submitted as part of a petition is public record and may be posted on the Medical Board's website at med.ohio.gov. This includes the submitter's name provided contact information, and responses.

Instructions:

- All sections below are required to be completed per Ohio Administrative Code 4731-32. All text boxes are required. Applicants may type "see attached" or "previously submitted" in the required fields.
- If you would like for the Medical Board to consider multiple conditions, please complete a separate submission for each one.
- Please refrain from providing personal medical information as all submissions are subject to public record requests.

First Name *	Last Name *	Email *
Suzanne	Mulvehill	info@femaleorgasmresearch.org
Address *	**City ***	**State ***
3230 NE 13 Street, Unit 105	Pompano Beach	FLORIDA
Zip Code *	**County ***	**Specific Disease or Condition ***
33062	OUT OF STATE	Female Orgasmic Difficulty/Disorder (FOD)

1) Information from experts who specialize in the disease or condition *

Please see attached

Please do not include any links in the text field. All materials submitted for review must be attached in the format of a Microsoft Word document or PDF

Question 1 Attachments

File Name	Size
Ohio - 1. Information from experts who specialize in the disease or condition.pdf	224.78 kB

Links will not be reviewed

2) Relevant medical or scientific evidence pertaining to the disease or condition *

Please see attached.

Please do not include any links in the text field. All materials submitted for review must be attached in the format of a Microsoft Word document or PDF

Question 2 Attachments

File Name	Size
Relevant medical or scientific evidence pertaining to female orgasmic difficulty.pdf	157.04 kB

3) Consideration of whether conventional medical therapies are insufficient to treat or alleviate the disease or condition *

Please see attached.

Please do not include any links in the text field. All materials submitted for review must be attached in the format of a Microsoft Word document or PDF

Question 3 Attachments

File Name	Size
3 Consideration of whether conventional medical therapies are insufficient to treat or alleviate female orgasmic difficulty.pdf	88.25 kB

4) Evidence supporting the use of medical marijuana to treat or alleviate the disease or condition, including journal articles, peer-reviewed studies, and other types of medical or scientific documentation *

Please see three attached documents:
1. Research studies in peer-reviewed journals and books revealing cannabis being associated with improved orgasm frequency, orgasm ease, and orgasm satisfaction.
2. Cross-over studies of scientific evidence of cannabis treating FOD's co-morbid conditions of PTSD and anxiety.
3. News reports of sex therapists recommending cannabis to women with female orgasmic difficulty/disorder and other news reports related to cannabis treating FOD.

Please do not include any links in the text field. All materials submitted for review must be attached in the format of a Microsoft Word document or PDF

Question 4 Attachments

File Name	Size
2 Merged file documentation of scientific evidence.pdf	28.41 MB
Merged File - Cross-over Cannabis Scientific Research Related to Cannabis Treating Female Orgasmic (1).pdf	3.34 MB
Cannabis Helps Women Orgasm News and Science Articles.pdf	1.28 MB

5) Letters of support provided by physicians with knowledge of the disease or condition. This may include a letter provided by the physician treating the petitioner, if applicable. *

Please see attached.

Please do not include any links in the text field. All materials submitted for review must be attached in the format of a Microsoft Word document or PDF

Question 5 Attachments

File Name	Size
Letter of Support Dr. Maureen Whelihan.pdf	73.01 kB
Ashley Manta letter of support.pdf	1.80 MB
Dr. Suzanne Mulvehill Letter of Support.pdf	647.66 kB
Jordan Tishler Letter of Support NM.pdf	158.17 kB
Letter of support from Dr. Tishler for CT.pdf	117.65 kB
Dr. Jordan Tishler Letter of Support for all US states.pdf	100.31 kB

1 Information from experts who specialize in the disease or condition.

Female Orgasmic Difficulty/Disorder

Female orgasmic difficulty/disorder (FOD) is one of the most prevalent sexual dysfunctions in women.[1-3] Female orgasmic disorder (FOD), also referred to as female orgasm difficulty,[4-8] is characterized by difficulty experiencing orgasm and/or markedly reduced intensity of orgasmic sensations.[9] FOD is a serious public health issue,[10] affecting up to 41% of women worldwide,[11] an unchanged statistic for 50 years,[12] with paucity of validated treatments.[13]

Fifty years of research reveals that cannabis helps women orgasm and helps women orgasm who have orgasm difficulty.[14-33] Numerous studies suggest cannabis *could* be a treatment for FOD and other female sexual disorders [15,20,26-28] A recent study found that women who used cannabis more frequently, were 2.10 times more likely to orgasm.[25]

There have been no randomized controlled trials yet on cannabis as a treatment for FOD, however, FOD's co-morbid conditions of anxiety and PTSD, discussed further in this paper, have been approved for medical cannabis.

FOD Sub-types

FOD can occur in several ways. A women may have never orgasmed in her life, referred to as anorgasmia, or Lifelong FOD, affecting approximately 10-15% of women worldwide,[34] with one validated treatment.[13] Acquired FOD occurs when a women can no longer orgasm from solo or partnered sex,[9] often due to medication[35] and has no empirically validated treatments.[13] Situational FOD occurs in certain situations or with certain partners[9] and is the most common FOD sub-type,[36] with no empirically validated treatments.[13]

FOD and Co-Morbid Medical Conditions

Women who report FOD experience high rates of mental health diagnoses, [37-39] prescription drug use,[40] anxiety,[41] Post Traumatic Stress Disorder (PTSD) [42-45] and sexual abuse histories.[46-48] Women with anxiety disorders are 3.5 times more likely to have FOD than non-anxious women.[49] Premenopausal women who have Type 1 diabetes are three times more likely to experience sexual dysfunction,[50] and the pooled prevalence of female sexual dysfunction among women with heart failure was 56%. [51] Moreover, FOD is the number one sexual complaint of sexual abuse survivors.[46]

A recent study revealed that women with FOD reported 24% more mental health issues, 52.6% more PTSD, 29% more depressive disorders, 13% more anxiety disorders, 22% more prescription drug use, and 33% more sexual abuse histories than women without FOD.[33]

Cannabis as a Treatment for FOD

Studies show that THC, the psychoactive ingredient in cannabis, significantly reduces rates of anxiety,[52] reduces traumatic memories related to trauma and PTSD by reducing activity in the

amygdala,[52] and reduces cognitive distractions by inhibiting activity in the prefrontal cortex.[53] Women's amygdala activity increases at orgasm [54,55] but decreases during ejaculation in men.[56]

THC creates an altered state of consciousness,[57] whereas higher sexual responsiveness is related to altered states of consciousness.[58] Women's orgasm is considered an altered state of consciousness.[59,60]

Cannabis Dosage and FOD

Dosage was first mentioned as an important criterion for experiencing cannabis' sexual enhancements when Dr. Erich Goode pioneered the first cannabis and sex study in 1969.[17] Several studies that did not evaluate dosage mentioned cases where cannabis inhibited female orgasm. [24,28] Gorzalka et al. (2010), stated, "The influence of cannabis intake on sexual behavior and arousability appear to be dose-dependent in both men and women, although women are far more consistent in reporting facilitatory effects." [20]

Conclusion

The research suggests that adding FOD as a condition of treatment for medical cannabis has the potential to reduce the persistently high percentage of women suffering from FOD and its co-morbid conditions, while improving the quality of life for women.

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Relevant medical or scientific evidence pertaining to female orgasmic difficulty/disorder (FOD)

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1. Female orgasmic difficulty/disorder (FOD) affects up to 41% of women worldwide (Laumann et al., 2005) and the percentage of women suffering from FOD has not changed in 50 years (Kontula & Miettinen, 2016).
2. FOD is a serious public health concern that impairs the quality of women's lives (Laumann et al., 1999).
3. A paucity of validated treatments exist for treating FOD (Marchand, 2021).
4. Women with anxiety disorders were 3.5 times more likely to have FOD than non-anxious women (Dunn et al., 1999).
5. Women with FOD reported 24% more mental health issues, 52.6% more PTSD, 29% more depressive disorders, 13% more anxiety disorders, and 22% more prescription drug use than women without FOD (Mulvehill & Tishler, 2023).
6. Women who report FOD experience high rates of mental health diagnoses, (Laumann et al., 1999; Basson et al., 2018; Leeners et al., 2014) prescription drug use (Conaglen & Conaglen, 2013; Raffa et al., 2021), anxiety (Meston et al., 2004; or PTSD (Letourneau et al., 1996; Bird et al., 2021; Yehuda et alk 2015).
7. The number one sexual complaint of female childhood sexual abuse survivors is FOD. (Kinzl et al., 1995).
8. FOD has well documented links to anxiety (Meston, 2004; Pauls et al., 2005).

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Consideration of whether conventional medical therapies are insufficient to treat or alleviate female orgasmic difficulty/disorder (FOD)

1. Currently, no data suggest that any medication is efficacious in the treatment of female orgasmic difficulty/disorder (FOD) (Conn& Hodges, 2023)
2. The largest percentage of women who have FOD, have situational FOD, (Krans, 2018), meaning not being able to orgasm in situations like partnered sex, for which there are no empirically validated treatments (Heiman & Meston, 1997).
3. There is only one validated treatment for FOD, and this treatment is only for women who have never had an orgasm (Heiman & Meston, 1997).
4. Treatments with little evidence for efficacy as a primary mode of treatment include systematic desentization, bibliotherapy and coital alignment technique training (Marchand, 2021).
5. Treatment of FOD has seen little innovation since the 1980s (Marchand, 2021).
6. The percentage of women suffering from FOD has not changed in 50 years (Kontula & Meittinen, 2016).

Citations:

Conn, A., & Hodges, K. R. (2023, November 12). *Female orgasmic disorder - gynecology and Obstetrics*. MSD Manual Professional Edition. https://www.msdmanuals.com/professional/gynecology-and-obstetrics/female-sexual-function-and-dysfunction/female-orgasmic-disorder

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Documentation (clinical, medical, or scientific data) Supporting Efficacy of Medical Marijuana as Treatment for Female Orgasmic Difficulty/Disorder

It is important to note the following in reviewing the scientific data:

- Up to 41% of women suffer from female orgasmic difficulty/disorder (FOD) (Laumann et al., 2005), and this percentage has not changed for 50 years (Kontula & Miettinen, 2016).
- All cannabis and sex studies that found cannabis was associated with improving orgasm frequency, orgasm intensity, orgasm ease, or orgasm satisfaction, included women with and without orgasm difficulty, as no studies excluded women with FOD.
- One study controlled for the high percentage of women with FOD (Halikas et al., 1982).
- One study dicotomized women with and without FOD (Mulvehill & Tishler, 2023).

The following summaries/excerpts are from studys published in scientific journals, conferences or books that reveal scientific evidence that cannabis is associated with improved orgasm frequency, orgasm intensity, orgasm ease, or orgasm satisfaction.

Summary: The majority of women perceived an improvement in orgasm. Women who reported marijuana use before sexual activity had 2.13 higher odds of reporting satisfactory orgasms (adjusted odds ratio ¼ 2.13; 95% CI ¼ 1.05, 4.35) than women who reported no marijuana use. After adjusting for race and age, women with frequent marijuana use, regardless of use before sex or not, had 2.10 times higher odds of reporting satisfactory orgasms than those with infrequent marijuana use (adjusted odds ratio ¼ 2.10; 95% CI ¼ 1.01e4.44).

Citation: Lynn, B. K., López, J. D., Miller, C., Thompson, J., & Campian, E. C. (2019). The relationship between marijuana use prior to sex and sexual function in women. *Sexual Medicine*, *7*(2), 192–197. https://doi.org/10.1016/j.esxm.2019.01.003

Summary: The primary outcomes of this study for women with orgasm difficulty/disorder (FOD) revealed statistically significant findings that cannabis use before partnered sex was associated with increased orgasm frequency (72.8%, n =147/202, $p < .001$), improved orgasm satisfaction (67% n = 136/202, $p < .001$) or improved orgasm ease (71%, n = 132/202, $p < .001$).

Citation: Mulvehill, S., & Tishler, J. (2023, May 18). *Assessment of cannabis use before partnered sex on women who report orgasm difficulty*. [Conference presentation]. Cannabis Clinical Outcomes Research Conference 2023, Orlando, FL, United States. https://ccorc.mmjoutcomes.org/2023/04/21/cannabis-helps-women-orgasm-andincreases-the-frequency-of-orgasm-in-women-who-report-difficulty-orgasming/

Summary: Improvement in female orgasm was statistically significant ($p = .0002$). Increased frequency of marijuana use was associated with improved sexual function among female users, whereas chemovar type, method of consumption, and reason for use did not impact outcomes. For each step up of cannabis use intensity (ie. times per week), the odds of reporting female sexual dysfunction declined by 21%.

Citation: Kasman, A. M., Bhambhvani, H. P., Wilson-King, G., & Eisenberg, M. L. (2020). Assessment of the association of cannabis on female sexual function with the female sexual function index. *Sexual Medicine, 8*(4), 699-708. https://doi.org/10.1016/j.esxm.2020.06.009

Summary: This study found statistically significant results that cannabis is statistically significant in influencing the ability to orgasm ($p < .05$) and influencing the ability to have more than one orgasm ($p < .05$). Medical implications of this study include the possible use of cannabis for treating sexual dysfunctions, especially within women.

Citation: Moser, A., Ballard, S. M., Jensen, J., & Averett, P. (2023). The influence of cannabis on sexual functioning and satisfaction. *Journal of Cannabis Research*, *5*(2). https://doi.org/10.1186/s42238-022-00169-2

Summary: Increased ability to orgasm was reported by 44% of participants (n=86/195). Of the participants who reported difficulty reaching orgasm, 50% said it was easier to reach orgasm while using cannabis.

Citation: Wiebe, E., & Just, A. (2019). How cannabis alters sexual experience: A survey of men and women. *Journal of Sexual Medicine*, *16*(11), 1758–1762. https://doi.org/10.1016/j.jsxm.2019.07.023

Summary: This study found that the highest percentages of positive responses pertain to increased pleasure, sexual sensations, and intensity of orgasms as well as increasing variety of sexual experiences. There is sufficient support to indicate that at least some experienced cannabis users derived an enhancement of sexual pleasure while they were using cannabis. The implication is that there may be value in researching the use of cannabis in treatment of sexual disorders.

Citation: Dawley, H. H., Baxter, A. S., Winstead, D. K., & Gay, J. R. (1979). An attitude survey of the effects of marijuana on sexual enjoyment. Journal of Clinical Psychology, 35(1), 212-217. doi:10.1002/1097-4679(197901)35:13.0.co;2-k

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Summary/Excerpts: Four of the women who talked with me said that they had "learned" to have their first orgasm while they were on (cannabis) and then were able to achieve orgasm straight (without cannabis). (p. 40).*

Citation: Lewis, B. (1970). *The sexual power of marijuana.* Wyden.

Summary: The subjective impression of cannabis' slowing down time might confer on a very unusual gratification in an orgasmic experience. These effects are more common with a low dosage. (p. 103).

Citation: Chopra, G. S. and Jandu, B. S. (1976). Psychoclinical effects of long-term marijuana use in 275 Indian chronic users: A comparative assessment of effects in Indians and USA users. Annals of the New York Academy of Sciences, 282(95-108), Retrieved from doi:10.1111/j.1749-6632.1976.tb49889.x

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Summary: "The orgasm is more intense than usual," was one of eight reasons offered by cannabis smokers as explanations of why using cannabis renders the sexual experience more pleasurable and exciting. (p. 48).

Citation: Goode, E. (1972). Sex and marijuana. *Sexual Behavior, 2,* 45–51.

Summary/Excerpts: Becoming high smoking marijuana is similar in many respects to the attainment of sexual orgasm, at least for women." (Chapter 6, page 12/15). An overwhelming 68% replied that marijuana increased their sexual enjoyment, that their orgasmic pleasure was heightened by the drug." (Chapter 7, page 20/34). *

"A 27-year-old divorcee, was able to achieve orgasm only under the influence of marijuana." Chapter 7, p. 23/34).

Citation: Goode, E. (1970). *The marijuana smokers.* Basic Books.

Summary/Excerpt: About 60% of the orgasmic females would be reporting enhanced quality of orgasm, controlling for as many as one third of women never or only occasionally experiencing orgasm (Fisher, 1973). (p. 59)

Citation: Halikas, J., Weller, R., & Morse, C. (1982). Effects of regular marijuana use on sexual performance. *Journal of Psychoactive Drugs, 14*(1–2), 59–70. https://www.doi.org/10.1080/02791072.1982.10471911

Summary: As cannabis use increases, there is an increase in sexual pleasure. Daily users report the highest increase in sexual pleasure. (p. 119)

Citation: Fisher, G., & Steckler, A. (1974). Psychological effects, personality and behavioral changes attributed to Marihuana use. *International Journal of the Addictions*, *9*(1), 101–126. https://doi.org/10.3109/10826087409046773

Summary/Excerpts: Eighty-four percent of the subjects engaged in sexual activity when using cannabis. It was apparent from the analysis on sexual activity that marijuana has a sensual effect on the subjects. They were more aware of their bodily functions and sensual pleasures. This is true of male and female, long and short-term users, both moderate and heavy smokers. (p. 354).

Citation: Haines, L., & Green, W. (1970). Marijuana use patterns. The British Journal of Addiction to Alcohol and Other Drugs, 65(4), 347–362. https://doi.org/10.1111/j.13600443.1970.tb03954.x

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Summary/Excerpts: "The effect of cannabis seems more noticeable during orgasm, there appeared to be more sensation in the genital organs." (p. 199). Our survey revealed cases of situationally nonorgasmic females following marijuana use. There were also cases of multiorgasm (from two different women who both stated that they never had more than one orgasm when engaged in intercourse while not under the influence of marijuana. (p. 203)**

"It seems conceivable that marijuana, with suitable psychological and sociological conditions, and taken in a light to moderate dose releases inhibitions." (p. 203)

Citation: Koff, W. (1974). Marijuana and sexual activity. *Journal of Sex Research, 10*(3), 194–204. https://doi.org/10.1080/00224497409550850

Summary/Excerpts: Participants commonly reported increased sensitivity on marijuana. These changes in sensation appear to have influenced length and intensity of sex as well as orgasm.; Some females reported an inability to achieve orgasm on marijuana due to lack of proper focus.**

Citation: Palamar, J. J., Acosta, P., Ompad, D. C., & Friedman, S. R. (2016). A qualitative investigation comparing psychosocial and physical sexual experiences related to alcohol and marijuana use among adults. *Archives of Sexual Behavior*, 47(3), 757–770. https://doi.org/10.1007/s10508-016-0782-7

Summary: The influence of cannabis intake on sexual behavior and arousability appear to be dose-dependent, in both men and women, although women are far more consistent in reporting facilitatory effects (p. 91). The positive effect of moderate cannabis consumption on female sexuality includes two areas: sexual desire and sexual functioning, the latter including sexual satisfaction, pleasure and orgasmic quality.

Citation: Gorzalka, B. B., Hill, M. N., Chang, S. C. (2010). Male–female differences in the effects of cannabinoids on sexual behavior and gonadal hormone function. Hormones and Behavior, 58(1), 91–99. https://doi.org/10.1016/j.yhbeh.2009.08.009

Summary/Excerpt: Frequent cannabis use was associated with difficulties in men, ability to reach orgasm as desired, not women. In the association between frequency of cannabis use and sexual problems for men and women, inability to reach orgasm was not statistically significant for women (p = .0770), while it was statistically significant for men (p - .011). Reached orgasm too quickly was statistically significant for men (p = .012), but was not statistically significant for women (p = .653) (Table 5, p. 791).

Citation: Smith, A. M. A., Ferris, J. A., Simpson, J. M., Shelley, J., Pitts, M. K., & Richters, J. (2010). Cannabis Use and Sexual Health. *The Journal of Sexual Medicine*, 7(2), 787–793. doi:10.1111/j.1743-6109.2009.01453.x

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Summary/Excerpt: Cannabis users indicated that sex was more enjoyable and their sensitivity to taste, sound, and touch increased, and that their ability to concentrate increased when smoking marijuana (p. 71).

Citation: Traub, S. H. (1977). Perceptions of marijuana and its effects: A comparison of users and nonusers. *Addiction*, *72*(1), 67–74. https://doi.org/10.1111/j.13600443.1977.tb03967.x

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Summary/Excerpt: 43% (*n* = 16/37) of women reported an increase in the number of orgasms experienced when using cannabis before sex. (Table 2, p. 190). The quality of orgasm was statistically significant in women (*p* = .025) with 86% reporting and increased quality of orgasm (n=32/37).

Citation: Weller, R. A., & Halikas, J. A. (1984). Marijuana use and sexual behavior. *The Journal of Sex Research*, 20(2), 186–193. https://doi.org/10.1080/00224498409551216

Summary/Excerpt: Relevant characteristic effects of using cannabis before sex included new, pleasurable qualities to orgasm (p. 289). The majority of users indicated that marijuana greatly enhances sexual pleasure. *

Citation: Tart, C. T. (1971). On being stoned: a psychological study of marijuana intoxication. essay, Science and Behavior Books, Palo Alto, CA.

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* Study was reported in a book, and the book is not attached.

** Study did not evaluate cannabis dosage or it was unclear what the dosage was that caused the inhibited orgasm. The influence of cannabis intake on sexual behavior and orgasm is known to be dose-dependent (Gorzalka, et al., 2010).

WOMEN'S SEXUAL HEALTH

The Relationship between Marijuana Use Prior to Sex and Sexual Function in Women

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ABSTRACT

Introduction: Scientific research on the effects of marijuana on sexual functioning in women, including libido, arousal, orgasm, and satisfaction, is limited.

Aim: To evaluate women's perceptions of the effect of marijuana use before sexual activity.

Methods: A cross-sectional design, from March 2016—February 2017, within a single, academic, obstetrics and gynecology practice, was performed. Patients were given a questionnaire at their visit and asked to complete it anonymously and place it in a locked box after their visit.

Main Outcome Measures: The primary outcome was satisfaction in the sexual domains of drive, orgasm, lubrication, dyspareunia, and overall sexual experience. The secondary outcome was the effect of the frequency of marijuana use on satisfaction.

Results: Of the 373 participants, 34.0% (n = 127) reported having used marijuana before sexual activity. Most women reported increases in sex drive, improvement in orgasm, decrease in pain, but no change in lubrication. After adjusting for race, women who reported marijuana use before sexual activity had 2.13 higher odds of reporting satisfactory orgasms (adjusted odds ratio = 2.13; 95% CI = 1.05, 4.35) than women who reported no marijuana use. After adjusting for race and age, women with frequent marijuana use, regardless of use before sex or not, had 2.10 times higher odds of reporting satisfactory orgasms than those with infrequent marijuana use (adjusted odds ratio = 2.10; 95% CI = 1.01—4.44).

Conclusion: Marijuana appears to improve satisfaction with orgasm. A better understanding of the role of the endocannabinoid system in women is important, because there is a paucity of literature, and it could help lead to development of treatments for female sexual dysfunction. **Lynn BK, López JD, Miller C, et al. The Relationship between Marijuana Use Prior to Sex and Sexual Function in Women. Sex Med 2019;7:192—197.**

Key Words: Female Sexual Response; Epidemiology; Health Behavior and Attitudes; Women's Sexuality

INTRODUCTION

Over the last decade, marijuana use and the legalization of marijuana, medically and recreationally, has continued to increase in the United States.[1] The internet is rife with claims of the beneficial effects of marijuana on several aspects of sexual function including libido, arousal, and orgasm. However, our scientific research on the effects of marijuana on sexual functioning is limited. Recently Palamar et al[2] evaluated self-reported sexual effects of marijuana, ecstasy, and alcohol use in a small cohort of men and women aged 18—25. They found that the majority of marijuana users reported an increase in sexual enjoyment and orgasm intensity, as well as either an increase or no change in desire.[2]

Endocannabinoids, which are structurally similar to marijuana, are known to help regulate sexual function.[3] The cannabinoid

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Table 1. Demographics of study population

Characteristics	Non-marijuana users (n = 197)	Marijuana users who don't use before sex (n = 49)	Marijuana users who use before sex (n = 127)	*P* value*
Age, years	36.3 ± 13.1	37.4 ± 13.1	34.0 ± 11.3	.17
Race†				.03
African American/other minorities	79 (40.7)	13 (26.5)	62 (48.8)	
Caucasian	115 (59.3)	36 (73.5)	65 (51.2)	
Sexual orientation‡				.02
Heterosexual	180 (91.4)	46 (93.9)	111 (87.4)	
Lesbian	3 (1.5)	0 (0.0)	4 (2.7)	
Bisexual	1 (0.5)	0 (0.0)	7 (5.5)	
Marital status§				.18
Married	95 (49.0)	24 (49.0)	46 (36.2)	
Living with a partner	62 (32.0)	18 (36.7)	55 (43.3)	
Single	37 (19.1)	7 (14.3)	25 (19.7)	
Cigarette smoker	17 (8.6)	10 (20.4)	30 (23.6)	<.01

Table values are frequencies (%) or means ± SD.
*χ^2, Fisher's exact test, and 1-way ANOVA. Significant at the $P < .05$ level.
†3 participants were missing for race and quality of life.
‡21 participants were missing for sexual orientation.
§4 participants were missing for marital status.

receptor, discovered in the 1990s, has been mapped to several areas of the brain that play a role in sexual function.[3] Cannabinoids and endocannabinoids interact with the hormones and neurotransmitters that affect sexual behavior. Although these interactions have not been clearly illuminated, some studies in rodents have helped to clarify the relationship between cannabinoids and the hormones and neurotransmitters that affect sexual behavior.[4] Although there is less data on human subjects, some studies have measured patient's perceptions of the effects of marijuana on sexual function. Studies have reported an increase in desire and improvement in the quality of orgasm.[5] Most recently, Klein et al[6] evaluated the correlation between serum levels of 2 endogenous endocannabinoids and found a significant negative correlation between endocannabinoids and both physiological and subjective arousal in women. Sumnall et al[7] reported that drugs such as cannabis and ecstasy were more frequently taken to improve the sexual experience than was alcohol.

The primary aim of this study was to determine how women perceive the sexual experience, specifically overall sexual satisfaction, sex drive, orgasm, dyspareunia, and lubrication, when using marijuana before sex. The magnitude of the change was also evaluated. The secondary aim sought to understand the effect of the frequency of marijuana use, regardless of marijuana use before sex, on satisfaction across the different sexual function domains.

MATERIAL AND METHODS

Women were enrolled prospectively from a single, academic, obstetrics and gynecology practice from March 2016—February 2017, and their data were retrospectively reviewed. The protocol was approved by the Institutional Review Board. Eligibility criteria consisted of being a female, ≥18 years of age, and presenting for gynecologic care irrespective of the reason. Each participant completed a confidential survey, including demographic data without unique identifiers after their visit, which was placed in a sealed envelope and dropped in a lock box at the clinic. The Sexual Health Survey was developed for the purpose of this study based on the aims of the study. There are several validated tools for evaluation of sexual function. The Female Sexual Function Index (FSFI)[8] assesses several domains of sexual function, but it does not address specifically marijuana or other substance usage. The Golombok Rust Inventory of Sexual Satisfaction[9] specifically relates to vaginal intercourse, but, for purposes of this study, sexual activity was deliberately left open-ended and not restricted to vaginal penetration. In addition, the goal was not to measure whether women had sexual dysfunction, which the FSFI addresses, but to assess basic questions regarding overall sexual activity. To limit bias, the authors embedded the questions about marijuana deeper into the questionnaire. If these specific questions had been added to the standard FSFI, there was concern that the questionnaire would have been too long and that the patients would get questionnaire fatigue and not finish or answer thoughtfully.

Measurement of marijuana use before sex was dichotomized as yes or no. The exact timing of marijuana use in relation to sex was not defined, and the majority of users were smokers of marijuana. For purposes of the study, groups consisted of non-marijuana users, marijuana users before sex, and marijuana users who didn't use before sex. Patients reported their usage as

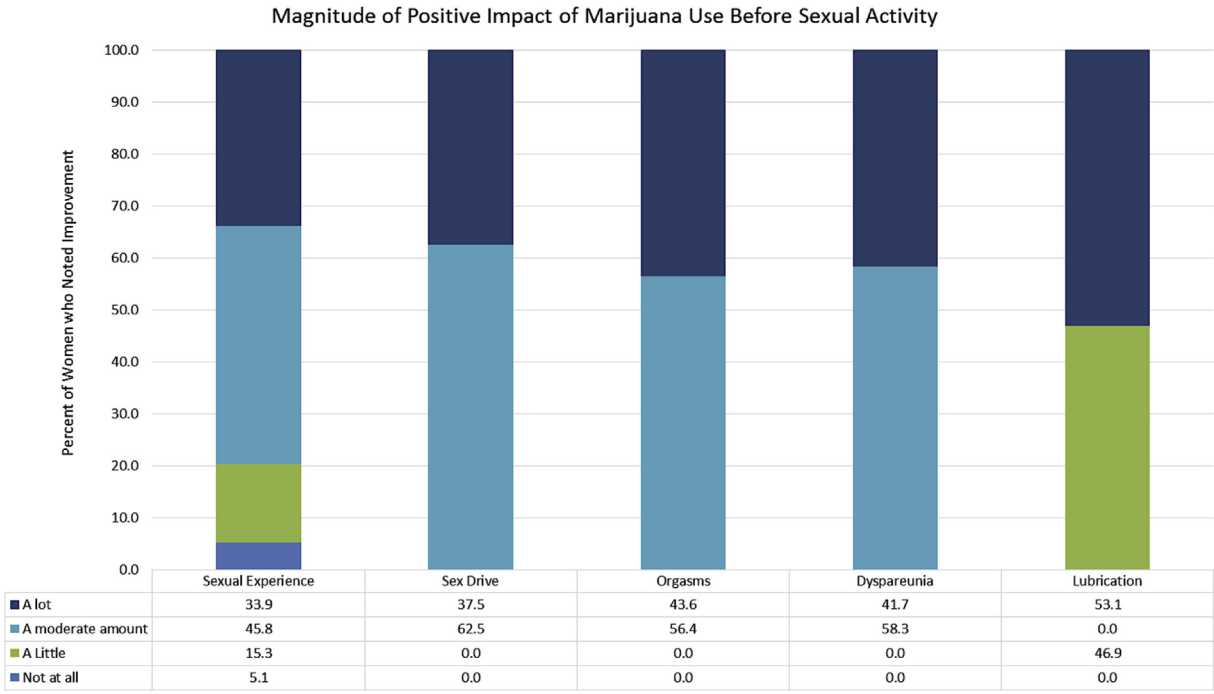

Figure 1. Magnitude of positive impact of marijuana use before sexual activity.

several times a day or week or year, once a day, week or year and less than once a year. For purpose of analysis, frequency of marijuana use was measured by dichotomizing into frequent (once a week—several times a day) and infrequent (several times a year—<once a year).

"Sex" was not specifically defined in the questionnaire, so each respondent used her own definition of sex. Initial questions assessed their perception of their overall sexual health, including satisfaction or dissatisfaction with current sex life, sex drive, orgasms, lubrication, and dyspareunia. An example survey question was, "How satisfied are you with your ability to maintain lubrication during sexual activity or intercourse?" This was followed by questions regarding marijuana usage, the frequency of use, and whether participants perceived any positive or negative effect of this on the above sexual domains. The magnitude of change was measured on a Likert scale of always, sometimes, rarely, or never, and then dichotomized as always—sometimes vs rarely—never. For example, if patients reported that marijuana use before sex increased their sexual desire, they were then asked, "How often did/does marijuana use before sex increase your sex drive?" If they reported a decrease in sex drive, they then answered the same question within the context of by how much.

Bivariate analyses were conducted to measure the sample characteristics. The Shapiro-Wilk test was conducted to test for normality of the data. 1-way ANOVA, χ and Fisher's exact tests were used to assess for comparisons among the groups. Multivariate logistic regressions identified the independent predictors in the sample and included all covariates with $P < .05$ established in the bivariate correlations. Then, covariates were retained in the final regression model if they changed the effect size between exposure and outcome by more than 10%, indicating a confounding effect. Final models were adjusted for race and tested using Hosmer-Lemeshow for goodness of fit. Data were analyzed using SAS Version 9.4 for Windows (SAS Institute Inc, Cary, NC, USA).

Table 2. Differences in sexual function domains between those who use before sexual activity and those who do not

Sexual function	Marijuana before sex (n = 127)	Marijuana users don't use before sex (n = 49)	*P* value*	aOR (95% CI)
Sexual life satisfaction	89 (70.1)	30 (61.2)	.11	1.85 (0.86, 3.99)
Satisfying sex drive	91 (71.7)	29 (59.2)	.10	1.84 (0.89, 3.82)
Satisfying orgasm	86 (67.7)	26 (53.1)	.04	2.13 (1.05, 4.35)
Increased lubrication	94 (74.0)	34 (69.4)	.50	1.32 (0.58, 3.00)
Reduced dyspareunia	20 (15.7)	10 (20.4)	.40	0.69 (0.30, 1.63)

aOR = adjusted odds ratio.
Table values are frequencies (%). Adjusted for race and age.
*χ^2, significant at $P < .05$ level.

Table 3. Overall satisfaction of sexual health based on frequency of use

	Frequent marijuana users n = 84	Infrequent marijuana users n = 86	*P* value*	aOR (95% CI)
Sexual life satisfaction	61 (72.6)	56 (65.1)	0.12	1.50 (0.64, 3.48)
Satisfying sex drive	57 (67.9)	61 (70.9)	0.94	0.77 (0.35, 1.71)
Satisfying orgasm	60 (71.4)	50 (58.1)	0.02	2.10 (1.01, 4.44)
Increased lubrication	63 (75.0)	60 (69.8)	0.23	1.41 (0.60, 3.31)
Reduced dyspareunia	12 (14.3)	18 (20.9)	0.29	0.68 (0.29, 1.59)

aOR = adjusted odds ratio.
Table values are frequencies (%). Adjusted for race and age.
*χ^2, Significant at $P < .05$ level.

RESULTS

A total of 373 patients completed the sexual health survey during the study period. Non-marijuana users constituted 52.8% (n = 197) of the sample. Of the 176 users, 34.1% (n = 127) used before sex and 13.1% (n = 49) did not. The mean age of the groups was not significantly different. The majority of women were white and identified as heterosexual (Table 1).

Among those who reported using marijuana before sex, 68.5% (n = 87) stated that the overall sexual experience was more pleasurable, 60.6% (n = 77) noted an increase in sex drive, and 52.8% (n = 67) reported an increase in satisfying orgasms. The majority reported no change in lubrication. Participants reported their sexual experiences as "always to sometimes" positive related to all the domains of sexual function, except for lubrication (Figure 1). After adjusting for race, women who reported marijuana use before sex had 2.13 higher odds of reporting satisfactory orgasms during sexual activity (adjusted odds ratio = 2.13; 95% CI = 1.05–4.35) than women who reported no marijuana use before sex (Table 2). There was no statistically significant difference in the other domains between these groups. Women with frequent marijuana use, regardless of use before sex or not, had 2.10 times higher odds of reporting satisfactory orgasms than those with infrequent marijuana use (adjusted odds ratio = 2.10; 95% CI = 1.01–4.44) (Table 3). There was no significant difference in the other domains.

DISCUSSION

In our study, the majority of women who used marijuana before sex reported positive sexual effects in the domains of overall sexual satisfaction, desire, orgasm, and improvement in sexual pain but not in lubrication. Women who used marijuana before sex and those who used more frequently were more than twice as likely to report satisfactory orgasms as those who did not use marijuana before sex or used infrequently.

Our study is consistent with past studies of the effects of marijuana on sexual behavior in women. In the above-mentioned study by Palamar et al,[2] 38.6% of respondents were women. Participants were asked questions similar to this study's questions regarding sexual domains, including sexual enjoyment, desire, and orgasm intensity and how these were affected by being under the influence of marijuana. The majority of respondents noted an increase in sexual enjoyment (53.5%) and orgasm intensity (44.9%), whereas 31.6% noted an increase in desire, and 51.6% noted no difference.[2] Our data showed a higher percentage of participants reporting improvements in each domain across the board. However, their data included both men's and women's responses, and their questions were worded differently.

Dawley et al[10] evaluated a group of marijuana using students (men and women) and found that marijuana smokers reported increased sexual pleasure, increased sensations, and increased intensity of orgasm. Only more-frequent users felt that marijuana was an "aphrodisiac," a surrogate measure of desire. This study included only 22% women.[10] Finally, Koff[11] evaluated sexual desire and sexual enjoyment after marijuana use in women via a questionnaire. The majority of the female respondents reported that sexual desire was increased (57.8% vs 60.6% in our study). Sexual enjoyment increased 42.9% of the time.[11] Interestingly, Sun and Eisenberg[12] reported a higher frequency of sexual activity in marijuana users, even when controlling for multiple variables (ie, age, socioeconomic status). The authors surmise from their data that marijuana use does not seem to impair sexual function. However, it is important to note that marijuana use may be harmful.

Our study provides an interesting insight into women's perceptions of the effect of marijuana on the sexual experience. It differs from other studies in that it is one of the largest series to date and has a wider range of ages. It also differed in that it was a cross-section of healthy women presenting for routine gynecologic care, where most studies target younger patients and include both sexes. For this reason, it is difficult to directly compare the studies, because the sexual activity, frequency, and expectation of these groups may be very different. However, we believe it is important to understand the potential effect in this patient population.

The question of how marijuana leads to these positive changes in sexual function is unknown. It has been postulated that it leads to improvement in sexual function simply by lowering stress and anxiety.[13] It may slow the temporal perception of time and prolong the feelings of pleasurable sensations.[5,14] It may lower sexual inhibitions and increase confidence and a willingness to experiment.[7] Marijuana is also known to heighten

sensations such as touch, smell, sight, taste, and hearing.[15] Although this was not specifically addressed in this article, according to Halikas et al,[5] the regular female marijuana user reported a heightened sensation of touch and increased physical closeness when using marijuana before sex.

It is postulated that marijuana works through a variety of mechanisms. It is recognized that marijuana and the hypothalamic-pituitary-gonadal axis, which controls the sex hormones, interact with each other. There are cannabinoid receptors in the hypothalamus that regulate gonadotrophin-releasing hormone and oxytocin release, both of which play a role in normal sexual functioning.[16] In addition, marijuana has been shown to affect testosterone levels, which play a role in sex drive, but how and in which direction in women is unclear.[17,18]

Female sexual function is not only regulated by hormones, but also by centrally acting neurotransmitters, such as dopamine and serotonin. Dopamine is a key pro-sexual modulator in normal excitatory female sexual function.[19,20] Activation of cannabinoid receptors has been shown to enhance dopamine,[19] which may be another pathway by which marijuana affects sexual function. Cannabinoid receptors have also been localized to other areas of the brain that control sexual function, including the hypothalamus, prefrontal cortex, amygdala, and hippocampus.[21,22] Serum levels of endocannabinoids have been correlated with both subjective and objective measures of arousal.[6]

The strength and weakness of this study is that it is a single-center study, which allows consistency of patient recruitment but does not allow for assessment of generalizability. It relied on women's memory and perceptions of the sexual experience; however, it is real life, and all questionnaires rely on recall. It did not address the context of the relationship, co-use with other drugs, or the timing and quantity of marijuana use before sex, all of which contribute to the memory of the sexual experience. It does not specifically ask whether the marijuana was taken because the patient had the perception that it would enhance performance, which would be an inherent bias. This may be less likely because women who were frequent users (that is not specifically timed with intercourse) had the same positive relationship with improvement in satisfying orgasm. A further study could address the specific timing of marijuana use on the sexual domains though this would be difficult unless patients were enrolled in a study that required certain timing (a very challenging study to get though the Institutional Review Board).

CONCLUSIONS

This study adds to our knowledge and understanding of the effect of marijuana use on female sexual functioning. Timing appears to be important with those who use before sex reporting a positive effect on orgasm. However, with any use, the majority of women perceived improvement in in overall experience, sex drive, orgasm and pain.

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Does Cannabis Use Before Partnered Sex Help Women Who Report Orgasm Difficulty?

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INTRODUCTION

Up to 41% of women experience orgasm difficulty,[1] a statistic unchanged for 50 years.[2] A paucity of validated treatments exists.[3,4] Researchers have suggested cannabis as a treatment for female orgasm difficulty and other sexual disorders for nearly 50 years. [5-7]

OBJECTIVES

To evaluate the effect of cannabis use before partnered sex on women with and without orgasm difficulty.

METHODS

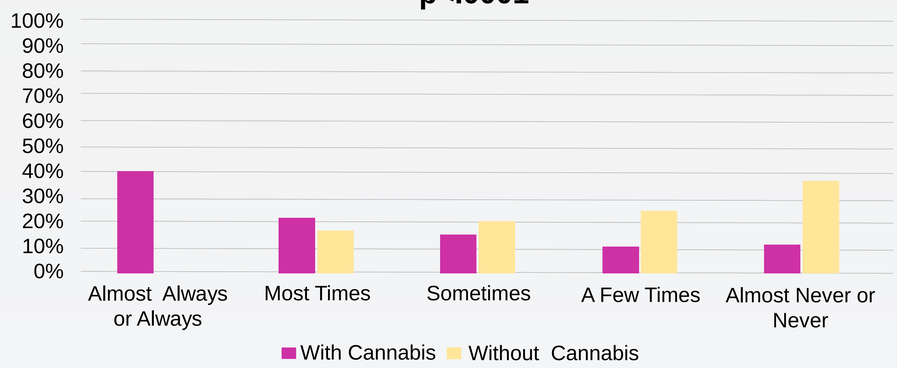
This IRB-approved observational study conducted between March and November, 2022, included 387 females, 52% (n-202) of whom reported orgasm difficulty during partnered sex. An anonymous, uncompensated 41-question online survey evaluated baseline demographics, sexual behavior, and cannabis use. Orgasm frequency, orgasm difficulty, and orgasm satisfaction were measured with and without cannabis use before partnered sex using the orgasm subscale questions of the Female Sexual Function Index (FSFI).[8]

FINDINGS

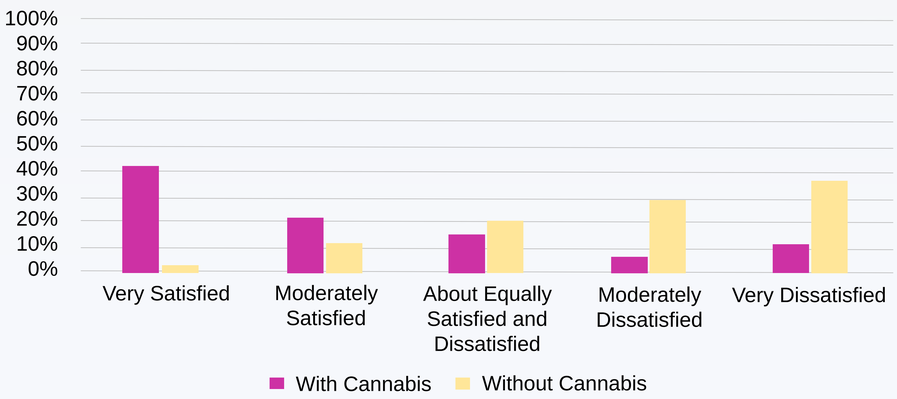
- **Increased Orgasm Frequency** 72.8% (147/202, p<.0001) of women with orgasm difficulty reported increased orgasm frequency when using cannabis before partnered sex.
- **Increased Orgasm Ease** 71% (143/202, p<.001) of women with orgasm difficulty reported it was easier to orgasm when using cannabis before partnered sex.
- **Increased Orgasm Satisfaction** 67% (136/202, p<.0001) of women with orgasm difficulty reported increased orgasm satisfaction when using cannabis before partnered sex.

STATISTICS

Orgasm Frequency
For Women with Orgasm Difficulty
With and Without Cannabis Before Partnered Sex
p<.0001



Orgasm Satisfaction
For Women with Orgasm Difficulty
With and Without Cannabis Before Partnered Sex
p<.0001



FINDINGS

- Among women who “almost never or never orgasm” without cannabis, 28.7% (n=58/202, p<.0001) experienced orgasm when using cannabis before partnered sex.
- The frequency of cannabis use before partnered sex increased the frequency of orgasm for women with orgasm difficulty (p<001).
- Women with or without orgasm difficulty who reported a mental health diagnosis (n=231/287, p=.004) or a sexual abuse history (n=125/387, p=.003), had a statistically significant more positive orgasm response when using cannabis before sex.

CONCLUSION

Cannabis-based treatment deserves further exploration into treatment for women who experience orgasm difficulty. Randomized-controlled studies should follow this observational study to evaluate the efficacy of cannabis in treating women who have orgasm difficulty.

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SEXUAL MEDICINE ORIGINAL RESEARCH

Assessment of the Association of Cannabis on Female Sexual Function With the Female Sexual Function Index

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ABSTRACT

Introduction: Cannabis use has increased in the last decade, and the impact of cannabis on female sexual function remains unclear.

Aim: To assess the impact of frequency of use, chemovar (tetrahydrocannabinol, cannabinol, or both) type, and method of consumption on female sexual function among cannabis users.

Methods: Adults who visited a single-partner cannabis dispensary's locations were invited to participate in an uncompensated, anonymous online survey October 20, 2019 and March 12, 2020. The survey assessed baseline demographics, health status, cannabis use habits as well as used the validated Female Sexual Function Index (FSFI) to assess sexual function.

Main Outcome Measure: The main outcomes of this study are the total FSFI score (sexual dysfunction cutoff <26.55) and subdomain scores including desire, arousal, lubrication, orgasm, satisfaction, and pain.

Results: A total of 452 women responded with the majority between the ages of 30−49 years (54.7%) and in a relationship or married (81.6%). Of them,72.8% reported using cannabis more than 6 times per week, usually through smoking flower (46.7%). Women who reported more cannabis use, reported higher FSFI scores (29.0 vs 26.7 for lowest vs highest frequencies of reported use, $P = .003$). Moreover, an increase in cannabis use frequency by one additional use per week was associated with an increase in total FSFI ($\beta = 0.61$, $P = .0004$) and subdomains including desire domain ($P = .02$), arousal domain ($P = .0002$), orgasm domain ($P = .002$), and satisfaction domain ($P = .003$). For each additional step of cannabis use intensity (ie, times per week), the odds of reporting female sexual dysfunction declined by 21% (odds ratio: 0.79, 95% confidence interval: 0.68−0.92, $P = .002$). Method of consumption of cannabis and chemovar type did not consistently impact FSFI scores or odds of sexual dysfunction.

Conclusion: Increased frequency of marijuana use is associated with improved sexual function among female users, whereas chemovar type, method of consumption, and reason for use does not impact outcomes. **Kasman AM, Bhambhvani HP, Wilson-King G, et al. Assessment of the Association of Cannabis on Female Sexual Function With the Female Sexual Function Index. Sex Med 2020;XX:XXX−XXX.**

Key Words: Cannabis; Marijuana; Female Sexual Function; Female Sexual Dysfunction; FSFI

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INTRODUCTION

The impact of cannabis use on sexual function is a matter of debate. An estimated 22.2 million people within the United States use cannabis monthly, and there are more than a 100 million lifetime users.[1−3] There have been major policy changes governing cannabis use since the 1960s as calls for legalization began with medical legalization in 1996 by California followed by adult use in 2012 by Colorado and Washington State.[4] There are now 29 states, and the District of Columbia have legalized use of cannabis either for medical or adult use.[5] As legalization has become more prevalent and users have become more widespread, there is a need to better understand the systemic effects of cannabis.[6]

Cannabis' effect on sexual arousal and sex steroid hormones has been previously studied.[7,8] Women who use cannabis have reported increased sexual frequency and increased endocannabinoids have been associated with increased arousal; however, examination of sexual function with regard to cannabis has led to conflicting reports.[7,9] Prior studies have either examined sexual function using a mix of validated and non-validated instruments with varied results.[10,11] Although a few studies have found a positive dose-dependent effect on arousal and shown a positive effect with pleasure, these studies have been small and have not examined other domains of female sexual function such as lubrication, pain, and overall satisfaction.[12] Interestingly, a large Australian survey found that men who used cannabis were more likely to report impaired sexual function, whereas women cannabis users did not have higher rates of sexual dysfunction.[13] To date, no studies have examined female sexual function with a validated survey in a large sample size nor have examined the impact of the cannabis chemovar (categorization of a plant species based on chemical composition, eg, tetrahydrocannabinol [THC] or cannabinol [CBD] dominant) or the method of consumption. Chemovar may be important as the receptors for THC and CBD are different, which may account for the psychoactive effects of THC compared with CBD.[14] Therefore, we sought to characterize the association between female sexual function and cannabis use by using a validated questionnaire (Female Sexual Function Index [FSFI]) using a U.S. population.

METHODS

Study Population

After institutional review board approval, adults who visited a single-partner cannabis dispensary were invited to participate in an uncompensated, anonymous online survey via a provided hyperlink or QR code upon purchase between October 20, 2019 and March 12, 2020. The partner dispensary was chosen based on a large customer base and willingness to distribute our survey. The survey was distributed throughout all locations of the partner dispensary.

Survey Instruments

All participants were administered the same anonymous survey in the English language via the online survey platform Qualtrics (Provo, UT). Informed consent was waived given the online nature of the survey, and waiver of documentation was provided before proceeding with the survey. The first half of the survey queried participants for demographic information, past medical history, and adult drug use habits. After selection of sex, female participants were directed to the validated FSFI. The FSFI is a validated 19-item survey instrument designed to assess female sexual function over the preceding 4 weeks.[15] It assesses 6 individual domains including desire, arousal, lubrication, orgasm, satisfaction, and pain. Each domain is scored via a Likert scale score from either 0−5 or 1−5 with a cutoff total score of 26.55 to define sexual dysfunction as per previous validation studies to define female sexual dysfunction.[15,16] To score, each domain sum is multiplied by a specific factor ratio and then summed to obtain the total FSFI score with a maximum of 36. As the FSFI was developed and validated in sexually active women, sexually inactive participants were excluded from the analysis.

Covariates

Demographics collected included age, race, primary region of residence (international or per U.S. census divisions), and relationship status. Clinical variables were height, weight, number of visits to a primary care provider in the last 3 months, tobacco smoking history, and the presence/absence of 13 common chronic comorbidities within the United States (ie, hypertension, hypercholesterolemia, diabetes, heart disease, arthritis, lung disease, kidney disease, thyroid disease, cancer, neurologic disease, liver disease, depression, and anxiety).[17] Responses (yes/no) to these variables were collapsed to a single continuous variable, "total comorbidities" for the purpose of analysis. The complete distribution of these comorbidities can be found in Supplemental Table 1.

Cannabis use variables included frequency of use within the last 4 weeks, method of consumption, primary cannabis chemovar (THC or CBD dominant), and reason for use. Options for frequency of use were never, 1−2 times per week, 3−5 times per week, and 6+ times per week. The frequency-response relationship was assessed in our regression analyses by converting this categorical variable to a continuous variable as follows: never users were assigned a value of 0; 1−2 times per week, a value of 1.5; 3−5 times per week, a value of 4; and 6+ times per week, a value of 6.1. These continuous variable values were chosen as the average weekly use frequency of their respective categorical variables. The options for method of consumption included smoking flower, edibles, smoking concentrates/extracts, tincture/oils, vaping, and other. 9 options were given for reason for use after performing a review of the literature: relax/unwind, improve mood, help with pain, help with sleep, help with stress, help with depression, glaucoma, nausea/loss of appetite, and neurologic condition.[18] The complete distribution of reason for use is illustrated in Supplemental Table 1.

Statistical Methods

Patient characteristics and survey responses were analyzed using descriptive statistics, including proportions, median, and mean ± SD. Categorical variables were analyzed by the χ^2 test or Fisher's exact test as appropriate. Normally distributed continuous variables were analyzed by Student's t-test, whereas skewed continuous variables were analyzed by the Wilcoxon rank sum test. Multiple linear regression was used to identify factors associated with the overall FSFI score, as well as each FSFI domain. We used multivariable logistic regression to identify factors associated with female sexual dysfunction. In this analysis, female sexual dysfunction was defined as a FSFI score of less than 26.55.[15] All data were analyzed using R v3.5.3 (R Foundation for Statistical Computing, Vienna, Austria). The significance

Table 1. Cohort demographics and stratification by frequency of cannabis use

Characteristic	Overall	Frequency of cannabis use		
		≥3 times per wk	≤2 times per wk	
N	452	392	60	*P* value
Age, y Overall (range)	42 (20–79)			
<30	67 (14.8)	58 (14.8)	9 (15.0)	.23
30–39	117 (25.9)	101 (25.8)	16 (26.7)	
40–49	130 (28.8)	109 (27.8)	21 (35.0)	
50–59	81 (17.9)	76 (19.4)	5 (8.3)	
60+	55 (12.2)	47 (12.0)	8 (13.3)	
Race (%)				
Caucasian	337 (74.6)	300 (76.5)	37 (61.7)	.02*
Black/African	15 (3.3)	14 (3.6)	1 (1.7)	
Hispanic/Latino	55 (12.2)	45 (11.5)	10 (16.7)	
Other	45 (10.0)	33 (8.4)	12 (20.0)	
Region (%)				
West	159 (35.2)	130 (33.2)	29 (48.3)	.05*
International	96 (21.2)	87 (22.2)	9 (15.0)	
Midwest	34 (7.5)	27 (6.9)	7 (11.7)	
Northeast	81 (17.9)	74 (18.9)	7 (11.7)	
South	75 (16.6)	69 (17.6)	6 (10.0)	
Unknown	7 (1.5)	5 (1.3)	2 (3.3)	
Relationship status (%)				
Married	245 (54.2)	210 (53.6)	35 (58.3)	.59
In a relationship	124 (27.4)	111 (28.3)	13 (21.7)	
Single	79 (17.5)	67 (17.1)	12 (20.0)	
Education (%)				
4-y degree	130 (28.8)	118 (30.1)	12 (20.0)	.01*
2-y degree	67 (14.8)	58 (14.8)	9 (15.0)	
Doctorate	32 (7.1)	27 (6.9)	5 (8.3)	
High school or less	33 (7.3)	33 (8.4)	0 (0.0)	
Professional degree	108 (23.9)	84 (21.4)	24 (40.0)	
Some college	82 (18.1)	72 (18.4)	10 (16.7)	
Weight, lbs (mean [SD])	155.20 (37.44)	154.69 (37.73)	158.48 (35.54)	.47
Height, cm (mean [SD])	165.41 (6.97)	165.43 (6.88)	165.31 (7.54)	.91
PCP visits in last 3 mo (%)				
0	213 (47.1)	181 (46.2)	32 (53.3)	.59
1	170 (37.6)	150 (38.3)	20 (33.3)	
2+	69 (15.3)	61 (15.6)	8 (13.3)	
Cannabis use frequency (%)				
Never	7 (1.5)	0 (0.0)	7 (11.7)	<.001
1–2 times per wk	53 (11.7)	0 (0.0)	53 (88.3)	
3–5 times per wk	63 (13.9)	63 (16.1)	0 (0.0)	
6+ times per wk	329 (72.8)	329 (83.9)	0 (0.0)	
Tobacco use (%)				
Never smoker	203 (44.9)	167 (42.6)	36 (60.0)	.05*
Current smoker	59 (13.1)	56 (14.3)	3 (5.0)	
Former smoker	189 (41.8)	168 (42.9)	21 (35.0)	
Method of consumption (%)				
Smoking flower	211 (46.7)	193 (49.2)	18 (30.0)	<.001*
Edibles	50 (11.1)	38 (9.7)	12 (20.0)	
Other	22 (4.9)	15 (3.8)	7 (11.7)	
Smoking concentrates	24 (5.3)	23 (5.9)	1 (1.7)	

(continued)

Table 1. Continued

Characteristic	Overall	Frequency of cannabis use		
		≥3 times per wk	≤2 times per wk	
N	452	392	60	*P* value
Tincture or oils	69 (15.3)	56 (14.3)	13 (21.7)	
Vaping	73 (16.2)	67 (17.1)	6 (10.0)	
Primary reason for use (%)				
Medical	364 (80.5)	327 (83.4)	37 (61.7)	<.001*
Recreational	88 (19.5)	65 (16.6)	23 (38.3)	
Cannabinoid (%)				
THC dominant	208 (46.0)	189 (48.2)	19 (31.7)	<.001*
Both THC and CBD	192 (42.5)	168 (42.9)	24 (40.0)	
Only CBD dominant	49 (10.8)	35 (8.9)	14 (23.3)	
Total comorbidities (%)				
0	111 (24.6)	87 (22.2)	24 (40.0)	.004*
1	111 (24.6)	94 (24.0)	17 (28.3)	
2	123 (27.2)	110 (28.1)	13 (21.7)	
3+	107 (23.7)	101 (25.8)	6 (10.0)	
FSFI score (mean [SD])				
Total score	28.6 (5.44)	28.9 (5.30)	26.7 (5.98)	.003*
Desire score	3.74 (1.11)	3.8 (1.10)	3.5 (1.12)	.03*
Arousal score	4.7 (1.19)	4.8 (1.17)	4.3 (1.24)	.003*
Lubrication score	5.2 (1.19)	5.2 (1.15)	4.9 (1.43)	.09
Orgasm score	4.9 (1.35)	5.0 (1.32)	4.6 (1.48)	.01*
Satisfaction score	4.74 (1.34)	4.79 (1.32)	4.39 (1.42)	.03*
Pain score	5.27 (1.18)	5.30 (1.12)	5.06 (1.49)	.14

BMI = body mass index; CBD = cannabidiol; FSFI = female sexual function index; OR = odds ratio; PCP = primary care physician; SD = standard deviation; THC = tetrahydrocannabinol.
Comorbidities included hypertension, diabetes, heart disease, arthritis, lung disease, kidney disease, thyroid disease, hypercholesterolemia, cancer, neurologic disease, liver disease, depression, and anxiety.
Region represents primary residence.
*Significant ($P < .05$).

level for all statistical tests was set at <0.05, and all tests were 2 sided.

RESULTS

Survey respondent demographics including age, race, relationship status, education, and cannabis use characteristics are outline in Table 1. In total, 452 women completed the survey with the majority between the ages of 30−49 years (54.7%) and in a relationship or married (81.6%). Most participants were educated with either a 4 year or professional degree (52.7%) and had not seen their primary care physician within the last 3 months (47.1%). Of them, 72.8% reported using cannabis more than 6 times per week in the last 4 weeks, usually through smoking flower (46.7%). Overall, 118 women reported sexual dysfunction with a FSFI score of <26.55.

When stratified by frequency of use (≥3 times per week vs <3 times per week), those who used more frequently had overall higher FSFI scores (28.9 vs 26.7, $P = .003$) and had higher FSFI subdomain scores except for pain (5.3 vs 5.06, $P = .14$). More frequent users tended to smoke flower (49.2% vs 30%) and vape (17.1% vs 10%), whereas less frequent users reported using edibles more commonly (20% vs 9.7%; $P < .001$). In addition, the dominant cannabinoid chemovar that more frequent users reported was THC dominant (48.2% vs 31.7%) compared with CBD dominant (8.9% vs 23.3%, $P < .001$). More frequent users had more comorbidities compared with less frequent users with 25.8% with 3 or more compared with 10% ($P = .004$). The most common reason for cannabis use was to relax (81%) followed by relieve stress (74.1%) and help with sleep (73.9%; Supplemental Table 1).

Demographics, health status (eg, body mass index, primary care provider visits, tobacco use), and cannabis use and methods were assessed in relation to total FSFI and FSFI subdomains using linear regression (Table 2). Women older than the age of 50 years were more likely to have lower total FSFI scores (25.04 vs 27.12, $P = .03$) as were those who had more comorbidities (26.68 vs 27.12, $P = .02$). An increase in cannabis use frequency by one additional use per week was associated with an increase in total FSFI ($\beta = 0.61$, SE = 0.17, $P = .0004$) and subdomains

Table 2. Linear regression models of female sexual function index scores and demographics, health status, and marijuana use habits

	Total FSFI		Desire domain		Arousal domain		Lubrication domain		Orgasm domain		Satisfaction domain		Pain domain	
Characteristic	β	*P* value	β	*P* value	β	*P* value	β	*P* value	β	*P* value	β	*P* value	β	*P* value
Age, y														
<30	Ref		Ref		Ref		Ref		Ref		Ref		Ref	
30–39	−1.32	.12	−0.29	.11	−0.28	.14	−0.08	.69	−0.25	.24	−0.40	.06	−0.02	.91
40–49	−0.32	.71	−0.30	.10	−0.15	.42	−0.09	.62	0.11	.62	−0.08	.73	0.19	.31
50–59	−2.08	.03*	−0.54	.008*	−0.53	.01*	−0.57	.008*	−0.14	.57	−0.16	.51	−0.14	.50
60+	−1.32	.21	−0.48	.03*	−0.22	.34	−0.48	.04	0.29	.27	−0.22	.40	−0.21	.38
Race														
White	Ref		Ref		Ref		Ref		Ref		Ref		Ref	
Black	−1.06	.46	0.02	.94	−0.26	.40	−0.03	.93	−0.58	.10	−0.40	.27	0.18	.56
Hispanic	0.69	.42	0.45	.01*	0.22	.25	0.19	.30	−0.09	.68	−0.11	.62	0.02	.90
Other	−2.12	.02*	−0.21	.27	−0.51	.01*	−0.33	.10	−0.70	.002*	−0.22	.33	−0.16	.42
Relationship status														
Married/in a relationship	Ref		Ref		Ref		Ref		Ref		Ref		Ref	
Single	0.86	.21	0.23	.12	0.43	.005*	0.24	.12	0.06	.71	−0.19	.28	0.09	.57
Region														
West	Ref		Ref		Ref		Ref		Ref		Ref		Ref	
International	−0.18	.82	0.00	.99	−0.08	.63	0.10	.54	−0.05	.80	−0.11	.57	−0.04	.80
Midwest	1.87	.07	0.16	.46	0.37	.09	0.41	.07	0.48	.06	0.51	.05*	−0.06	.78
Northeast	−0.33	.66	−0.05	.77	−0.10	.53	−0.02	.89	−0.04	.82	−0.19	.31	0.07	.66
South	0.79	.30	0.03	.87	−0.03	.85	0.36	.03*	0.00	.99	0.11	.56	0.32	.05*
BMI														
Normal	Ref		Ref		Ref		Ref		Ref		Ref		Ref	
Underweight	−2.91	.11	−0.01	.97	−0.53	.19	−1.14	.01	−0.63	.17	−0.33	.48	−0.28	.49
Overweight	0.34	.59	0.03	.82	0.08	.59	0.08	.55	0.02	.91	−0.05	.73	0.19	.18
Obese	0.16	.85	0.02	.91	0.06	.75	0.12	.52	0.10	.63	−0.21	.33	0.06	.73
Extremely obese	0.43	.65	−0.08	.68	0.06	.76	0.01	.95	0.39	.11	−0.04	.88	0.09	.67
Tobacco use														
Never	Ref		Ref		Ref		Ref		Ref		Ref		Ref	
Current	0.92	.27	0.14	.42	0.17	.36	0.17	.37	0.25	.25	0.06	.79	0.14	.45
Former	−0.01	.98	0.12	.31	−0.04	.76	0.09	.46	−0.08	.59	−0.15	.29	0.04	.77
PCP visits in last 3 mo														
0.00	Ref		Ref		Ref		Ref		Ref		Ref		Ref	
1.00	−0.91	.12	−0.23	.07	−0.14	.28	−0.12	.38	−0.11	.47	−0.24	.11	−0.02	.88
2+	−0.62	.43	−0.06	.71	−0.10	.58	−0.17	.32	−0.06	.78	−0.03	.87	−0.10	.57

(continued)

Table 2. Continued

Characteristic	Total FSFI		Desire domain		Arousal domain		Lubrication domain		Orgasm domain		Satisfaction domain		Pain domain	
	β	*P* value	β	*P* value	β	*P* value	β	*P* value	β	*P* value	β	*P* value	β	*P* value
Cannabis use frequency (continuous)	0.61	.0004*	0.09	.02*	0.14	.0002*	0.07	.08	0.14	.002*	0.13	.003*	0.05	.20
Method of consumption														
Smoking flower	Ref		Ref		Ref		Ref		Ref		Ref		Ref	
Edibles	−0.59	.51	−0.11	.55	−0.11	.59	−0.19	.34	−0.08	.73	−0.01	.98	−0.10	.60
Other	−1.22	.36	−0.03	.90	−0.10	.72	0.11	.71	−0.15	.66	−0.36	.27	−0.68	.02*
Smoking concentrates	−1.67	.16	−0.23	.36	−0.06	.82	−0.28	.29	−0.59	.05	−0.30	.32	−0.28	.41
Tincture or oils	−0.09	.91	−0.04	.82	0.19	.30	−0.12	.53	0.09	.67	−0.25	.23	0.04	.85
Vaping	0.04	.96	−0.13	.44	−0.06	.70	0.19	.27	−0.03	.89	−0.11	.58	0.18	.30
Primary reason for use														
Medical	Ref		Ref		Ref		Ref		Ref		Ref		Ref	
Recreational	1.03	.15	0.22	.14	0.21	.18	0.01	.93	0.27	.13	0.29	.11	0.03	.83
Cannabinoid														
THC dominant	Ref		Ref		Ref		Ref		Ref		Ref		Ref	
Both THC and CBD	0.32	.57	0.06	.61	0.11	.39	0.15	.24	0.21	.14	0.06	.69	−0.26	.03*
CBD dominant	0.28	.77	0.09	.66	−0.07	.74	0.15	.50	0.21	.40	0.01	.96	−0.10	.64
Total comorbidities (continuous)	−0.44	.04*	−0.03	.44	−0.05	.33	−0.08	.08	−0.11	.04*	−0.09	.09	−0.08	.07

BMI = body mass index; CBD = cannabidiol; FSFI = female sexual function index; OR = odds ratio; PCP = primary care physician; THC = tetrahydrocannabinol.
Comorbidities included hypertension, diabetes, heart disease, arthritis, lung disease, kidney disease, thyroid disease, hypercholesterolemia, cancer, neurologic disease, liver disease, depression, and anxiety.
Region represents primary residence.
*Significant ($P < .05$)

Table 3. Multivariable logistic regression identifying factors associated with female sexual dysfunction (FSFI total < 26.55)

Characteristic	OR (95% CI)	*P* value
Age, y		
<30	Ref	
30–39	1.65 (0.73–3.77)	.22
40–49	0.85 (0.37–2.02)	.71
50–59	1.76 (0.73–4.38)	.21
60+	1.28 (0.48–3.42)	.62
Race		
White	Ref	
Black	2.52 (0.69–8.3)	.14
Hispanic	0.51 (0.20–1.19)	.14
Other	1.71 (0.78–3.67)	.17
Relationship status		
Married/relationship	Ref	
Single	0.66 (0.33–1.27)	.23
Unknown	1.01 (0.05–9.08)	1.00
Region		
West	Ref	
International	0.66 (0.32–1.35)	.27
Midwest	0.36 (0.12–0.95)	.05
Northeast	0.63 (0.31–1.24)	.19
South	0.71 (0.36–1.40)	.34
BMI		
Normal	Ref	
Underweight	2.45 (0.43–11.85)	.28
Overweight	1.04 (0.57–1.85)	.91
Obese	0.94 (0.43–1.99)	.87
Extremely obese	1.12 (0.47–2.53)	.79
Tobacco use		
Never	Ref	
Current	0.48 (0.18–1.16)	.12
Former	1.04 (0.63–1.70)	.88
PCP visits in last 3 mo		
0	Ref	
1	1.33 (0.78–2.29)	.30
2+	0.99 (0.47–2.03)	.99
Cannabis use frequency (continuous)	0.79 (0.68–0.92)	.002*
Method of consumption		
Smoking flower	Ref	
Edibles	1.42 (0.65–3.02)	.37
Other	1.06 (0.32–3.22)	.92
Smoking concentrates	1.63 (0.55–4.48)	.35
Tincture or oils	1.2 (0.57–2.52)	.62
Vaping	1.01 (0.48–2.05)	.99
Cannabinoid		
THC dominant	Ref	
Both THC and CBD	0.64 (0.38–1.09)	.10
CBD dominant	1.34 (0.58–3.05)	.49
Total comorbidities (continuous)	1.26 (1.05–1.52)	.02*

BMI = body mass index; CBD = cannabidiol; FSFI = female sexual function index; OR = odds ratio; PCP = primary care physician; THC = tetrahydrocannabinol.

Comorbidities included hypertension, diabetes, heart disease, arthritis, lung disease, kidney disease, thyroid disease, hypercholesterolemia, cancer, neurologic disease, liver disease, depression, and anxiety.

Region represents primary residence.

*Significant ($P < .05$)

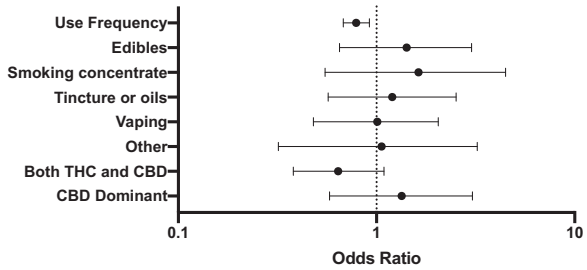

Figure 1. Forest plot demonstrating results of multivariable logistic regression with regard, to factors associated with female sexual dysfunction (FSFI total < 26.55). CBD = cannabidiol; FSFI = female sexual function index; THC = tetrahydrocannabinol.

including desire domain ($\beta = 0.09$, SE = 0.04, $P = .02$), arousal domain ($\beta = 0.14$, SE = 0.04, $P = .0002$), orgasm domain ($\beta = 0.14$, SE = 0.04, $P = .002$), and satisfaction domain ($\beta = 0.13$, SE = 0.04, $P = .003$). The method of consumption, cannabis chemovar, or primary reason for consumption did not consistently impact FSFI scores.

The odds of female sexual dysfunction, as defined by a FSFI total score less than 26.55, were assessed using logistic regression (Table 3). For each additional step of cannabis use intensity (ie, times per week), the odds of reporting female sexual dysfunction declined by 21% (odds ratio [OR]: 0.79, 95% confidence interval [CI]: 0.68−0.92, $P = .002$). In addition, having more comorbidities was associated with higher odds of sexual dysfunction (OR: 1.26, 95% CI: 1.05−1.52, $P = .02$). The methods of use and chemovar type were not associated with odds of developing sexual dysfunction (Figure 1).

DISCUSSION

To our knowledge, this study is the first to use a validated questionnaire to assess the association between female sexual function and aspects of cannabis use including frequency, chemovar, and indication. In this survey of more than 400 women, we found a dose response relationship between increased frequency of cannabis use and reduced odds of female sexual dysfunction. In addition, while the increase in index scores was small (and possible below clinical significance for some domains), increased cannabis use was associated with improved sexual desire, arousal, orgasm, and overall satisfaction as well as overall improved FSFI scores as compared with less frequent users. Older women and those with more comorbidities tended to have more sexual dysfunction. Importantly, our study did not find an association between cannabis chemovar (eg, THC vs CBD dominant), reason for cannabis use, and female sexual function.

As cannabis use has been shown to be associated with increased sexual frequency in the United States, it is possible this may cause positive effects on sexual experiences.[7] Much of the research focusing on sexual function and experiences with regard to cannabis began in the 1970s and 1980s. Cannabis' potential positive effect on female sexual function was noted as early as 1970 by Tart[19] who sought to describe the common experiences of cannabis users. He noted in interviews with college students that orgasms are improved, arousal increases, and "sexual feelings are much stronger" leading to more satisfaction. Although this was a small, non-controlled qualitative study without detailed cannabis use characterization, it was suggestive of cannabis' positive effect on female sexual function and is consistent with the current report. In a similar interview-based study with 37 female cannabis, the authors found that frequent users (>5 times per week) reported increased sexual pleasure, orgasms, satisfaction, and intimacy compared with less frequent users (<5 times per week).[20] However, this observation did not reach statistical significance. However, in interviews in 84 graduate students, of which 18 were female students, heavy users of cannabis tended to report more positive sexual experiences (ie, pleasure and intensity of orgasm) compared with lower intensity users.[21] These findings are similar to those by Koff[22] who, in a survey of 128 women, found that users of cannabis tended to enjoy sexual activity more than non-users. Interestingly, unlike most studies, he assessed if method of consumption had any impact on sexual experiences (eg, method of smoking and ingestion), and similar to the findings reported here, found no impact. However, the issue with these early studies has been that they represent a small, select sample size, and use non-validated questionnaires in an interview format.

More recently, researchers have used survey instruments to examine the effect of cannabis on female sexual function. However, many of these studies still do not use validated instruments or use sets of individual questions from them resulting in inconsistent findings. Johnson et al[23] surveyed 1,801 women asking specifically about sexual dysfunction and substance use. Although there was no significant increase in sexual dysfunction among cannabis users (10% of the survey respondents), inhibited orgasm (OR: 1.76, 95% CI: 1.12−2.74) and dyspareunia (OR: 1.69, 95% CI: 1.13−2.55) were more common among female cannabis users. This is in contrast to the present study that found orgasm to be improved in more frequent users, whereas pain during sexual activity was unaffected. In contrast, Lynn et al[10] surveyed 373 women (127 users of cannabis) and reported that frequent users had improved orgasms (OR: 2.10, 95% CI: 1.01−4.44). Other realms of sexual function, such as satisfaction, sex drive, lubrication, and dyspareunia, were not impacted by either use vs not or frequency of use. An Australian survey of 8,650 men and women, of which 754 reported cannabis use, found no association between cannabis use and sexual dysfunction in women when comparing users vs non-users as well as frequency of use.[13] While sexual dysfunction was assessed, a validated questionnaire was not used to obtain composite scores. In contrast to these studies, Johnson et al,[23] who asked questions specifically about female sexual dysfunction, found that cannabis use was associated with inhibited orgasm in a survey of more than 1,500 women.

The exact mechanisms by which cannabis may increase sexual function in women is unknown. The endocannabinoid system

has been postulated to be involved in female sexual function, and prior studies have demonstrated that increased amounts of endogenous cannabinoids such as arachidonoyl ethanolamide and 2-arachidonoylglycerol are associated with increased sexual arousal.[9] Exogenous use may similarly lead to activation of the endocannabinoid system leading to increased sexual function as we found here. As many patients use cannabis to reduce anxiety, it is possible that a reduction in anxiety associated with a sexual encounter could improve experiences and lead to improved satisfaction, orgasm, and desire.[24] Similarly, THC can alter the perception of time which may prolong the feelings of sexual pleasure.[25] Finally, CB1, a cannabinoid receptor, has been found in serotonergic neurons that secretes the neurotransmitter serotonin, which plays a role in female sexual function thus activation of CB1 may lead to increased sexual function.[12]

Several limitations of the present study warrant mention. Our cohort of women was derived from a population of cannabis users who made a purchase at a single-partner cannabis dispensary during a specific time period that may represent a unique subset of cannabis users especially as prior reports show lower prevalence of cannabis use in the general population introducing possible selection bias. In addition, while respondents had purchased a product at the partner dispensary, the specific locations from which respondents purchased their product is unknown. However, the population was geographically diverse and was not representative of only 1 region within the United States. Any survey distributed in such a manner is subject to volunteer and recall bias. Although respondents were asked about chemovar, it is possible some respondents did not know the dominant chemovar in the product they purchased thus altering the results. In addition, while frequency was assessed the exact dosage of product (eg, milligrams of THC), duration of use or chronicity is unknown. The impact of frequency of use on sexual function was compared by dichotomizing less frequent and more frequent users with no comparison to a non-user control group. It is possible that inclusion of a non-user population may alter the findings. In addition, we cannot exclude the possibility of causation in that more frequent female cannabis users happen to have higher FSFI scores rather than causal relationship. Although the multivariable linear regression was adjusted for available factors, residual confounders may exist that were not examined and therefore alter the results. While the FSFI is the most commonly used female sexual function survey, it is not the only one (eg, Sexual Quotient-Female and Golombok Rust Inventory of Sexual Satisfaction), and use of another validated survey may yield differing results. Althoough the FSFI cutoff of 26.55 for female sexual dysfunction has been validated and was examined here in associated with frequency of cannabis use, the clinical significance in FSFI subdomain scores is unknown. Although other aspects of sexuality were not assessed, such as vaginismus, this would be a potential area for future study.[26] Finally, while the survey assessed cannabis use within the last 4 weeks, it did not differentiate between chronic and new users.

Our results demonstrate that increasing frequency of cannabis use is associated with improved sexual function and is associated with increased satisfaction, orgasm, and sexual desire. Neither, the method of consumption nor the type of cannabis consumed impacted sexual function. The mechanism underlying these findings requires clarification as does whether acute or chronic use of cannabis has an impact on sexual function. Whether the endocannabinoid system represents a viable target of therapy through cannabis for female sexual dysfunction requires future prospective studies though any therapy has to be balanced with the potential negative consequences of cannabis use.

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STATEMENT OF AUTHORSHIP

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SUPPLEMENTARY DATA

Supplementary data related to this article can be found at https://doi.org/10.1016/j.esxm.2020.06.009.

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ORIGINAL RESEARCH

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The influence of cannabis on sexual functioning and satisfaction

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Abstract

Background The purpose of this study was to examine the perceived influence of cannabis on sexual functioning and satisfaction. This study used Kaplan's and Masters and Johnson's sexual response cycle (desire, excitement, orgasm, plateau, resolution) and included satisfaction to complete the sexual response cycle. Given increased attention in the research literature to the potential benefits of cannabis and the lack of research on the sexual benefits of cannabis use, the current study was completed.

Methods Data were collected using the online survey tool "Qualtrics" from a self-selected, convenience sample of adults over the age of 18 who reported previous cannabis use. The survey, developed by the researchers based on previous literature, included demographic questions followed by a scale to measure sexual functioning and satisfaction in relation to cannabis use ($\alpha = 0.897$).

Results The final sample was 811 participants ranging in age from 18 to 85 years old ($M = 32.11$). The majority of participants were identified as female ($n = 536$, 64.9%), White/Caucasian ($n = 640$, 78.9%), and college educated ($n = 650$, 80.1%). Almost 25% of the participants were identified as LGBTQIA+ ($n = 187$, 23.1%). Most of the participants reported being in a monogamous sexual relationship ($n = 598$, 73.7%). Data were analyzed using descriptive statistics, *t*-tests, one-way ANOVA, and multiple regression. Age and gender were not found to have significant effects on cannabis use and sexual functioning and satisfaction. Over 70% of participants reported increased desire ($M = 4.05$, SD = 0.962) and orgasm intensity ($M = 4.05$, SD = 0.884). Participants who reported masturbating indicated that cannabis enhanced their pleasure while masturbating ($n = 620$, 62.5%). Participants also stated that cannabis enhanced their sense of taste ($n = 583$, 71.9%) and touch ($n = 576$, 71.0%).

Discussion The results of this study contrast and establish new evidence within the literature. Demographic results indicate that the people who use cannabis are of a wide range of ages, from a variety of occupations, and have differing cannabis use preferences. The inclusion of LGBTQIA + respondents is a strength of this study. Overall, results indicated that both men and women perceived that cannabis use increased their sexual functioning and satisfaction, particularly increased desire and orgasm intensity.

Conclusion This study updates the current literature on cannabis and sexuality and provides implications for improving sexual quality. Medical implications of this study include the possible use of cannabis for treating sexual dysfunctions, especially within women.

Keywords Sex, Cannabis, Sensuality, Weed, Marijuana, Sexual pleasure

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Introduction

"*Cannabis sativa* L.," also known as "cannabis" or "marijuana", encompasses different varieties based on cannabinoid profiles (Small 2017). Cannabis has been historically used as a multi-functional crop including use as a medicine (Mechoulam et al. 2014; Mikuriya 1969; Russo, 2005), an aphrodisiac (Touw 1981), and as a potential treatment for sexual dysfunctions, such as low sexual desire or sexual pain (Dawley et al. 1979; Lynn et al. 2019). There has been increased attention given to the benefits of cannabis in recent years as it has become legal in many states (Han et al. 2018). Despite its many uses and the increased attention, there is a lack of research on the sexual benefits of using cannabis. Therefore, the purpose of this study is to examine the influences of cannabis on sexual functioning and satisfaction. This paper uses the term "cannabis" in reference to all forms of *Cannabis sativa* L., except within data collection where the term "marijuana" is used as a more recognizable term for all audiences.

Sexual functioning is physiological responses associated with the sexual response cycle that includes desire, excitement, plateau, orgasm, and resolution (Kaplan 1974; Masters and Johnson 1966). Sexual satisfaction encompasses both emotional and physical satisfaction (Basson 2001). Sensuality involves the different sensual effects (touch, taste, smell, sound, and sight) that are associated with sex. While sexual satisfaction has been shown to be influenced by sexual functioning and sensuality (Basson 2001), there is support for sexual satisfaction to be considered as a component of the sexual response cycle (Kontula and Miettinen 2016; Pascoal et al. 2018). The sexual response cycle provides a framework for this study to be organized by each phase (desire, excitement, plateau, orgasm, resolution, satisfaction).

This study compliments gender equality and may have implications for closing the orgasm inequality gap in our society (Mintz 2018). The orgasm inequality gap refers to the fact that orgasms are less consistent for women (Mintz 2018), yet research shows that orgasm is important to sexual satisfaction (Kontula and Miettinen 2016; Pascoal et al. 2018). The current research study emphasizes an individual's sexual functioning and sexual satisfaction and addresses the need to explore options to help women have more regular orgasms. One possibility for increased orgasm frequency is cannabis (Balon 2017). Using cannabis before sex has possibilities for social change by increasing sexual pleasure within our society as previous research indicates beneficial sexual implications, especially for women (Sun and Eisenberg 2017).

Background

The literature reviewed will be organized by sexual functioning (specifically using the sexual response cycle as a framework), sexual satisfaction, cannabis, and finally cannabis' influence on sexual functioning and satisfaction.

Sexual functioning and satisfaction

Masters and Johnson (1966) established the sexual response cycle that includes four phases: excitement, plateau, orgasm, and resolution. Each phase is identified by physiological responses of the body during sex; however, each phase may not be distinguishable from the next and may differ extensively each time and by each individual. Kaplan's (1979) Triphasic Concept of sexual response included desire as the first stage of the sexual response cycle and Basson (2001) considered sexual satisfaction to be an important component of the sexual response cycle.

Newer research has expanded the sexual response cycle and adds to the original work of Masters and Johnson and Kaplan. Rather than being linear, the sexual response cycle is circular with overlapping phases that follow a variable order and incorporates mental and emotional components, not just physiological responses (Basson, 2005; Cherkasskaya and Rosario 2018).

Sexual desire, also known as libido, is characterized as a sexual drive or interest in sex that lasts throughout the sexual encounter until orgasm or satisfaction is reached (Kaplan 1979). Cherkasskaya and Rosario (2018) found that sexual desire is on a spectrum that varies between absent or diminished to high desire. Without desire, one may not experience the excitement phase or any following stages of the sexual response cycle because one's mental state has greater implications than one's physical desire and arousal (Basson 2008) Toates (2009) created the incentive motivation model that considers the "intertwined progression of desire and arousal" that reinforces the idea that desire and arousal are reciprocally reinforcing.

Excitement is characterized by an increase in sexual tension from an unaroused state and occurs as a result of physical and/or psychological sexual stimulation (Masters et al. 1995). Physiological responses that occur during the excitement phase for both sexes include myotonia (increased neuromuscular tension that occurs throughout the entire body, not just the genital region) and vasocongestion (the swelling of bodily tissues in the genital region due to increased blood flow). Vasocongestion can lead to lubrication in women and an erection in men; however, vaginal lubrication alone is not an accurate measurement of arousal. Women may have genital responses such as lubrication or vasocongestion while not experiencing desire (Chivers and Bailey 2005).

During the plateau phase, sexual arousal is increased while sexual tension levels off prior to reaching the threshold levels required to trigger an orgasm (Masters et al. 1979). During orgasm, there is a release of accumulated sexual tension, and the body induces involuntary rhythmic contractions within the genital region. However, an orgasm is a total body response and is not strictly localized to the pelvic region (Masters et al. 1979).

After orgasm, the body enters the resolution phase and returns to its unaroused state. Yet, if a woman maintains sexual arousal, she is physiologically capable of being multi-orgasmic, meaning having more than one orgasm before returning to her pre-aroused state. Men are typically unable to be multi-orgasmic because of the inevitable phase of the refractory period (i.e., the recovery period required for men to orgasm again after orgasm and ejaculation, which typically gets longer with age).

Sexual satisfaction can be defined as an individual's subjective evaluation of the positive and negative aspects of one's sexual relationships (Lawrance and Byers 1995) and may be influenced by many factors such as relationship quality, physical health, and overall well-being (Pascoal et al. 2018). Multiple and consistent orgasms and frequent sex were found to be correlated with higher sexual satisfaction (Kontula 2009; Kontula and Miettinen 2016).

While more than 90% of men report usually experiencing orgasm during sex, less than 50% of women regularly experience orgasm during intercourse and only 6% reported always experiencing an orgasm during sex (Kontula 2009; Koontula and Miettinen 2016). Mintz (2018) in her book *Becoming Cliterate* coined the term "orgasm inequality" to describe the phenomenon of men having routine and consistent orgasms, while women do not. Orgasm consistency is significantly related to sexual satisfaction in women. Women who experience orgasm infrequently or not at all report, on average, lower levels of sexual satisfaction (Kontula, 2009; Kontula and Miettinen 2016). This implies that orgasms during sex are expected for men, but a bonus if accomplished for women (Kontula 2009).

Sex and cannabis

Cannabis has been identified to have sexually stimulating effects and can intensify sexual experiences (Cohen 1982). The cannabinoid profile in cannabis influences sexual functioning and satisfaction as too much tetrahydrocannabinol (THC) may cause more inhibiting effects (Palamar et al. 2018). Due to its muscle relaxant properties (Small 2017), cannabis use may be inhibitory to men's sexual functioning, yet, does not impair and may be beneficial for women's sexual functioning (Sun and Eisenberg 2017). Cannabis may indirectly enhance sexual functioning by decreasing anxiety and increasing relaxation and sensory focus (Klein et al. 2012). It also has been found to be independently associated with increased sexual frequency with daily and weekly users having significantly higher sexual frequency compared to never-users (Sun and Eisenberg 2017).

Historically, and among different cultures, cannabis has been suspected to have an aphrodisiac effect increasing desire and sexual arousal among individuals (Chopra and Jandu 1976; Dawley et al. 1979; Halikas et al. 1982; Mayor's Committee, 1944). Recent studies support this early research with reports of increased receptivity to and interest in sexual activity after using cannabis with women reporting higher rates of increased desire from cannabis use as compared to men (Androvicova et al. 2017; Lynn et al. 2019). Research has also found that cannabis users intentionally used cannabis for increased sexual desire as well as to decrease pain associated with sex (Green et al. 2003; Lynn et al. 2019).

Cannabis may also have implications during the excitement phase of the sexual response cycle which is characterized by the attainment of an erection in men and vaginal lubrication in women (Masters and Johnson 1966). Using cannabis has been reported to cause the inability to achieve and maintain an erection among men (Chopra and Jandu 1976; Masters et al. 1979) with a higher likelihood of developing erectile dysfunction among habitual users (Aversa et al. 2008). Foreplay could be considered an important part of the excitement stage and Palamar et al. (2018) found that cannabis use can increase the chances and duration of foreplay. Cannabis is also a vasodilator and because there are cannabinoid receptors in the genital region (Small 2017), cannabis may cause vasocongestion (i.e., lubrication) within female users. However, there is contradictory evidence on the influence of cannabis on female lubrication (Masters et al. 1979; Palamar et al. 2018).

During the plateau stage, which occurs after excitement but before orgasm, the vasocongestion response is at its peak in both men and women and the man's penis is at its full-potential erection (Masters and Johnson 1966). Men are more likely to report increased duration of intercourse when using cannabis compared to women (Palamar et al. 2018; Weller and Halikas 1984). However, time may be *perceived* to last longer when using cannabis due to the altered time effect of cannabis use (Chopra and Jandu 1976; Kaplan, 1974; Palamar et al. 2018) or this may be due to increased time spent during foreplay when couples may engage in sexual exploration and try new behaviors while using cannabis (Palamar et al. 2018).

Orgasm is the release of sexual tension and cannabis use may contribute to more prolonged and pleasurable orgasms (Androvicova et al. 2017; Halikas et al. 1982).

However, men's daily cannabis use has been associated with inability to reach orgasm and reaching orgasm too quickly or too slowly (Smith et al. 2010). Those who are able to orgasm when using cannabis have also reported an increase in the quality and intensity of the orgasm, which was found to be especially apparent for men (Weller and Halikas 1984; Halikas et al. 1982; Palamar et al. 2018).

Cannabis use before sex has been reported to enhance sexual enjoyment and pleasure for individuals, including oral sex (Dawley et al.1979; Halikas et al. 1982; Traub 1977). Sensuality involves the senses (taste, touch, smell, sound, and sight) and, for the purpose of this study, is incorporated as an aspect of sexual satisfaction. Cannabis has continuously been reported to enhance taste and touch but seems to have less of an effect on hearing, smell, and sight (Koff 1974; Masters et al. 1979; Halikas et al. 1982; Weller and Halikas 1984). Increased sensation and sensuality have been found to be related to cannabis use which may be related to length and intensity of intercourse (Palamar et al. 2018). Cannabis use before sex has been associated with more tender, slower, and compassionate sexual acts while also feeling more relaxed with their partner (Palamar et al. 2018).

There is a need for updated research as cannabis use is becoming more prevalent due to legalization (Substance Abuse and Mental Health Services Administration 2018). The majority of existing literature is outdated and some of it is contradictory, such as the physiological effects of cannabis on sexual functioning and satisfaction.

Research questions

The following exploratory research questions were proposed based on findings from previous literature as well as variables that have not been reported in previous literature: (a) Are there differences between men and women who use cannabis and their perceptions of sexual desire, orgasm intensity, and sexual satisfaction? (b) Does cannabis affect men's ability to achieve and maintain an erection? (c) Does cannabis use affect women's orgasm frequency? (d) How does cannabis use affect pleasure while masturbating? (e) What effect does gender, age, duration of cannabis use, intentionality, frequency of cannabis use, and cannabis form have on predicting sexual functioning and satisfaction?

Methods

This study was approved through the East Carolina University Institutional Review Board and was a self-report survey administered through the online software Qualtrics. Recruitment was purposeful and used snowball sampling. A brief description of the research and the survey were posted on the lead investigator's personal social media pages (Facebook, Twitter, Instagram, and Tumblr) with encouragement to share with others to increase the sample size. It was also shared on various Facebook groups related to cannabis, cannabidiol (CBD), alternative medicine, and related groups and emailed various cannabis organizations (e.g., medical and legal advocacy organizations) asking members to share the study information on their webpages or through email listservs. The study was voluntary and consent was obtained from all participants. Age and previous cannabis use were the first two questions on the survey to verify inclusion criteria (over 18 years old and have used cannabis in the past). Data collection was open for approximately 5 weeks in January 2019.

Measures

Study recruitment materials and questions in the survey used the term "marijuana" to refer to all forms of cannabis because it is a widely recognized term. The survey included demographic questions followed by a comprehensive scale developed by the researchers to measure sexual functioning and satisfaction in relation to cannabis use in a manner that used easy to understand format and phrasing.

Cannabis use

The questions regarding cannabis measured intentionality of use, benefits of use, where cannabis was obtained, forms used (e.g., flower, wax, etc.), frequency, and duration of use. Sensuality is a construct composed of the five senses. The question measuring cannabis forms asked participants to "check all that apply." To analyze how each form (flower, wax, oil, edible, topical) varied by scale score, each form selected was treated as a separate variable. A dichotomous variable for each of the five forms was created with 1 indicating that form was used by the participant and 0 indicating that it was not used. The frequency of cannabis use question was re-coded to be in the same direction as the other questions with a higher score indicating greater frequency.

Sensuality

Previous literature suggests that relaxation enhances sensuality so one item was included to measure relaxation during sex when using cannabis (Palamar et al. 2018). Sensuality was measured with five items with Likert scale response options ranging from *significantly decrease* to *significantly increase*.

Masturbation

Masturbation was included to measure sexual functioning and satisfaction with participants who use cannabis for self-pleasure purposes or may not have a sexual

partner. Three questions were asked about masturbation: whether or not participants masturbate, if participants use cannabis before masturbating, and if so, how cannabis affects their pleasure while masturbating.

Sexual functioning and satisfaction

A scale was developed to measure the participants' sexual functioning and satisfaction based on the incorporated framework (desire, arousal, orgasm, resolution, satisfaction) to analyze how cannabis influences each stage. This scale was developed as a direct and complete measure to analyze how cannabis specifically influences one's sexual functioning and satisfaction through each sexual response phase and overall satisfaction in a clear and concise format. The scale consisted of 14 items using the response options ranging from *significantly decrease* to *significantly increase*. These items were influenced by the following empirical studies: Dawley et al. (1974); Koff (1974); and Weller and Halikas (1984). Following development of the scale, all authors reviewed it for accuracy and clarity and to ensure that it adequately reflected current theory and research on sexual response, functioning, and satisfaction.

Arousal was measured with two questions for men (achieving and maintaining an erection) and one question for women (lubrication). In order to have a consistent number of items for both men and women, a new variable was created to measure arousal using one item measuring the ability to achieve an erection for men and one item measuring lubrication for women. The item on maintaining an erection was not used since lubrication and achieving an erection are analogous. The final scale included twelve items (see Table 1) with an internal reliability of 0.897.

Covariates

Basic demographic information collected included sex/gender, race, LGBTQIA + status, state of residency, education level, relationship status, and socioeconomic status. Participants indicated sex/gender by choosing one of three response options: male, female, or other. Eight response options were provided to measure race: White/Caucasian, Black/African American, Hispanic, Asian, Native American, Pacific Islander, Biracial, and Other. LGBTQ + status was measured by asking participants if they identified as LGBTQ + by choosing yes, no, or prefer not to answer. A drop-down menu was provided for state of residency. Education level was measured in a single item with seven response options ranging from "less than high school diploma or GED" to "Ph.D/Doctorate." Relationship status was measured with a single item with the following four response items: (a) In a monogamous relationship with one person, (b) In an open relationship, (c) Casually hooking up, (d) Not engaging in sexual activity with anybody. Socioeconomic status was measured using the participants' occupation and annual income which were open-ended questions.

Analysis plan

Descriptive statistics were used to determine the effect of cannabis use on pleasure during masturbation.

Table 1 Independent-samples *t*-tests of individual items of the sexual functioning and satisfaction scale

Item	Men *M* (*SD*)	Women *M* (*SD*)	Overall *M* (*SD*)
How does using marijuana affect your *relaxation* during sex?*	4.30 (0.830)	4.45 (0.778)	4.39 (0.801)
How does using marijuana influence your *desire* to have sex (libido, sex drive)?*	3.95 (0.963)	4.10 (0.952)	4.05 (0.962)
How does using marijuana influence your *intimacy/emotional closeness* during sex?	4.06 (0.844)	4.08 (0.930)	4.07 (0.898)
How does using marijuana influence your *physical pleasure*?	4.36 (0.803)	4.31 (0.844)	4.33 (0.830)
How does using marijuana influence your *frequency of sex* (how often you engage in sex)?	3.55 (0.865)	3.54 (0.862)	3.54 (0.860)
How does using marijuana influence your *variety of sexual activities* (i.e. locations, positions, times)?	3.63 (0.813)	3.56 (0.877)	3.58 (0.859)
How does using marijuana influence your *ability to orgasm*?*	3.48 (1.00)	3.86 (0.978)	3.72 (1.00)
How does using marijuana influence your *intensity of orgasm* (how strong the orgasm is)?	4.12 (0.822)	4.01 (0.914)	4.05 (0.884)
How does using marijuana influence your ability to have *more than one orgasm* per sexual encounter (multi-orgasmic)?*	3.45 (0.819)	3.67 (0.901)	3.59 (0.879)
How does using marijuana influence the *duration of sex* (how long sex lasts)?*	3.89 (0.928)	3.59 (0.856)	3.69 (0.894)
How does using marijuana influence your *ability to repeat sex* after orgasm?	3.48 (0.837)	3.43 (0.873)	3.45 (0.858)
Arousal			3.45 (1.01)
Males – How does cannabis influence your ability to *achieve* an erection (boner)?	3.57 (0.892)		
Females – How does using marijuana influence your *vaginal lubrication* (wetness of vagina)?		3.39 (1.05)	

Means range from 1 (significantly decreases) to 5 (significantly increases) with 3 being"does not change"

*$p < .05$

Descriptive statistics and independent-samples *t*-tests using individual items from the sexual functioning and sexual satisfaction scale were used to address the first four research questions. Prior to conducting the regression analysis, a Pearson Correlation was performed to examine associations between variables (age, gender, duration of cannabis use, form of cannabis, intentionality of using cannabis prior to sex, and frequency of cannabis use). The results of these preliminary analyses informed the inclusion of variables in the multiple regression. A multiple linear regression was then calculated predicting participants' scores on the sexual functioning and satisfaction scale based on age, gender, duration of cannabis use, form (flower, wax, oil, edible, topical), and frequency of cannabis use.

A one-way ANOVA was conducted to compare the effect of intentionality on and the sexual functioning and satisfaction scale. Intentionality was measured using one item asking if participants intentionally used cannabis before having sex which had two response options, "yes" or "no". All statistical analyses were performed using SPSS Statistics V28 (IBM Corporation).

Results

Sample description

The original sample size was 1299 participants. Participants ($n=133$) were removed from the study if they were under the age of 18 or indicated that they had never used cannabis. Another 355 participants did not answer the sexual functioning and satisfaction scale questions resulting in a final sample size of 811 for this study. Analyses were conducted to compare those who had not answered the dependent variable questions and thus excluded from this study ($n=355$) with those who answered dependent variable questions and were included in the study ($n=811$). These analyses revealed no significant association between race or ethnicity with inclusion in the study, X2 (7, 1165) = 9.974, $p=.190$, or between sex or gender with inclusion in the study, X2 (2, 1165) = 2.024, $p=.364$. However, a *t*-test revealed that there was a significant difference in age between those included and those who were not included, t (1159) = 1.898, $p=.029$. Those included in the study (m = 32.09 years) were older than those excluded (m = 29.27 years) which may have reflected greater comfort in responding to sensitive questions regarding sexual behavior and cannabis use.

Participant ages ranged from 18 to 85 years old ($M=32.11$). The majority of the participants stated their sex/gender as female ($n=536$, 64.9%), but the sample also included men ($n=277$, 34.2%) and those that identified as other ($n=8$, 1.0%). Most of the participants stated being White/Caucasian ($n=640$, 78.9%) had at least some college education ($n=650$, 80.1%) and almost 25% of the participants identified as LGBTQIA+ ($n=187$, 23.1%). A variety of occupations were represented in this study, including police officers, professors, and stay at home moms. The sample included at least one individual from each state, except South Dakota and Wyoming, and also included individuals from D.C., Puerto Rico, and participants ($n=104$) that resided outside the USA. Most of the participants reported being in a monogamous sexual relationship ($n=598$, 73.7%).

Cannabis use

Over half of the participants reported using cannabis daily ($n=509$, 62.8%), for recreational and medicinal purposes ($n=468$, 57.7%), and intentionally using before engaging in sex ($n=485$, 59.8%). A majority of participants have used cannabis at least a few years (88%; $n=714$). Almost all participants indicated using cannabis in the form of flower (i.e., pot, weed) (95.9%; $n=778$). Other forms used by participants included edible (59.2%; $n=480$), oil (48.0%; $n=389$), wax (36.5%, $n=296$), and topical (18.0%; $n=146$). The majority of participants (78.8%) stated that cannabis does not affect their sexual decision making ($n=639$) and that cannabis *slightly increases* or *significantly increases* relaxation during sex (87.7%; $n=711$). Results of the Pearson correlation indicated that there was a strong positive association between age and duration of cannabis use ($r=.457$, $p=.000$), age and frequency of cannabis use ($r=.167$, $p=.000$), and frequency of cannabis use and duration of cannabis use ($r=.239$, $p=.000$).

Sensuality

Many participants stated that cannabis *slightly increases* or *significantly increases* enhancement of sense of taste ($n=583$, 71.9%) and 71.0% stated that cannabis *slightly increases* or *significantly increases* their sense of touch ($n=576$). The majority of participants stated that the enhancement of the following senses does not change with cannabis use: smell (53.3%; $n=432$), sight (57.2%; $n=464$), and hearing (56.7%; $n=460$). Over 70% of participants ($n=583$) reported that taste was slightly or significantly enhanced when using cannabis ($M=3.96$, $SD=0.943$). Similarly, over 70% ($n=576$) reported that touch was slightly or significantly enhanced when using cannabis ($M=4.02$, $SD=0.906$). Table 2 provides mean scores for enhancement of the five senses.

Masturbation

In examining the effects of cannabis use while masturbating, the majority of the participants stated that they masturbate (88.3%; $n=716$). Of the participants who stated that they masturbate, 76.4% reported using cannabis before masturbating ($n=620$) and 62.5% indicated

Table 2 Mean scores of cannabis use and effect on sensuality by gender

Sense	Men *M* (*SD*)	Women *M* (*SD*)	Overall *M* (*SD*)
Taste	4.02 (0.928)	3.93 (0.949)	3.96 (0.943)
Touch	4.00 (0.905)	4.03 (0.911)	4.02 (0.906)
Smell	3.33 (0.895)	3.28 (0.849)	3.30 (0.865)
Sight*	3.12 (0.817)	2.97 (0.791)	3.02 (0.803)
Hearing*	3.42 (0.889)	3.22 (0.797)	3.29 (0.832)

Means range from 1 (significantly decreases) to 5 (significantly increases) with 3 being "does not change"

*$p < .05$

that cannabis slightly increases or significantly increases pleasure while masturbating ($n = 507$).

Sexual functioning and satisfaction

Over 70% of men and women ($n = 601$) reported that cannabis slightly or significantly increases desire ($M = 4.05$, $SD = 0.962$). An independent-samples *t*-test was conducted to compare desire in men and women. The perceived influence of cannabis on sexual desire was significantly higher for women ($M = 4.10$, $SD = 0.952$) as compared to men ($M = 3.95$, $SD = 0.963$); $t(799) = -2.187$, $p = .029$.

Men perceived either no effect or an increased ability to achieve and maintain an erection when using cannabis. Specifically 255 men (93.4%) reported no change or an increased ability to achieve an erection ($M = 3.57$, $SD = 0.892$) and 254 (92.4%) men reported no change or an increase in maintaining an erection ($M = 3.60$, $SD = 0.928$).

Over 70% of men and women ($n = 582$) reported that cannabis slightly or significantly increased orgasm intensity ($M = 4.05$, $SD = 0.884$). An independent-samples *t*-test was conducted to compare cannabis use and orgasm intensity in men and women. There was not a significant difference in the scores comparing men ($M = 4.12$, $SD = 0.822$) and women ($M = 4.01$, $SD = 0.914$); $t\ (798) = 1.586$, $p = .113$. However there was some support for orgasm frequency among women with over 40% of women ($n = 356$) reporting increased ability to have more than one orgasm per sexual encounter ($M = 3.67$, $SD = 0.901$).

Using descriptive statistics of the scale, men and women reported increased sexual satisfaction ($M = 3.825$, $SD = 0.613$). *T*-test analysis indicated that there was no significant effect based on gender, $t(801) = -0.187$, $p = .852$. However, because there were significant gender differences in other individual items, gender was included in the regression analyses. A multiple linear regression was calculated predicting participants' scores on the sexual functioning and satisfaction scale based on age, gender, duration of cannabis use, form (flower, wax, oil, edible, topical), and frequency of cannabis use. The regression equation was significant ($F(9,789) = 2.582$, $p = .006$) with a R^2 of 0.029. The forms wax and flower were significant predictors with topical forms approaching significance (Table 3). A one-way ANOVA was conducted to compare the effect of intentionality of cannabis use prior to sex on the sexual functioning and satisfaction scale. There was a significant effect of intentionality on the scale at the $p < .05$ level [$F(1,806) = 4.938$, $p = .000$] with those intentionally using cannabis before sex having higher scores on the sexual functioning and satisfaction scale.

Table 3 Results from linear regression model predicting effects of cannabis use on sexual functioning and satisfaction

Predictor	B	SE	*β*	*t*	*P*
Constant	3.518	0.144		24.503	0.000
Gender	0.021	0.046	0.016	0.451	0.652
Age	0.003	0.002	0.061	1.462	0.144
Duration of cannabis use	−0.027	0.022	−0.050	-1.229	0.219
Frequency of cannabis use	−0.001	0.016	−0.003	−0.083	0.934
Form—flower	0.235	0.111	0.077*	2.126	0.034
Form—wax	0.131	0.053	0.103*	2.484	0.013
Form—oil	−0.013	0.049	−0.010	−0.261	0.794
Form—edible	0.050	0.048	0.040	1.039	0.299
Form—topical	0.107	0.061	0.067	1.767	0.078
R^2		0.029			
F		2.582*			

*$p < .05$

Discussion

This nationwide study had a large sample size with the majority of participants being White college educated women. The inclusion of LGBTQIA + individuals is a strength of this study with almost 25% of the sample identifying as LGBTQIA+. Over half the sample ($n = 485$) reported intentional use of cannabis prior to engaging in sexual activities. Results indicate that the people who use cannabis are of a wide range of ages, from a variety of occupations, and have differing cannabis use preferences. This demographic profile of our sample aligns with previous research that indicates cannabis users vary in age and tend to be non-Hispanic White (Han et al. 2017; Mauro et al. 2017; O'Connell and Bou-Matar 2007). However, our sample differs from recent research regarding sex/gender and relationship status. Although approximately two thirds of our sample were women, Carliner et al. (2017) found that men continue to use at higher

rates than women despite the fact that cannabis use has increased for both men and women. Almost 74% of our sample reported being in a monogamous relationship which does not align with recent research that found that regular cannabis users were less likely to be in a relationship (Chan et al. 2021). These differences in our sample as compared to previous research on the sex/gender and relationship status of cannabis users suggest that caution should be used when generalizing results in regard to these demographic characteristics.

Sexual functioning and satisfaction

An important contribution of this study is the high reliability ($\alpha = 0.897$) for an expanded sexual functioning and satisfaction scale which incorporated Kaplan's phase of desire, Masters and Johnson's model (excitement, plateau, orgasm, resolution), and sexual satisfaction as the final stage. This comprehensive scale moves beyond the physiological effects (e.g., achieving an erection) and incorporates overall sexual functioning and satisfaction. The creation of the scale was crucial to gain a comprehensive oversight on aspects of sexual functioning and satisfaction with the ability to analyze and report how cannabis affects various sexual responses. The scale also incorporates the influence of cannabis on sexual functioning and satisfaction, as opposed to a scale that only measures sexual functioning and/or satisfaction.

In contrast to early literature (Koff 1974; Weller and Halikas 1984), no gender differences were found in regard to cannabis use and overall sexual functioning and satisfaction. Results from this study indicated that both men and women see benefits from using cannabis before sexual intercourse or masturbation. However, *t*-tests reveal that there were gender differences with the specific scale items of desire, relaxation during sex, and ability to orgasm. Decreased ability to orgasm could be influenced by both reduced desire and difficulty relaxing during sex. Therefore, if cannabis use allows women to relax and increases desire, they may then have improved orgasm capacity.

Many of the results were consistent with existing literature. One notable exception is men's ability to achieve and maintain an erection due to cannabis. Previous literature stated that men would have a more difficult time achieving and maintaining an erection when using cannabis, possibly due to the muscle relaxation properties of cannabis (Masters et al. 1979). The current study found that men did not report a decreased ability to achieve and maintain an erection. However, due to the self-report nature of this survey, social desirability may have prevented them from reporting erectile issues.

Similar to existing literature (Androvicova et al. 2017; Lynn et al. 2019), both men and women perceived increased desire and orgasm intensity when using cannabis. Women reported increased ability to have more than one orgasm per sexual encounter, which is similar to previous findings (Weller and Halikas 1984). These results align with the increased relaxation when using cannabis; those who use cannabis report being more relaxed, whether mental or physical, which would improve overall sexual functioning and pleasure. There was no difference in sexual functioning and satisfaction scale scores by age. This indicates that despite age, individuals still report sexual benefits from using cannabis. The age of the sample ranged from 18 to 85, suggesting that cannabis use may have benefits across the lifespan. The positive correlations between age and duration of cannabis use and between age and frequency of cannabis use further support the idea of regular use throughout the lifespan. Additionally, the positive correlation between individuals who have used cannabis for a longer amount of time (duration) and frequency of use means that those who use more cannabis more often were more likely to have been using cannabis for a longer period of time. However, neither duration or frequency of use influenced sexual functioning and satisfaction. People that identify as LGBTQIA + did not differ with cannabis use as one's sexual functioning and satisfaction is not generally impacted by sexual orientation.

Those who reported intentionally using cannabis before sex had significantly higher scale scores than those who reported not intentionally using cannabis before sex. This can be interpreted as those who intentionally used cannabis before sex perceived a greater benefit to their sexual functioning and satisfaction compared to those who do not intentionally use cannabis before sex. These results may be because of the mental mindset that using cannabis will increase pleasure due to the aphrodisiac notions of cannabis rather than a true physiological effect. However, the relaxation effects of cannabis may contribute to increased desire or reduced inhibitions that might contribute to increased sexual functioning and satisfaction. This also aligns with Palamar et al. (2018) who found that cannabis use can result in more and longer foreplay which can also contribute to positive sexual functioning and seuxual satisfaction. Individuals may also intentionally use cannabis before sex thinking that cannabis use helps with any sexual issues that they have, therefore increasing their sexual functioning and satisfaction.

While dosage could not be measured, forms of cannabis can give an indication of dosage, which has been found to have an impact on sexual functioning (Palamar et al. 2018). Although duration and frequency of cannabis use were not significant predictors, the forms of wax and flower predicted increased sexual functioning and satisfaction. While there is no literature on specific

cannabinoid profiles regarding sexual functioning and satisfaction, some products may have a greater influence on the physiological effects and overall satisfaction of sex due to the THC potency and cannabinoid profile.

Sensuality is an important aspect of sexual intercourse as it relates to the five senses. During sex, one uses many, if not all, of their senses. Men and women reported increased enhancement to touch and taste when using cannabis, which is consistent with previous literature (Weller and Halikas 1984). The enhancement of taste and touch could increase overall sexual functioning and satisfaction because these are two senses that are heavily used during sexual intercourse.

Implications

This study has the potential to impact policy, medicine, and practice by providing support for policy change and legalization advances for cannabis use. Increased access to cannabis may facilitate more research on its effects. Medical implications of this study include the possible use of cannabis for treating sexual dysfunctions, especially with women. Women with vaginismus (i.e., painful intercourse) may benefit from the muscular relaxation and increased sexual functioning that results from cannabis use, while women with decreased desire could also see possible benefits (Lynn et al. 2019).

Finally, regarding practice, results from this study suggest that cannabis can potentially close the orgasm inequality gap (Mintz 2018). The orgasm inequality gap states that men statistically are more likely to orgasm per sexual encounter compared to women (Kontula, 2009). Women may be more likely to orgasm when using cannabis before sexual encounters, which could contribute to equity in the amount of sexual pleasure and satisfaction experienced by both women and men. Sex therapists could incorporate use of cannabis in states where it is currently legal.

Limitations

While this study had a large sample size and was able to report evidence that has not been found in the literature, there were some limitations. Although the survey was internally reviewed multiple times by all members of the research team, it was not pilot-tested or externally validated. The sample was a convenience sample of individuals who self-selected to participate in the study which may cause selection bias. Additionally, participants were asked to retrospectively self-report based on many years which could result in recall bias. The collection of data by self-report rather than direct observation results in self-report bias in that results are measuring participants' perceptions of the effects of cannabis rather than the collection of physiological data. Respondents were largely college educated White women, so this study does not represent the majority of US cannabis users.

Dosage was not measured and many individuals are unaware of the amount and potency of cannabis that they are consuming. This is especially true for individuals who do not live in a state where cannabis has been legalized and where all products bought from a regulated dispensary are labeled. Social desirability may be another limitation to this study because of the sensitive nature of the survey questions. Participants may have answered in a desirable manner, particularly related to questions related to erection. This study did not measure medications, mental health status, and other predictors of sexual functioning (Basson 2001; Cherkasskaya and Rosario 2018). Chronic cannabis use has been found to have possible effects (Aversa et al. 2008; Hall, 2014), which this study did not extensively evaluate. Also, several variables were measured using single items and although the scale created had high reliability, it does not have established validity.

Future research

Cannabis has not been studied extensively, partly because of legalization barriers. This is especially true regarding the intersection of cannabis and sexual functioning and satisfaction. This study found that duration of cannabis use or frequency of cannabis use does not predict sexual functioning. However, previous literature indicates that daily and habitual users reported erectile difficulties in men (Aversa et al. 2008). Future research should focus on men's frequency and duration of cannabis use in regard to their sexual functioning. Additionally, age was positively correlated with both duration of cannabis use and frequency of cannabis use and the interaction between these three variables should be researched further.

Future cannabis research should focus on specific cannabinoid profiles, methods, and forms to indicate which has greatest sexual impact and implications. Clinical research to study this would be most accurate due to the social desirability effect of self-report surveys. Future research would also benefit from reviewing the endocannabinoid system and its impact on sexual functioning and satisfaction.

Conclusion

This study extended the limited literature regarding the influence of cannabis on sexual functioning and satisfaction. Results help to update the literature on cannabis and sexuality and contribute to implications for advancing policy, medicine, and practice. Expanding the sexual response cycle to include desire and sexual satisfaction

provided a useful framework for this study and results supported this expanded model. Overall, cannabis use tends to have a positive influence on perceived sexual functioning and satisfaction for individuals despite gender or age and cannabis might help to decrease gender disparities in sexual pleasure.

Abbreviations

THC	Tetrahydrocannabinol
CBD	Cannabidiol
LGBTQIA+	Lesbian/gay/bisexual/transgender/queer or questioning/other

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Authors' contributions
AM—conceived the topic of study, collected the data, data entry and processing, manuscript writing. SMB—responsible supervisor of AM, data entry and processing, manuscript writing; JJ—contributed substantially to the conception and design of the study, the acquisition of data, or the analysis and interpretation; contributed data and analysis tools; data analysis; manuscript review; and editing of final copy. PA—contributed substantially to the conception and design of the study, the acquisition of data, or the analysis and interpretation; manuscript review; and editing of final copy. All authors consent for publication. The authors read and approved the final manuscript.

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Declarations

Ethics approval and consent to participate
This study was approved by the Institutional Review Board and all participation was voluntary and anonymous.

Consent for publication
Consent was obtained from all participants.

Competing interests
The authors declare that they have no competing interests.

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Publisher's Note

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How Cannabis Alters Sexual Experience: A Survey of Men and Women

Ellen Wiebe, MD,[1] and Alanna Just, MPhil[2]

ABSTRACT

Introduction: Cannabis is reported to enhance sexual function; yet, previous studies have shown that physiological and subjective indices of sexual arousal and motivation were associated with decreased availability of circulating endocannabinoid concentrations.

Aim: To explain this contradiction, we evaluated which aspects of sexual experience were enhanced or diminished by cannabis use.

Methods: We used an online questionnaire with a convenience sample of people who had experience with cannabis. We asked questions regarding various aspects of sexual experience and whether they are affected by cannabis. We also asked about sexual dysfunction.

Main Outcome Measure: Aspects of participant sexual experience enhanced by cannabis.

Results: We analyzed results from 216 questionnaires completed by people with experience using cannabis with sex. Of these, 112 (52.3%) said they used cannabis to alter their sexual experience. Eighty-two participants (38.7%) said sex was better, 34 (16.0%) said it was better in some ways and worse in others, 52 (24.5%) said it was sometimes better, and only 10 (4.7%) said it was worse. Of 202 participants, 119 (58.9%) said cannabis increased their desire for sex, 149 of the 202 participants (73.8%) reported increased sexual satisfaction, 144 of 199 participants (74.3%) reported an increased sensitivity to touch, and 132 of 201 participants (65.7%) reported an increased intensity of orgasms. Out of 199 participants, 139 (69.8%) said they could relax more during sex, and 100 of 198 participants (50.5%) said they were better able to focus. Of the 28 participants who reported difficulty reaching orgasm, 14 said it was easier to reach orgasm while using cannabis, but only 10 said that sex was better.

Clinical Implications: The information in this study helps clarify which aspects of sexual function can be improved or interfered with by cannabis use.

Strengths & Limitations: We asked about specific sexual effects of cannabis and were therefore able to understand the paradox of how cannabis can both improve and detract from sexual experience. Limitations of this study include bias that may have been introduced because the sample included only people who responded to the advertisements; it may not represent the general population of people who use cannabis. Moreover, over one-third of our sample said they use cannabis daily and so represent heavier than average users.

Conclusion: Many participants in our study found that cannabis helped them relax, heightened their sensitivity to touch, and increased intensity of feelings, thus enhancing their sexual experience, while others found that cannabis interfered by making them sleepy and less focused or had no effect on their sexual experience. **Wiebe E, Just A. How Cannabis Alters Sexual Experience: A Survey of Men and Women. J Sex Med 2019; 16:1758–1762.**

Key Words: Cannabis; Sexual Experience; Sexual Dysfunction

INTRODUCTION

Cannabis has a reputation for enhancing sexual function. Several surveys in the 1970s found that both men and women reported that using cannabis enhanced their sexual experience.[1,2] Women reported greater increases in desire and satisfaction than men.[3] Various hypotheses for why people report cannabis-related enhancement of sexual experiences include the effect of cannabis

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Table 1. Participant demographic information

Demographic	Frequency	Percent of respondents
Gender (n = 211)		
Female	133	63
Male	76	36
Transgender	2	1
Education (n = 210)		
Some high school	5	2.4
High school diploma/General Education Development	15	7.1
Some college/university	77	36.7
College/university degree	113	53.8
Ethnic origin (n = 193)		
White/Caucasian	141	73.1
South or East Indian	52	26.9
Born in Canada (n = 209)		
Yes	142	67.9
No	67	32.1

Table 2. Participant responses regarding cannabis use

Participant responses	Frequency	Percent of respondents
Frequency of cannabis use (n = 217)		
Daily	82	37.8
Most weeks	51	23.5
Sometimes	57	26.3
Not any more	27	12.4
Experience using cannabis during sex? (n = 216)		
Yes	209	96.8
No	7	3.2
Have you used cannabis specifically to alter your sexual experience? (n = 217)		
Never	104	47.9
Rarely	27	12.4
Occasionally	64	29.5
Usually	15	6.9
Always or almost always	7	3.2
Do you prefer to be high on cannabis when you have sex? (n = 209)		
Yes	86	41.1
No	123	58.9
How has using cannabis altered your sexual experience? (n = 212)		
Better	82	38.7
No change	34	16.0
Worse	10	4.7
Better in some ways, worse in others	34	16.0
Sometimes better but at other times no change or worse	52	24.5

on heightened perceptions, time distortion, relaxation, and decreased inhibition.[1] A large survey of 8,656 Australians found that daily cannabis use was associated with having more sexual partners and sexually transmitted infections. Moreover, daily cannabis use was related to increased reports of difficulty reaching orgasm in men but was unrelated to sexual problems in women.[4]

Conversely, a more recent study showed that increases in both physiological and subjective indices of sexual arousal were significantly associated with decreased endocannabinoid concentrations.[5] In rodents, studies have shown that sexual motivation is decreased following cannabinoid administration and increased following cannabinoid receptor antagonism.[6,7]

Cannabis (or marijuana) is commonly used. The 2015 National Survey on Drug Use and Health in the United States reported that 22.2 million Americans had used cannabis in the previous month.[8] In many jurisdictions, including Canada, where this study was conducted, and in 13 US states, cannabis is legal for recreational use.[9,10] The leaves and flowering tops of cannabis plants contain at least 489 distinct compounds, distributed among 18 different chemical classes and harboring more than 70 different phytocannabinoids.[11] The main cannabinoids are delta-9-tetrahydrocannabinol and cannabidiol. Endogenous cannabinoids (or endocannabinoids) bind to the same receptors as those of tetrahydrocannabinol, the psychoactive component of cannabis. There are cannabinoid receptors in the ovary, endometrium, and myometrium,[12,13] and this may be relevant to sexual effects.

The purpose of this study was to explore what people experience when using cannabis with sex and whether they specifically use cannabis to enhance sexual experience. We hypothesized that cannabis use has both negative and positive effects on sexual experience and that the positive effects would be greater than the negative ones.

METHODS

This study consisted of an online questionnaire for people in the community who had experienced using cannabis during sex. The questionnaire included demographic questions plus questions regarding frequency of cannabis use, purposes for cannabis use, whether participants engaged in sexual activity while under the influence of cannabis, and whether cannabis use enhanced, interfered with, or made no difference in their sexual experience. We designed the survey with input from a sexologist colleague and pilot tested it before posting.

Men and women were recruited from various sites using various methods: word of mouth, posters in cannabis retail outlets, cannabis advocacy groups, women's groups, university bulletin boards, and a classified advertisement website (Craigslist). In the cannabis shops, we talked to the vendors (shop managers) and, if permitted, posted the study information with the URL link to the online questionnaire (using SurveyMonkey). When contacting people by e-mail (eg, through word of mouth, advocacy groups) the link was given. No identifying information was collected.

Table 3. Aspects of participant sexual experience that were enhanced by cannabis use

Aspect of sexual experience that was enhanced	Frequency	Percent of respondents
Desire for sex (n = 202)	119	58.9
Sexual satisfaction (n = 202)	149	73.8
Vaginal lubrication (n = 153)	44	28.8
Erectile function/hardness (n = 133)	49	36.8
Sensitivity to touch (n = 199)	144	74.3
Intensity of orgasm (n = 201)	132	65.7
Ability to orgasm (n = 195)	86	44.1
Ability to relax during sex (n = 199)	139	69.8
Ability to focus during sex (n = 198)	100	50.5
Sexual confidence (n = 198)	107	54.0
Emotional closeness to partner (n = 197)	117	59.4

Data from the questionnaires were entered into an SPSS Statistics 25 (IBM Corp; Armonk, NY) database by a research assistant, and descriptive statistics were prepared. We used *t*-tests for continuous variables and chi-square tests for categorical variables to compare men to women. For the open-ended questions on the questionnaire, thematic analysis was used. The 2 investigators began by looking at the whole, then use detailed coding to discover themes.[14–16] Investigators met several times to discuss and revise themes until a consensus was reached.

RESULTS

Out of the 373 respondents, 350 said they had previously used cannabis, and only responses from these respondents were analyzed (see Table 1 for demographic information). The ages of respondents ranged from 17 to 75 years, with a mean of 29.9 years and a median of 25 years. The majority of participants (96.8%) had experience using cannabis during sex, 52.3% of whom reported using cannabis specifically to alter their sexual experience. When asked how cannabis affected sex, 16.0% of the 212 respondents said sex was better, 16.0% said it was better in some ways and worse in others, 24.5% said it was sometimes better in some ways and worse in others, and 4.7% said it was worse (Table 2).

Participants were asked how specific aspects of their sexual experience were altered by cannabis use during sex (Table 3). Participants reported an increased desire for sex (n = 119 of 202), increased sexual satisfaction (n = 149 of 202), increased vaginal lubrication for women (n = 44 of 153), increased erectile function/hardness for men (n = 49 of 133), increased sensitivity to touch (n = 144 of 199), increased intensity of orgasms (n = 132 of 201), increased ability to orgasm (n = 86 of 195), increased ability to relax during sex (n = 139 of 199), increased ability to focus during sex (n = 100 of 198), increased sexual confidence (n = 107 of 198), and increased emotional closeness to their partner (n = 117 of 197). Only 2 aspects differed significantly between men and women; 62 out of 122 women (50.8%) said that it was easier to reach orgasm when using cannabis, but only 22 out of 70 men (31.4%) did ($P = .038$). Additionally, 37 out of 127 women (29.4%) said it was more

Table 4. Open-ended questions and participant responses

Theme	Participant response
Cannabis increases sensitivity and intensifies the experience.	The occasional night of stoned sex can be incredibly loving, intimate, and intense.
	More physically intense, emotionally intimate, rhythmic. I am able to last longer and am more interested in giving oral sex and extending foreplay.
	Be more present. More pleasure.
Relaxation improves the experience.	[I am] more relaxed and engaged in the act, more likely to let go = higher chance of orgasm.
	It's a lot easier to come, both because I get out of my own head a bit and because physically I'm just more in the moment and more sensitive.
Cannabis improves or worsens focus and that affects sexual pleasure.	It helps the mind focus on the pleasure of touch. Every sense is heightened, you feel light and warm and in the moment of bliss.
	Sex can be much better, but as a woman who has to focus to reach orgasm, doing so is more difficult. That being said, when it does happen it is more intense.
Cannabis can interfere with sexual pleasure; this interference is often related to using too much.	It depended. Sometimes it enhanced the experience, sometimes I became self-conscious and paranoid and it detracted from the experience.
	Sometimes when stoned and having sex I lose my concentration and stop for some reason.
	Too distracted to be completely present.
	I'm usually too tired from the marijuana to be in the mood.
	Too much makes it worse, but just a little bit makes it better.

difficult to focus during sex compared to 8 out of 70 men (11.4%) ($P < .03$).

We asked questions regarding sexual dysfunction to determine whether people used cannabis to treat this condition. Eight people (7 women and 1 man) reported that sex was often painful. Of these 8 people, all said they were better able to relax when using cannabis. Seven reported increased sexual satisfaction, 6 reported increased focus, 6 reported increased emotional closeness to their partner, and 5 said it was easier to have an orgasm when using cannabis. Twenty-eight people reported difficulty reaching orgasm; of these, 14 said it was easier to reach orgasm when using cannabis. Ten said that sex was better, 7 said that sex was better in some ways and worse in others, 6 said that sex was better sometimes and not others, 4 reported no changes, and 1 said that sex was worse when using cannabis.

In response to open-ended questions and comments, people expanded on their answers, and we were able to identify several themes (Table 4). The most important theme was that cannabis increased sensitivity and intensified the sexual experience. The next most important theme was about how relaxation improved the sexual experience. Many people commented on how cannabis could improve or worsen focus and how that affected sexual pleasure. The descriptions of how cannabis could interfere with sexual pleasure were varied but appeared to be mostly about using too much.

DISCUSSION

The general impression that sex is better with cannabis does not fit with what we know about the physiological responses to cannabinoids.[5–7] The results from this survey shed some light on this contradiction. The reports of increased sensitivity to touch and intensity of feelings, both of orgasms and emotional closeness, would logically improve sexual experience. The relaxation described would likely improve sexual experiences in stressful situations and in anxious people. Reports of enhanced focus or increased distraction may relate to the amount of cannabis used or individual reactions to cannabis. This is also true of reported sleepiness and paranoia. None of these reactions to cannabis is specifically related to physiological sexual response, but they do impact sexual experience. We found only a few differences between men and women, with women having more difficulty with focus and less difficulty achieving orgasm when using cannabis. This may be due to women needing more focus, and, as a result, women may have more difficulty achieving orgasm. This survey is limited by being a convenience sample of people who responded to the advertisements. As such, it may not represent the general population of people who use cannabis. Over one-third of our sample said they used cannabis daily and so represent heavier than average users. Further research is needed to delineate the different effects of cannabis on sexual experience and more specifically on sexual dysfunction.

CONCLUSION

In this survey of people who had used cannabis with sex, the majority found that cannabis helped them relax, heightened sensitivity to touch, and increased intensity of feelings, thus enhancing sexual experience. Others found that cannabis made them sleepy, less focused, and distracted, and some reported no change in their experience.

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AN ATTITUDE SURVEY OF THE EFFECTS OF MARIJUANA ON SEXUAL ENJOYMENT

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Determined attitudes on the effects of marijuana on sexual enjoyment by self-report for a group of 84 graduate students of health sciences. The students were grouped in three categories: those who had sexual experience while under the influence of marijuana (experienced smokers), those who have smoked marijuana but who have not had such experience (non-experienced smokers), and non-smokers. Results are again inconclusive despite the fact that a majority in each category responded in a positive manner to the initial question concerning the effect of marijuana on the enjoyment of sexual intercourse. There is sufficient support to indicate that at least some experienced smokers have derived an enhancement of sexual pleasure while they were using marijuana. The implication is that there may be value in researching the use of marijuana in treatment of sexual disorders.

One of the persistent questions related to marijuana usage is that of its effect on sexual performance and enjoyment. Part of the mystique associated with marijuana usage involves its purported qualities as an aphrodisiac. Although marijuana long has been rumored to have these qualities, little systematic research has been directed to this area. Nevertheless, there are several accounts of an enhancement of sexual pleasure as an effect of marijuana usage (Brown & Stickgold,

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[2]Appreciation is expressed to Clifford Hurndon for his assistance in the preparation of this manuscript.

1974; Chausow & Saper, 1974; Hager, 1975). Bouguet (1950) stated that in North Africa and Egypt there is a strong belief that marijuana enhances sexual satisfaction and that this is an important cause for initiating use. Chopra and Chopra (1967) reported that 10% of a sample of approximately 1200 users listed increased sexual excitement as a cause that led to the cannabis habit. Goode (1969) surveyed 200 marijuana users with regard to the effects of marijuana on sexual enjoyment. In response to the question, "Do you think being high on marijuana stimulates sex interest, or not?", 38% replied that it did not; 5% replied that it had a decidedly negative effect; 13% replied that the effect depended on either their mood, partner or both; but 44% replied that marijuana definitely increases their sexual desire. With respect to the male-female response pattern, 39% of the men and 50% of the women claimed increased sexual interest. There is, however, insufficient evidence at the present time for conclusive statements on the relationship between marijuana and sexual enjoyment. The need for further investigations in this area is obvious. The present study is an assessment of attitudes with regard to the effects of marijuana on sexual excitement.

Method

Subjects and Instruments

Eighty-four graduate students of health sciences enrolled in a southeastern medical center served as *Ss*. A 57-item multiple choice and true-false questionnaire was developed by one of the authors to determine the attitudes of the individuals in the sample with regard to sexual behavior and marijuana usage as well as the actuarial characteristic of the sample. Included among these questions were 15 Lie (L) scale items from the MMPI[1] (Reproduced by permission for research purpose only. Copyright 1943, renewed 1970 by the University of Michigan. Published by The Psychological Corporation, New York, N.Y. All rights reserved.) These questions were used as a rough validity check of the responses.

Fifty-one percent of the 84 students in this survey were between the ages of 24 and 28; 44% were between the ages of 19 and 23. As might be expected, only 4% of the students were above 28 and 1% below 18 years of age. Seventy-eight percent of the respondents were male and 22% female.

Procedure

An explanation of the purpose of the questionnaire (i.e., to investigate the perceived effects of marijuana on sexual pleasure and satisfaction) was given to the students in a classroom setting. Individuals who had participated in sexual activity while under the influence of marijuana were asked to complete the questionnaire with respect to their personal experience. Those who had not had such experience, whether or not they had ever used marijuana, were asked to answer the question in terms of what they thought the relationship between marijuana and sexual activity would be.

The completed questionnaires were collected and the answers tabulated. Individuals who scored above 11 on the Lie scale questions and those who neglected to note whether they were experienced users of marijuana were omitted from further consideration. Eleven questionnaires were eliminated for these reasons.

Results

A majority of the sample (59 of 84) reported that they had at least once, but most of these smokers reported their use as less than 15 times. Thirty-nine percent of those surveyed reported that they had engaged in sexual intercourse

[1]Since there is evidence to indicate that item responses obtained to selected items isolated from the context of a personality inventory may not be comparable to those obtained within the context, the results of this research should not be considered applicable to the standardized complete form of the inventory.

while under the influence of marijuana. Of the remainder of the sample, 26 were smokers and 25 were not. Since all *S*s were asked to complete the questionnaire regardless of their experience, the data are best viewed with a consideration of three *S* types: Experienced smokers (33 *S*s), non-experienced smokers (26 *S*s), and non-smokers (25 *S*s). The pertinent results are presented in Table 1.

TABLE 1

GROUP RESPONSES TO QUESTIONS THAT CONCERN EFFECT OF MARIJUANA ON SEXUAL PLEASURES

Question	A Experienced smokers ($N = 33$) (%)	B Non-experienced smokers ($N = 26$) (%)	C Non-smokers ($N = 25$) (%)	D Total ($N = 84$) (%)
34. Marijuana usage has the following effect on enjoyment and satisfaction associated with sexual intercourse:				
A. Increases pleasure	88	77	52	74
B. Decreases pleasure	6	8	20	11
C. No effect	6	15	28	15
35. While under the influence of marijuana the sensations associated with sexual intercourse are:				
A. Positive effect	48	69	48	55
B. Negative effect	12	12	12	12
C. No effect	36	19	24	27
D. No response	4	0	16	6
46. Marijuana usage has the following effect on the frequency of engaging in sexual intercourse:				
A. Positive effect	27	38	32	32
B. Negative effect	3	15	12	10
C. No effect	64	46	44	52
D. No response	6	1	12	6
49. My partner's use of marijuana has the following effect on my sexual enjoyment:				
A. Increases pleasure	48	54	44	49
B. Decreases pleasure	3	8	4	44
C. No effect	12	38	52	5
D. No response	7	0	0	2
51. Marijuana usage affects the satisfaction and enjoyment associated with oral sex as follows:				
A. Increases pleasure	42	54	20	39
B. Decreases pleasure	3	15	20	12
C. No effect	39	27	52	39
D. No response	16	4	8	10
52. I engage in more varied sexual activity while under the influence of marijuana:				
A. More varied	12	54	40	33
B. No more varied	76	42	40	55
C. No response	12	4	20	12
53. Marijuana usage affects the frequency of my engaging in oral-genital sex as follows:				
A. Positive effect	24	38	28	30
B. Negative effect	0	4	4	2
C. No effect	64	54	56	58
D. No response	12	4	12	10

TABLE 1 (continued)

Question	A Experienced smokers (N = 33) (%)	B Non-experienced smokers (N = 26) (%)	C Non-smokers (N = 25) (%)	D Total (N = 84) (%)
54. When both my partner and I use marijuana, sexual pleasure and satisfaction is affected as follows:				
A. Increases pleasure	76	65	32	60
B. Decreases pleasure	3	8	16	8
C. No effect	12	23	40	24
D. No response	9	4	12	8
55. The use of marijuana has the following effect on the intensity of sexual orgasm:				
A. Increases intensity	58	35	36	44
B. Decreases intensity	6	15	12	11
C. No effect	27	46	40	37
D. No response	9	4	12	8
57. An aphrodisiac increases sexual pleasure and I feel marijuana is an aphrodisiac.				
A. True	61	35	36	45
B. False	27	50	50	44
C. No response	12	15	14	11

Experienced smokers (cf. Table 1) held the most positive views on the pleasure-enhancing effects of marijuana. Marijuana was seen as increasing sexual pleasures and sensations as well as the intensity of orgasm. Usage by the partner or by both individuals was seen as enhancing sexual enjoyment. In general, these students did not feel that marijuana had any major effect on the frequency of sex or oral sex. The majority of this group (61%) considered marijuana an aphrodisiac.

Non-experienced smokers (see Table 1) differed only slightly in their ideas about how marijuana would influence sexual behavior. Marijuana was felt by most students to increase pleasure and sensations associated with sexual intercourse and oral sex. Usage by the partner or by both members was viewed as enhancing pleasure. In general, marijuana was felt to have little or no effect on the frequency of intercourse or oral sex, the variety of sexual encounters, or the intensity of orgasm. In contrast to experienced smokers, this group did not consider marijuana to be an aphrodisiac.

Non-smokers (cf. Table 1) conceded that marijuana would increase the pleasure and sensations of sexual intercourse, but in general viewed marijuana as having no effect. Similarly, marijuana was not considered an aphrodisiac.

When the total sample (cf. Table 1) is considered, highest percentages of positive responses are seen in those items that pertain to increased pleasure, sexual sensations, and intensity of orgasms as well as increasing variety of sexual experiences. Smoking by both partners also is viewed as enhancing pleasure. Respondents reported no effect or a split decision on marijuana's effect on frequency of intercourse or oral sex, and pleasure associated with oral sex, as well as pleasure associated with partner's usage. Similarly, the aphrodisiac question was a split decision; 45% viewed marijuana as an aphrodisiac and 44% said no. Yet, very few respondents felt that marijuana would decrease pleasure or have deleterious effects.

Discussion

The results of this study revealed rather complicated attitudes about the effects of marijuana on sexual excitement, yet several general statements are apparent. Enthusiasm for marijuana as an agent that enhanced sexual pleasure was most prominent in the group of experienced smokers, with the non-experienced smokers and non-smokers following in that order. Very few *Ss* in any of the groups felt that marijuana use would decrease pleasure or have negative effects, yet only the experienced smokers considered marijuana to be an aphrodisiac.

There are at least two possible explanations for the mode of action of marijuana in this regard. The first is that smokers are more inhibited or sexually conflicted and that cannabis use is directed at lessening inhibitions, decreasing anxiety, and/or repressing conflicts. Brill and Christie (1974) in their follow-up study of the psychosocial adaptation of a collegiate population speculated that although users are sexually more active, they are also more maladjusted with regard to sex and marriage. If marijuana is being used to diminish sexual inhibitions, the mechanism might be similar to the punishment-lessening effects of benzodiazepines (Stein, Belluzzi, & Wise, 1977). Winstead and his associates (Winstead, Blackwell, & Lawson, 1978) have viewed drug use as a biological coping device aimed at decreasing an individual's level of discomfort, which is seen as a combination of internal personality susceptibility and external enviromental stress. Such a theory would view marijuana use at the time of a sexual encounter as an individual's attempt to cope with the stress of the situation.

An alternate explanation is that marijuana enhances sexual pleasure by a direct euphorogenic mechanism. Research by Heath and his associates (Heath, 1964, 1972; Heath & Gallant, 1964; Heath, John, & Fontana, 1968) suggests that the active constituents of marijuana produce a unique effect on the activity of brain cells associated with pleasureable feelings. Other data confirm this, as marijuana users have been found to begin sexual experience at an earlier age and to have more sexual experience as well as a more liberal attitude toward sex (Hochman & Brill, 1973). Pleasure enhancement also might be related to marijuana's reported influence on temporal span of awareness and the secondary increase in concentration on present events (Melges, Tinklenberg, Hollister, & Gillespie, 1971).

Obviously both mechanisms might be possible in different individuals or in the same individual at different points in time. Alternately, the effects merely may be dose-related.

Unfortunately, our present study does not answer this question of mode of action. Further research is necessary before any definitive answers are available. Nevertheless, the possibility that marijuana has a role as a treatment adjunct for sexual dysfunctions should be explored.

When one is considering the results of this study, it is important to note several limitations. As is true in much survey research, the validity of individual responses is almost impossible to verify, although an attempt to do so has been made here by inclusion of the Lie scale items from the MMPI. Also, the limited nature of the sample in terms of socioeconomic background must be considered as well. Obviously generalization beyond equivalent samples is questionable at best. Problems of multiple drug use and the confounding effects of drug interactions have not been addressed in spite of the known pattern of simultaneous alcohol and marijuana use (Kandel & Faust, 1975). It is the intention of the authors to present these findings not as conclusive, but for their heuristic value for further investigations.

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PSYCHOCLINICAL EFFECTS OF LONG-TERM MARIJUANA USE IN 275 INDIAN CHRONIC USERS. A COMPARATIVE ASSESSMENT OF EFFECTS IN INDIAN AND USA USERS

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INTRODUCTION

The use of marijuana has aroused horror and rejection as well as adulation in the world. The present widespread use of the drug is a worldwide phenomenon. No caste, creed, nation, or country is free from its use. There are divergent views about its long-term effects. Despite keen public and professional interest in the adverse reactions and complications that result from chronic use of cannabis drugs, the description and documentation of associated medical and psychic effects have seldom gone beyond generalizations. This study will report on 275 chronic cannabis users and also on 17 alienated youths ("hippies") from America and Europe who had come from Nepal to India and smoked or consumed cannabis drugs regularly for periods of 6 months to several years. They volunteered information and submitted to examination. The studies were conducted in original settings at places of indulgence and work.

METHODOLOGY

The subjects were examined immediately after they had taken the drug and also after its effects had disappeared. Routine physical and neurologic examinations were performed, during which the individuals were subjected to intense interviews concerning the history of drug abuse, dose, frequency of use, duration, family, friends, interest in work, and their own assessment of the effects of marijuana. The subjects were also evaluated with respect to personality, mood, attitudes, and emotional stability.

Clinical Groups

Considering that the Indian and Nepali marijuana used in India is approximately equal in potency to the Mexican plant, which contains 1.47% Δ^9-tetrahydrocannabinol (Δ^9-THC), TABLE 1 lists the mean daily dose of the subjects as calculated in equivalents of Δ^9-THC content. The subjects were divided into four groups according to age, dose, and duration of use. Educational and vocational and income data are presented in TABLES 2 and 3, respectively.

TABLE 1

DOSE, AGE, AND DURATION

Group	Sample No.	Mean Age (years)	Mean Duration (years)	Mean Daily Dose of Δ^9-THC (mg)
I	56	48.5	27.1	350
II	58	29.7	7.0	150
III	72	19.1	3.5	75
IV	89	17.2	2.1	40

* *Bhang, ganja,* and *charas* were assessed and found to contain about 1, 3, and 5% by weight of Δ^9-THC, respectively.

TABLE 2

EDUCATIONAL LEVELS

Group	Sample No.	Uneducated		High School *		University	
		No.	%	No.	%	No.	%
I	56	40	71.42	16	28.57	—	—
II	58	32	55.17	18	31.03	8	13.79
III	72	20	27.77	45	62.50	7	9.72
IV	89	17	19.10	30	33.70	42	47.19
Total	275	109	39.63	109	39.63	57	20.72

* Fifteen hippies were high-school dropouts, and two were high-school graduates.

TABLE 3

VOCATIONS AND INCOME

Vocation	Number	Percent	Average Monthly Income (US dollars)
No income, beggars	26	9.45	0
Religious mendicants	25	9.09	25
Priests	20	7.27	31
Laborers	80	29.09	40
Artisans	46	16.72	50
Semiskilled workers	35	12.72	40
Skilled workers	15	5.45	65
Students	22	8.01	dependent on parents
White-collar workers	6	2.18	75

RESULTS

Subjective Assessment of Physical Health

The subjects' assessments of the effects of marijuana on their general health and working capacity are listed in TABLE 4. The 29.09% from the younger groups who used smaller doses believed that the drug had no adverse effect on their health. In 23.60% of the cases, health was thought to be impaired to a minor degree, whereas 43.63% complained of a marked degree of impairment in their general health and working capacity. The remaining 10 (3.68%) thought that their health and working capacity had improved.

TABLE 4

SUBJECTIVE ASSESSMENT OF PHYSICAL HEALTH

Group	Number	Mean Daily Dose of Δ^9-THC (mg)	No Adverse Effect on Health	Minor Impairment	Marked Impairment	Improvement
I	56	350	26 (32.50) *	18 (27.69)	50 (41.56)	
II	58	150	13 (16.25)	28 (43.07)	35 (29.16)	
III	72	75	22 (27.50)	5 (7.5)	25 (20.88)	6 (60)
IV	89	40	19 (23.75)	14 (21.53)	10 (8.3)	4 (40)
Total	275		80 (29.09)	65 (23.6)	120 (43.63)	10 (3.63)

* Figures within parentheses are percentages.

Effects of habitual indulgence in cannabis drugs on general health (TABLE 5) were generally minor, taking into consideration the poor nutrition and insanitary health conditions in which the Indian marijuana users live, when compared to the effects of other psychotoxic drugs, including alcohol. The former included respiratory disorders, such as laryngitis, pharyngitis, asthma, irritation cough, and dyspnea. The gastrointestinal system was seldom involved, although there were instances of increased appetite, dyspepsia, and minor liver damage. In the long-standing cases, there was evidence of malnutrition, anemia, poor skin condition, and congestion of ciliary vessels, sometimes with discoloration of the conjunctiva due to prolonged congestion. All of the effects were more pronounced in the first two groups, which was comprised of older individuals taking large drug doses over prolonged periods.

TABLE 5

GENERAL SYSTEMIC EFFECTS (SAMPLE 275)

Effects	Group I	Group II	Group III	Group IV	Total
Malnutrition, anemia, asthenia, sallow complexion	15 * (5.45) †	7 (2.54)	2 (0.72)	—	24 (8.62)
Conjunctival vessels, congestion, discloration of conjunctiva	38 (13.81)	13 (4.72)	5 (0.18)	—	56 (20.25)
Respiratory disorders, pharyngitis, dryness of throat, chronic bronchitis	58 (21.09)	23 (8.35)	8 (2.90)	—	89 (32.36)
Gastrointestinal disorders, indigestion, unduly increased appetite, diarrhea	17 (6.18)	8 (2.90)	4 (1.45)	—	29 (10.54)
Poor condition of skin, sallow muddy complexion	51 (18.54)	30 (10.9)	23 (8.36)	6 (2.18)	110 (40.0)

* Number.
† Percent.

Psychopharmacologic Effects of Daily Doses in Chronic Users

TABLE 6 summarizes the effects and symptoms observed in each group with controlled doses. Most of the subjects in our present series took the drug with the objective of attaining a mild sense of intoxication, a relaxation of feelings toward sociability. The environment had a pronounced effect on the general trend of the subjective symptoms. Even though the doses were regulated, adverse reactions occurred in some individuals. These reactions are listed in TABLE 6.

Adverse psychic effects were found to occur with a greater incidence in the younger groups, which included subjects with mean ages between 19.1 and 17.2 years. Some of these younger subjects had histories of childhood neurosis, psychopathic personality, deviancy, and anxiety. They took the drug to stabilize these conditions and to regain self-confidence.

Psychologic Reactions When the Daily Dose Was Exceeded

Numerous addicts were contacted in the same region. Eighty-five subjects were found who had taken the drug in larger than the usual doses and were in a state of acute intoxication. TABLE 7 shows the adverse psychiatric reactions that occurred and the mean doses necessary to elicit each reaction, with the durations and doses specified. It can be seen that the type and intensity of the reaction varied with the dosage. As previously reported, prolonged marijuana use in larger doses may induce psychosis in individuals with low psychotic thresholds. It may also produce hallucinations and psychomimetic effects, as seen in stage of acute intoxication. There were wide variations in reactions among different individuals and within the same individual. The variations can be attributed to dosage, mood, personality, and preexisting psychopathology.

In all cases, the reactions subsided when the individual was no longer under the influence of the drug. Abnormal reactions that occur after large doses are manifestations of a temporary effect on the cerebral cells, whose physiologic activities are either maintained at a status quo or are partially or totally disorganized. This distorted action of the cerebral cells causes the higher control centers to be activated, thus allowing the senses to be more easily influenced by the preexisting personality traits or external stimuli. When the drug is absorbed into the system, it does not add any new elements to the brain; it only removes the higher control activity and excites the preexisting trend of mental abberrations, if any.

Long-Term Effects

During these investigations, relatives, friends, and employers of these addicts were contacted. They gave information regarding the daily lives of the subjects, the extent of their family interest, their attitudes toward society, and their interest in work. The subjects were examined several times by a sociologist and a psychiatrist. TABLE 8 summarizes these observations.

It is obvious that persons from groups I and II were more involved with the drug. Those in groups III and IV were younger, had used marijuana for a shorter period, and were taking smaller doses. Continued states of intoxica-

TABLE 6

PSYCHOLOGIC REACTIONS WITH CONTROLLED DAILY DOSES (SAMPLE 275)

Reactions	Group				Total
	I	II	III	IV	
Prolonged sense of well-being with euphoria	50 * (18.18)†	34 (12.35)	59 (21.45)	24 (8.72)	167 (60.72)
Weakening of inhibitions, false sense of ability to perform physical and intellectual duties	20 (7.27)	12 (4.35)	8 (2.90)	9 (3.27)	49 (17.81)
Amotivation, self-neglect, dirty habits	15 (5.45)	4 (1.45)	2 (0.72)	— —	21 (7.63)
Release of social inhibitions	50 (18.18)	30 (10.90)	23 (8.35)	21 (7.63)	124 (45.09)
Amnesia	58 (21.09)	23 (8.35)	7 (2.54)	4 (1.45)	92 (33.45)
Partial loss of sense of time and space, mild degree of confusion	5 (1.8) 18 (6.54)	4 (1.45) 2 (9.72)	6 (2.18) 2 (0.72)	— — — —	15 (5.45) 22 (8.0)
Increased sexual drive	30 (10.90)	15 (5.45)	8 (2.90)	15 (5.45)	68 (24.72)
Hallucinations and delusions	5 (1.80)	4 (1.45)	— —	— —	9 (3.27)

* Number.
† Percent.

TABLE 7

PSYCHOLOGIC REACTIONS WITH HIGHER DOSES

Reactions	Number	Percent	Mean Dose of Δ^9-THC (mg)	Approximate Duration
Elation, feeling of happiness, weakening of inhibition, false sense of security	10	11.75	100	0.5–2 hr
Amnesia	6	7.05	100	0.5–6 hr
Release of repressed behavior, occasionally hostile and violent	16	18.82	105	2–3 hr
Mild degree of confusion	10	11.75	75	10–24 hr
Loss of control, staggering gait, loss of coordination of muscular movements, slurred speech, dizziness	7	8.23	175	1–2 hr
Disorientation, depersonalization	2	2.35	175	0.5–2 hr
Hallucinations and delusions	4	4.70	180	0.5–36 hr
Amotivation, lethargy, self-neglect, general apathy	10	11.75	110	4–24 hr
Schizophrenia	6	7.05	190	several days
Paranoia of a minor degree	1	1.17	100	several days
Depressions of short duration	4	4.70	90	4 days
Anxiety	3	3.52	110	a few to 36 hr
Agitation	1	1.17	150	2 days
Acute brain syndrome	1	1.17	200	4–6 days
Criminal and aggressive tendencies	4	4.70	85	more or less permanent change in personality

tion, present in some individuals at some times, led to a state of confusion, manifested by disturbances in performance of their physical and intellectual work or duties. Little or no gross damage was noticed in the last two groups. More individuals in groups I and II showed a lack of initiation, motivation, and interest in their work and family. The work performed by these individuals while under the influence of the drug was not up to normal standards, as compared with that of a control group composed of individuals from the same area and of same general characteristics.

Behavioral Changes

Amotivational Syndrome

Chronic cannabis use in heavy doses affects the central nervous system. The changes are related to the type of dose and the setting in which the drug is taken. Overall, the picture is one of depression and apathy, but continued repeatedly higher doses sometimes may produce increased locomotor activity

and aggressive behavior. Subjects who take smaller doses tend to be quiet, apathetic, and disinterested in their surroundings; these changes are followed by permanent behavioral alterations, which are more marked under stress, starvation, poor health, and so on, resulting in an "amotivational syndrome." In the present studies, all of the subjects were extensively interviewed and questioned about their goals, interest in life and family, and their attitudes toward Indian society and the world in general. Eighty-two (29.81%) individuals showed behavioral changes (TABLE 8) concerning lack of interest in work and family, a happy-go-lucky attitude, and other personality traits. In addition, 30 (10.90%) individuals, who mostly belonged to lower social strata, such as religious mendicants and other beggars, exhibited an "amotivational syndrome." They were generally ill-nourished and neglectful of personal hygiene. Excessive use is associated with personality inadequacies. Persons who exhibit emotional immaturity, low frustration tolerance, and failure to assume responsibility tended to be overrepresented in groups I and II, the heavy cannabis users. In behavioral terms, these traits are manifested in an unrealistic emphasis on the present as opposed to the future, a tendency to drift along in a passive manner, failure to develop long-term abilities or skills, and a tendency to favor regressive and magical rather than rational thinking processes.

Crime

Cannabis drugs are generally used by the poorer sectors of society, which include a higher percentage of criminals and other disreputable individuals.

TABLE 8

LONG-TERM EFFECTS (SAMPLE 275)

Effects	Group				Total	
	I	II	III	IV	No.	%
Amotivational syndrome	14	12	3	1	30	10.90
Lazy habits, loss of drive	6	7	2	—	15	5.45
Instability and immaturity	7	1	6	2	16	5.81
Short-term amnesia	4	2	3	—	9	3.27
Impairment of intellectual faculties	5	3	—	—	8	2.90
Lack of interest in work and family	9	2	1	5	17	6.18
Change in goals, happy-go-lucky attitude toward life	10	2	6	4	22	8%
Slow breakdown of personality	4	1	1	—	6	2.18
Character changes	8	3	7	2	20	7.27
Suspicious and hypersensitive, easily excited, unreasonable, aggressive	4	5	7	1	17	6.18
Premature senility	2	3	1	1	7	2.54
Status intoxicatus	4	2	—	—	6	2.18
Dementia	2	—	—	—	2	0.72
Criminal tendency	9	5	1	—	15	5.45

Most of their earnings are used for the purchase of drugs at exorbitant prices, through the black market. Little money thus remains for food and daily necessities. In such a situation, some of the heavy and chronic addicts are impelled to steal and commit other crimes to sustain themselves. In such instances, cannabis addiction is indirectly associated with crime. Concerning premeditated crime, cannabis may actually act as a deterrent due to its stupefying and depressive effects. Unlike alcohol, there therefore is little or no feelings in such a mental state toward violence. Another category of chronic cannabis users have personality problems, and exhibit irritable and amotivational behavior, and want to live by themselves quietly, undisturbed, and not interested in violence. Such persons sometimes may become irritable and violent when they feel that their "quiet" life is being disturbed. We came across four such instances among the religious mendicants, who attacked their associates with rods when disturbed under the influence of the drug. They may have been hallucinating or suffering from delusions while performing the acts of violence. TABLE 9 provides an analysis of the statements regarding convictions.

Twenty-six (9.44%) persons, mostly ganja and charas users, admitted having been convicted once. Nineteen (6.88%) stated that they had been convicted more than once. These conviction figures are higher than those for the general population. Ganja and charas users predominated, because the effects are more intense and instantaneous when the drugs are smoked; also, ganja and charas smokers mostly come from the lower sections of society, which has a higher percentage of habitual criminals.

Homicide and Suicide

Cannabis drugs have been used from very ancient times by criminals to fortify themselves for committing premeditated crime and also to enable them to endure unusual fatigue or exposure to inclement weather. Cannabis drugs are rarely used for suicidal or homicidal purposes, in comparison to opium and barbiturates. There are, however, few cases on record in India where ganja or charas was used to stupefy the victims for purposes of theft. It is doubtful that cannabis alone can fulfill this objective, so it is mixed with *dhatura* or *stra-*

TABLE 9

DRUG CONVICTIONS

Drug	Sample No.	No Convictions	One Conviction	More Than One Conviction
Bhang (mean Δ^9-THC): dose, 150 mg; range, 75–200 mg	192	171 * (89.06) †	15 (7.82)	6 (3.12)
Charas and ganja (mean Δ^9-THC): dose, 300 mg; range, 200–350 mg	83	59 (71.08)	11 (13.26)	13 (15.66)
Totals	275	230 (83.63)	26 (9.44)	19 (6.98)

* Number.

† Percent.

TABLE 10
EFFECTS IN CHRONIC USERS

Drug Data	Stimulant	Depressant	Stimulant Earlier and Depressant Later	No Effect
Mostly bhang: mean dose, 150 mg; range, 75–200 mg (sample 83)	33 * (39.75) †	8 (9.36)	19 (22.88)	23 (27.74)
Mostly ganja and charas: mean dose, 300 mg; range, 200–300 mg (sample 192)	29 (15.10)	67 (34.89)	50 (26.06)	46 (23.98)

* Number.
† Percent.

monium to stupefy the victim. There is another preventive factor, in that ganja and charas can be readily detected by their pungent odor. Thus, it is difficult to mix them with tobacco or other substances for the purpose of smoking without fear of detection. Ganja and charas, however, have been employed to stupefy persons who are habituated to their use by secretly mixing potent drugs like dhatura with them. There were three such instances, in which prostitutes were stupefied in this manner and robbed of their jewelry. Similar cases have also been reported among children who were offered sweets that contained bhang or ganja to stupefy them and were robbed of their belongings. Such instances are, however, rare in adults because of easy detection and uncertain action.

In this connection, it may be stated that one of the authors came across an interesting case during his law practice, where the wife of a medical practitioner who was habituated to ganja smoking regularly gave dhatura mixed with ganja to her husband for several years to stupefy him and make him incapable of sexual performance, with the objective that she could enjoy illicit intercourse with her lover. The case is still pending in the court at Patiala.

Sexuality

Aphrodisiac use of cannabis drugs have been reported from very ancient times. It is claimed by younger users that sexual performance and enjoyment are enhanced when under the influence of the drug. The subjective impression of slowing of time might, indeed, confer on the performer a very unusual gratification in an orgasmic experience, if it is extended from 30 sec to 30 min. These effects are more common with a low dosage. When taken in moderate doses, the effects are somewhat similar to those of alcohol: the drug induces the desire but makes performance impossible. The chronic use of the drug leads to a sad condition, where the lack of desire may also be coupled with inability to perform. TABLE 10 summarizes the experience of chronic marijuana users.

Fecundity

The marital histories of 75 chronic marijuana users in the present series who were married and taking the drug prior to marriage and after it were carefully studied. The average duration of use was 10.2 years. Numbers of children and the mean doses are given in TABLE 11. The number of sterile marriages was higher with larger doses. Those who used smaller doses had more children than those who took large doses.

In addition to the information obtained above, the question of fertility was pursued further in 150 subjects in five villages of Patiala who were married or widowers and who were using cannabis prior to marriage or who began to use it soon afterward. The number of children per 100 families was compared to that found in opium users and in the general population. The figures obtained were 344, 273, and 396, respectively. Sterility was found in 2% of the marriages, or almost twice the percentage in the general population but much lower than the 8.4% found among families of opium addicts. It is concluded that the fertility rate is lower than normal among cannabis users but higher than in opium addicts. Also, there was a marked difference between the bhang and the ganja and charas users: 0.4% of the marriages of bhang users were sterile, as opposed to 5.7% of ganja and charas user marriages, and the proportion of families with five or more children was higher in the former than in the latter group. This finding was attributed to the fact that ganja and charas "are mostly taken by sadhus, fakirs, and low-class people with loose morals and high incidence of venereal disease."

Tolerance and Dependence

It was verbally ascertained that subjects acquired tolerance to each dosage within a few days after each increment. In several cases, it developed rapidly and was more marked. These subjects become refractory to the drug, even to the point when toxicity symptoms developed. On withdrawal of the drug, abstinence symptoms occurred, namely, irritability, yawning, loss of appetite, occasional tremors, twitching, cramps, insomnia, and photophobia. Withdrawal symptoms, though mild, developed within a few hours of abstinence and lasted

TABLE 11

CANNABIS AND MARITAL HISTORY

Drug Data	Sterile Marriages	One or Two Children	More Than Three Children
Bhang (mean Δ^9-THC): dose, 150 mg; range, 75–200 mg	1	31	18
Ganja and charas (mean Δ^9-THC): dose, 300 mg; range, 200–350 mg	7	9	9
Totals	8 (10.66)*	40 (53.33)	27 (36.01)

* Percent.

TABLE 12

NEUROLOGIC EFFECTS

Effects	No.	Average Duration
Partial numbness	4	0.5–1 hr
Lack of coordination of muscles, as seen in weakening of hand grip and staggering gait	18	1–2 hr
Increased sense of taste and smell	7	a few minutes
Romberg's sign was positive in individuals who took large doses, and there was difficulty in maintaining the balance	2	a few minutes
Impairment of muscular grip when measured with ergograph	4	0.5–2 hr

for 3–4 days. Tolerance was less marked than with opiates, barbiturates, and alcohol but was similar to that which occurs with other hallucinogenic drugs, such as amphetamines and lysergic acid diethylamide. The withdrawal symptoms of some subjects subsided on administration of alcohol or barbiturates, thus suggesting a cross-tolerance reaction among cannabis, alcohol, and barbiturates. Also, it cannot be excluded that a storage capacity for the drug might also be achieved in some individuals over prolonged periods of cannabis consumption. In judging the presence or absence of psychic dependence in an individual, it is important to ascertain to what extent the use of the drug is a life-organizing factor, to what extent it takes precedence over the use of other means for coping with personality problems, or whether both factors are important. Our studies indicate that a large percentage of heavy users developed dependence. Whereas most of those who used it a few times on an experimental basis, or casually on a few festive occasions, during one year did not show psychic or other forms of dependence.

Neurologic Reactions

With higher doses of cannabis drugs, intellectual and physical performances are affected. Four typists in the series were given a passage to type. At the same time, four other typists, of the same age and group, who had never used cannabis were given the same passage to type. There were significant differences in the time required to type the passage and in the number of mistakes made. Five to 10% more time was required, and 6–12% more mistakes were made by those under the influence of the drug. Tests that involved counting backward and recitation of the alphabet also demonstrated the adverse effects of cannabis. Work performed under the influence of cannabis showed decreased accuracy. With larger doses, there was a marked decline in coherence and clarity. The performance impairment of complex tasks appears to arise from difficulty in maintaining and a logical train of thought (TABLE 12).

Acute Toxicity

Acute somatic toxicity of cannabis drugs is low when compared with that of other simple chemical substances that are rapidly absorbed in their pure form

in the gastrointestinal tract. This lower toxicity explains why marijuana is not used for suicidal purposes. It was observed that severe physical side effects of marijuana are poorly correlated with its psychotoxicity and its ability to disintegrate mental functions, a condition that secondarily may cause bodily harm to self and others.

Chronic Toxicity

Among the vital organs affected by cannabis are the brain, which is the primary target, the liver, lungs, where the active ingredients are metabolized, and the heart, which rapidly accelerates its rate in response to the drug. Despite the long history of use of this drug, as old as the history of man, it has not been possible to observe any structural changes in the brain. There appears to be no or little morphologic or structural changes in the brain. Apparently, however, alterations in sensitivity of brain cells, or distortions in their functions occur, which result in changes in performance of mental functioning. One cannot exclude the possibility that repetitive impairment of these processes by frequent and long-term cannabis intoxication in adolescent years might induce permanent changes in thinking patterns or behavior. Such permanent changes would be related to permanent organic alterations.

Comparative Assessment of Effects in Indian and USA Chronic Cannabis Users

The subjective effects varied widely among different individuals and within the same individual. These variations may be explained by the fact that the crude form of the drug, as used in India, is not always of the same potency. It consists of a mixture of stems, leaves, and flowering tops with varying psychoactive properties. This factor partially explains the differences in observations by researchers in India and in the West, where observations are based mostly on studies of occasional and comparatively smaller numbers of subjects using weaker preparations. It is thus difficult to judge even approximately what drug potency is being studied. In our study, we have used an approximately equivalent Δ^9-THC content for determining the mean daily dose. Other than information about the active ingredient, Δ^9-THC, knowledge about other elements of the plant is lacking. Because of the dramatic changes in the psychologic, environmental, and sociologic aspects of the world today, more knowledge is needed about the long-term effects of marijuana. The present studies are only a preliminary effort in this direction. The intensity of the chronic effects of marijuana usage, as observed in India and Africa, has not been reported by Western observers. The milder preparations of cannabis used in the West partially explain this comparative absence of such psychoses. In India, there has always been a popular belief that prolonged and excessive use of these drugs leads to certain types of mental disorder and crimes of a violent nature. In previous studies, we have discussed the relationship between hemp habituation and mental disease and crime. It became evident in these studies that excessive indulgence in these drugs by unstable and susceptible individuals was likely to produce states of confusion, characterized by hallucinations, delusions, and disorientation. Prolonged excessive use also appeared to lead to the develop-

ment of toxic psychosis. This paper was based on a study of 200 cannabis dependents that took place from 1963 to 1968. Taken into consideration were age of onset, education, socioeconomic status, dosage, motivation, psychologic and general health, signs of malnutrition, personality type, and so on. The present study also suggests similar findings.

Motivation and the environment have important roles in inducing predominant psychic effects. Various individuals listed different reasons for using cannabis. Most commonly, it was used as a substitute for alcohol. Among the 275 persons studied, 20% used the drug as a substitute for opium or alcohol. The lower cost of cannabis drugs than hemp, and the fact that the withdrawal symptoms are milder, make it an attractive substitute in developing countries, such as India. The use of cannabis drugs by certain sectors of the population in developing countries can be compared to the use of alcohol in the West. However, a recent study conducted at a university campus in Punjab (India) revealed that 60% of the students were using cannabis drugs, mostly ganja. It appears that the younger generation in India is trying to rapidly "catch up" with their counterparts in the West. This phenomenon appears to be characteristic of the general widespread use of marijuana worldwide. Distinctions should thus be made among occasional, regular, and moderate users and those who indulge excessively. The latter category of users is obviously more prone to adverse psychoclinical effects. Users in the United States and Canada belong mostly to the first two categories. This fact, again, partly explains the low frequency of acute toxic reactions among users in the United States and Canada. Like alcohol, excessive cannabis use can be attributed to preexisting personality problems. This conclusion is supported by a Moroccan saying, which states that, "You are a kif addict before you smoke your first pipe." In India, the highest percentage of excessive hemp users comes from the unemployed, from low-income classes, and from the student community. These individuals are mostly passive and nonproductive and are more prone to psychosis than are normal individuals, who have a regular, daily vocation.

Cannabis has also played a central role in the religions of Africa and South America, and in India. In Africa, an entire village has sometimes experienced a situation of "madness" after indiscriminate indulgence of *dagga.* In India, the drug is commonly abused by religious mendicants in places of worship and in the *takyas* of Muslim fakirs.

Marijuana has also been, and is, used by persons in the arts; supposedly, it enables one to expand his creativity. It is likely that the drug enhances the emotional aspects of the art media. However, there is no proof that it helps in technical performance. This is true in certain chronic users who use the drug in moderation.

Marijuana is also used for the relief of fatigue, monotony, and boredom. Cannabis is smoked among the laboring and working classes in urban areas to relieve these conditions. Such usage is not frequently excessive and is similar to that of alcohol in Western society.

Conclusions and Summary

Despite the rapidly changing scene of cannabis drug usage, it is becoming more frequent among university students; however, the majority of users (41.8%) are still uneducated. A high school education had been attained by

34.57% of this majority, while the remaining 29.5% were university students. Adverse reactions were more common in the uneducated group. Again, a different situation exists in the United States, where many marijuana users are educated youth from college campuses. With regard to occupation, persons in lower income groups were more susceptible to adverse reactions. This finding, again, contrasts with marijuana users in the United States and other Western countries, where users are mostly from the middle classes.

The individuals studied were apparently healthy persons with little or no apparent personality problems and no history of mental disorder or neurosis. An invariable element was their history of drug use. The symptoms and the effects were so similar and uniform that they suggest that, simply, a definite effect follows a definite cause. The effects were mostly of a mental nature that simulated toxic psychosis. There were no other common factors beyond the use of the drug. This eliminated the possibility that the adverse toxic reactions observed were caused by other factors. Thus, cannabis may precipitate latent psychiatric disorders, may aggravate preexisting psychiatric problems, or may have both effects.

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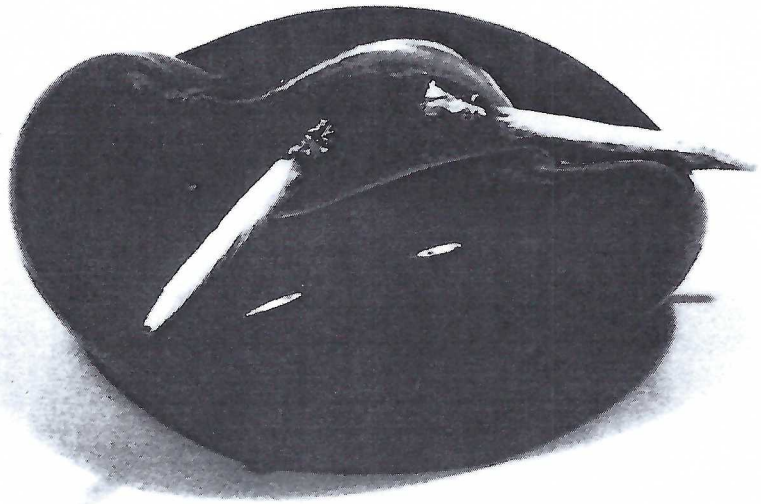
Sex and Marijuana

Yes, they are related, but not as directly as myth would have it.



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In April 1971, an article entitled "Effects of Marijuana on Adolescents and Young Adults" was published in *The Journal of the American Medical Association.* It was written by two Philadelphia psychiatrists, Harold Kolansky and William Moore. Among the many ill-effects sustained by Kolansky and Moore's young patients was, in their terms, "sexual promiscuity." In summarizing thirteen cases of "female individuals" (the term "promiscuity" does not, apparently, apply to young men), they state: "This group is singled out because of the unusual degree of sexual promiscuity, which ranged from sexual relations with several individuals of the opposite sex to relations with individuals of the same sex, individuals of both sexes, and, sometimes, individuals of both sexes on the same evening. In the histories of all of these individuals, we were struck by the loss of sexual inhibitions after short periods of marijuana smoking. Seven patients of this group became pregnant (one on several occasions), and four developed venereal diseases. . . . In no instance was there sexual promiscuity prior to the beginning of marijuana smoking. . . . *We take these results to indicate marijuana's effect on loosening the superego controls and altering superego ideals"* (my emphasis).

Dr. Thaddeus Mann, Professor of Physiology of Reproduction at Cambridge University in England, claims that there is "evidence of a link" between the use of marijuana (as well as other drugs, such as opiates, LSD, and the amphetamines) "and certain types of sexual incompetence or deviation." "Young people frequently seem to indulge in drugs," Dr. Mann writes, "for their presumed pleasure-giving properties, and in the hope, however ill-founded, of prolonging sexual gratification. To them the drugs serve as a sex substitute." Dependency on drugs, including cannabis, "stems from decreased capability and is a pathetic attempt at overcoming . . . sexual incompetence."

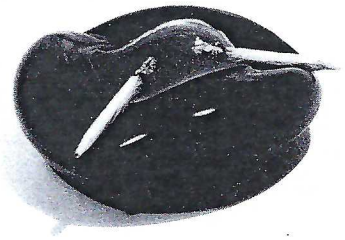
There is an important difference between these conclusions. Dr. Mann suggests that drugs, marijuana included, may be used *because of* sexual incompetence—in addition to *further* deteriorating sexual capabilities. Drs. Kolansky and Moore mention only one direction for this relationship—that marijuana *causes* sexual behavior of an overactive sort. Perhaps, too, mention should be made of the factor of gender. Sexual promiscuity tends to be mentioned almost exclusively with women—a reflection of our prevailing double standard. Sexual incompetence is associated overwhelmingly with marijuana use

among men; the analogous situation among women, frigidity, is rarely discussed in association with the marijuana smoking of women. What is supposed to happen under the influence or after a certain duration of marijuana use fits in very neatly with what is most feared and condemned by conventional society about the behavior of the two sexes. The male is urged to be aggressive and masculine; his greatest failure lies today in impotence. The female, virtuous and passive, is most condemned for "promiscuity," an overeagerness in regard to sex. In this context the marijuana-sex link is an exemplification of society's insecurities and fears—but they tell us practically nothing about the influence of the drug itself!

These ideological colorations of the issue operate on both sides of the controversy. To most members of the "counter culture," both a permissive style of sexual expression as well as marijuana use have become accepted—indeed, even glorified. Thus, marijuana, as the common denominator of the drug-using counter-culture, must be attributed with causing more sex, better sex, and just plain sex. In this case, as with conventional attributions, that which is considered "good" is linked with something else considered "good." But this is another mythology. After the ideology has been paraded, what are the facts? What is the relationship between sex and marijuana?

An archaic view would be that specific drugs "cause" specific outcomes, both effects and behavior. We now know that this is false, that a multitude of factors influence the drug-effects and drug-behavior equations. Some of these factors are related to the drug itself (such as dose, or potency, and route of administration), but the most important factors are non-pharmacological and have to do with the people themselves and the social environment they live in.

Drugs do not act on mindless tissue; their "effects" are weighed, interpreted, considered, translated, accepted, struggled against, thought about, explained, and woven into certain activities. No drug-taking occurs in a sociocultural vacuum; each of these social processes has an impact on



Drugs do not act on mindless tissue

what "effects" a given drug has, as well as what forms of behavior follow its ingestion.

Every drug has a wide range of effects, and each effect touches off a wide range of human reactions. A drug's formal biochemical properties only form a *potential.* Of the many possible effects that a drug has, or might have, some or one or two may be emphasized by a group or individual taking it. Users may "attend" to certain effects, while ignoring or discounting others. Users learn to attune their bodies to the specific effects which their social group approves of, and to discount and disregard those that are not "supposed" to happen. Drug experience is totally dependent on these subcultural and individual conventions.

Effect of marijuana

There are at least two types of marijuana effects of interest to the researcher. The first would be those which can be observed or measured externally by the scientist; these can be called "objective" effects. Heartbeat rate would be an example. So would be performance on various standardized performance tests, memory, motor coordination, and so on. In addition, certain types of behavioral changes are commonly associated with heavy "chronic" use—such as a diminished interest in conventional achievement—but as to whether this is a direct action of the drug, or is a consequence of differential subcultural involvement, cannot be known for sure at this point.

The second type of effect cannot be observed externally; the researcher must rely on self-descriptions by the user himself. Here we are in the realm of the drug *experience*—or the "subjective" effects.

A dozen or so studies have been published in the past few years on marijuana's subjective effects. There are a number of consistent threads running through descriptions unearthed by these studies, in spite of some surface differences. The following effects appear to be very frequently mentioned by users as a common component of the marijuana experience: (1) *relaxation*; (2) *euphoria*; (3) *increased sensitivity in all of the senses*; (4) *greater emotional impact of everything*; (5) *a feeling of freedom*; (6) *a sensation of time slowing down*; (7) *heightened hilarity at everything*; (8) *a sense of one's mind wandering*; (9) *greater enjoyment in doing things*; (10) *forgetfulness*; (11) *increased hunger*; (12) *greater pleasure specifically in listening to music*; (13) *a feeling of lethargy.*

There are, of course, many more commonly reported "subjective" effects. But the overall thrust of these and the hundreds of others that crop up appears to be in the direction of the simple, the hedonistic, the frivolous, the sensual, the pleasurable. This is not to say that the much publicized negative or painful experiences do not result in some users. Nausea and vomiting, diarrhea, and psychotic episodes have been known to occur, but they are extremely rare. Most marijuana smokers enjoy what they feel while high, and use, and continue to use, the drug specifically *because* they enjoy what they feel.

What is fascinating about these self-reports by marijuana users on the effects of the drug is that *they are not simple out-and-out endorsements of cannabis.* Users do not offer an across-the-board eulogy of their high experiences. An obvious objection to accepting the word of users on being high is that they have an all-too-obvious motive for painting a rosy picture. This is a plausible objection, but it cannot account for the fact that many positive effects are *denied* as happening, and a few negative effects are des-

cribed. Activities of a rational and logical character tend to *deteriorate* under the influence, according to users' descriptions. In my own study of 200 New York marijuana users, only a third of the interviewees said that they had ever read or studied a book while high, and of these, two thirds said that the reading experience was impaired by being high. A study by Richard Brotman and Frederic Suffet of 74 New York marijuana users found that while most or nearly all respondents agreed to certain positive effects, such as relaxation and music sounding better, some responses were more often denied than agreed to—such as bringing out talent (51% disagreed) and understanding oneself better (62% disagreed). Marijuana users offer *selective* endorsements of their drug of choice, and not simple indiscriminate tributes to it.

Sexual reactions

What of sex under the influence of marijuana? Positive descriptions and evaluations by users of the sexual experience while high almost universally figure heavily in nearly all studies of marijuana's subjective effects. Two physicians, Joel Simon Hochman and Norman Q. Brill, found that "increased sexual pleasure" was the *second most common response* agreed to among "chronic" marijuana users as an effect of the drug—83 percent said that they experienced it often or always. (Among occasional marijuana users, increased sexual pleasure was often or always experienced by only 50 percent, and it was the eighth most common effect.) "Increased sexual appetite" was experienced by 60 percent of the chronics, and 43 percent of the occasionals. As a check, Hochman and Brill asked their sample about "decreased sexual appetite" and "decreased sexual pleasure"; 75 percent of the chronics said that the first *never* occurred, and 85 percent said the second never occurred—the figures were 70 and 78 percent for the occasionals.

Three other physicians, James Halikas, Donald Goodwin, and Samuel Guze, found that a third (or 34%) of their sample of regular marijuana users

Expectations make a profound difference . . .

Comment by:
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DR. GOODE'S ARTICLE underscores a number of important points about marijuana which are frequently ignored even in professional discussion. Drug use and its effects are deeply embedded in the sociocultural context. The expectations created by the culture make a profound difference, whether we are talking about effects on sexuality or effects on other aspects of behavior or subjective experience.

The classical 1894 Report of the Indian Hemp Drugs Commission, for example, commented that hemp drugs have "no aphrodisiac power whatever; and, as a matter of fact, they are used by ascetics in this country [i.e., in India] with the ostensible object of destroying sexual appetite." Others in other times and places have found they enhance experience, while not a few claim that chronic use results in impotence. In short, users and those observing them have to a considerable extent experienced what they expected to on the basis of their cultural orientation, their personal set, and the setting of use.

Although, as Dr. Goode observes, a majority of the 150 experienced American users studied by Tart found their sexual experiences to be enhanced, Tart also observed that at very high levels of intoxication "chances are good that the user will be absorbed in his own inner experience and not get interested in making love with someone." A minority, he also reported, found their contact with their sexual partners reduced as they became absorbed in their own intensified sensation. Thus, it should be kept in mind that, like other psychoactive drugs, marijuana's effects are heavily dependent on dosage as well as the set and setting of use. None of this is intended to deny that large numbers in any given culture may agree on a particular effect—it is only to emphasize that psychoactive drugs, including marijuana, do not simply have effects on people but that people and drugs interact, sometimes in unexpected ways.

The observations cited by Dr. Goode are based virtually on the experiences of white, middle-class Americans. Little is known about the experiences of others from different socioeconomic levels and other ethnic and racial groups. Obviously, these are also of interest and importance.

Patterns and personal expectations regarding sexual behavior are also profoundly variable from culture to culture, and even within the same culture and within the same individual from time to time. This, too, must be taken into account in considering the effects of such drugs as alcohol and marijuana on sexual feelings and subjective experience.

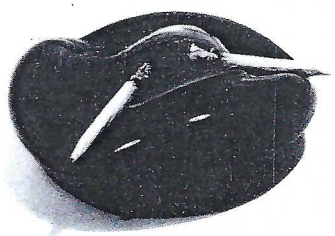
Finally, it should be emphasized that while in the affluent West marijuana is most commonly used for recreational purposes, in much of the rest of the world it is more typically used as a means of warding off fatigue, as self-medication for a wide array of illness, and as part of religious expression. It is of obvious interest and importance to learn more about the multiple uses and effects of marijuana cross-culturally—including those involving effects on human sexuality.

said that they "usually" experienced a "heightened sexual feeling" while under the influence; 59 percent said that they felt this occasionally. Almost exactly the same percentages said that they usually (33%) or occasionally (59%) felt an "increased sexual arousal." A psychologist, Charles Tart, found that two thirds of his sample of users (or 65%) reported very often or usually experiencing their sense of touch, while high on marijuana, as more exciting than usual. Over half (or 56%) said that their sexual orgasm was very often or usually more exciting than when "straight." And the response "touch takes on new qualities" was agreed to by 55 percent of Tart's sample.

In my own interview study, marijuana and sex were closely intertwined. Three quarters of my respondents said that they had had intercourse at least once when high. When I asked "Do you think that being high on marijuana stimulates your sex *interest*, or not?" slightly over a third said that it was no different from normal, 5 percent said that marijuana usually had a negative effect, that it tended to turn them off sexually, 13 percent said that it depended–and 44 percent said that the drug tended to *increase* their sexual desires. And when I asked "Is your *enjoyment* of sex any different high?", about two thirds (68%) said that marijuana generally acts as a pleasure-enhancer–that it usually *increased* their sexual enjoyment.

There were, moreover, interesting variations among the respondents. The *frequent* users attributed significantly more sexual impact to the drug than the infrequent users did. Over *half* (52%) of the three times a week or more users said that marijuana acted as an aphrodisiac, and stimulated their sexual desires, but less than a third (30%) of the infrequent, or less than weekly, users agreed. The same pattern obtained for answers to the question on orgasmic pleasure. More than three quarters (77%) of the frequent users claimed that marijuana tended to increase their sexual enjoyment, while only half (49%) of the infrequent users agreed.

Clearly, these evaluations of the "high" sexual experience were not specific to sex itself. The other areas



Frequent users are more likely to have premarital sex than nonusers

which marijuana was said to improve–as well as those thought to be impaired–yield clues as to *why* sexual gratification and interest were described as heightened under the influence by most users. Activities requiring precision, attention to detail, sustained effort, and technical mastery, are widely denigrated as rewarding "high" experiences; behavior involving spontaneity, immediacy, visceral involvement, and emotional engagement, are felt to be intensified.

The following reasons are offered by marijuana smokers as explanations of why being under the influence renders the sexual experience more pleasurable and exciting:

(1) One's sense of touch is more intense and stimulating.

(2) One's skin feels warm, tingly, and flushed.

(3) The emotional impact of the experience is much greater.

(4) Emotional warmth and affection toward one's partner appear to be stronger.

(5) The sex act appears to last longer than clock time indicates.

(6) One feels more relaxed, less uptight, freer, more "natural."

(7) The sex act becomes a total entity in itself, a kind of totally involving, all-encompassing vortex or experience.

(8) The orgasm is more intense than usual.

Of course, the traditionalist will object that many, if not all, of these perceptions are "objectively" in error; more time did not "really" pass, and one does not "really" feel more love for one's sex partner. But within the microcosm of the high sexual experience, these effects are perceived to occur; they do, in fact, occur–viscerally. The *sensation* of their occurrence is the very reality, the experience itself.

The role of life style

These "effects" are not simple pharmacological consequences of marijuana. The predominant source of these positive evaluations is locatable within the subcultural arena. As a young person begins to use marijuana, his friendships and peer network undergo a subtle transformation. Using marijuana implies having friends with certain attitudes and practices. Marijuana use, especially at specific frequencies, can be used as an indicator of one's involvement with the drug subculture. Thus, one is likely to *ascribe* to the marijuana experience positive evaluations specifically within those areas that one's social intimates value. A positive evaluation of sex under the influence is, in part, merely a reflection of one's immersion in, and agreement with, a certain social group.

Which leads us to the connection between marijuana use and sexual behavior. Does marijuana "cause" sexual "promiscuity"? If we accept these data on sexual pleasure as valid in characterizing the nature of the sexual experience under the influence of marijuana, what would we predict in regard to the sexual *behavior* of users? In what way does the drug become woven into the sexual life styles of marijuana smokers? What is known about patterns of sexual activity among users?

I distributed a questionnaire on drug use to the undergraduates attending a large lecture course at a state university in 1970; there were between five and six hundred respondents in the study. I employed four measures of sexual activity: whether or not the respondent had ever engaged in premarital intercourse; the total number of different sexual partners he or she had ever had sex with; the age at first engaging in intercourse; and the average frequency of having intercourse in the six months prior to the question-

naire. I also asked about three indices of drug use: whether or not the respondent had ever smoked marijuana; the frequency of smoking marijuana in the six months prior to the survey; and the total number of drugs or drug types the respondent had ever tried or experimented with. What I found was that *all measures of sexual activity correlated significantly and powerfully with all measures of drug use.* Marijuana users were *far* more likely to have engaged in premarital sex than nonusers. The overwhelming majority of users or experimenters had had intercourse at least once (72%, in fact), whereas only a third (34%) of the nonusers reported ever having engaged in premarital sexual intercourse. And the more frequently that any given undergraduate smoked marijuana, the greater was his or her likelihood of having engaged in intercourse; there was an almost perfect linear relationship between frequency of smoking marijuana and premarital sexual experience.

In addition, the more frequently marijuana was used, and the greater the number of drugs experimented with, *the greater the number of sexual partners the respondent had had intercourse with.* Among the frequent, or three times a week or more, marijuana smokers, only *one in five* (19%) claimed to be virginal; this was true of *six in ten* (61%) of the respondents who had not smoked marijuana at all in the previous six months. At the other end of the sex spectrum, *a third* of the frequent users (32%) said that they had had intercourse with *four or more* partners in their lives; this was true of

Myth of the "perfect orgasm" may lead to gilding the lily with drugs . . .

Comment by:
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IT IS CERTAINLY true that "drugs do not act on mindless tissue." The same claims about enhancement of sexual performance and enjoyment were being made several years ago on behalf of LSD and, in some people's minds, the effects of marijuana still pale when contrasted with those of amyl nitrate ("poppers"). That drugs with such divergent pharmacological effects should all enjoy a reputation as sexual superchargers suggests that their effects are mainly in the eye of the beholder. One can't help wondering if there is not some pervasive myth of the perfect orgasm that keeps driving people to gild the lily with drugs. In any case, if marijuana is as beneficial for sexual performance as is claimed, one might make a strong case for limiting its use to people over forty years of age. It is one of the great paradoxes that sexual stimulants are sought by those who have least need of them.

Nonetheless, if someone believes a drug works, and the manifestation of the desired action is a psychological effect, then it works. In pharmacology, we refer to this phenomenon as the "placebo effect"—the ability of the drug to please the patient (or the physician) by meeting his prior expectations. Studies to date indicate a rather high degree of such placebo effects among marijuana users, many of whom are able to attain satisfactory "highs" with marijuana which contains virtually no active materials. Truly these are instances of mind over matter.

So much about sexual performance. What about sexual behavior? I'm afraid that the lib movements have not yet convinced me of sexual equality. A woman can engage in sexual intercourse even if she is frigid; a man cannot if he is impotent. It's just that simple. So the effects of a drug on sexual behavior may vary between the sexes. The observation of Shakespeare that wine increases lechery and lessens performance referred to men. Ogden Nash's couplet about seduction, "Candy is dandy but liquor is quicker," referred to women. One must, however reluctantly, give the psychoanalysts their due: drugs can break down the ordinary controls of conscience that limit one's behavior, and alcohol and marijuana are among these so-called disinhibiting agents.

That one's pattern of sexual behavior could be changed under the influence of marijuana is entirely possible. The thorny question is how often is the taking of the drug related to the conscious adoption of a life style in which many behaviors are altered, including that of drug-taking? No simple answer will do; it depends on your point of view. If you are a sociologist sending out questionnaires to large groups of people, you may favor the latter pattern. If you are a psychiatrist, trying to deal with parents distraught by the fact that their cherished daughter became the neighborhood trollop after taking up marijuana smoking, you may favor the former hypothesis.

Let us suppose that use of marijuana is the paradigm of the "drug culture," with all of its altered ways of living. We then have a situation in which those who seek the many attractive pharmacological effects of a drug lose to some degree their choice of life style. A somewhat similar situation prevails with heroin use, which must of necessity (because of the way the drug is trafficked) involve the user in criminal activity. We have no such precedents with other social drugs, for the decision to use alcoholic beverages or nicotine smokes entails no change from "straight" life. To the extent that we can separate the decision to enjoy the effects of a drug from the necessity to change one's life, we may better preserve the freedom of the drug user.

only one fifth as many marijuana abstainers (7%). By employing the number of drugs ever tried, or experimented with, exactly the same relationship prevailed; the greater the number of drugs ever experimented with, the greater the number of sexual partners the respondents had ever had in their lives. If having had intercourse with four or more partners is defined as "promiscuous" (a heavily loaded value term), then marijuana users, especially at the upper reaches of frequency of use, are much more likely to be "promiscuous" than nonusers. This is not to say that all, or even most, were, but the correlation was about as striking as any the social researcher is likely to see.

Drug users generally, and marijuana smokers specifically, also tended to have intercourse *earlier* in their lives. Among drug abstainers, only 4 percent said that they had had intercourse by age 16; this was true of six times as many (24%) of the respondents who had experimented with four or more drugs. At the other end, fully two thirds of the respondents who had never tried any drugs in their lives (or 67%) were virginal, but this was true of less than a fifth (18%) of the four or more drug experimenters.

The magnitude of this relationship might incline the observer to posit that somehow marijuana, as well as other drugs used, *causes* early sex, and sex with a number of partners. This conclusion would, I think, be entirely mistaken. The relationship can be turned around. Not only were marijuana smokers, and drug experimenters generally, more likely to have sex early in their lives, *it is also the sexually precocious who are more likely to use drugs, including marijuana.* Of all those respondents who said that they had intercourse by age 16, only 7 percent said that they had *not* tried any illegal drug, but this was true of *almost half* (47%) of those who were virginal. A third of those who had lost their virginity by age 16 (33%) had tried four or more drugs; this was true of only one in 10 (10%) of the virginal respondents. Thus, it is clear that using marijuana or other illegal drugs no more "causes" sexual behavior than sexual behavior "causes" drug use.

There is a powerful *selective recruitment* process operating here. *Both* sexual permissiveness *and* marijuana use—as well as, to some extent, experimentation with certain other illegal drugs—are indicators of the young person's involvement in and with a subculture which is tolerant toward a wide range of nontraditional values and activities. This subculture embraces certain styles of dress and tonsorial fashion, specific musical tastes, attitudes toward formal religious ties and activities (usually alienated), as well as attitudes toward the formal aspects of college and university institutions (often negative), and, above all, politics and ideology (liberal or radical). Thus, to say that marijuana use "causes" a liberal or radical political orientation would be absurd.

Marijuana use grows out of a specific life style

Sexual permissiveness is an organic component of this emerging counterculture ideology in much the same way that a liberal political style is. Clearly, the "cause" of sexual permissiveness is much the same as the "cause" of a liberal ideology—and of marijuana use as well. The origin of all three is a culture which is anti-authoritarian and nontraditional in a wide range of ways. As a young person becomes interested in, and makes friends with, individuals who are a bit older and more involved with this way of life, they begin to adopt similar styles, attitudes, and forms of behavior—which include marijuana use and sexual permissiveness. To be a part of this subculture almost implies certain attitudinal and behavioral correlates.

Sociologist Bruce Johnson, in a thorough survey of drug use patterns in colleges and universities in and around the New York area, found an almost perfect correlation between marijuana use and a number of simple social variables—gender, cigarette use, politics, and religious orientation. It was possible to predict, with almost perfect accuracy, who would use marijuana, and who would not—simply by knowing four basic social facts about the respondent: gender (men were more likely to use marijuana than women), whether or not he or she smoked tobacco cigarettes (smokers were more likely to use marijuana than nonsmokers), whether he or she participated in formal religion or not (the religiously alienated were more likely to use marijuana than religious believers and participants), and the respondent's politics (liberals were more likely to use marijuana than conservatives and middle-of-the-roaders). In fact, *97 percent of the nonreligious, liberal, cigarette-smoking men had tried marijuana, and 62 percent smoked it weekly or more!* But only *4 percent of the religious, politically conservative, nonsmoking women had even tried marijuana, and not one was a weekly or more marijuana user!* Quite clearly, marijuana use grows out of a specific life style, which is, in turn, partly dependent on specific sociocultural background factors. And permissive sexual behavior (branded as "promiscuous" by those who disapprove of it) is a part of this life style.

Psychological problems

There are experts in the drug field who disagree with this characterization of an emerging "normal" permissive sexual life style among marijuana users. Jordan Scher, in "The Marijuana Habit," an article published in *The Journal of the American Medical Association,* claims that something like one user in five or ten experiences sufficient psychic difficulty in his life—in large part due to his use of marijuana—that he requires psychiatric attention. Furthermore, Scher observes that his marijuana-using patients progressively lose interest in sex as they use the drug over a period of time. (However, Scher has also suggested, in

It can make sex more pleasurable as can perfume and even waterbeds . . .

Comment by:
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MARIJUANA IS a social drug. Its use is learned in a social setting and its use is continued in a social setting. The major effects of the drug are the result of the interaction of the drug and the beliefs, expectations, and experiences of the user. Many users do not become intoxicated (get off) the first time they use the drug, and do not get off until they learn to interpret certain drug effects as "being stoned" and ignore others as irrelevant. In this context the impact of being "stoned" may well represent a self-fulfilling prophecy—one gets stoned in the way the culture who taught you to expects you to. If you believe marijuana to have aphrodisiac qualities, you probably will be aroused when you first get "turned on." If you expect to eat a lot and enjoy food or get lost in music, you will do those things. If you expect to go crazy from the drug you will probably get very anxious or experience nothing.

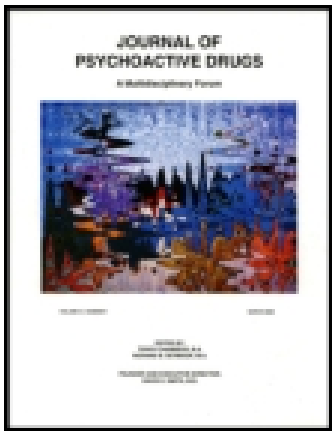
In screening subjects for experiments with marijuana we asked over 100 "normal" (at least not referred patients) young men about their most pleasant experience with marijuana, and the largest commonly mentioned event was sexual behavior. Many subjects reported that smoking marijuana did not increase desire for sexual behavior—that is, it did not act as an aphrodisiac—but that it could make sexuality more pleasurable. As one of our subjects stated, "Smoking dope doesn't make you sexually aroused, but if that's where you're at it really enhances it." Subjects report increased tactile awareness, increased imagery, and time distortion as major experience-enhancing features of intoxication. Similar things can be said for candlelight, perfume, or even waterbeds.

A second major question is the extent to which marijuana creates long-term changes in social behavior, or chemically erodes superegos or otherwise saps morality. A common belief is that chemical changes underlie and are causal to "deviant behaviors" observed in drug users. Changes in level of aspiration, redefinition of goals from achievement to growth orientation, can then be seen as pathology and changes in sexual mores are seen as the result of drugs. It may well be that increases in subscribing to sexual activity on questionnaires is related to a "new ethic" that embraces candor was well as marijuana, or that embraces more open sexual behavior or even "promiscuity" (a most unfortunate value-laden sexist word). It would appear that sex and marijuana are related, but mostly if you would like them to be related.

The American Journal of Psychiatry, that marijuana substitution be tried to wean alcoholics off their drug of choice; of the two, Scher feels that alcohol is far more damaging and debilitating than marijuana.)

Although this view cannot account for the fact that frequent and long-term users are most likely to attribute positive sexual effects to marijuana (a finding which all surveys have turned up), and it is, I believe, mistaken as to the magnitude of the number of users who experience difficulty in their lives due to the use of the drug, the source of the disagreement might rest more in the universe under study than in actual substance. The sociologist examines the full range of a given phenomenon, whereas the psychiatrist typically looks at a fairly narrow segment of it. This is not to say that one is wrong and the other right, but that they are attempting to describe and explain quite different aspects of that reality. There are something like 15 million Americans who have tried and who use marijuana—probably a conservative estimate. Judging from a wide range of studies, it is clear that the average frequency of the use of marijuana is less than once a week. This means that the typical marijuana smoker is under the influence of his drug 3 or 4 percent of his waking hours. It is against this background that any description of the impact of marijuana use must be made.

Now, it is conceivable that some marijuana smokers use the drug to avoid meaningful contact with members of the opposite sex. It is certainly possible that some users experience difficulty in their lives which can, at least in part, be traced in some way or another to their use of marijuana. And no doubt some users engage in a compulsive, self-flagellating form of "promiscuity" that they themselves despise and condemn. Marijuana users can certainly be dredged up with sexual hangups, as can nonusers. Possibly with a greater volume and complexity of sexual episodes will come a greater volume of psychic problems, especially given their opposition to dominant "mainstream" values. But these generalizations are not a valid characterization of the full range of users and their behavior. Most marijuana users enjoy their high experiences, and they use the drug as an adjunct and an enhancer of recreational activities, and for this reason their numbers are increasing. But this is not an endorsement of the values and behaviors of the—for want of a better word—"drug culture," but it is a life style which appears well on the way to becoming conventional and standard among very large segments of respectable conforming members of society and therefore cannot be ignored. As with many beliefs and practices, the cultural margin will eventually become the center. □



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Effects of Regular Marijuana Use on Sexual Performance

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Effects of Regular Marijuana Use on Sexual Performance

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During the last 15 years, the use of marijuana as a social intoxicant has become almost as commonplace as the use of alcohol among individuals under the age of 35. Throughout this era of marijuana use, it has been alleged that marijuana is a sexual stimulant; an aphrodisiac, an enhancer of sexual performance (Lewis 1970). Yet, virtually no systematic work has explored this reported effect of marijuana. Eric Goode (1972) found that for most of his surveyed group of marijuana users, marijuana indeed enhanced sexual desire and performance, and was subjectively perceived as a sexual stimulant. In response, Peterson (1972) maintained that these effects were dose- and setting-dependent. Koff (1974) also found that mood, expectation and setting were the sexually stimulating elements.

In 1975, Robert Kolodny and his colleagues presented the results of two endocrinologic studies of adult male marijuana users (Kolodny et al. 1975, 1974). They found that after more than six months of regular marijuana use, serum testosterone levels were significantly lower. Although these levels were not lowered beyond the range of normal, the uniformity of the trend was worrisome. In addition, at least one of the subjects noted potency problems, which disappeared after cessation of marijuana use, and 35% of the subjects were noted to have had lower sperm counts during the course of the study. Thus, although the current folklore indicates that marijuana is a sexual stimulant, there is at least some evidence that this may not be a universally achieved effect.

METHODOLOGY

In 1969-70, 100 regular marijuana users and 50 nonusers were systematically interviewed as part of a large descriptive study of marijuana use and its effects (Halikas 1974; Halikas & Rimmer 1974; Halikas, Goodwin & Guze 1972a, 1972b, 1971). As part of the criteria for admission to that study, all subjects were at least 18 years of age and White. The user group viewed themselves as regular marijuana users, and had used marijuana on more than 50 separate occasions during a time period lasting more than six months. In fact, the average duration of marijuana use at that time was more than two years, with an average frequency of two to three times per week. All subjects were paid volunteers. In addition to a thorough review of marijuana use and its effects on subjects' lives, the original interview collected descriptive information in a wide variety of psychosocial areas for each subject, including growth and development, education, a systematic psychiatric symptom review, developmental landmarks, family history and rearing practices, and current and past drug and alcohol use patterns.

Between 1975 and 1977, a study was undertaken to find and reinterview all of the subjects. Of the 150 index

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TABLE I

SEXUAL DEMOGRAPHIC CHARACTERISTICS

	Population		User Gender		Recent Usage		Abuse Status	
	Users (N = 97) %	Nonusers (N = 35) %	Males (N = 60) %	Females (N = 37) %	Less Frequent (N = 75) %	Frequent Users (N = 22) %	Male Nonabusers (N = 52) %	Male Abusers (N = 8) %
Ever married	52	74	48	56	52	50	54	13
	p = .057		Not significant		Not significant		p = .08	
Currently married	33	60	32	35	36	23	35	13
	p = .006		Not significant		Not significant		Not significant	
Age of first heterosexual intercourse less than 18	49	14	50	46	41	73	44	88
	p = .0008		Not significant		p = .02		p = .057	
More than one meaningful sexual relationship ever	68	49	68	69	67	73	63	100
	p = .07		Not significant		Not significant		Not significant	
Currently married, subjects unfaithful	17	19	11	23	19	0	6	100
	Not significant		Not significant		Not significant		No chi-square	
Unmarried subjects, number of sex partners in prior 12 months								
None	3	0	2	4	4	0	3	0
One	20	36	20	21	19	24	21	14
Two-Four	37	36	29	50	42	24	32	14
Five +	40	29	49	25	35	53	44	71
	Not significant		Not significant		Not significant		Not significant	
Partner swapping or group sex (all subjects)	5	6	5	5	4	9	4	13
	Not significant		Not significant		Not significant		Not significant	
Sexual orientation								
Heterosexual	88	97	88	87	87	91	86	100
Bisexual	6	0	5	8	8	0	6	0
Homosexual	6	3	7	5	5	9	8	0
	Not significant		Not significant		Not significant		Not significant	
Postpubertal homosexual experiences	26	6	22	32	24	32	23	13
	p = .02		Not significant		Not significant		Not significant	

subjects, one was known to have died. Of the 149 living subjects, 148 were found and 147 agreed to be reinterviewed. The subjects were found in 40 cities, in 25 states and three foreign countries. With the exception of the three subjects overseas, all subjects were interviewed in person by a social science professional, specially trained in the administration of the follow-up interview. Again, all the subjects were paid.

The follow-up interview collected descriptive information concerning the time interval between the index interview and the follow-up interview (approximately six years), in the areas of educational progress, legal problems, vocational experiences, social relationships, family events, intercurrent psychiatric problems and psychosocial adjustment, and a complete drug- and alcohol-interval history. Patterns of marijuana use during the interval and consequences in their lives, in a variety of areas, were canvassed.

One of the areas explored with the subjects was the effect of marijuana intoxication and regular marijuana use on sexual interest and performance. In this regard, eight global questions were asked of all the subjects interviewed, regarding the effect of marijuana intoxication on various aspects of intercourse, duration, ability to repeat, and interest in familiar partner. Approximately one-third of the way through the data collection phase of the project, an additional set of questions was added to the interview regarding the specific effects of marijuana intoxication on various sensory or sensual modalities involved in sexual activity. These included sight, hearing, tasting, snuggling and intimacy. Thus, information was obtained on these questions from about two-thirds of the total user population. All questions were asked for the time interval of the 12 months prior to the follow-up interview or for the most recent 12 months of marijuana use.

This report will present data dealing with the effects of marijuana use on sexual activity among the users with respect to gender differences, differences associated with differential frequency of use, and abuse-nonabuse characteristics of these users. Comparisons between the user group and the control group will be made relating to their patterns of sexual activity.

The mean age of the users at follow-up was 27.5, with a range of 23-38; mean age of the index nonusers was 28.3, ranging from 23-39. The population was well-educated: by the time of follow-up, 95% of the users and all of the nonusers had had some college experience. Also at the time of follow-up, 80% of both groups were employed in occupations that ranged from physician to ditch digger. The index users had now been using marijuana for approximately eight years. During the 12 months prior to the follow-up interview, 86% of the users had used marijuana. Nearly one-quarter were using marijuana five or more times per week during the prior 12 months. Another 30% were using marijuana one to four times per week.

Between the index and follow-up interviews, the distinction between the user and nonuser groups had blurred somewhat. At follow-up, 30% of the index nonusers reported that they either had been or were currently marijuana users. Sixty-two percent had used marijuana at some time in the preceding year, but only four percent had used it five or more times a week during that year. It seems that both groups could now be better described as user groups differing mainly in the length and frequency of their marijuana use, but both having marijuana use rates considerably above the national norm. This is not surprising, considering that the controls were originally obtained by word-of-mouth referral as nondrug using friends of the users. The nonusing peers of the users would naturally be expected to have had a greater opportunity to try marijuana and to develop more liberal attitudes toward the drug than a control group drawn from a different social milieu. That the users and controls exhibit considerable interchange and overlap in their marijuana usage patterns illustrates the comparability of the groups. Nevertheless, in order to maximize the contrast between users and nonusers, the "nonusers" who reported having been regular users (30%) at some time were excluded from the analyses reported here.

RESULTS

Sexual Demographics

A series of chi-square analyses were performed to compare subjects on a number of areas relevant to their sex lives, including marital status, living arrangements, infidelity rates and homosexual experiences (see Table I). The users were compared with the nonusers in one series of analyses. Differences among users were pursued by partitioning them according to gender, frequency of recent usage, and abuse-nonabuse characteristics in subsequent analyses.

Comparisons of users with comparison group: Among the users, 52% had been married at some time, compared with 74% of the nonusers ($p = .057$). Sixty percent of the nonusers and 33% of the users were currently married ($p = .006$). At the time of the follow-up interview, 30% of the users versus 63% of the nonusers were living with their spouse; 22% of the users were living with lovers compared with six percent of the nonusers; and 49% of the users were living alone, with friends or family versus 32% of the nonusers. Thus at

follow-up, approximately 52% of the users versus 69% of the nonusers were living with a sexual partner.

The two groups did not differ significantly in the number of divorces or separations, the age they were first married or the age they were first divorced. Of those currently married, 80% of both groups described their marriage as good, and over 80% of both groups had never been unfaithful. About five percent of each group had engaged in partner swapping, group sex or both. The currently unmarried users did not differ significantly from the unmarried nonusers in the number of sexual partners they had had in the year preceding follow-up.

Forty nine percent of the users and 14% of the nonusers had experienced their first heterosexual intercourse before the age of 18 ($p = .0008$). Since puberty, 26% of the users had had homosexual relations compared with only six percent of the nonusers ($p = .02$). About six percent of the users reported they were bisexual and another six percent claimed homosexuality as their primary sexual orientation. This compares with three percent homosexuality and no bisexuality among nonusers. This difference between groups was not statistically significant.

The users did not differ from the nonusers in the number of sexual problems reported or the number of times they sought treatment for such problems. About 10% of each group reported problems and/or treatment.

Comparisons of selected groupings of users:

1. Males and females: There were no significant differences between males and females on sexual demographic characteristics.
2. Frequent and less frequent users: Subjects ($N = 22$) who reported using marijuana at least five times per week in the year preceding follow-up were compared to those reporting less frequent usage ($N = 75$). More of the frequent users had had their first heterosexual intercourse before age 18 than had the less frequent users ($p = .02$). No other significant differences between the groups were found.
3. Male abusers and nonabusers: Nine percent of the user group were classified as marijuana abusers according to criteria established by Weller and Halikas (1980). Abusers manifested problems in three or four of the following areas: (a) adverse physiological and psychological drug effects; (b) control problems; (c) social and interpersonal problems; and (d) adverse subjective opinions of others. All but one of the abusers identified were male, so only the eight male abusers and 52 male nonabusers were included in these comparisons. Only one abuser had been married (13%) compared with 54% of the nonabusers ($p = .08$). The abusers had experienced heterosexual intercourse at an earlier age, with 88% before 18 years of age compared with 44% of the nonabusers ($p = .057$). These were the only sexual demographic variables that approached significance in this breakdown of subjects.

Summary of sexual demographics: The users differed from the controls in three main respects: (1) more users remained single; (2) the users first sexual relations occurred earlier; and (3) more users had engaged in homosexual activity. Among the users, females and males shared very similar sexual demographics. When frequent and less frequent users were compared, more frequent users had early (pre-18) heterosexual intercourse. The male marijuana abusers had sexual demographics similar to the frequent users. Table I presents the complete sexual demographic statistics of this population.

Sexual Activity and Substance Abuse Patterns

Subjects reported what role marijuana, alcohol and other drugs played in their first heterosexual experience and the proportion of the time they used these drugs in conjunction with their current sexual activity.

Users versus comparison group: No nonuser reported having used alcohol, marijuana or other drugs before their first sexual intercourse, compared with 33% of the users who had used an intoxicant ($p = .0015$) (see Table II). All of the subjects were asked if they had ever engaged in intercourse when intoxicated and, if so, would they have, had the intoxicant not been a factor. Forty six percent of the marijuana users had had this experience, and of these, 30% implicated alcohol, 17% cited marijuana and 52% blamed other drugs or a combination of intoxicants. By contrast, 33% of the nonusers had experienced undesired intercourse when intoxicated, with 76% of these citing alcohol and 12% implicating marijuana and another 12% indicating other drugs or a combination of drugs. The patterns of group differences were significantly different ($p = .05$) (see Table III).

With respect to ongoing sexual activity, about 65% of both groups used alcohol one percent to 10% of the time they had sex, but more nonusers than users had never used alcohol before sex and fewer nonusers reported using it at high levels of frequency ($p = .06$). None of the nonusers had used marijuana or other drugs more than 10% of the time they engaged in sexual activity. By contrast, 45% of the users had used marijuana more than 10% of the time they engaged in

TABLE II

INTOXICATION AND INITIAL INTERCOURSE

	Population		User Gender		Recent Usage		Abuse Status	
	Users (N = 97)	Nonusers (N = 35)	Males (N = 60)	Females (N = 37)	Less Frequent (N = 75)	Frequent Users (N = 22)	Male Nonabusers (N = 52)	Male Abusers (N = 8)
	%	%	%	%	%	%	%	%
First intercourse after intoxicant?								
No	67	100	68	65	69	59	67	75
Yes, alcohol	23	0	22	24	23	23	24	13
Yes, marijuana	7	0	7	8	7	9	6	13
Yes, other drugs/combination of drugs	3	0	3	3	1	9	4	0
Group differences	p = .0015		Not significant		Not significant		Not significant	
Intoxicant influence first intercourse? (of those using intoxicant)	(N = 36)	(N = 0)	(N = 22)	(N = 14)	(N = 28)	(N = 8)	(N = 19)	(N = 3)
	%	%	%	%	%	%	%	%
No effect	50	0	50	50	54	38	53	33
Made more willing	50	0	50	50	46	63	47	67
Group differences	No chi-square		Not significant		Not significant		Not significant	

sexual activity ($p < .0001$), and 67% of users versus 21% of nonusers had at some time used other drugs or combinations of drugs preceding intercourse ($p < .01$) (see Table IV).

Sexual activity and substance use patterns of selected groupings of users:

1. Males and females: The male and female users did not differ significantly on any of the substance use variables (see Tables II-V).
2. Frequent and less frequent users: The frequent users differed from the less frequent users only in terms of their current usage patterns. The frequent users more often used alcohol ($p = .10$), marijuana ($p = .004$) and other drugs ($p = .02$) in conjunction with their sexual activity than did the less frequent users (see Table IV). Moreover, their use of marijuana was more likely to be by design in preparation for sexual activity than was the use of the less frequent users ($p = .004$) (see Table V).
3. Male abusers and nonabusers: The abusers differed from the nonabusers marginally in one category, the use of other drugs before intercourse ($p = .07$) (see Table IV).

TABLE III

INTOXICANT EVER LEAD TO UNDESIRED INTERCOURSE?

	Population		User Gender		Recent Usage		Abuse Status	
	Users (N = 97)	Nonusers (N = 35)	Males (N = 60)	Females (N = 37)	Less Frequent (N = 75)	Frequent Users (N = 22)	Male Nonabusers (N = 52)	Male Abusers (N = 8)
	%	%	%	%	%	%	%	%
"Yes," any intoxication	46	33	45	49	44	55	46	43
Of those answering "yes":								
Alcohol	30	76	28	34	29	33	27	33
Marijuana	17	12	24	12	17	25	27	0
Other drugs/combination of drugs	52	12	48	56	54	42	46	66
Group differences	p = .05		Not significant		Not significant		Not significant	

TABLE IV

PERCENT OF TIME DRUGS USED BEFORE INTERCOURSE

	Population		User Gender		Recent Usage		Abuser Status	
	Users (N = 97) %	Nonusers (N = 35) %	Male (N = 60) %	Female (N = 37) %	Less Frequent (N = 79) %	Frequent Usage (N = 22) %	Male Nonabusers (N = 52) %	Male Abusers (N = 8) %
Alcohol:								
0%	5	18	7	3	7	0	8	0
1%-10%	64	67	64	64	63	67	60	88
11%-25%	19	12	21	17	23	10	22	13
25% +	12	3	9	17	8	24	10	0
Group differences	p = .06		Not significant		p = .10		Not significant	
Marijuana:								
0%	2	41	3	0	3	0	4	0
1%-10%	53	59	52	54	60	29	50	63
11%-25%	22	0	21	23	22	19	22	13
25% +	24	0	24	23	15	53	24	25
Group differences	p < .00001		Not significant		p = .004		Not significant	
Other drugs/combination of drugs:								
0%	32	79	29	38	40	5	34	0
1%-10%	64	21	67	59	57	90	64	88
11%-25%	2	0	4	0	2	5	2	13
25% +	1	0	0	3	2	0	0	0
Group differences	p = .01		Not significant		p = .02		p = .07	

Summary of sexual activity and substance use patterns: The users as a group were more likely than nonusers to utilize intoxicating substances before sexual activity. Marijuana was consumed by the users more often than alcohol or other drugs in conjunction with sexual activity. However, it was less likely than alcohol to have been used before sexual initiation or undesired intercourse. Other drugs or combinations of intoxicants were most often linked to undesired intercourse. Frequent users were more likely to use marijuana by design in preparation for sex than were less frequent users.

General Marijuana-Induced Effects on Sexual Performance

The users were asked whether or not marijuana affected them with regard to the duration of intercourse, the quality of orgasm, the number of orgasms and their ability to repeat intercourse. Specifically, they reported whether marijuana increased, decreased, variably affected (i.e., was setting-dependent) or had no effect on each of these aspects of sexual performance.

Comparisons of selected groupings of users:

1. Males and females: In general, the majority of females reported no effect in any of these categories. A larger minority of males (39%) reported that marijuana increased or variably increased the duration of intercourse. This compares with 26% of the women reporting an increase or variable increase in duration (p = .05). More males (68%) than females (50%) reported that marijuana enhanced or variably enhanced the quality of their orgasm (p = .02).

   The number of orgasms increased or variably increased for 27% of the women and 19% of the men (not significant) and decreased for two percent of the men. The ability to repeat increased or variably increased for eight percent of the women and 17% of the men (not significant), and decreased for two percent of the men (see Table VI).
2. Frequent and less frequent users: When those who had used marijuana at least five times per

TABLE V

PERCENT OF TIME MARIJUANA USED BY DESIGN IN PREPARATION FOR SEXUAL ACTIVITY

	Gender		Recent Usage		Abuser Status	
	Males (N = 60)	Females (N = 37)	Less Frequent (N = 75)	Frequent Users (N = 22)	Male Nonabusers (N = 52)	Male Abusers (N = 8)
	%	%	%	%	%	%
Coincidental use only	20	29	28	8	19	25
1%-10%	43	36	45	17	45	25
11%-25%	17	14	16	17	16	25
25% +	20	21	12	58	19	25
Group differences	Not significant		p = .004		Not significant	

TABLE VI

MARIJUANA-INDUCED EFFECTS ON SEXUAL PERFORMANCE

	Gender		Recent Usage		Abuser Status	
	Males (N = 60)	Females (N = 37)	Less Frequent (N = 75)	Frequent Users (N = 22)	Male Nonabusers (N = 52)	Male Abusers (N = 8)
	%	%	%	%	%	%
Duration of intercourse:						
Increased	27	8	22	14	28	25
Decreased	0	0	0	0	0	0
Variable	12	8	10	14	10	25
No Effect	61	84	68	72	62	50
Group differences	p = .05		Not significant		Not significant	
Quality of orgasm:						
Enhanced	58	32	51	36	57	63
Decreased	0	0	0	0	0	0
Variable	10	8	8	14	8	25
No Effect	32	60	41	50	35	12
Group differences	p = .02		Not significant		Not significant	
Number of orgasms:						
Increased	12	16	16	5	12	13
Decreased	2	0	1	0	2	0
Variable	7	11	5	18	6	13
No Effect	80	73	78	77	80	75
Group differences	Not significant		Not significant		Not significant	
Ability to repeat:						
Increased	14	3	11	5	12	25
Decreased	3	0	3	0	4	0
Variable	3	5	4	5	4	0
No Effect	80	92	82	90	80	75
Group differences	Not significant		Not significant		Not significant	

week were compared with the others, there were no statistically significant differences (see Table IV).

3. Male abusers and nonabusers: Male abusers and nonabusers reported very similar effects of marijuana on their sexual performance and there were no statistically significant differences. It is interesting to note that the males reporting negative effects (i.e., a decrease in number of orgasms and a decrease in ability to repeat) were not among the abusers or the frequent users (see Table VI).

Summary of marijuana-induced effects on sexual performance: Over half of the males and less frequent users reported an enhancement of quality of orgasm. The majority of subjects reported no effect of marijuana on duration of intercourse, number of orgasms or ability to repeat. When effects were reported they were almost always positive. A very small percentage of males – not marijuana abusers or frequent users – reported negative effects on their performance. (See Table VI for a complete presentation of these data.)

TABLE VII

MARIJUANA-INDUCED EFFECTS ON SEXUAL PARTNER PREFERENCE

	Gender		Recent Usage		Abuser Status	
	Males (N = 60) %	Females (N = 37) %	Less Frequent (N = 75) %	Frequent Users (N = 22) %	Male Nonabusers (N = 52) %	Male Abusers (N = 8) %
Desire familiar partner:						
Increased	50	60	52	59	54	25
Decreased	3	3	4	0	2	13
Variable	12	11	11	14	10	25
No Effect	35	27	33	27	34	38
Group differences	Not significant		Not significant		Not significant	
Desire unfamiliar partner:						
Increased	43	14	28	41	39	63
Decreased	5	3	3	9	4	13
Variable	3	5	4	5	4	0
No Effect	49	78	65	46	53	25
Group differences	$p < .01$		Not significant		Not significant	
Desire multiple partners:						
Increased	12	3	8	9	14	0
Decreased	3	0	3	0	2	13
Variable	0	0	0	0	0	0
No Effect	85	97	89	91	84	88
Group differences	Not significant		Not significant		Not significant	
Desire homosexual partner:						
Increased	7	3	4	9	8	0
Decreased	2	0	1	0	2	0
Variable	0	3	0	5	0	0
No Effect	91	94	95	86	90	100
Group differences	Not significant		Not significant		Not significant	

TABLE VIII

MARIJUANA-INDUCED EFFECTS ON SPECIFIC SENSES DURING SEXUAL ACTIVITY*

	Gender		Recent Usage		Abuser Status	
	Males (N = 60) %	Females (N = 37) %	Less Frequent (N = 75) %	Frequent Users (N = 22) %	Male Nonabusers (N = 52) %	Male Abusers (N = 8) %
Touching:						
Enhanced	59	57	62	47	60	50
Decreased	0	0	0	0	0	0
Variable	3	3	4	0	3	0
No Effect	39	40	35	53	37	50
Physical Closeness:						
Enhanced	51	56	50	67	55	25
Decreased	0	0	0	0	0	0
Variable	9	4	8	0	10	0
No Effect	40	41	42	33	36	75
Snuggling:						
Enhanced	34	56	42	50	36	25
Decreased	0	0	0	0	0	0
Variable	9	4	8	0	7	25
No Effect	57	41	50	50	58	50
Taste:						
Enhanced	23	33	24	42	23	25
Decreased	0	0	0	0	0	0
Variable	0	4	2	0	0	0
No Effect	77	63	74	58	77	75
Smell:						
Enhanced	23	7	16	17	23	25
Decreased	3	0	0	8	3	0
Variable	0	4	2	0	0	0
No Effect	74	89	82	75	74	75
Hearing:						
Enhanced	17	11	16	8	19	0
Decreased	0	0	0	0	0	0
Variable	3	0	2	0	0	25
No Effect	80	89	82	92	81	75
Sight:						
Enhanced	11	7	10	8	13	0
Decreased	0	0	0	0	0	0
Variable	0	4	0	0	0	0
No Effect	89	93	90	92	87	100

*No group differences significant at or above .05 level.

TABLE IX

IS MARIJUANA AN APHRODISIAC?

	Gender		Recent Usage		Abuser Status	
	Males (N = 60)	Females (N = 37)	Less Frequent (N = 75)	Frequent Users (N = 22)	Male Nonabusers (N = 52)	Male Abusers (N = 8)
	%	%	%	%	%	%
Yes, mild	36	34	33	54	38	25
Yes, strong	8	11	10	8	9	0
Variable effect	28	21	26	23	25	50
No effect	28	29	31	15	28	25
Group differences	Not significant		Not significant		Not significant	

Marijuana-Induced Effects on Sexual Partner Preference

Comparisons of selected groupings of users:

1. Males and females: A majority of subjects (60% of males, 72% of females) reported that marijuana increased or variably increased their desire for a familiar partner. Three percent of both males and females reported a decrease.

   More males than females reported an increased desire for an unfamiliar partner ($p < .01$). Marijuana had no effect on desire for multiple partners or homosexual partners for over 85% of both males and females. Further analysis revealed that all subjects reporting an increase in their desire for a homosexual partner claimed either bisexuality of homosexuality as their sexual orientation (see Table VII).
2. Frequent and less frequent users: There were no significant differences between frequent and less frequent users on sexual partner preference (see Table VII).
3. Male abusers and nonabusers: There were no significant differences between the groups, but this may be due to the small number of abusers in the sample. When percentage scores were examined, the groups appeared quite distinct, although this may reflect differences in sexual contacts more than differential effects of marijuana. In general, the abusers were more likely to experience an increase in their desire for an unfamiliar partner than for a familiar partner, a pattern unlike any of the other groups under study (see Table VII).

Summary of marijuana-induced effects on sexual partner preference: At least 50% of all groups reported an increase or variable increase in their desire for a familiar partner. A significantly greater percentage of males than females reported an increase in their desire for an unfamiliar partner. Higher proportions of frequent users and abusers also reported this increase. (See Table VII for the partner preference data.)

Marijuana-Induced Effects on Specific Senses During Sexual Activity

The users were asked if marijuana had effects on their senses of touching, smell, sight, taste and hearing as well as snuggling and physical closeness during sexual activity. They reported whether each sense was enhanced, decreased, variably enhanced or was unaffected (see Table VIII).

The modalities most affected by marijuana were the tactile-related senses of touching and physical closeness, which were reported enhanced or variably enhanced by 60% of the users. The next most affected was snuggling (50%), followed by taste (29%), smell (19%), hearing (17%) and sight (10%). Two male subjects reported that marijuana decreased their sense of smell.

The men and women did not differ significantly in their reports of any of these sensory effects, nor did the frequent and less frequent users. A smaller proportion of abusers reported enhancement of touching (50% vs. 63% for nonabusers) and of physical closeness (25% vs. 65%), but there were no significant differences between the groups in their reports on sensory modalities.

General Effects of Marijuana on Sexual Activity and Enjoyment

Perceived aphrodisiac: Over 70% of the users felt that marijuana acts as an aphrodisiac, but only about nine percent rated the effect strong. There were no significant group differences in this estimation (see Table IX).

Pleasure and satisfaction: A majority (81%) reported that feelings of sexual pleasure and satisfaction increased or variably increased when they used mari-

TABLE X

MARIJUANA-INDUCED EFFECTS ON SEXUAL ENJOYMENT*

	Gender		Recent Usage		Abuser Status	
	Males (N = 60) %	Females (N = 37) %	Less Frequent (N = 75) %	Frequent Users (N = 22) %	Male Nonabusers (N = 52) %	Male Abusers (N = 8) %
Feelings of Sexual Pleasure and Satisfaction:						
Increased	70	76	75	65	72	50
Decreased	3	0	2	0	3	0
Variable	5	14	8	12	6	0
No Effect	23	10	15	24	19	50
Feelings of Emotional Closeness and Intimacy:						
Increased	46	63	52	58	48	25
Decreased	3	0	2	0	3	0
Variable	14	7	10	17	13	25
No Effect	37	30	36	25	36	50

*No group differences reached .05 level of significance.

juana.

Emotional closeness and intimacy: Sixty four percent reported an increase or variable increase in feelings of emotional closeness and intimacy. Three percent of the males reported a marijuana-induced decrease in both these feelings (see Table X). Overall, however, the males did not differ from the females, nor did the frequent users differ strikingly from the less frequent users in their report of these marijuana-induced feelings.

The abusers reported less effect on their sexual pleasure and satisfaction, and their feelings of emotional closeness and intimacy than nonabusers. The differences, however, were not statistically significant.

Summary of general effects of marijuana on sexual activity and enjoyment: About three-quarters of the users considered marijuana an aphrodisiac, but less than 10% considered the effect strong. Feelings of marijuana-induced sexual pleasure and satisfaction were reported by high percentages (above 75%) of all groups except the abusers. Feelings of emotional closeness and intimacy were reported increased or variably increased by 60% or more of all groups except, again, the abusers. (See Table X for a detailed summary.)

CONCLUSIONS

The evidence from this study indicates that marijuana, when it affects the sexual experience, affects it in a positive way. The most uniformly reported effects were general ones: feelings of sexual pleasure and satisfaction, feelings of emotional closeness and intimacy, and a general concurrence that marijuana has mild aphrodisiac properties.

Specific performance variables were apparently not affected to any large extent. For the majority of these subjects, both men and women, marijuana does not increase the duration of intercourse, as was suggested in the early 1970's, nor does it increase the number of orgasms or the ability of these sexually active adults to repeat sexual activity. However, the majority of males reported an enhanced quality of orgasms while about 40% of the women reported this effect. If as many as one-third of women never or only occasionally experience orgasm (Fisher 1973), then one-third of the females in this sample would have little or no basis of comparison for this item. Controlling for this possibility, about 60% of the orgasmic females would then be reporting enhanced quality of orgasm – a figure roughly comparable to the men. This effect is probably less attributable to set and expectancy than some other general findings, and therefore suggests that marijuana may have some mild but specific effects on sexual performance.

Of the sensory variables, the items involving touch

were, in general, enhanced by marijuana for the majority of users. Enhancement of the other senses was reported by considerably fewer subjects.

Marijuana appeared to increase, in some nonspecific fashion, the desire for a partner (both familiar and unfamiliar) for about half of the male users. Marijuana consistently increased the desire for a familiar partner only on the part of the majority of the women. It may be reassuring for society to note that for most of these chronic marijuana users – men and women – marijuana intoxication did not increase their desire for an unfamiliar partner, for multiple partners or for a homosexual partner. Thus marijuana may be promoting fidelity, a virtue not often associated with this drug or its users.

Comparison of the marijuana users with the nonusers yielded three main differences: (1) more users remained single; (2) the users' first sexual relations occurred at an earlier age; and (3) more users had engaged in homosexual activity. The two groups were quite similar, however, with respect to infidelity rates, the single subjects' number of sexual partners, and participation in group sex or partner swapping.

More users than controls had used an intoxicant at the time of their first heterosexual intercourse, however alcohol was usually the associated drug in these instances. Moreover, the use of all intoxicants, including alcohol, was a less frequent phenomenon in the sex lives of the comparison group.

While a significant majority of the users agreed that marijuana is consistently an aphrodisiac, or at least under some circumstances, it is apparent that only the most frequent users often seek out the use of this substance specifically for its sexually stimulating qualities. For the others, their use of marijuana is more likely to be coincidental to their sexual behavior. While marijuana does appear to be a drug of choice for the users where sexual activity is concerned, the effects are mild, positive and facilitating, but not compelling.

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Psychological Effects, Personality and Behavioral Changes Attributed to Marihuana Use

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Abstract

Data from 530 marihuana users on the psychological effects, personality and behavioral changes attributed to their marihuana use are presented. Age, sex, marital status, and educational level are reported. Data were analyzed according to five use patterns: (1) trial users, (2) past users, (3) occasional users, (4) regular users, and (5) daily users. *S*s reported on the occurrence of 33 psychological effects of marihuana, changes in 14 behavioral and personality variables, effect on alcohol and tobacco consumption, effect on sexual orientation, and reasons for marihuana use.

> Results are consistent in that as marihuana use increases, there is an increase in pleasurable effects and beneficial results in personality and behavioral realms and a decrease in negative and untoward sequelae. Trial users report the least pleasant effects and the greatest untoward effects, and past users report considerably less benefits than current users.

The recent volume *Marihuana: A Signal of Misunderstanding* (Shafer et al., 1972), the official report of the National Commission on Marihuana and Drug Abuse, has increased the already widespread interest in the marihuana phenomenon. Until the past 6 or 7 years, most reports of the effects of marihuana were either anecdotal in style or based on poorly designed studies from abroad. More recently there have been laboratory studies on the physiological effects of marihuana (e.g., Isbell, 1967; Weil, Zinberg, and Nelsen, 1968); effect on human performance (e.g., Clarke, 1971; Crancer, 1969; Jones and Stone, 1969; Kiplinger, 1971); and clinical reports on adverse reactions such as feelings of confusion and disorientation (e.g., Smith and Mehl, 1970); depression, panic, and depersonalization (e.g., Keeler, 1967); anxiety and paranoia (e.g., Durham, 1968); and psychotic reactions (e.g., Hekimian and Gershon, 1968). Especially among social scientists there is a trend away from an attempt to relate marihuana use to specific behavioral effects, such as opiate addiction or criminal activity, and to explore the complexity of factors which determine functional use or abuse of marihuana (e.g., Blum, 1969; Blumer, 1967; Fisher and Strantz, 1972; Goode, 1970; Kaplan, 1970; McGlothlin and West, 1968; Smith and Mehl, 1970). The Canadian Commission of Inquiry into the Non-Medical Use of Drugs (Canadian Interim Report, 1970) has concluded, ". . . the psychological effects of cannabis vary greatly with a number of factors and are often difficult to predict. . . (and) depend to a considerable degree on the personality of the user, his past experience with cannabis or other drugs, his attitudes and the setting in which the drug is used."

The present study reports on the natural use of marihuana and presents data on the reported psychological effects of marihuana, the personality and behavioral changes attributed to marihuana use, and the reasons given for use. These data are self-report data and contain all the limitations inherent in such a study.

THE SAMPLE

The sample consists of 530 *S*s. Each *S* completed a 220-item questionnaire. The data were collected in 1969–1970 and sampling was conducted

using two methods: The social network method and random sampling utilizing voter registration lists. The locale was predominantly Southern California. For the social network method, questionnaires were distributed to acquaintances of the researchers who were asked to enlist the cooperation of their marihuana-using friends. A cover letter explaining the research as well as a stamped, return-addressed envelope accompanied the questionnaire. Anonymity of respondents was assured. Since we were primarily interested in an adult middle to upper class sample, an attempt was made to restrict social networks to this population. However, college and university students were included in these networks. In order to broaden the base of sampling, random sampling, from voter registration lists from Los Angeles County, was conducted. Precincts that were predominantly middle-upper to upper class were utilized. The return rate from the mail-out questionnaire was 35%. Of those 525 usable returned questionnaires, 98 were from *S*s who had used or were currently using marihuana. Thus the user rate from this sample was 18.7%. Of the total 530 users studies, 98 (18.5%) were from the random mail-out sample.

For analysis the sample was categorized according to marihuana use pattern. The following categories were established: (1) *Trial users*: $N = 47$ (*S*s who had only used marihuana from one to three times); (2) *past users*: $N = 79$ (*S*s who had used marihuana in the past but who currently considered themselves nonusers); (3) *occasional users*: $N = 147$ (*S*s whose current use was less than once per week); (4) *regular users*: $N = 200$ (*S*s who use at least once per week to those who use up to 6 days a week); (5) *daily users*: $N = 57$ (*S*s who use at least once every day).

DEMOGRAPHIC CHARACTERISTICS OF SAMPLE

Age

Age distribution by marihuana use group is given in Table 1. The

Table 1
Age Distribution by Marihuana Use Groups

	Trial users	Past users	Occasional users	Regular users	Daily users
Age	% N	% N	% N	% N	% N
20 and under	21.7 (10)	17.9 (14)	12.4 (18)	31.2 (62)	28.6 (16)
21–30	47.8 (22)	57.7 (45)	57.2 (83)	57.8 (115)	58.9 (33)
31–40	17.4 (8)	12.8 (10)	17.9 (26)	8.0 (16)	8.9 (5)
Over 40	13.0 (6)	11.5 (9)	12.4 (18)	3.0 (6)	3.6 (2)

majority of users in all use groups are in the 21 to 30 year age bracket. The range in age was from 16 to 66 years. The sample is essentially of adults with a tendency for the more frequent users to be younger.

Sex

Sex distribution by marihuana use groups is given in Table 2. The sample consisted of 300 males and 224 females. There was a tendency for the more frequent users to be male and for the occasional users to be female. Trial and past use groups did not differ in sex composition.

Table 2
Sex Distribution by Marihuana Use Group

	Trial users	Past users	Occasional users	Regular users	Daily users
Sex	% N	% N	% N	% N	% N
Male	47.8 (22)	47.4 (37)	61.4 (89)	59.3 (118)	60.7 (34)
Female	52.2 (24)	52.6 (41)	38.6 (56)	40.7 (81)	39.3 (22)

Marital Status

Marital status by marihuana use group is shown in Table 3. The majority of respondents in all categories are single. The regular and daily users have the highest percentage of single respondents, and part of this is undoubtedly due to their being a younger group. About 10% of *S*s in all use categories are divorced or separated.

Table 3
Marital Status by Marihuana Use Group

	Trial users	Past users	Occasional users	Regular users	Daily users
Marital status	% N	% N	% N	% N	% N
Single	50.0 (23)	55.3 (42)	54.6 (77)	70.9 (139)	64.3 (36)
Married	41.3 (19)	35.5 (27)	33.3 (47)	17.9 (35)	25 0 (14)
Divorced/ separated	8.7 (4)	9.2 (7)	9.9 (14)	10.2 (20)	10.7 (6)
Widowed	0 (0)	0 (0)	2.1 (3)	1.0 (2)	0 (0)

Educational Level

Educational level by marihuana use group is shown in Table 4. The sample is fairly well educated with only a small percentage of *S*s having

less than some college education. Occasional users are the best educated—64.4% having baccalaureate or graduate degrees, and the trial users the least educated—13.3% having less than some college education.

Table 4
Educational Level by Marihuana Use Groups

	Trial users		Past users		Occasional users		Regular users		Daily users	
Education	%	N	%	N	%	N	%	N	%	N
Less than high school	2.2	(1)	0	(0)	0.7	(1)	1.5	(3)	5.4	(3)
High school graduate	11.1	(5)	6.3	(5)	2.7	(4)	4.1	(8)	1.8	(1)
Some college	51.1	(23)	46.8	(37)	32.2	(47)	60.4	(119)	57.1	(32)
College graduate	17.8	(8)	22.8	(18)	24.7	(36)	15.2	(30)	23.2	(13)
Graduate or professional degree	17.8	(8)	24.1	(19)	39.7	(58)	18.8	(37)	12.5	(7)

PSYCHOLOGICAL EFFECTS OF MARIHUANA

Respondents were asked about the feelings and experiences that occur to them when using marihuana. The question was asked "Check the following words which you would use to describe the feelings and experiences *you* have with marihuana." Table 5 shows the results of this question. The phenomena are listed from the most frequently checked to the least frequently checked for the total group. It is readily apparent that *S*s use marihuana because they have more pleasant than unpleasant experiences. Of the 33 phenomena studied, 14 can be considered desirable, 12 undesirable, and seven neutral, depending on a *S*'s reaction to the phenomenon (e.g., distortion of time sense, altered depth perception, openness to suggestion). Of the 16 top ranked occurring phenomena, 10 are positively valued, six neutrally valued, and none negatively valued. Among the 10 lowest ranked occurring phenomena, eight are negatively valued, one neutrally valued, and one positively valued.

Over half of all *S*s experience tranquility (73.3%), increased sensory awareness (69.3%), hunger (68.9%), giggles (64.8%), distortion of time sense (63.3%), and drowsiness (56.3%). Over 40% of all *S*s experience euphoria (49.6%), introspectiveness (45.8%), difficulty with concentration (43.2%), love for fellow man (40.7%), and psychological insight (40.7%). About one-third of all *S*s report experiencing eroticism (39.6%), openness

Table 5
Marihuana-Induced Phenomena Experienced by Subjects by Use Pattern Groups

Item	Rank frequency	Total *Ss* reporting		Trial users		Past users		Occasional users		Regular users		Daily users	
		%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*
Tranquility	1	73.3	(387)	40.4	(19)	53.8	(42)	77.0	(114)	81.4	(162)	89.3	(50)
Increased sensory awareness	2	69.3	(366)	31.9	(15)	53.8	(42)	67.6	(100)	81.9	(163)	82.1	(46)
Hunger	3	68.9	(364)	25.5	(12)	64.1	(50)	59.5	(88)	82.4	(164)	89.3	(50)
Giggles	4	64.8	(342)	34.0	(16)	57.7	(45)	66.2	(98)	73.9	(147)	64.3	(36)
Distortion of time sense	5	63.3	(334)	36.2	(17)	57.7	(45)	60.8	(90)	72.9	(145)	66.1	(37)
Drowsiness	6	56.3	(297)	17.0	(8)	61.5	(48)	58.1	(86)	63.3	(126)	51.8	(29)
Euphoria	7	49.6	(262)	23.4	(11)	32.1	(25)	48.0	(71)	59.3	(118)	66.1	(37)
Introspectiveness	8	45.8	(242)	12.8	(6)	30.8	(24)	41.9	(62)	57.8	(115)	62 5	(35)
Difficulty with concentration	9	43.2	(228)	21.3	(10)	55.1	(43)	31.8	(47)	53.3	(106)	39.3	(22)
Love for fellow man	10.5	40.7	(215)	12.8	(6)	32.1	(25)	35.1	(52)	50.8	(101)	55.4	(31)
Psychological insight	10.5	40.7	(215)	6.4	(3)	24.5	(23)	27.7	(41)	58.8	(117)	55.4	(31)
Eroticism	12	39.6	(209)	12.8	(6)	33.3	(26)	39.9	(59)	48.2	(96)	39.3	(22)
Openness to suggestion	13	36.2	(191)	10.6	(5)	33.3	(26)	25.0	(37)	44.7	(89)	60.7	(34)
Heightened creativity	14	32.8	(173)	6.4	(3)	17.9	(14)	25.0	(37)	43.7	(87)	57.1	(32)
Greater honesty	15	30.5	(161)	6.4	(3)	21.8	(17)	25.7	(38)	36.2	(72)	55.4	(31)
Altered depth perception	16	25.6	(135)	21.3	(10)	26.9	(21)	21.6	(32)	30.7	(61)	19.6	(11)
Depression	17	23.7	(125)	14.9	(7)	33.3	(26)	16.9	(25)	29.1	(58)	16.1	(9)
Fear	18	23.3	(123)	19.1	(9)	25.6	(20)	19.6	(29)	26.6	(53)	21.4	(12)
Synesthesia	19	22.5	(119)	4.3	(2)	19.2	(15)	19.6	(29)	27.1	(54)	33.9	(19)
Greater ability to concentrate	20	22.2	(117)	12.8	(6)	3.9	(3)	22.3	(33)	25.6	(51)	42.9	(24)

Sadness	21	21.2 (112)	14.9 (7)	23.1 (18)	19.6 (29)	22.1 (44)	25.0 (14)
Self-consciousness or embarrassment	22	18.6 (98)	10.6 (5)	19.2 (15)	9.5 (14)	25.1 (50)	25.0 (14)
Religious or mystical feelings	23	18.0 (95)	2.1 (1)	14.1 (11)	13.5 (20)	22.1 (44)	33.9 (19)
Hallucinations	24	17.2 (91)	8.5 (4)	15.4 (12)	12.8 (19)	19.1 (38)	32.1 (18)
Hyperactivity	25	15.5 (82)	6.4 (3)	11.5 (9)	10.1 (15)	20.1 (40)	26.8 (15)
Better judgment	26	13.4 (71)	2.1 (1)	5.1 (4)	6.8 (10)	19.1 (38)	32.1 (18)
Telepathy	27.5	12.5 (66)	6.4 (3)	10.3 (8)	7.4 (11)	16.1 (32)	21.4 (12)
Poor judgment	27.5	12.5 (66)	8.5 (4)	24.4 (19)	8.1 (12)	12.6 (25)	10.7 (6)
Headaches	29	11.4 (60)	14.9 (7)	14.1 (11)	8.1 (12)	10.6 (21)	16.1 (9)
Grandeur or feeling of omnipotence	30	8.5 (45)	2.1 (1)	11.5 (9)	7.4 (11)	7.5 (15)	16.1 (9)
Nausea	31	7.4 (39)	4.3 (2)	14.1 (11)	8.1 (12)	4.0 (8)	10.7 (6)
Anger	32	4.2 (22)	0.0 (0)	2.6 (2)	5.4 (8)	4.5 (9)	5.4 (3)
Less honesty	33	2.8 (15)	2.1 (1)	5.1 (4)	.7 (1)	3.0 (6)	5.4 (3)

to suggestion (36.2%), heightened creativity (32.8%), and greater honesty (30.5%). Fewer than 10% of all *S*s experienced grandeur or feelings of omnipotence (8.5%), nausea (7.4%), anger (4.2%), and being less honest (2.8%). The most frequently reported negatively valued phenomena are depression and fear, and these two reactions are reported by 23.7 and 23.3% of *S*s, respectively.

Consequently, *S*s using marihuana report experiencing considerably more pleasant than unpleasant phenomena, and what we have conservatively called neutral phenomena (e.g., openness to suggestion, altered depth perception) are probably experienced more as a pleasant effect rather than as a negative effect.

Table 6 is generated from the data in Table 5 and reports the ranked frequency of reported phenomena by use pattern group. An attempt was made to determine if there was a difference in reported effects by *S*s with differing use patterns. As use increases there is an increase in the reported frequency of the varying phenomena. This is understandable in that the more one uses marihuana, the more likely the occurrence of a variety of psychic effects. There are marked differences among use pattern groups in the frequency of the occurrence of certain phenomena. As use increases, there is an increase in the reporting of positively valued phenomena. Trial users report the least pleasant experience and the most unpleasant experiences. This would undoubtedly relate to their not becoming marihuana users in that their experiences were not that pleasant. For example, of the 13 most frequently reported phenomena for trial users, only four are positively valued, four negatively valued, and five neutrally valued whereas for daily users, of the 13 most frequently reported phenomena, nine are positively valued, none are negatively valued, and four are neutrally valued. In addition, what we have called "neutrally" valued probably become positively valued as marihuana use increases. It is of interest that characteristic but unusual phenomena which might be distressing to the novice is less prominent to the habitual user. For example, *altered depth perception* is ranked seventh by trial users, fifteenth by past users, seventeenth by occasional users, sixteenth by regular users, and twenty-sixth by daily users. Obviously, adaptation to this characteristic phenomenon occurs with increased use, and it becomes less prominent in the consciousness of the user. This same phenomenon apparently applies to *difficulty with concentration*, which is ranked seventh by trial users, fifth by past users, eleventh by occasional users, tenth by regular users, and fifteenth by daily users. *Distortion of time sense*, another characteristic phenomenon, apparently does not "adapt" in the same fashion, as this

phenomenon is ranked high by all groups: second by trial users, third by past users, fourth by occasional users, fifth by regular users, and fourth by daily users. *Hunger* is also among the top five ranked phenomena by all use pattern groups.

It is interesting to observe the difference among groups in reported *drowsiness*. Trial users rank it tenth, past users second, occasional and regular users sixth, and daily users thirteenth. Although it is somewhat pretentious to speculate on the dynamics of these differences, it may be that trial users did not relax enough to get the drowsiness sensation, past users had it so frequently so as to make the experience uninteresting, occasional and regular users experience it as part of the total marihuana experience, and daily users have integrated use into their life style to such an extent that marihuana ceases to dull the consciousness as it does in less frequent users.

Post-marihuana *depression* is a sometimes complaint of marihuana users. Past users rank depression ninth and trial users rank it twelfth, whereas occasional users rank it twenty-one, regular users seventeenth, and daily users twenty-eighth. Consequently there is a large difference in the occurrence of depression among use pattern groups with past users reporting the greatest, and daily users the least prominence of this phenomenon in their marihuana experience.

Great differences also occur among use pattern groups in the prominence of other negatively valued phenomenon: *fear* is ranked ninth by trial users, sixteenth by past users, and twenty-fourth by daily users; *headaches* are ranked twelfth by trial users, and twenty-seventh, twenty-ninth, and twenty-eighth by occasional, regular, and daily users, respectively; *sadness* is ranked twelfth by trial users and twenty-second by regular and daily users.

The greatest differences among use pattern groups appear to be in the prominence and frequency of positively valued phenomena. Positive psychologically oriented phenomena are reported more frequently as use increases. For example, *heightened creativity* is ranked ninth by daily users (57.1%), fourteenth by regular users (43.7%), fourteenth by occasional users (25.0%), twenty-second by past users (17.9%), and twenty-fourth by trial users (6.4%). *Greater honesty* is ranked eleventh by daily users (55.4%), fifteenth by regular users (36.2%), thirteenth by occasional users (25.7%), nineteenth by past users (21.8%), and twenty-fourth by trial users (6.4%). *Introspectiveness* is ranked seventh by daily users (62.5%), ninth by regular users (57.8%), thirteenth by past users (30.8%), and fifteenth by trial users (12.8%). *Euphoria* is ranked fourth by daily

Table 6

Rank	Trial users	Percentage of Ss reporting	Rank	Past users	Percentage of Ss reporting	Rank	Occasional users	Percentage of Ss reporting
1	Tranquility	(40.4)	1	Hunger	(64.1)	1	Tranquility	(77.0)
2	Distortion of time sense	(36.2)	2	Drowsiness	(61.5)	2	Increased sensory awareness	(67.6)
3	Giggles	(34.0)	3.5	Giggles	(57 7)	3	Giggles	(66.2)
4	Increased sensory awareness	(31.9)	3.5	Distortion of time sense	(57.7)	4	Distortion of time sense	(60.8)
5	Hunger	(25.5)	5	Difficulty with concentration	(55.1)	5	Hunger	(59.5)
6	Euphoria	(23.4)	6.5	Tranquility	(53.8)	6	Drowsiness	(58.1)
7.5	Altered depth perception	(21.3)	6.5	Increased sensory awareness	(53.8)	7	Euphoria	(48.0)
7.5	Difficulty with concentration	(21.3)	9	Eroticism	(33.3)	8	Introspectiveness	(41.9)
9	Fear	(19.1)	9	Depression	(33.3)	9	Eroticism	(39.9)
10	Drowsiness	(17.0)	9	Openness to suggestion	(33.3)	10	Love for fellow man	(35.1)
12	Headaches	(14.9)	11.5	Euphoria	(32.1)	11	Difficulty with concentration	(31.8)
12	Sadness	(14.9)	11.5	Love for fellow man	(32.1)	12	Psychological insight	(27.7)
12	Depression	(14.9)	13	Introspectiveness	(30.8)	13	Greater honesty	(25.7)
15.5	Introspectiveness	(12.8)	14	Psychological insight	(29.5)	14.5	Openness to suggestion	(25.0)
15.5	Love for fellow man	(12.8)	15	Altered depth perception	(26.9)	14.5	Heightened creativity	(25.0)
15.5	Eroticism	(12.8)	16	Fear	(25.6)	16	Greater ability to concentrate	(22.3)
15.5	Greater ability to concentrate	(12.8)	17	Poor judgment	(24.4)	17	Altered depth perception	(21.6)

Rank Order of Marihuana-Induced Experiences by Use Pattern Groups

Rank	Regular users	Percentage of *Ss* reporting	Rank	Daily users	Percentage of *Ss* reporting
1	Hunger	(82. 4)	1. 5	Tranquility	(89. 3)
2	Increased sensory awareness	(81. 9)	1. 5	Hunger	(89. 3)
3	Tranquility	(81. 4)	3	Increased sensory awareness	(82. 1)
4	Giggles	(73. 9)	4. 5	Distortion of time sense	(66. 1)
5	Distortion of time sense	(72. 9)	4. 5	Euphoria	(66. 1)
6	Drowsiness	(63. 3)	6	Giggles	(64. 3)
7	Euphoria	(59. 3)	7	Introspectiveness	(62. 5)
8	Psychological insight	(58. 8)	8	Openness to suggestion	(60. 7)
9	Introspectiveness	(57. 8)	9	Heightened creativity	(57. 1)
10	Difficulty with concentration	(53. 3)	11	Greater honesty	(55. 4)
11	Love for fellow man	(50. 8)	11	Love for fellow man	(55. 4)
12	Eroticism	(48. 2)	11	Psychological insight	(55. 4)
13	Openness to suggestion	(44. 7)	13	Drowsiness	(51. 8)
14	Heightened creativity	(43. 7)	14	Greater ability to concentrate	(42. 9)
15	Greater honesty	(36. 2)	15. 5	Difficulty with concentration	(39. 3)
16	Altered depth perception	(30. 7)	15. 5	Eroticism	(39. 3)
17	Depression	(29. 1)	17. 5	Synesthesia	(33. 9)

(*continued*)

Table 6

Rank	Trial users	Percentage of *Ss* reporting	Rank	Past users	Percentage of *Ss* reporting	Rank	Occasional users	Percentage of *Ss* reporting
18.5	Self-consciousness or embarrassment	(10.6)	18	Sadness	(23.1)	19	Sadness	(19.6)
18.5	Openness to suggestion	(10.6)	19	Greater honesty	(21.8)	19	Fear	(19.6)
20.5	Poor judgment	(8.5)	20.5	Synesthesia	(19.2)	19	Synesthesia	(19.6)
20.5	Hallucinations	(8.5)	20.5	Self-consciousness or embarrassment	(19.2)	21	Depression	(16.9)
24	Psychological insight	(6.4)	22	Heightened creativity	(17.9)	22	Religious or mystical feelings	(13.5)
24	Heightened creativity	(6.4)	23	Hallucinations	(15.4)	23	Hallucinations	(12.8)
24	Greater honesty	(6.4)	25	Nausea	(14.1)	24	Hyperactivity	(10.1)
24	Telepathy	(6.4)	25	Headaches	(14.1)	25	Self-consciousness or embarrassment	(9.5)
24	Hyperactivity	(6.4)	25	Religious or mystical feelings	(14.1)	27	Headaches	(8.1)
27.5	Nausea	(4.3)	27.5	Hyperactivity	(11.5)	27	Poor judgment	(8.1)
27.5	Synesthesia	(4.3)	27.5	Grandeur or feelings of omnipotence	(11.5)	27	Nausea	(8.1)
30.5	Less honesty	(2.1)	29	Telepathy	(10.3)	29.5	Grandeur or feelings of omnipotence	(7.4)
30.5	Better judgment	(2.1)	30.5	Better judgment	(5.1)	29.5	Telepathy	(7.4)
30.5	Religious or mystical feelings	(2.1)	30.5	Less honesty	(5.1)	31	Better judgment	(6.8)
30.5	Grandeur or feelings of omnipotence	(2.1)	32	Greater ability to concentrate	(3.9)	32	Anger	(5.4)
33	Anger	(0.0)	33	Anger	(2.6)	33	Less honesty	(0.7)

(continued)

Rank	Regular users	Percentage of *Ss* reporting	Rank	Daily users	Percentage of *Ss* reporting
18	Synesthesia	(27. 1)	17. 5	Religious or mystical feelings	(33. 9)
19	Fear	(26. 6)	19. 5	Better judgment	(32. 1)
20	Greater ability to concentrate	(25. 6)	19. 5	Hallucinations	(32. 1)
21	Self-consciousness or embarrassment	(25. 1)	21	Hyperactivity	(26. 8)
22. 5	Sadness	(22. 1)	22. 5	Sadness	(25. 0)
22. 5	Religious or mystical feelings	(22. 1)	22. 5	Self-consciousness or embarrassment	(25. 0)
24	Hyperactivity	(20. 1)	24. 5	Telepathy	(21. 4)
25. 5	Better judgment	(19. 1)	24. 5	Fear	(21. 4)
25. 5	Hallucinations	(19. 1)	26	Altered depth perception	(19. 6)
27	Telepathy	(16. 1)	28	Headaches	(16. 1)
28	Poor judgment	(12. 6)	28	Depression	(16. 1)
29	Headaches	(10. 6)	28	Grandeur or feelings of omnipotence	(16. 1)
30	Grandeur or feelings of omnipotence	(7. 4)	30. 5	Nausea	(10. 7)
31	Anger	(4. 5)	30. 5	Poor judgment	(10. 7)
32	Nausea	(4. 0)	32. 5	Anger	(5. 4)
33	Less honesty	(3. 0)	32. 5	Less honesty	(5. 4)

users (66.1%), seventh by regular users (59.3%), and eleventh by past users (32.1%). It is of interest to note that *greater ability to concentrate* is reported by 42.9% of daily users and ranked fourteenth, whereas only 3.9% of past users reported this phenomenon and ranked it thirty-second. It is also of interest that *eroticism* is ranked highest (ninth) by occasional (39.9%) and past users (33.3%), followed by regular users (48.2%) who rank it twelfth, and ranked equally low (fifteenth) by trial (12.8%) and daily users (39.3%). Thus eroticism appears to be of less prominence for daily and regular users than for less frequent users, and this may be because eroticism is less integrated for less frequent users than for more frequent users. Worth comment is the fact that few *S*s report feelings of *anger* with marihuana. Anger is ranked thirtieth by daily, thirty-first by regular, thirty-second by occasional, and thirty-third by past and trial users. *Less honesty* is another infrequently reported phenomenon by all groups: ranked last by daily, regular, and occasional users, and thirtieth by past and trial users. *Poor judgment* is ranked low by current users: thirtieth by daily, twenty-eighth by regular, and twenty-seventh by occasional users, but ranked considerably higher (seventeenth) by past users and twentieth by trial users. *Hallucinations*, a supposedly common phenomenon with marihuana use, is ranked relatively low by all groups: twentieth by trial, twenty-third by past and occasional, twenty-fifth by regular, and nineteenth by daily users.

Thus the differences in experienced phenomena by use pattern groups are fairly clear: those who use it most report the greatest frequency of the most favorable phenomena and the least relative occurrence of negatively valued phenomenon, whereas past users and trial users, respectively, report the highest relative occurrence of negatively valued phenomena and the lowest relative occurrence of positively valued phenomena.

CHANGE IN SEXUAL ORIENTATION, AND ALCOHOL AND TOBACCO CONSUMPTION AS AN EFFECT OF MARIHUANA USE

Respondents were asked if the use of marihuana had altered their sexual orientation. Of the 495 *S*s answering this item, 88.3% answered that marihuana use had no effect on their sexual orientation whereas 11.7% stated it had had some effect. Four *S*s (0.9%) (one past user, two occasional users, and one daily user) stated their sexual orientation had changed in the direction of homosexuality; 24 *S*s (4.9%) (two past users, three occasional users, 15 regular users, and four daily users) stated their

sexual orientation had changed in the direction of heterosexuality; and 30 *Ss* (6.1%) (one trial user, one past user, five occasional users, 17 regular users, and six daily users) stated their sexual orientation had changed in the direction of bisexuality. For this latter category, we have no data indicating what percentage of *Ss* who were tending toward a bisexual orientation were previously exclusively heterosexual and what percentage had previously been exclusively homosexual. Thus the most frequent change (6.1%) in sexual orientation is toward bisexuality, followed by a change (4.9%) toward heterosexuality, with few *Ss* (0.9%) changing toward homosexuality. These data do not support the contention that marihuana use causes marked changes in sexual orientation.

Respondents were asked if marihuana had altered their use of alcohol. Table 7 shows the results of this question by use pattern group. As marihuana use increases, there is a decrease in the use of alcohol. Very few *Ss* (total of 13) report an increase in alcohol consumption. The percentage of *Ss* reporting a decrease in alcohol consumption rises sharply as marihuana use increases. These data tend to support the contention that marihuana replaces alcohol use. Other data available indicate that when *Ss* were asked their use of alcohol, current users reported more use of alcohol than nonusers or past users. Thus it is not that marihuana users use less alcohol than nonusers, but that the more they use marihuana, the less they use alcohol. A confounding factor in these data, however, is that wine consumption was not separated out from use of hard liquor. It is apparently a very common practice that wine and marihuana are used simultaneously. Consequently marihuana users reported usage of alcohol may be highly determined by their use of wine rather than hard liquor. When *Ss* were asked if the reasons for their use of marihuana

Table 7
Effect of Marihuana in Changing Use of Alcohol by Use Pattern Group

Change in alcohol use	Use pattern group									
	Trial users		Past users		Occasional users		Regular users		Daily users	
	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*
Alcohol increased	3.0	(1)	1.3	(1)	0.7	(1)	4.7	(9)	1.8	(1)
Alcohol decreased	6.1	(2)	14.7	(11)	27.5	(39)	41.7	(80)	60.0	(33)
No change	90.1	(30)	84.0	(63)	71.8	(102)	53.6	(103)	38.2	(21)
		(33)		(75)		(142)		(192)		(55)

Table 8
Effect of Marihuana Use on Tobacco Use by Use Pattern Group

Change in tobacco use	Use pattern group							
	Past users		Occasional users		Regular users		Daily users	
	%	N	%	N	%	N	%	N
Tobacco increase	5.4	(4)	2.9	(4)	10.5	(20)	10.9	(6)
Tobacco decrease	12.2	(9)	5.0	(7)	12.1	(23)	29.1	(16)
No change	82.4	(61)	92.1	(129)	77.4	(147)	60.0	(33)
		(74)		(140)		(190)		(55)

paralleled most peoples use of alcohol, among the current users there was an inverse relationship between answering this question positively and frequency of marihuana use. That is, 66.9% of occasional users, 42.7% of regular users, and 34.6% of daily users answered "yes," i.e., that their *reasons* for using marihuana were the same as most peoples' *reasons* for using alcohol. Thus it appears that as an individual's marihuana use increases, his use of alcohol declines, that the heavier the use of marihuana, the less likely is the individual to judge the reason for his use of marihuana parallels other peoples' reason for using alcohol, but that in frequency of use, the heavier the use of marihuana, the heavier the use of alcohol. This last fact, however, might be highly contaminated by the use of wine by marihuana users rather than hard liquor, though we have no data on this factor.

Respondents were asked if their marihuana use had increased, decreased, or had no effect on their use of tobacco. Table 8 shows the results of this question by use pattern group. The majority of respondents in all use groups state that marihuana use has had no effect on their tobacco consumption. Very few respondents (from 2.9 to 10.9%) state their tobacco use has increased as a function of their marihuana use. Twice as many daily users (29.1%) than any other use group state that their tobacco consumption has *decreased* as a function of their marihuana use. Consequently marihuana use does not appear to affect tobacco consumption with the exception of daily marihuana users, 29.1% of whom state their tobacco consumption decreased as a function of marihuana use.

CHANGES IN ATTRIBUTES OF SELF AS A FUNCTION OF MARIHUANA USE

Respondents were asked if they attributed any change in themselves in a number of areas in their life as a function of their use of marihuana. Table 9 shows the results of this question.

Table 9
Changes in Attributes of Self as a Function of Marihuana Use by Use Pattern Group

	Use pattern group			
	Past users	Occasional users	Regular users	Daily users
	% N	% N	% N	% N
Self-knowledge				
Increased	30.4 (21)	34.3 (48)	59.3 (115)	70.9 (39)
Decreased	1.5 (1)	0.0 (0)	0.0 (0)	0.0 (0)
No change	47.8 (33)	54.3 (76)	32 5 (63)	20.0 (11)
Doesn't apply	20.3 (14)	11.4 (16)	8.3 (16)	9.1 (5)
Self-approval				
Increased	8.7 (6)	21.4 (30)	35.9 (69)	56.4 (31)
Decreased	13.0 (9)	2.1 (3)	2.1 (4)	1.8 (1)
No change	56.5 (39)	64.3 (90)	47.9 (92)	30.9 (17)
Doesn't apply	21.7 (15)	12.1 (17)	14.1 (27)	10.9 (6)
Sexual pleasure				
Increased	25.4 (17)	33.6 (47)	57.5 (111)	69.8 (37)
Decreased	1.5 (1)	0.7 (1)	1.0 (2)	0.0 (0)
No change	53.7 (36)	56.4 (79)	34.2 (66)	26.4 (14)
Doesn't apply	19.4 (13)	9.3 (13)	7.3 (14)	3.8 (2)
Enjoyment of music, movies, paintings, TV				
Increased	36.2 (25)	55.4 (77)	81.4 (158)	83.3 (45)
Decreased	0.0 (0)	0.7 (1)	0.0 (0)	0.0 (0)
No change	43.5 (30)	37.4 (52)	16.0 (31)	14.8 (8)
Doesn't apply	20.3 (14)	6.5 (9)	2.6 (5)	1.9 (1)
Enjoyment of nature				
Increased	34.8 (24)	46.7 (64)	75.5 (145)	75.9 (41)
Decreased	1.5 (1)	0.7 (1)	0.0 (0)	0.0 (0)
No change	46.4 (32)	46.7 (64)	20.3 (39)	22.2 (12)
Doesn't apply	17.4 (12)	5.8 (8)	4.1 (8)	1.9 (1)
Ability to communicate with others				
Increased	18.6 (13)	25.0 (35)	47.1 (89)	63.5 (33)
Decreased	5.7 (4)	0.7 (1)	2.7 (5)	1.9 (1)
No change	58.6 (41)	62.9 (88)	40.7 (77)	30.8 (16)
Doesn't apply	17.1 (12)	11.4 (16)	9.5 (18)	3.9 (2)
Ability to think through problems				
Increased	10.3 (7)	12.1 (17)	22.4 (43)	39.6 (21)
Decreased	11.8 (8)	3.6 (5)	7.3 (14)	3.8 (2)
No change	58.8 (40)	73.6 (103)	62.0 (119)	54.7 (29)
Doesn't apply	19.1 (13)	10.7 (15)	8.3 (16)	1.9 (1)

(*continued*)

Table 9 (continued)

	Use pattern group							
	Past users		Occasional users		Regular users		Daily users	
	%	N	%	N	%	N	%	N
Creativity, imagination								
Increased	10.3	(7)	23.0	(32)	49.0	(94)	63.0	(34)
Decreased	7.4	(5)	0.7	(1)	0.5	(1)	1.9	(1)
No change	61.8	(42)	66.2	(92)	44.8	(86)	33.3	(18)
Doesn't apply	20.6	(14)	10.1	(14)	5.7	(11)	1.9	(1)
Memory								
Increased	3.0	(2)	2.9	(4)	6.8	(13)	15.1	(8)
Decreased	16.4	(11)	7.9	(11)	20.4	(39)	20.8	(11)
No change	59.7	(40)	77.0	(107)	67.0	(128)	62.3	(33)
Doesn't apply	20.9	(14)	12.2	(17)	5.8	(11)	1.9	(1)
Mystical interest								
Increased	19.4	(13)	23.0	(32)	43.0	(83)	52.8	(28)
Decreased	1.5	(1)	1.4	(2)	1.0	(2)	1.9	(1)
No change	55.2	(37)	59.7	(83)	44.0	(85)	41.5	(22)
Doesn't apply	23.9	(16)	15.8	(22)	11.9	(23)	3.8	(2)
Sense of responsibility								
Increased	4.4	(3)	6.4	(9)	10.4	(20)	18.9	(10)
Decreased	15.9	(11)	3.6	(5)	12.5	(24)	9.4	(5)
No change	60.9	(42)	73.6	(103)	66.1	(127)	66.0	(35)
Doesn't apply	18.8	(13)	16.4	(23)	10.9	(21)	5.7	(3)
Acceptance of conventional values								
Increased	5.9	(4)	0.7	(1)	3.6	(7)	5.6	(3)
Decreased	32.4	(22)	37.7	(52)	58.0	(112)	61.1	(33)
No change	41.2	(28)	51.4	(71)	26.9	(52)	24.1	(13)
Doesn't apply	20.6	(14)	10.1	(14)	11.4	(22)	9.3	(5)
Conformity to conventional modes of behavior								
Increased	0.0	(0)	0.7	(1)	2.1	(4)	1.9	(1)
Decreased	25.4	(17)	34.8	(48)	56.5	(109)	64.8	(35)
No change	56.7	(38)	55.1	(76)	32.6	(63)	31.5	(17)
Doesn't apply	17.9	(12)	9.4	(13)	8.8	(17)	1.9	(1)
Conventional religious interest								
Increased	4.4	(3)	3.6	(5)	4.7	(9)	7.6	(4)
Decreased	10.3	(7)	8.0	(11)	18.8	(36)	24.5	(13)
No change	64.7	(44)	70.3	(97)	57.1	(109)	49.1	(26)
Doesn't apply	20.6	(14)	18.1	(25)	19.4	(37)	18.9	(10)

Self-Knowledge and Self-Approval. As marihuana use increases, there is an increase in self-knowledge and self-approval. Among daily users, 70.9% reported an increase of self-knowledge, and only one *S* of the total group reported a decrease in self-knowledge. Daily users also reported the highest increase, 56.4%, in self-approval, and past users reported the highest decrease, 13.0%, in self-approval. Consequently, the more one uses, the greater the probability of his reporting an increase in self-knowledge and self-approval, with no current users reporting a decrease in self-knowledge and a minimum number reporting a decrease in self-approval.

Enjoyment of Nature, Music, Movies, Sexual Pleasures, etc. As marihuana use increases, there is an increase in sexual pleasure. Daily users report the highest increase in sexual pleasure, 69.8%, and past users report the least amount of increase, 25.4%. Only three *S*s of the total group report a decrease in sexual pleasure. As use increases, there is an increase in the enjoyment of music, movies, painting, TV, etc. A high percentage of regular and daily users, 81.4 and 83.3% respectively, report an increase in enjoyment in these areas. Only one *S* of the total group reported a decrease of enjoyment in these areas. Again, past users report the least increase, 36.2%. As use increases, there is an increase in the enjoyment of nature. Only two *S*s of the total group report a decrease in this area. A high percentage of regular and daily users, 75.5 and 75.9%, respectively, report an increase in enjoyment of nature.

Ability to Communicate, Think Through Problems, and to be Creative and Imaginative. As marihuana use increases, there is an increase in the ability to communicate with others, to think through problems, and to be creative and imaginative. Only seven current users (about 1%) report a decrease in the ability to communicate, and three report a decrease in the ability to be creative and imaginative. A larger, but still negligible percentage (about 5%), report a decrease in the ability to think through problems. Daily users again report the greatest increase, 63.5%, in ability to communicate and the greatest increase, 63.0%, in creativity and imagination. Past users report the smallest percentage of increase and the largest percentage of decrease in all three areas.

Memory. Among all use groups, the majority of *S*s report no change in memory. However, 20% of both regular and daily users report a decrease in memory whereas 16% of past users and 8% of occasional users report such a decrease. It is of interest to note that 15% of daily users report an increase in memory function whereas only 7, 3, and 3% of the other use groups report such an increase. Consequently, the ma-

jority of *S*s report no change in memory with about 20% of regular and daily users reporting a decrease and 15% of daily users an increase.

Mystical Interest and Conventional Religious Interest. As use increases, there is an increase in mystical interest and a decrease in conventional religious interest. Except for daily users, the majority of users report no change in their interest in conventional religion. Very few *S*s report an increase in conventional religious interest and few *S*s report a decrease in mystical interest. Daily users report the highest increase, 52.8%, in mystical interest and the highest decrease, 24.5%, in conventional religious interest.

Sense of Responsibility. The majority of all *S*s in all use groups report no change in sense of responsibility. As use increases, there is an increase in sense of responsibility, with 18.9% of daily users reporting such an increase. Past users report the highest decrease, 15.9%, in sense of responsibility whereas 12.5% of regular users report a decrease, and 9.4% of daily and 3.6% of occasional users report such a decrease. Consequently, most *S*s report no change in sense of responsibility with past users reporting the highest decrease (15.9%) and daily users reporting the highest increase (18.9%).

Conformity to Conventional Modes of Behavior and Acceptance of Conventional Values. As use increases, there is a decrease in acceptance of conventional values and a decrease in conformity to conventional modes of behavior. Very few *S*s report an increase in either area. Past users report the least change and daily users the greatest changes in these two areas. There is a greater change for all groups in their value system than there is in their conformity to conventional modes of behavior. Consequently, behavior changes appear more slowly than value changes.

The results of these aspects of attributes of self as a function of marihuana use are not surprising. The greater the use of marihuana, the more favorable the reporting of the consequences of that use. Past users report the least favorable results and the greatest negative results, whereas daily users generally report the greatest favorable results and the least negative results. It is of interest that a very high percentage of users reported favorable results in almost all areas and a negligible number of users reported unfavorable results. The only exception to this is in the area of memory, where one-fifth of daily and regular users report decreases in memory function. This phenomenon is certainly not new and is part of the marihuana folklore.

REASONS FOR USING MARIHUANA

Respondents were asked "How frequently do you take marihuana for the following reasons" and the *S*s marked "never," "occasionally," "frequently," or "always" to 16 listed reasons. Table 10 shows the results to this question by use pattern group with the reasons listed in order from the most to least frequent given reason for using as "frequently" or "always."

As use increases, there is an increase in the frequency of using marihuana for a variety of reasons. Daily users use marihuana for a greater variety of reasons more often than do regular users, and they, in turn, use for a greater variety of reasons more often than do occasional users. For example, 44.4% of daily users report "frequent or always" use of marihuana for "developing inner life" whereas 16.7% of regular users and 5.8% of occasional users report using marihuana with that frequency for that reason. Again 29.1% of daily users report "frequent or always" use of marinhuana for introspective psychological purposes whereas 15.4% of regular and 9.2% of occasional users report using that often for that purpose. Among daily users, 34.5% report "frequent or always" use for "facilitating creative abilities" whereas 13.9% of regular and 5.8% of occasional users report using marihuana that frequently for that endeavor. This pattern is seen throughout the data and consistently applies to all motivations—the more one uses, the more varied are the reasons for use. Consequently, the greater the use of marihuana, the greater the effects of the drug and the more varied the experiences with the drug. This confirms other data in the study.

The primary reason for using marihuana is "to have fun," supporting the notion that marihuana, regardless of the plethora of reasons for use, is a pleasure-recreational drug. Of note is that this reason is given almost twice as frequently as the second most popular reason. The second most popular reason, like the first, is to increase and sustain pleasure. The third most frequent reason is again in the service of pleasure, i.e., to be relieved of boredom, monotony, and dullness. The fourth ranked reason is of a different quality, that of inducing relaxation by relieving tension. The fifth ranked reason is again in the service of pleasure, specifically sexual pleasure. The next four reasons given are in the area of psychological introspectiveness, creativity, and sociability. Relatively few *S*s (about 5%) state that they "frequently or always" use marihuana out of a compulsion or something they feel they have to have. Thus it appears that few *S*s

Table 10

Rank order	No. *Ss* reporting frequent or always	Reason	Occasional users: Never %	Never *N*	Occasionally %	Occasionally *N*	Frequent or always %	Frequent or always *N*
1	280	To have fun	10.6	(15)	25.5	(36)	63.8	(90)
2	147	To make a good mood last longer or to make a fine feeling into an even better one	30.7	(43)	45.0	(63)	24.3	(34)
3	81	To relieve boredom, e.g., break up monotony or a dull period	45.8	(65)	44.4	(63)	9.9	(14)
4	75	To relieve tension or nervousness	45.8	(65)	44.4	(63)	9.9	(14)
5	72	To improve your sexual appetite or sensitivity or to improve your sexual capacities	46.1	(65)	39.7	(56)	14.2	(20)
6	64	To develop inner life	74.8	(104)	19.4	(27)	5.8	(8)
7	60	To make you more friendly or extroverted, to enhance sociability	52.5	(73)	36.7	(51)	10.8	(15)
8	59	To find out more about yourself, e.g., about your personality, your inner problems, or your human potentials	62.4	(88)	28.4	(40)	9.2	(13)
9	54	To facilitate creative abilities	76.8	(106)	17.4	(24)	5.8	(8)
10	31	To make you feel less depressed or sad	74.6	(106)	23.2	(33)	2.1	(3)
11	26	To have a religious or mystical feeling or to come close to God	85.2	(121)	13.4	(19)	1.4	(2)
12.5	17	To relieve or counteract anger or irritability	84.3	(118)	15.0	(21)	0.7	(1)
12.5	17	To satisfy a strong craving or compulsion, something you just *had* to have	90.8	(129)	6.3	(9)	2.8	(4)
14.5	10	To make you feel less afraid or more courageous	90.8	(128)	7.8	(11)	1.4	(2)
14.5	10	To make you smarter or improve your ability to learn or remember things	95.7	(135)	4.3	(6)	0.0	(0)
16	1	To reduce sexual desires or sexual activities	97.1	(135)	2.9	(4)	0.0	(0)

Reasons for Using Marihuana by Use Pattern Group

Regular users				Daily users			
Never		Occasionally		Frequent or always		Never		Occasionally		Frequent or always	
%	N	%	N	%	N	%	N	%	N	%	N
4.1	(8)	23.2	(45)	72.7	(141)	1.8	(1)	10.7	(6)	87.5	(49)
14.9	(29)	40.2	(78)	44.8	(87)	13.0	(7)	38.9	(21)	33.8	(26)
25.4	(50)	50.8	(100)	23.9	(47)	12.5	(7)	51.8	(29)	35.7	(20)
28.4	(55)	50.0	(97)	21.6	(42)	13.5	(7)	50.0	(26)	36.5	(19)
41.8	(82)	40.8	(80)	17.3	(34)	20.4	(11)	46.3	(25)	33.3	(18)
57.8	(111)	25.5	(49)	16.7	(32)	33.3	(18)	22.2	(12)	44.4	(24)
40.7	(79)	42.8	(83)	16.5	(32)	34.5	(19)	41.8	(23)	23.6	(13)
49.2	(96)	35.4	(69)	15.4	(30)	34.5	(19)	36.4	(20)	29.1	(16)
53.6	(104)	32.5	(63)	13.9	(27)	30.9	(17)	34.5	(19)	34.5	(19)
51.0	(98)	39.1	(75)	9.9	(19)	18.9	(10)	64.2	(34)	17.0	(9)
75.9	(148)	17.9	(35)	6.2	(12)	60.0	(33)	18.2	(10)	21.8	(12)
72.3	(141)	23.6	(46)	4.1	(8)	37.0	(20)	48.1	(26)	14.8	(8)
78.1	(153)	17.9	(35)	4.1	(8)	64.3	(35)	25.9	(14)	9.3	(5)
84.5	(164)	14.9	(29)	0.5	(1)	72.2	(39)	24.1	(13)	3.7	(2)
91.2	(176)	6.7	(13)	2.1	(4)	74.5	(41)	14.5	(8)	10.9	(6)
96.9	(186)	3.1	(6)	0.0	(0)	92.6	(50)	5.6	(3)	1.9	(1)

feel they are addicted or habituated to marihuana use. Marihuana is seldom used to make one feel less afraid and more courageous, a concept that heretofore has been much proposed by opponents of marihuana.

Summarily, the more one uses marihuana, the more varied the effects and the greater the breadth of reasons for use. Marihuana is used primarily for pleasure-recreational purposes and, secondly, for psychological introspective purposes. A sizeable number of daily users also use the drug to induce a religion-mystical consciousness. Few *S*s consistently use marihunana for any other reasons.

IMPLICATION FOR DRUG EDUCATION

Among our *S*s, there was a relationship between frequency of use and reported effects—the more frequent the use, the more varied the effects, the more pleasant and beneficial the effects, and the fewer the unpleasant and untoward effects. Those *S*s who had more unpleasant than pleasant effects either did not continue to use after trial experimentation or else they quit after some period of use. For those continuing to use, beneficial results far outweigh negatively valued results. In a previous paper (Fisher and Strantz, 1972) we have said, ". . . in approaching a project aimed at the ameliorating of drug abuse it behooves the change agent. . . (to) analyze whether use or abuse is occurring. He must first of all determine if the user. . . considers his drug use to be functional (usage) or dysfunctional (abusage), i.e., whether or not he sees his drug use as an integral part of his whole life style in that it enhances and enables him to meet needs and achieve goals, within his system, that he deems of value. If in fact, he evaluates his drug use as an enabling phenomenon within his total value orientation, it is highly unlikely that an external change agent is going to have much success in changing the user's *evaluation* of his drug experience. . . . If the user evaluates his drug usage as basically dysfunctional, i.e., not positively contributing to a realization of his value system, then the change agent has some entree into the user's psychological world." In a program with youthful drug offenders, Blumer (1967) sought to establish a core of prestigious youth leaders, who would be won over to a position of nonusage, and that these youths would by their opinion leadership position be influential in convincing other youths to give up drug usage. Blumer stated, "We found rather early we were not having any success in developing a form of collective abstinence. It became clear that the youths were well anchored in their drug use and well fortified in their belief against all the 'dangers' of drug use. . . we would invite any group of educators, scientists, welfare workers or police officials to try

to meet effectively the well-buttressed arguments, based on personal experience and observation, that our youthful drug users present in frank, open and uncowed discussion. In sum, we learned that youthful drug users are just not interested in abstaining from drug use."

The results of this study would suggest that it would be highly unlikely that these marihuana users would give up their usage as they overwhelmingly report positive, rather than negative, results from their usage. If the dominant culture evaluates such drug usage to be dysfunctional, whereas the user judges such usage to be functional, what position and action can agents of the dominant culture take? The current position in America is to imprison the breaker of the cultural mores. An alternative would be to let the individual be his own judge as to the effective-ineffective use of the drug. A third alternative, the success of which rests upon the ingenuity of the establishment's change agent, is the ecological approach. Based on the assumption that for any one individual there exists a complex of interrelated variables relative to his drug use, and that it is the individual's evaluation of his drug use differential to each of these variables within his total system, we have earlier suggested, ". . . the only position the change agent can take is to induce a change in the *evaluation* by the user of his drug experience by changing the ecosystem of which that drug experience is but one part. The only entree the change agent has is through manipulating other variables in the ecosystem of the user. In manipulating and changing the character of the user's ecosystem lies the possibilities of changing the evaluation by the user of his drug usage" (Fisher and Strantz, 1972, p. 1409). We await with interest the reporting of research and treatment programs which successfully implement changes in the marihuana habituee's ecosystem which appreciably reduces his use of the drug.

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Marijuana use Patterns

LLOYD HAINES* and WARREN GREEN*

I. THE SAMPLE

This survey is compiled from a total of 131 questionnaires. Subjects were not selected with the goal of obtaining a representative cross-section of the community. Rather, emphasis is on the use patterns of moderate to heavy marijuana smokers. Of the 131 people interviewed, only 8 (6 per cent) smoked less often than once a week.

Although many subjects were from the Berkeley area, effort was made to analyze people from other areas as well. Questionnaires were returned from New York, Illinois and Michigan, in addition to other cities in California.

Of the 131 respondents, 75 were male and 56 female. 74 were students, 43 worked full-time, and 14 were unemployed. The student group broke down as follows: 32 were in or had completed some high school, 27 had some college education and left before graduation, 43 were currently in college, and 29 were doing or had completed some graduate work.

As noted above, the sample consisted mainly of moderate and heavy smokers. Broken down, the results were as follows:

Every day:	32	24·4%
Every other day:	29	22·1%
At least twice a week:	30	22·8%
Once a week:	32	24·4%
Less frequently:	8	6%

Throughout this paper, reference will be made back to the figures given in this section.

Questionnaires were administered orally avoiding the risk of blank answers. Subjects were questioned about their answers, permitting the interviewer to find out why a particular answer was given. Occasionally, questions were asked twice, at different times during the interview session, in order to establish the validity of a response. On the average, each questionnaire took 50–70 min to administer. Subjects were questioned in private, eliminating any possibility of their inhibitions affecting an answer.

Use patterns may differ in areas where laws regulating marijuana are different. Thus in Berkeley, where little enforcement of the marijuana laws is attempted, people will smoke while walking in the streets. In Chicago, for example, where strict enforcement is practiced, and jail sentences are imposed, use is almost exclusively restricted to residences.

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Another aspect of use that differs in various communities is size of a marijuana cigarette. In California, where marijuana is relatively inexpensive, large "joints" are used and grass is freely given to friends. In contrast, New York smokers roll very thin "joints," and are more covetous of their dope supply. Price differentials in these two areas may be as high as 150 per cent.

II. TURNING ON THE FIRST TIME

Approximately three of every four subjects first smoked with a close friend or relative. Only 2 stated that their first drug experience was with a stranger. This clear pattern is undoubtedly a product of the illegality of marijuana use and the resulting "subculture." Also, for novices, drug use is a relatively important event. The initiate is most at ease around close friends.

The survey suggested, although a precise empirical finding was not possible, more experienced smokers were more willing to smoke with strangers. Those who recently have begun using marijuana do most of their smoking with close friends.

It is commonly thought most people do not get high the first time they smoke. Surprisingly, this survey revealed that better than two of every three subjects (91 v. 40) did get high the first time they tried. There is some evidence that the older the novice, the less likely he was to get high on his first attempt; this, however, is not a clear finding.

Subjects were asked to recall how much marijuana they smoked to get high the first time, and how long they had to smoke. Few, however, could even venture a guess, although most were sure they smoked more than they must now smoke to get stoned.

III. METHOD OF USE

Respondents were asked how they usually use grass. Not at all surprisingly, smoking was the predominant method. Only 20 people replied they smoked less than 90 per cent of the time. Most people had tried cooking grass into brownies or cookies at least once. Only a few had boiled it to tea.

The main reasons given for the popularity of smoking as opposed to ingesting were: relative ease of preparation and predictability of dosage. Most who had eaten cooked marijuana said there was no accurate way to gauge a likely reaction to a given amount of ingested grass.

Other than the factor of ease and predictability, few subjects told of a qualitative preference for smoking or ingesting. Yet most noted varying degrees of qualitative difference in the two experiences. Ingested grass was said to take much longer to "come on," perhaps upwards of two hours. The experience was likely to be of longer duration and greater intensity, although this may be related to the amount taken, which is usually greater when ingested. A small number of respondents (6) who had also taken LSD or mescaline, likened the ingesting experience (if the dosage proved adequate) to "dropping" a psychedelic drug.

When the subjects smoked marijuana, by far the most popular method was the "joint." The breakdown between joint and pipe was as follows:

Joint	
100% of the time	38
95% ,, ,, ,,	17
90% ,, ,, ,,	21
80% ,, ,, ,,	14
70% ,, ,, ,,	19
50% ,, ,, ,,	15
40% ,, ,, ,,	4
20% ,, ,, ,,	3

This result is not surprising, since joints are the most uniform method of gauging dosage, and require minimal investment or preparation. Many subjects volunteered the fact, however, that the likelihood of a pipe being used increased when the number of smokers increased.

Respondents were asked the approximate number of joints they must presently smoke to get high. Answers ranged from a low of $\frac{1}{4}$ to a vague "1 to 4." The vast majority of responses were between $\frac{1}{2}$ and one joint, and the group average was 0·91 joint.

This finding, however, is of extremely limited value, for an overwhelming number of subjects said that this depends on the quality of the grass smoked (124 vs. 7). Those answering affirmatively were asked if these qualitative differences were "major," "moderate," or "slight." The results:

major	=	84
moderate	=	35
slight	=	5

Perhaps consistently with these results, a vast majority of those questioned believed there are different "types" of grass, e.g., "Acapulco Gold," "Panama Red," "michoacan," etc. 98 replied affirmatively, and only 15 negatively. 18 declined to answer.

Asked to rate these "types" in order of potency, the test group came up with no consistent finding. They did state that Acapulco Gold and Panama Red were clearly distinguishable by their color, that michoacan was the flowered tops only, with no stems, and that all three varieties were far stronger than "average" grass.

Eleven respondents said they had smoked grass cured in psilocybin, a mixture which is apparently highly potent. A few of these people said that such grass had a faintly bitter smell, and if taken in moderately heavy doses could produce hallucinations.

Four of the subjects believed they had smoked grass cured or soaked in belladonna. Their opinion of this blend was unfavorable. The mix was highly potent, but alien to a grass high. The consensus was that the belladonna had been added to make otherwise low-quality grass saleable.

Many reported having seen or smoked marijuana cut with sugar; probably this was not designed to enhance quality but to increase weight.

Most smokers continue to smoke even after they are high. Of 125 people answering this question, only 30 replied negatively. Of these 30, 21 had been

smoking for less than a year. This finding seems consistent with the over-all developmental trend the interviewers perceived: novices treat turning on as a "big thing," while the more experienced smokers develop increasingly casual attitudes.

IV. SETTING OF USE

Subjects were asked where they turned on, and how regularly in each setting. Obviously, most cited "private residence." More interesting, however, were the responses to other settings; car, outdoors, and entertainment activity. Fully half of the test group stated that they had turned on in cars. These 66 people turned on an average of 14 per cent of the time in cars. 83 people turned on outdoors, for an average of 12 per cent of the time. And 51 said they smoked at entertainment activities (e.g., Fillmore, movies, etc.) for an average of 10 per cent of the time.

Those subjects who turned on in one non-residence setting, were likely to do so in the other settings as well. Apparently, once the initial fear of arrest subsides, the smoker is likely to turn on most everywhere. Predictably, novices (especially females) were least likely to smoke outside of a private residence.

V. OWNERSHIP PATTERNS

Three of every four respondents own their own grass. Here it is appropriate to reiterate that the sample consists of relatively heavy users, and is not a representative cross-section of the community. Of those who do not own their own (32), 20 were girls, and of these 20, 14 had husbands or boy friends who do own their own grass.

By far, the amount most commonly owned was the lid. 74 usually owned about a lid; 9 usually owned about 2 lids; 7 usually owned less than a lid; and 9 usually owned about one pound.

Most of these subjects usually buy their grass by the lid. 17 subjects purchase by the kilogram, on an average of 56 per cent of the time. All of these 17 admitted to doing some selling of grass.

Small-time selling was fairly widespread among the sample. 51 replied that they had sold, and 61 had never done so. The most likely sellers were experienced male smokers. There was no clear evidence linking selling to more "hard core" drug users. Although sellers turned on more often than the rest of the sample, they by no means monopolized use of other drugs. One who sells marijuana is not necessarily a hard-core drug user.

105 people said they had at least one particular "source." Those having one, two, or three such sources were divided fairly evenly, and constituted 80 per cent of the subjects. Very few knew more than three sources.

The subjects are generally well acquainted with their sources. Subjects were asked if they knew their sources closely, fairly well, slightly, or hardly at all:

Closely:	67
Fairly well:	35
Slightly:	3
Hardly at all:	0

Most of the sample was confident of their ability to obtain grass whenever they wanted it. Asked how probable were their chances of success at a given time, they replied as follows:

Certain:	54
Highly probable:	62
Fair chance:	15
Improbable:	0

These results are probably influenced by the high degree of usage of the test group. Ease of access would seem to increase as does one's involvement in the drug's "subculture".

VI. ACTIVITY PATTERNS

Subjects were asked if they usually get high with a purpose in mind. They were also given several activities, and asked what percentage of the time they turned on for the purpose of performing that activity. The results of the first general question, i.e., do subjects usually get high with a purpose in mind, were inconclusive. 72 said yes and 53 no. Affirmative answers were particularly prevalent among those who had been turning on for a relatively short period of time; conversely, experienced smokers turned on more often with no purpose in mind.

The following, listed by purpose/activity, tells how many people turn on for that purpose, and, on the average, what percentage of the time they turn on for the purpose.

Purpose	No. of people saying yes	Average % of time
To relax	81	35%
Entertainment activity	68	36%
Sexual activity	47	14%
To pass the time	44	22%
To go to sleep	29	10%
Go to class	12	13%
Work (non-school)	11	40%
Study	8	4%

Subjects were asked if they usually became more quiet or talkative when high. The results here were inconclusive. 47 said they became more quiet, 25 became more talkative, 33 said that both may happen, depending on their mood, 26 did not know.

One fairly clear finding was most people become more passive when stoned. 19 said they became more alive or agitated, and 76 said they became more passive.

40 subjects have worked while high. This is not a regular occurrence. 8 subjects work on a regular or semi-regular basis while high. These eight subjects work a good part of the day. They turn on during lunch and coffee breaks. The jobs do not require great mental acuity. Four of the subjects work in gas stations and the others perform various other manual labor tasks. These eight subjects claim to work as effectively or more effectively in comparison to being "straight." One subject, a gas station attendant, feels he can communicate better with his customers and can give them outstanding service when high. It should be noted that these eight subjects are high *every day, whether at work or not.*

Of the 32 remaining subjects who answered yes, 23 have worked infrequently when high. They are fairly heavy users at home, but do not like to smoke or be high on their jobs. 16 feel their ability is impaired, and 7 do not feel comfortable in business surroundings while high.

Many subjects are students who hold part-time jobs. These jobs tend to require little concentration, which may contribute to the reason(s) why the subjects are willing to be high. 8 subjects work fairly regularly when high and find they can perform adequately. This group will read for pleasure when high. They claim to read just as effectively on comparison to being "straight." These subjects are generally long-time users, having used the drug for an average of two years. They also use marijuana at least every two days. It is possible to conclude that because marijuana has been integrated into most of their activities, they can perform "as normal" at work.

Study

33 subjects study when high. (60 per cent of the test group are students; thus 40 per cent of the students study when high.) 28 of the subjects study infrequently. 16 of the 28 feel their potential to study is inhibited, and attempt to stay "straight" when required to study. In contrast, 12 feel they function just as effectively in comparison to being "straight." 8 of the 12 feel their reading speed is decreased, but retention is increased. 25 of the 28 prefer to study when "straight" and study when high only if the situation arises.

Five subjects claim to study exclusively when high. They also claim their effectiveness is improved by using marijuana. These five subjects feel they are more productive when high. They will drive, read and work when high. They have integrated marijuana into all aspects of their lives. One law student has finished three years at Hastings in a continued high state. He has taken finals when high, and just recently graduated.

40 per cent of the students have attended class when high. 23 per cent of the students find their classwork ineffective, and 17 per cent can perform adequately. All but 5 attend class infrequently when high. These 5 are discussed above. They study, attend class, and do many things when high.

Read

84 subjects read for pleasure when high. 47 do not. Every subject who studies when high also reads for pleasure while high. 40 people read infrequently while high. 36 read frequently, and 8 read most of the time, while high. Of all the subjects who read while high, those subjects who read most often are generally the most effective readers. This is not an exclusive rule, however. Many claim their reading speed is slowed considerably. This problem seems to be offset by increased retention or heightened enjoyment from reading the material. 18 feel they read more effectively, 36 just as effectively; and 30 less effectively.

Drive

81 licensed drivers answered that they have driven while high. Of the 50 who said no, 30 were female, who permitted their escorts to do the driving. The other

20 were licensed drivers who either drove infrequently, or found marijuana to impair their driving abilities.

An interesting fact about this group (those who can drive but don't), is that they have not been turning on very long, i.e., they averaged only 11¼ months. This might mean that they have not had enough experience with marijuana to function properly. It should also be noted that this group also cannot read or study when high. Marijuana appears to impair their whole behavioral pattern.

Of the 81 who drive while high, 63 drive frequently. They do not let marijuana interfere with their plans. They use highways and city streets. As earlier indicated, many use the car to turn on, while others turn on in the car when traveling to a particular destination.

67 of the 81 mentioned above, feel they drive as well as, or better than driving while "straight." 59 of the 67 expressed confidence in their ability to drive. 14 feel they drive less effectively. 18 expressed some doubts in their ability.

None of the subjects has ever incurred physical harm or has been involved in an auto accident when stoned. This finding is fairly important, because many of the subjects have been driving for some time when stoned. This fact dispels many theories that marijuana aids in causing traffic accidents. 25 of the people who drive on a regular basis claim their ability to control the car is improved by use of marijuana. They feel their concentration is improved and find fewer distractions compared to being "straight." 15 subjects feel motion is slowed and therefore their reactions seem improved.

Subjects were questioned if they were concerned about others who drive when high. Unanimous concern was expressed if the "high" in question was a product of speed, LSD or liquor. The subjects felt little concern about drivers using marijuana. One subject stated: "Smoking in automobiles is a way of life." This feeling was fairly pervasive among the subjects. Subjects in a fast-moving city, such as New York, showed concern about scurrying automobile traffic. It is obviously more difficult to drive in this setting than in Berkeley. One subject, who lives in New York and attends a school in Berkeley, drives constantly while high in Berkeley. When in New York, he prefers to stay "straight" if driving is required.

Eat

All the subjects responded affirmatively to this question. 91 per cent of the subjects eat every time they smoke.

85 per cent of the people interviewed ate greater quantities when high. The interviewers tried to elicit the reason for this phenomenon and were unsuccessful in finding any one answer. 30 per cent said they were hungrier; 27 per cent felt they liked the tastes of food and the textures; 37 per cent said they liked the chewing and swallowing sensation; and 6 per cent did not know.

One may attempt to explain the phenomenon simply by stating people are usually in the house and have easy access to food consumption. This is too simplistic, because many subjects stated they went out to exotic restaurants when high and ate "hot" foods. When high, people have many reasons for eating. Hunger is only one. Many subjects (67 per cent) confessed they continued to eat voraciously even when their hunger is gone. 27 per cent continued to eat when bloated. They

attribute this to the enjoyment received from tastes and textures. 17 per cent consider eating an enjoyable, sensual activity.

Sex

84 per cent of the subjects engage in sexual activity when high. Of the 16 per cent who don't, approximately half do not engage in sex at any time (many high school students were interviewed, thus many of the subjects were young). Of the 109 people who engage in sex, approximately 45 do so more frequently than when "straight." 60 engage in sex at the same frequency. Only 4 subjects have sex less frequently. 53 subjects claim the sexual act is longer. 80 subjects feel the experience is more enjoyable compared to being "straight." The explanation for these findings is that marijuana enhances physical sensations.

It is apparent from an analysis of the answers elicited on eating food and on sexual activity, that marijuana has a sensual effect on the subjects. They were more aware of their bodily functions and sensual pleasures. This is true of male and female, long- and short-term users, both moderate and heavy smokers. This is not to say that when one smokes marijuana, he or she immediately engages in sexual activity. The responses show that most subjects have regular sexual partners, whether it be a spouse or lover. The incidences occur when they are together and have the opportunity.

Only one unattached subject in the test group claimed to go out and "hustle" or try to "pick up" a partner. All the other unattached subjects found their ability to "hustle" impaired after smoking marijuana. They had little ambition to get up, get dressed, and attempt to meet people. The subjects dispelled notions that marijuana smokers roam the streets in search of sexual prey. In fact, quite the opposite occurs; the subjects stay at home and engage in sex only if a partner is available and willing.

Movies

Subjects were questioned about movies. Four-fifths of the subjects attend movies when high. They were split in their answers as to frequency. 43 go frequently; 51 infrequently; and 10 go most of the time. Compared to being "straight," 38 attend movies more often; 32 go just as often; and 34 go less frequently.

The subjects have a tendency to get high, intending to go to the movies. They claim to appreciate colors, characterizations, and good films much more when high. They become more selective about the movies they attend. The subjects will not see poor movies. The subject's tolerance for poor acting and trite plots decreases when high. 23 subjects have walked out of movies after a few minutes for precisely this reason. However, 62 per cent have gone to see cartoons or children's films when high. Subjects also stated certain films are "head" films. Some feel that such pictures are especially produced to be seen when high: "Yellow Submarine" was the most commonly given example, with "2001" also mentioned often.

TV and Music

When high, $\frac{2}{3}$ of the subjects watch TV. The responses to the questions on TV were similar to those on movies. The subjects had little tolerance for poor TV shows.

Watching TV, along with listening to music and talking, constitute most of the average "head's" time. The explanation for this is quite simple. The TV is easily accessible in one's house; thus TV, music and talking become the major activities. 55 people listen to music most of the time when high. 68 subjects listen frequently. 43 per cent of the subjects listen to music at a louder volume when high. 57 per cent have a tendency to listen to "hard rock" music when high.

SUBJECTIVE VIEWS

Subjects were questioned if marijuana is part of their "life style." Subjects were occasionally hesitant in responding to these questions, but, after repetition of the question, all subjects were cooperative.

Do you consider grass part of your life style? ¾ (95) responded Yes: 32 said No. Subjects were questioned about what "part" or "role" marijuana plays in their lives. Those who felt marijuana was not part of their life style checked "no particular role," exclusively. Those who checked "major role—fairly important role," were the heaviest users. This was not a mutually exclusive category, however. 6 subjects who smoke every day checked "no particular role," and said they could stop at any time. They said marijuana served as a pleasurable "thing," but could be eliminated from their lives without any trouble. Few of the light smokers (once a week) felt marijuana played more than a minor role. There is not a direct correlation between the amount one smokes and his view on what role it plays, as the following chart demonstrates.

	Every day	Every other day	Twice week	Once week	Longer	(how often smoke)
Major role	16		3			
Significant role		12	4	6		
Fairly important	3	2	6	7		
Minor role	5	9	16	14		
No particular role	6	4	3	3	12	

32 subjects said grass was not part of their life style, even though some of these used marijuana every two days. These subjects explained that marijuana was just a pastime, like drinking liquor or playing cards, and it meant little in the spectrum of their lives.

Subjects were questioned about their feelings when marijuana was unavailable, 6 considered this question not applicable. They have always been able to get marijuana. Of the remaining subjects, 81 said they *did* miss grass when unavailable; and 42 replied in the negative. Subjects rated their feelings:

5 — lost without it
2 — intensely aware of its absence
33 — significantly miss it
39 — only slightly miss it
42 — don't miss it

When do you begin to miss grass?

immediately	— 13
after one day	— 8
after a few days	— 36
after a week	— 13
longer	— 14
do not miss it	— 39

The findings are fairly clear. However, the difference between "significantly miss it" and "slightly miss it" did not depend on frequency of use. Both heavy and moderate users checked each category. The following chart shows the correlation between frequency of use and feelings when grass is unavailable.

	Every day	Every other day	Twice week	Once week	Longer
Lost without it		4	2		
Intensely aware of absence	4				
Significantly miss it	17	6	7	3	
Slightly miss it	9	6	11	9	3
Do not miss it	3	4	11	19	5

Heaviness of use will not necessarily determine when a subject will miss marijuana.

	Every day	Every other day	Twice week	Once week	Longer
Immediately	5	4		3	
After one day	8			3	
After a few days	11	15	5	4	
After a week			6	6	
Longer	7	2		3	3

(note—39 subjects never miss grass)

The majority of heavy users, 24, feel the loss within a few days. 3 subjects who smoke once–twice weekly do not miss marijuana.

A surprising finding is $\frac{1}{3}$ of the subjects, who have been without grass, feel a change of mood. These 34 subjects feel tension, experience irritability, and increased nervous energy. Most of the 34 are heavy users (at least every other day). Subjects were conscious that marijuana acts as a quasi-tranquilizer. One student said, "Before I began using grass on a regular basis," at least every other day, "I was nervous and irritable. I required tranquilizers. Since I have been using grass, I find no need for tranquilizers and am perfectly satisfied with my new-found tranquility."

Half of the subjects have substitute activities in the absence of marijuana. The substances most commonly used are liquor and hashish. Mescaline and LSD are used less frequently. 41 of the 56 who use substitutes during the summer, a period when marijuana is often scarce, relied on hash to "get through." They feel hash is the closest substitute for marijuana, and is readily available in times of grass shortage. Wine and beer were listed frequently. Little hard liquor was consumed.

Two-thirds (86) of all subjects claim that after long periods of being stoned, i.e., 10 hours or more, they feel physical differences. People complain of headaches,

grogginess and haziness. Subjects did not seem overtly concerned with this physical state. Some said they just took aspirin for the headache. Others would stop using marijuana for a while. Generally, the subjects accepted as fact that those who maintained a continual high would not operate at maximum efficiency.

Communication

When high, do you deal with people who have never turned on?

(yes–97) (no–34)

How effectively?	more effectively	14
	less effectively	63
	just as effectively	54

Are you inhibited or nervous at such times?

(yes–63) (no–68)

When high, do you deal with people who have turned on but who are not stoned?

How effectively?	more effectively	12
	less effectively	26
	just as effectively	93

Are you inhibited or nervous at such times?

(yes–23) (no–108)

When high, do you deal with people who are also high?

(yes–131) (no–0)

How effectively?	more effectively	52
	less effectively	18
	just as effectively	61

Are you inhibited or nervous at such times?

(yes–5) (no–126)

The charts show responses to questions: how well do you deal and communicate with people when they are high? Subjects were also questioned about their nervousness and inhibitions. Most subjects deal with all three types of people. Almost half the subjects feel they deal less effectively with people who have never turned on. Half the subjects feel they deal more effectively with those who are also high. Explanations were "heads understand each other," or "straight people don't understand." These responses can be tied in with findings that $\frac{6}{7}$ (109) subjects felt that high people have a sixth sense and can understand unspoken feelings and thoughts. Subjects had difficulty in explaining this phenomenon, but were emphatic in their assertion that it does exist.

Subjects reinforce their beliefs by staying with stoned people after smoking. They will generally avoid straight people unless it is necessary for shopping or doing chores. An artificial barrier is placed between straight and stoned people. Subjects

deal with straight people infrequently, but deal with stoned people most of the time. Two separate communities are created, but this does not happen continually. When subjects are straight, their dealings with other straight people increase. However, good friends of smokers are usually "heads." Few straight people are in their peer group.

Subjects feel better understood by fellow smokers.

Nervous

63 subjects were inhibited or nervous when dealing with straight people. In comparison, only 5 subjects felt this way when dealing with people who were high.

The explanation for their feelings is two-fold. First, the subjects feel a bit paranoic when dealing with straight people. 23 subjects responded this way and showed some special concern about the police. The remaining 39 cannot express themselves well, and feel foolish at such times. 113 subjects feel they can communicate with people who are high in an effective manner (only 69 can do this with straight people).

80 subjects can perceive if someone else is high. 40 cannot. Subjects can usually tell by a person's eyes, actions, and speech patterns whether or not a person is stoned. This makes for easy group identification. This fact reinforces segregation of smokers from non-smokers.

Subjects were asked to analyze qualitatively the effects of marijuana. They were questioned about grass being a stimulant or depressant. The results are:

Stimulant	—	36
Depressant	—	45
Neither	—	7
Depends on mood	—	5
Both	—	18

Both stimulant and depressant 50 per cent of time—19.

Subjects were fairly well divided when asked if they tired more or less easily after smoking. 48 said they tired more; 63 said less; and 9 tired just as easily. Subjects explained, classifying marijuana as a stimulant or depressant often depends on the type of marijuana. Several subjects thought "Panama Red" has a stimulating effect. After smoking "red," several subjects found themselves doing chores around the house.

Marijuana affects people differently. Some become stimulated and others lethargic. When one becomes stimulated, it is in areas that do not require strenuous physical activity. Those who claim grass is a depressant usually sit around, talk, watch TV and listen to music. Rarely do they engage in activities outside their homes. Only 4 subjects engage in strenuous activity when high. They ride motorcycles, run and swim.

Subjects were questioned about their performance of planned activities after smoking. The responses were almost unanimous. 98 subjects complete the activity as planned. Even those who reported grass as a depressant complete planned activities after they smoke. It seems that marijuana only depresses spontaneous action, and has little effect on scheduled plans.

VII. GRASS-SMOKERS AND THE LAW

Subjects were asked if the fact they were breaking the law in any way disturbed them. Almost half (57 v. 69) of those answering said No. Those saying Yes were asked to explain how it disturbed them. All cited the fear of arrest, while none expressed any moral qualms whatever.

Whilst most smokers are aware of the possibility of arrest, relatively few show great concern. Asked how worried they were about the prospects of arrest, the subjects responded as follows:

Extremely worried	—	15
Concerned	—	29
Little concern	—	61
No concern	—	18

Of the test group, only 4 had ever been arrested (1 for codeine possession) and none had been sent to jail.

The test group was asked if they perceived a difference in their fear of being arrested when they are and are not high. The results were almost perfectly even: 60 said Yes and 63 No. Of those saying Yes, 7 were less concerned when stoned, and 2 could go either way.

Predictably, an overwhelming majority view the marijuana laws as being unrealistic. Asked if they should be changed, all but two answered affirmatively. These two did not express approval of the present laws, but stated that they simply didn't know what was right. The others uniformly advocated milder laws.

VIII. SUBJECTIVE VIEWS

In the next section of the survey, subjects were asked to give their opinions on various drugs, rating each on the basis of its physical, psychological and moral harm. For each category, a rating of "*5*" was "most harmful," and "*1*" was "least harmful." This section was intended to provide some insight as to the way confirmed marijuana smokers view the over-all drug context.

The first category was that of physical harm. The results are set out below:

	1	*2*	*3*	*4*	*5*
Cigarette smoking	9	11	28	50	33
Marijuana	91	15	7	0	0
Alcohol	0	20	33	41	24
Tranquilizers	9	29	31	0	36
Stimulants	7	9	22	36	44
LSD	11	19	20	30	37

What is most significant in these results is that most of the sample, although moderately heavy users, continued to recognize a sharp delineation between grass and other "heavier" drugs. The results were contradictory to the notion that experienced, heavy smokers lose their sense of perspective and become psychologically attuned to all drugs.

Using *3* to *5* ratings as expressing opinions of physical harm, this finding is quickly perceived. While only 7 ratings of *3* were given to marijuana, there were 87 ratings of *3* to *5* for LSD; 67 for tranquilizers; and 102 for stimulants.

Also significant is the fact that this perceived delineation between grass and other drugs was not restricted to those who only use grass. Even those subjects who had experimented extensively with other drugs did not lump them together in the same category with grass.

The next category was *psychological* harm.

	1	*2*	*3*	*4*	*5*
Cigarette smoking	47	16	30	11	20
Marijuana	55	47	10	0	2
Alcohol	15	26	26	25	31
Tranquilizers	8	22	41	25	14
Stimulants	9	9	20	44	31
LSD	3	10	23	22	49

These results are consistent with the above-mentioned delineation between grass and other drugs. While only 12 people give grass a psychological harm rating of *3* to *5*, 94 feel LSD is harmful; 80 find tranquilizers harmful; and 95 think stimulants are psychologically harmful. Here again, there is no perceivable trend among frequent users to stop discriminating between drugs.

Asked to rate drugs on the basis of *moral* wrong, a slightly different result was noticeable. A large number of subjects (38) refused to make any moral judgments whatsoever on the taking of any drugs. This attitude seemed linked to the length of time the subject had been turning on. The results:

	1	*2*	*3*	*4*	*5*
Cigarette smoking	80	7	3	3	7
Marijuana	93	6	5	0	0
Alcohol	81	26	0	0	0
Hashish	88	13	3	2	0
Tranquilizers	68	6	19	10	3
LSD	70	9	7	10	13
Barbiturates	38	7	8	9	17
Stimulants	59	8	6	6	20
Opiates	56	0	13	7	28

As can be seen from the above, more than 20 subjects refused to answer the question at all; in addition, 31 marked a uniform "*1*" for all topics. There is thus a strong tendency among frequent smokers to avoid moral judgments on the taking of any drugs. Among those who did make judgments, however, the same delineation that was evident in the first two ratings was present. There were only 5 ratings of *3* to *5* for both marijuana and hashish, while there were 48 for opiates; 32 for stimulants; 30 for LSD; and 32 for tranquilizers.

PERSONAL PERCEPTIONS

86 subjects have less confidence in their ability to perform tasks when high; 31 have greater; and 14 have equal confidence. The subjects explained that motor functions are occasionally imparied and sometimes mental acuity is lessened. 92 perceived a differing ability to perform. A vast majority of subjects prefer to stay straight if required to function in demanding situations.

However, 113 subjects have deeper thought and insights when high; 115 become more introspective; and 109 become more analytic. It is indeed odd that subjects report this type of ability, and still feel mental acuity is impaired. Apparently, there is a distinction between functional, utilitarian thought—directed to a given purpose—and spontaneous, unrestricted thought. The former seems more difficult when stoned, while grass seems to facilitate the latter.

AFTER-EFFECT

Subjects were asked approximately how long, on the average, they stayed high without smoking more. The results broke down as follows:

Less than 1 hr	2
1–2 hr	16
2–3 hr	46
3–4 hr	42
More than 4 hr	11

Thus, of those answering, 75 per cent usually stayed high from 2 to 4 hr.

The sample was also asked for how long a period they felt they were "coming down" from a grass high. The results:

Less than 1 hr	17
1–2 hr	43
2–3 hr	21
3–4 hr	3
More than 4 hr	5

Thus, the vast majority of people felt they came down on the average of less than 3 hours. Consistent with this is the finding that only 22 felt they usually had to sleep it off before being "completely normal"; 90 disagreed.

Respondents were asked if their next-day performance was in any way impaired by having been high. 38 said Yes, stating they felt a slight lethargy or fuzziness, especially in the morning; 91 said their next day performance was in no way impaired. Of those who noted some impairment, all but one said that such impairment did not continue throughout the entire next day.

CONCLUSION

This study has focused its attention on various aspects of Marijuana use. The study was begun with the intention of finding if some pattern of marijuana use exists. The information gathered has in fact proved that frequently marijuana smokers think and act alike.

Some concern may be expressed over faulty methodology, i.e., not choosing a random sample. Of course it is difficult to choose a random sample in a study such as this, but it can be done.

Interestingly enough, the authors feel the test group represents a cross-section of heavy marijuana smokers. After data was compiled and conclusion drawn, new questionnaires were administered to randomly selected subjects. A few people were approached on the streets of Berkeley and asked to cooperate in a survey. In addition,

people unknown by the authors were approached at a New Jersey party. They too were requested to complete questionnaires. The responses to the questions were remarkably similar to the majority of answers elicited from the original test group. Although not conclusive, these facts lead the authors to believe the selected test group is representative of heavy marijuana users.

Some selected findings deserve mention. These findings dispel often held misconceptions about marijuana use. First, although one makes marijuana part of his life style, he can and will function in society. A heavy user still can drive, read, work and attend school. Secondly, one can be a heavy user and still refrain from using other "hard core" drugs.

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Marijuana and Sexual Activity

WAYNE C. KOFF

Abstract

This research was intended to discern any correlations between marijuana and human sexual activity. I was specifically interested in exploring the concept that the drug might produce different effects on males and females in regard to their sexual activity. Finally, I was concerned with the dosage of the drug which would produce the most pronounced effect on the majority of the users in regard to their sexual activity.

The controversy over a possible aphrodisiac effects of marijuana has lingered ever since introduction to the drug. Our research was limited to a study of marijuana and heterosexual activity.

In researching the connection between marijuana and various aspects of sexual activity, several methods were utilized. Questionnaires were distributed at eight major universities in the United States. The colleges involved were Washington University; Michigan State University; SUNY at Albany; University of Miami; University of Denver; Massachusetts Institute of Technology; Boston University; George Washington University. The method of distribution was via the campus mail of the colleges, to insure confidentiality. The participants were chosen at random, and of the 640 questionnaires 345 were returned, a ratio of 53.9%. Figure 1 is a sample of the questionnaire distributed.

The second method consisted of interviews with known marijuana users. The questions were directed towards the comparison between sexual activity with and without the use of marijuana. The final method of research was aimed at eliminating a variable in marijuana use, that of dosage. Several marijuana users were asked to roll certain weeds (including marijuana) into cigarettes which were then weighed to determine the "average" constitution of a joint. The results of these tests will be discussed extensively in a later section.

One must bear in mind that the majority of cannabis users (in the U.S.) are youths between the ages 14—25. Bloomquist (1968) notes, "The age span 14—25 needs no aphrodisiac to stimulate either interest or capacity to perform. If young men have the sex act in mind when they use the drug, they will probably move toward a

The following questionnaire is a segment of a research project concerning the connections between sexual activity and marijuana. You have been chosen in a random sampling and we wish that you will answer the questions truthfully and to the best of your ability. When you have completed this form please return it to:

RESEARCH STUDY
Box 4375 Washington University
6515 Wydown Blvd.
Clayton, Missouri 63105

One final note, the questionnaire is designed to be anonymous, so please *do not* include your name. Thank You.

1. Sex: M F (circle one)
2. Age: a) less than 17 b) 17—24 c) 25—30 d) over 30 (circle one)
3. Use of Marijuana:
   a) never
   b) occasionally—at parties etc.
   c) daily (circle one)
   d) other—Please comment
4. Method of using Marijuana:
   a) smoking
   b) eating—in brownies, cookies, etc. (circle one or more)
   c) other—Please comment
5. Amount of marijuana used each time you take the drug:
   a) one "joint" or less
   b) 2—4 "joints" (circle one)
   c) more than 4 "joints"
6. Following the use of marijuana, was *sexual desire:*
   a) increased
   b) decreased (circle one)
   c) remained the same
7. As compared to sexual activity without the use of marijuana, was sexual activity following the use of marijuana:
   a) more enjoyable
   b) less enjoyable (circle one)
   c) the same
8. As compared to sexual activity without the use of marijuana, would you say *your partner* following the use of marijuana found sexual activity:
   a) more satisfying
   b) less satisfying (circle one)
   c) the same
9. Realizing that marijuana affects different people in different ways due to such factors as personality and atmosphere, please comment on the way in which the drug affects *you,* and what effect it has on *your* sexual activity. Please feel free to add any additional comments concerning marijuana and sexual activity on both the remainder of this side and on the back of this page.

FIG. 1. *RESEARCH STUDY: Marijuana and human sexual activity*

selected partner. The woman for her part will find it easier to acquiesce . . . "

Medical opinion as to the capacity of marijuana to act as an aphrodisiac is extremely varied. Some physicians undoubtedly are convinced that the drug is specifically associated with sensuousness and carnality, while others claim that the aphrodisiac effect of marijuana is purely a wild notion. It is a known fact that the Orientals in the 19th century took the drug to prolong coitus. Doria, in Brazil, reports instances of women becoming unusually aggressive in sexual affairs while under the influence of the drug. Considering this wide diversity of opinion, the questionnaire (fig. 1) and interviews were conducted as an attempt to clear up this controversy. Table 1 gives the numerical results of the questionnaire. It must be noted that of the 345 replies, 93 never smoked marijuana and so are not included in the results.

As shown in Table 1, #6, following the use of marijuana sexual desire was said to increase by 48.5% of those questioned. The significant plurality of this result may be attributed to various factors. First of all, the mysticism surrounding the drug plays an integral part in its effect. Psychologists stress the importance of mood, expectation, and setting as shaping the nature of the drug experience. With marijuana, all of the ideas concerning its inhibition releasing and sexual stimulating tendencies may result in the increase of sexual desire. It seems conclusive now that the drug itself is not a sexual stimulant. However, one cannot separate the drug from its surroundings. The social conditions of marijuana use make it act as an aphrodisiac.

Ms. A is between the ages 17—24. She smokes marijuana two to three times per week, averaging two joints per sitting. Her comment concerning the issue of sexual desire was, "Marijuana itself does not in any way increase sexual desire. It is merely the atmosphere in which the drug is used combined with the drug . . . a darkened room with candlelight, incense burning possibly, often just the two alone, which actually promotes sexual desire."

Mr. B smokes marijuana occasionally one joint or less and is also between the ages 17—24. He comments, "I find that after using marijuana, I experience a period of intense sexual arousal and suggestibility for about 40 minutes after which the effect seems to diminish . . . closely related to this phenomenon is the increase of

TABLE 1

1. Sex: Male 123 Female 128 Total 251

2. Age: 98% of sample between ages 17—24; 2% were 25—29

3. Use of marijuana:
   a) occasionally— Male 65.3% Female 81.2%
   b) daily— Male 22.2% Female 8.5%
   c) other— Male 12.4% Female 10.2%

4. Method of using marijuana:
   a) smoking— Male 85.4% Female 79.8% Total 82.6%
   b) eating— Male 14.5% Female 20.1% Total 17.3%
   c) other—two replies of snorting the drug

5. Average dosage each time drug is taken:
   a) 0—1 joints Male 25.0% Female 22.6% Total 23.8%
   b) 2—4 joints Male 68.8% Female 71.4% Total 70.1%
   c) More than 4 Male 6.2% Female 5.9% Total 6.1%

6. Sexual Desire:	Increased	Decreased	Remains the Same
a) Male	39.1%	10.9%	50.0%
b) Female	57.8%	4.8%	37.4%
c) Total	48.5%	7.9%	43.6%

7. Sexual Enjoyment:	Increased	Decreased	Remains the Same
a) Male	59.8%	6.5%	34.7%
b) Female	42.9%	6.5%	50.6%
c) Total	51.3%	6.5%	42.2%

8. Partner Satisfaction—from sexual activity following use of marijuana.

	Increased	Decreased	Remains the Same
a) Male	59.5%	4.1%	36.4%
b) Female	47.4%	8.8%	43.7%
c) Total	53.5%	6.5%	40.0%

fantasies, and the relaxation of the body. I strongly suspect that part of the excitement generated by pot is a result of psychological suggestion, one expects to be aroused after its use."

Though 48.5% of all the people replying noted that sexual desire was increased, the proportions were extremely varied between males and females. While only 39.1% of males noted an increase, a remarkable 57.8% of the females said that their desire was increased. Performing a chi-square probability test on these results, we obtained a P value equal to .048 which is equivalent to saying that the results were significant and not dependent on chance alone. How then may

this 18.7% difference between males and females be explained? Erich Goode, a sociologist at SUNY Stony Brook, interviewed 200 marijuana users in 1969 and recorded a 50% increase in sexual desire among women following marijuana use as compared to a 39.0% increase among men. Goode (1969) notes, "First, because of their cultural association with sex, women are more likely to think themselves into becoming excited; second, women need an excuse to justify their desire; third, men are less concerned with the ritual of sex and with what textbooks refer to as foreplay, than are women. For women, these aspects of the sexual act are often more meaningful than the immediate physical gratification it gives her . . . . a woman is more preoccupied with the path to sex, whereas for the man, the overture is often only instrumental." In addition one may say that man's cultural role permits him to freely express his desires. The woman has been taught to repress sexual desires more than man. They have been taught the sex-evil, sex-dirty, sex-forbidden notions more than the sex-fun, sex-enjoyable ones. The lessening of tensions and of inhibitions allows the woman to overcome these concepts and to express her desires. Therefore, as an inhibition releaser and body-relaxer, one may group these effects of marijuana under the heading of "stimulant to human sexual activity."

The next area of interest is the connection between marijuana and sexual enjoyment. It was shown that 51.3% of those questioned said that following the use of marijuana, sexual enjoyment increases. This result may be accounted for in different ways. First of all, many of those replying noted that sex while "high" was a completely different experience than sex while straight. It seems probable that the effects of the drug cloud the mental scope of human sexual activity and allow the physical sensation to become more pronounced. To many, this pronouncement of the physical sensation seemed exciting, vibrant, and fantastic.

Ms. C replying to the question concerning sexual enjoyment said, "Although I seemed to get more physically involved, I was much less mentally involved . . . . it kind of feels like you're in a weird, dream-like world with the person you're with, and sex can be more exciting because it's a new and different experience."

Ms. D, a 19 year old marijuana user who averages smoking two joints per day notes, " . . . sex is different since some sensations are seemingly heightened by the drug. However, sex is neither worse nor

better. Sexual activity seems to take on a bit more variety or bizarreness when you are under the influence of pot."

From the male point of view, Mr. E eats the equivalent of one joint of marijuana in brownies and cookies every other day. He replies, "Any effects of the drug would tend to make the user less inhibited under situations where you would worry if someone walked in on you or fear pregnancy. The effect of the drug seems more noticeable during orgasm, there appeared to be more sensation in the genital organs and the rest of the body seems to be placed in a void. While I find a relaxed mood after sexual intercourse, I found that marijuana seemed to take a lot out of me, leaving me very tired while still being sexually aroused. While the physical sensation may be better, I find the mental sensation not as pleasing as when straight."

Dividing the males and females up for the question of sexual enjoyment, our results show the converse of sexual desire. While 59.8% of the males seemed to enjoy sexual activity more when stoned, only 42.9% of the females were in accord with this concept of increased enjoyment. At first glance, these results seem unexplainable in light of the sexual desire figures. However, by taking into account the cultural and sociological factors, one arrives at a definite correlation between the results on sexual desire and sexual enjoyment. Referring to the culture scheme once again, the physical sensation of sexual activity is more predominant than the mental response from the males' standpoint. In contrast, the female views the foreplay as a more gratifying precursor to the actual climax than the male. When marijuana is smoked (or ingested), the drug tends to relay a feeling of unreality while also making tactile stimulation seem more distinct. In other words, physical sensations seem more real, and mental reactions more oblique. For the female, her inability to have complete control of the mental feelings lessens her enjoyment. For the male, the increased physical sensation results in a more enjoyable sexual experience.

Another factor closely related to sexual enjoyment concerns partner satisfaction. In our sample, 59.5% of the males believe that their partners' satisfaction of sexual activity was greater while stoned, while 47.4% of the females believe that their partners found sexual activity more satisfying while "high." When the male is enjoying sexual activity, it seems reasonable for him to assume that his partner is also enjoying it. The same is true for females. Thus, there should

be a positive correlation between the questions of sexual enjoyment and partner satisfaction. We verify this by comparing the results of #7 and #8 in Table 1 and noting that they are nearly identical. Upon questioning Mr. F concerning sexual enjoyment and partner satisfaction, he replied "We had made love just before getting stoned, not expecting to want to afterwards. My girlfriend was turned on sexually and I got aroused; we made love and I climaxed much sooner after the last time than I would normally have been able to. My girlfriend's desire and satisfaction were probably heightened judging from the number of her orgasms."

From the female standpoint: Ms. G smokes daily and believes that both sexual desire and sexual enjoyment are increased from the drug, as well as her partner's satisfaction. She is between the ages 25—30 and comments, " . . . the closeness of someone's body while stoned gives me a sense of security and uniqueness. Weed decreases my inhibitions allowing me to express more affection and give more to my partner's enjoyment."

Realizing that partner satisfaction is undoubtedly more subjective than replies concerning desire and enjoyment, conclusions reached from the area of partner satisfaction are considered less relevant than others. However, it is interesting to note that the majority of those people claiming that sexual enjoyment was decreased following the use of marijuana, also stated that they believed that their partner's satisfaction was also decreased.

Upon obtaining results for such concepts as sexual desire and enjoyment following marijuana use, one must not overlook the variable factor of dosage. Dosage can be divided into two categories, those being quality and quantity. For our purposes, the quality of the marijuana used was impossible to be accurately judged since those interviewed and questioned used different types of marijuana at different times. It is learned that the strength of the drug is dependent on its content of both 9—THC and 6—THC. (THC is abbreviation of tetrahydrocannabinol; 9 and 6 are the two most active constituents of marijuana, distinguished by their chemical formulas.) The quality of the marijuana is dependent on the quality of the resin found in the plant. The most potent marijuana known originates in Thailand and consists of 4.1% THC. Most marijuana used in the United States originates in Mexico and its THC content ranges from 0.8%—1.4%. For the sake of simplicity, we assume that

the THC content of marijuana from Mexico has the average value of 1.0%. Having ascertained a value for the quality of the drug, the final aspect of dosage is the quantity. To find the average constitution of a joint of marijuana by weight, twenty users of the drug volunteered to roll into cigarettes four leafy, grainy substances (one of which was marijuana). Upon averaging the weights of the rolled marijuana cigarettes, the value of .73 gm was found for the constitution of a joint by weight. The weights of the rolled cigarettes ranged from .49—1.8 gms. By simple mathematics, it is shown that a joint smoked and shared by two people places between 3.75 and 5.00 mg of THC into the bloodstreams of the users. One marijuana cigarette is usually sufficient to produce an adequate intoxication of two people.

Having determined the dosage, one is now able to make a comparison of the effects of one joint of marijuana on sexual desire and enjoyment of sexual activity, as opposed to using two or more joints of the drug. Specifically, in regard to sexual desire, 61% of those individuals who smoked one joint or less noted an increase. Separating this percentage by the sexes of the individuals involved, 50.5% of the males and 70.9% of the females noted an increase in sexual desire. For the people who smoked two or more joints per sitting, males recorded a 34.5% increase while 49.5% of the females concurred that their sexual desire had increased. Thus, it is evident that as dosage increases, the tendency for an increase in sexual desire decreases.

Concerning enjoyment of sexual activity following the use of marijuana, males who smoked one joint or less noted more of an increase in enjoyment than those who smoked two or more joints per sitting. The same quantitative conclusions were recorded by the females. This result further substantiates the idea that as the dosage is increased past a peak concentration point, the positive effects of increased sexual desire and enjoyment of sexual activity will not be as noticeable. The quantitative results of the question concerning dosage are summarized in Table 2.

From the results in Table 2, it seems evident that over-intoxication of marijuana does not enhance either sexual desire or enjoyment of sexual activity as much as mild dosage. Once again it must be noted that the varied quality of the marijuana has a definite effect on these results. For instance, one cigarette of 2% THC quality is equivalent to two cigarettes of 1% THC quality. For our purposes however,

assuming the use of a consistent quality of the drug upholds the validity of our data and subsequent conclusions.

Finally, a comparison may be made between the effects of smoking the marijuana through cigarette or pipe, or ingesting it through brownies, cookies, etc. The different methods of use are known to cause different types of "highs." Smoking yields a shorter, more potent intoxication, while eating results in a milder, longer intoxication. From our survey, 82.6% of those questioned smoked their marijuana while 17.3% ingested the drug to obtain a "high." With regard to sexual desire and enjoyment of sexual activity, the results indicate that there is no appreciable difference in the effect of the different methods of use. The quantitative results of this question are compiled in Table 3. Thus, although the type of "high" obtained from the two methods is different, both affect sexual desire and enjoyment is a similar fashion. This may be explained by noting that although the type of "high" differs, a person who eats marijuana is more likely to use a larger dose than one who smokes, assuring himself of an adequate supply of THC in his bloodstream. Overcoming the digestion process (in which some of the THC is not absorbed into the bloodstream) by using larger doses, the ingester matches the THC content of the smoker and thus shows the same effects to sexual stimuli.

TABLE 2

1. Sexual Desire	Increased	Decreased	No Change
a) 1 joint or less			
1) Male	50.5%	8.6%	40.9%
2) Female	70.9%	5.4%	23.7%
3) Total	61.0%	6.9%	32.1%
b) 2 or more joints			
1) Male	34.5%	14.6%	50.9%
2) Female	49.5%	4.6%	45.9%
3) Total	42.1%	9.6%	48.3%
2. Enjoyment of Sexual Activity	Increased	Decreased	No Change
a) 1 joint or less			
1) Male	67.0%	2.5%	30.5%
2) Female	51.0%	5.1%	43.9%
3) Total	59.0%	3.8%	37.2%
b) 2 or more joints			
1) Male	45.2%	10.7%	44.1%
2) Female	32.5%	8.4%	59.1%
3) Total	38.9%	9.5%	51.6%

TABLE 3

1. Sexual Desire	Increased	Decreased	No Change
a) Smoking	48.1%	8.5%	43.4%
b) Eating	48.8%	7.8%	43.4%
2. Enjoyment of Sexual Activity	Increased	Decreased	No Change
a) Smoking	52.7%	6.9%	40.4%
b) Eating	50.1%	6.2%	43.7%

Totals given without respect to sex. Insufficient numbers of individuals who ingested marijuana made a division by sex invalid for our purposes. There were 44 individuals who noted ingesting marijuana, of which 27 were female and only 17 male.

In summary, the study of the effects of marijuana on human sexual activity is a field in need of more research. One must consider the psychological and sociological factors of both the drug and human sexual activity when attempting to draw the connective lines. The physiological effects of marijuana may also affect the sexual response of the human being. Our survey revealed cases of secondary impotence among males, and cases of situationally nonorgasmic females following marijuana use. On the other hand, there were also cases of multi-orgasm (from two different girls who both stated that they never had more than one orgasm when engaged in intercourse while not under the influence of marijuana). Three males noted that orgasm was reached at a faster rate after using marijuana as against not using it. It seems conceivable that marijuana, with suitable psychological and sociological conditions, and taken in a light to moderate dose releases inhibitions to the extent of being termed "aphrodisiac." Perhaps a certain level of THC content in the blood is needed for these effects to be manifest. Our results have shown that the most active dose (the one in which sexual desire and enjoyment is increased to the greatest extent) is between 1—2 cigarettes containing 1% of THC. To verify these results, laboratory tests on THC content in the blood, absorbtion rates of THC into the bloodstream, and THC content of the resin of Cannabis sativa should be undertaken. Our study has tried to reveal some of the mysteries of marijuana in connection with human sexual activity and to offer highly qualitative and semi-quantitative conclusions. Quantitative laboratory data are now needed to confirm our hypotheses and conclusions.

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ORIGINAL PAPER

A Qualitative Investigation Comparing Psychosocial and Physical Sexual Experiences Related to Alcohol and Marijuana Use among Adults

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Abstract Alcohol and marijuana are two of the most prevalent psychoactive substances and each may result in distinct psychosocial and physical sexual experiences and different sexual risk behaviors. With marijuana becoming more accepted in the US along with more liberal state-level policies, it is important to examine and compare users' psychosocial and physical sexual experiences and sexual risk behavior associated with these drugs. In this study, we interviewed 24 adults who recently used marijuana before sex. Participants were 50 % female and all self-identified as heterosexual and HIV-negative. Using thematic analysis, we compared self-reported psychosocial and physical sexual experiences of alcohol and marijuana. Participants described differences between drugs with regard to psychosocial (e.g., partner interactions and contexts before sex, partner choice, perceived attractiveness of self and others, disinhibition, and feelings of regret after sex) and physical sexual experiences (e.g., sexual dysfunction, dose effects, sensations of body/sex organs, length and intensity of sex, and orgasm). Alcohol use was commonly associated with social outgoingness and use facilitated connections with potential sexual partners; however, alcohol was more likely than marijuana to lead to atypical partner choice or post-sex regret. Both alcohol and marijuana had a variety of negative sexual effects, and the illegality of marijuana reportedly facilitated intimate encounters. While sexual experiences tended to be similar across males and females, we did find some variation by gender. Results can inform prevention and harm reduction programming that will allow us to design more realistic programs and to craft interventions, which guide potential users to make safer choices.

Keywords Marijuana · Alcohol · Risk behavior · Orgasm · Sexual dysfunction

Introduction

Cannabis (marijuana) use and approval toward use have recently increased in the US (Johnston, O'Malley, Bachman, Schulenberg, & Miech, 2014). The majority of adults in the US now support marijuana legalization (Motel, 2014; Palamar, 2014; Palamar, Ompad, & Petkova, 2014b), four states and the District of Columbia have legalized recreational use, and at least 24 other states have legalized medical marijuana or decriminalized recreational use. Correlational studies have linked marijuana use to risky sexual behavior (e.g., Castilla, Barrio, Belza, & de la Fuente, 1999; Kingree & Betz, 2003; Smith et al., 2010), but richer data are needed to investigate these associations. Since the landscape is changing, and marijuana continues to increase in popularity; research is needed to continue to examine if and how marijuana use may influence risk for unsafe sexual behavior. A novel method is to compare the psychosocial and physical sexual experiences of marijuana to the experiences related to the most prevalent intoxicating substance—alcohol.

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Nationally, two-thirds of 18-year olds have consumed alcohol and half of 18-year olds report ever being drunk (Johnston et al., 2014; Miech, Johnston, O'Malley, Bachman, & Schulenberg, 2015). Risky drinking increases throughout young adulthood (age 19–28) with 64 % of young adults getting drunk in the last year. Likewise, in 2013, nearly half (44 %) of 18-year olds reported using marijuana in their lifetime and 35.1 % reported use in the last year. Roughly two-thirds of adults have used marijuana by age 30 (Johnston et al., 2014; Miech et al., 2015).

A robust literature suggests that drinking—particularly binge drinking—places individuals at risk for engaging in high-risk sexual behaviors (e.g., Pedrelli et al., 2011; Tran, Nehl, Sales, & Berg, 2014). Alcohol has been shown to diminish both social and sexual inhibitions (Coleman & Cater, 2005), and it is also commonly used to boost confidence and to cope with emotions such as fear of rejection by potential sexual partners (Lewis et al., 2008). Coleman and Cater conducted a qualitative study and found that alcohol consumption tends to alter perception of potential partner's attractiveness. They also found that alcohol is often used as an "excuse" for certain sexual behaviors; it impairs judgment (e.g., ability to detect a risky situation), and use can lead to a loss of control (e.g., blacking out). Alcohol consumption is often associated with high-risk sexual behaviors, such as unplanned sex, having casual sex, multiple partners, and a decrease in protective behaviors (e.g., condom use) (Cooper, 2002; Dermen & Cooper, 2000; Mutchler, McDavitt, & Gordon, 2013; Rehm, Shield, Joharchi, & Shuper, 2012; Townshend, Kambouropoulos, Griffin, Hunt, & Milani, 2014). Findings from an older national survey of more than 17,000 college-age students found that heavy drinkers were nearly three times as likely to engage in these types of behaviors (Wechsler, Dowdall, Davenport, & Castillo, 1995). Alarmingly, about half (46 %) of acquaintance rapes have occurred when one or both parties have been drinking alcohol (Lanutti & Monahan, 2002). Hingson, Zha, and Weitzman (2009) found that every year roughly 97,000 students between the ages of 18 and 24 are victims of alcohol-related assault or date rape.

While extensive research has been conducted on the sexual risks associated with alcohol use, less research has focused on how marijuana use impacts sexual behavior. Many studies link marijuana use to sexual risk behavior, but often in an indirect, correlational manner. For example, many studies suggest that individuals who have used marijuana (e.g., in the last year) tend to report having had more partners (Bedoya et al., 2012; Brodbeck, Matter, & Moggi, 2006; Castilla et al., 1999; Poulin & Graham, 2001; Tyurina et al., 2013), or report engaging in sex without a condom (Castilla et al., 1999). Some studies have even concluded that marijuana use may be riskier, sexually, than alcohol (Kingree & Betz, 2003; Kingree, Braithwaite, & Woodring, 2000). Few studies, however, have examined the psychosocial and physical sexual experiences related to marijuana use, and to our knowledge, no empirical studies have compared alcohol and marijuana with regard to potential psychosocial and physical sexual experiences, which in turn may affect (risky) sexual behavior. Likewise, to our knowledge, no qualitative studies of marijuana use have focused on the details of sexual effects or sexual interactions, or to the situations prior to sexual encounters, and this information is needed to help inform prevention and harm reduction. Despite increasing use and major policy changes, research on marijuana-related psychosocial and physical sexual experiences is limited. Continued research on the sexual effects of marijuana is warranted because more individuals may become at increased risk for potential adverse sexual outcomes in light of increasing popularity. Here we aim to compare psychosocial and physical sexual experiences (in a qualitative manner) to inform prevention in a time that marijuana use is gaining prevalence and acceptance.

Method

Participants

We interviewed 24 adults who were recruited online via CraigsList in New York City. Eligible participants (1) were ages 18–35, (2) spoke English; (3) must have engaged in sexual intercourse while high on marijuana within the last 3 months, and (4) must have engaged in sexual intercourse within the last 3 months while not high on marijuana. Reporting use of other illicit drugs in the last 3 months was exclusionary. Sex was defined as any sexual activity (involving some form of genital contact) with another individual that can result in orgasm in either individual. HIV serostatus and sexual orientation were not inclusion criteria.

Sample demographics are presented in Table 1. The sample was 50 % female, 10 (42 %) identified as White, 11 (46 %) Black, and 3 (12 %) identified as Hispanic. The mean age was 27.4 years ($SD = 5.8$) and marijuana had been used on average of 10.1 years ($SD = 6.7$). All participants self-reported being HIV-negative and heterosexual.

Measure and Procedure

The sample was stratified by sex and a male research assistant (RA) interviewed male participants and a female RA interviewed female participants. Data for this study were collected via in-depth interviews using a semi-structured interview guide. Following the conventions of Grounded Theory (Strauss & Corbin, 1990), we a priori set a number of predefined core questions, and the interview guided RAs to ask about additional topics that arose. When possible, the trained RAs probed for details and elaboration. This analysis focuses on a series of questions at the end of the structured interview, which focused on comparisons between marijuana- and alcohol-related psychosocial and physical sexual experiences. Specifically, participants were asked open-ended) to compare what sex is like on alcohol compared to sex on marijuana. The interviewers also used a series of probes to follow-up on factors of interest not discussed by the participant

Table 1 Sample characteristics ($N = 24$)

	Full sample *n* (%)	Males *n* (%)	Females *n* (%)
Age, years *M* (SD)	27.4 (5.8)	27.1 (6.3)	27.8 (5.6)
Gender			
Male	12 (50.0)	12 (100.0)	0 (0.0)
Female	12 (50.0)	0 (0.0)	12 (100.0)
Race/ethnicity			
White	10 (41.7)	5 (41.7)	5 (41.7)
Black	11 (45.8)	7 (58.30	4 (33.3)
Hispanic	3 (12.5)	0 (0.0)	3 (25.0)
Heterosexual sexual orientation	24 (100.0)	12 (100.0)	12 (100.0)
HIV-negative (self-report)	24 (100.0)	12 (100.0)	12 (100.0)
Years using marijuana *M* (SD)	10.1 (6.7)	10.9 (7.9)	9.3 (5.4)

There were no significant differences by gender

M mean, *SD* standard deviation

(probes listed in Table 2). Interviews were recorded and professionally transcribed.

Data Analysis

Analysis of transcripts focused on identifying patterns based on the entire sample using a multilevel process (Miles & Huberman, 1994). Two raters independently coded text into relevant topics/categories, which were largely predetermined by the structured interview questions. Dominant and repeated codes were then categorized into themes. Quotations that fit with specific topics and themes were then cataloged to form a comprehensive picture. After a consensus was reached regarding occurrences and classification of codes and themes, quotations in each domain were summarized. Data were analyzed utilizing Atlas.ti software. Since this was a relatively small sample, results are highly descriptive in nature (Sandelowski, 2000). Despite the relatively small sample size, when possible we examined whether there were potential differences by gender.

Results

We classified our codes into three themes—psychosocial experiences, physical experiences, and behavior. We first present and compare self-reported psychosocial experiences as the majority relate to situations prior to the physical sexual encounter(s).

Psychosocial Experiences

Self-Perception of Attractiveness

Participants often described themselves as feeling more attractive after use of alcohol or marijuana. Many participants—males and females—reported feeling sexier after use of marijuana, but this was more commonly related to use of alcohol. While many participants noted that they see others as being more attractive while they are on alcohol or marijuana (discussed below in the *Partner Choice* section), some mentioned that feeling more attractive or sexy after use (particularly of alcohol) increased the likelihood of having sex with individuals with whom they would not normally have sex. One female stated: she felt so attractive on alcohol that she feels she is the "diva of the party," yet another stated: she felt like the "sexiest woman on the planet" while high on marijuana. So both drugs appear to be potentially associated with increased feelings of self-attractiveness, but possibly more so for alcohol.

> When I'm drunk, I'm drunk, so I'm like, "I'm hot." Then with weed, I usually feel more sexy…and happy. You usually feel a little sexier, a little bit more turned on and ready to have sex, instead of being self-conscious. (Female, White, 32)

> When I'm drinking…I feel like I'm the prettiest person in the world, like no one has anything on me. I'm just so confident. (Female, Hispanic, 26)

While males also tended to suggest feeling more physically attractive, one male suggested that the confidence he feels from alcohol is what he feels makes him more attractive. Similarly, with regard to marijuana, one male mentioned that smoking marijuana makes him attractive because it makes him more relaxed, nonchalant, and less needy, and another mentioned females tell him he is sexy during the act of smoking marijuana. However, one male mentioned that while drinking helped numb his insecurities, smoking could actually increase his body image issues. Although the same male pointed out that "acting stupid" and blacking out on alcohol could make one appear unattractive, which he compared to the "less-unattractive" characteristic of having squinty eyes on marijuana.

Table 2 Questions and probes used to assess and compare sexual experiences of alcohol and marijuana

Questions and probes
Can you compare what it is like to have sex on marijuana compared to sex on alcohol?
Follow-up probes to initial question:
Do they prefer sex while high on either?
Compare how these drugs affect the kinds of partners they have
Compare how these drugs affect interactions leading to sex (and whether use of either drug is used for sex or to meet someone to have sex)
Compare whether either drug makes them feel more sexually (or socially) attractive
Compare whether they find partners more sexually (or socially) attractive on either drug
Compare how these drugs affect libido/sex drive
Compare how these drugs affect inhibitions (socially or sexually)
Compare how these drugs affect specific sexual acts
Compare potential sexual dysfunction (e.g., penile and vaginal) associated with each drug
Compare sensations (overall body and sexual organ-specific) and emotions experienced related to use of each drug
Compare length and intensity of sex and orgasm related to use of each drug
Compare how dose (amount used) of each drug affects sex
Probe for black-outs, physical effects (e.g., sensations/numbness, impotence, nausea, and dizziness), wakefulness, decision-making ability, superficial effects like smell)
Compare how participants normally feel after sex on these drugs
Probe for satisfaction
Compare potential regret after sexual experiences on these drugs
Probe for regret about partners, specific acts, and protection
Ask whether they feel one drug leads to riskier sexual situations
Probe for unprotected sex and riskier partners
Compare interactions after sex on each drug
Probe for embarrassment, "beer" goggle effect for either drug, attractiveness of partner, post-sex connection, and/or compatibility

Sociability and Loss of Social Inhibitions

When discussing situations that preceded potential sexual encounters, some participants compared the feelings of sociability associated with use of alcohol versus marijuana. For instance, although some participants reported feeling more talkative on marijuana, use was commonly discussed as actually leading users to feel quieter and less social than usual. Alcohol, however, tended to make participants—both males and females—more outgoing and social.

> I don't feel as outgoing (on marijuana). I don't want to hold a conversation and stuff like that. Whereas if I'm drunk, I talk to anybody. (Male, Black, 18)

> I'm quiet, but it (marijuana) makes me laugh more, and I guess when you laugh, it makes people want to socialize with you. I feel like when you're drunk, you're down for everything. (Female, White, 19)

Thus, in some respects, alcohol—particularly in larger doses—may serve as a more effective social lubricant than marijuana. Not only did some participants high on marijuana report not talking because they were "staring at the clouds" or not feeling social, but some noted being more selective in group situations.

> When I'm high I'm a people person, but I'm selective. When I drink, I don't mind being in a crowd of people. There's times I'd be high, and I go to a party, and I'll pick this guy or this girl. But when I'm drunk, I'm just going to mingle with everybody. (Male, Black, 35)

Most participants felt that alcohol made them more socially disinhibited than marijuana. In fact one male participant referred to alcohol as "liquid courage." A clear difference between alcohol and marijuana was that many participants stated that alcohol use can lead to more "aggressive" social behavior than marijuana, which reportedly tends to make users feel more laid-back, "chill," relaxed, mellow, and/or that they and everyone else feels happy. The "aggressive" behavior associated with alcohol use seems to apply more to males, however.

> When there's drinking involved, guys seem to get more belligerent and crazy, and get this weird aggressive energy…– Maybe I'm looking for it (sex) more if I were drunk, whereas when I'm high, I'm happy doing other things. Sex is great. Watching a movie is great. Resting's great. But when I'm drunk, fucking would be great. (Female, White, 31)

Some participants reported that on alcohol they have a willingness to "do anything," say things they normally would not say ("without a filter"), or "say yes to people" (regarding

sexual behavior). However, females were more likely to discuss this in terms of being more "adventurous," as compared to the boldness or confidence described by some males. Others reportedly feel rowdy and "all over the place" on alcohol, but this was often discussed with a negative connotation. But despite the confidence commonly associated with alcohol use, some participants implied that marijuana use is accompanied with a sense of wariness in unfamiliar situations that participants did not generally seem to experience after using alcohol. For example, one male user reported that while he felt "loose" on marijuana, he noted that users maintained a sense of intuition on it that they did not experience on alcohol.

> It feels like you get a lot more primal (on alcohol)…maybe you get horny or something. Like "I need this," and I'm just going to do whatever. But being high—it's not something like you're like, "Oh, I need to go out and get some girls." (Male, White, 27)

> When I'm drinking, I want to do anything. I'm up for anything. Not thinking, all right, this is probably not going to be good the next day. But at that moment, you're not worried about any of that stuff. (Female, Hispanic, 26)

Facilitation of Social Connection with Others

While these two substances reportedly affected social inhibitions, some participants also discussed how alcohol or marijuana were often used in different social situations in order to promote or facilitate sociability. In fact, both marijuana and alcohol were often reportedly available at gatherings and/or provided by others. In general, alcohol use was often provided in social situations to facilitate sociability, and some reportedly drank alcohol in order to loosen up to meet new people. Marijuana, however, was often discussed as being limited to more familiar situations or crowds—not gatherings full of strangers. In addition, not only do many attendees at gatherings drink alcohol to facilitate socialization, but there are also common social rituals or methods or social bonding involving the serving or consumption of alcohol such as buying someone a drink, toasting, and taking shots with others.

Although often used at different types of gatherings, some participants reported that sharing marijuana with someone who asked for a "hit" also tended to facilitate connections between users; thus, sharing the substance appears to influence the social effects associated with actual use of the substance. For example, some males reported smoking at concerts or parties and having women approach them asking to blow smoke in their faces. An intimate form of doing this is via "shot-gunning" in which someone places his or her mouth on another person's mouth and blows smoke in. Thus, both substances are sometimes used to facilitate social connections—with users taking advantage of direct pharmacological effects as well as social rituals—and results suggest that for both alcohol and marijuana—males appear to be more likely to initiate the sharing ritual with women.

> When you're drinking, and you know the other person is drinking, you can always be like, "Let's get another drink." There is always that connection. (Male, White, 23)

> Usually the way I meet people is I'm smoking, and they ask for a hit. There have been countless numbers of people that I have met just by, "Can I get a hit of that?" I think marijuana creates a common interest. (Male, Black, 23)

However, while some participants reported that marijuana was an effective "ice-breaker" for meeting others at certain parties, using with others in private (e.g., at a residence) was more common (as it is an illegal substance with a strong odor). In fact, the "taboo" or "forbiddenness" of use being illegal appeared to have facilitated sexual interactions when using marijuana with another individual in private—and both males and females reported asking someone of the opposite sex to come smoke marijuana in order to help facilitate a potential intimate encounter.

> When I'd go on a date, if it went well, I'd be like, "Want to come back to my place and smoke weed?" That's a great transition into the intimacy of being at my house. "Let's do something a little bit taboo together." And then it's like you're sharing a sensation that's a little bit forbidden. Also, maybe just the fact of it being illegal and you have to do it privately…it seems kind of exclusive. It feels more intimate. (Female, White, 31)

> I was probably thinking that this (marijuana) might increase the chances that we are going to have sex. This would be fun, and we're already sort of in this intimate experience anyway…in my room in college smoking weed. (Male, White, 27)

However, this method does not appear to be successful unless both individuals are users. For example, two participants (one male and one female) alluded to experiencing stigma when the other (non-using) individual found out that he or she was a marijuana user. So disclosing that one is a user may place one at risk of a stigmatizing situation, although if the other individual is a user it may facilitate a more intimate social encounter.

Partner Choice

While both substances were often noted to affect the types of potential partners participants approached, they overwhelmingly reported that alcohol use was more likely to (negatively) affect the partners they chose. Seeing partners "in the daylight" for the first time and waking up next to a "different person" was a common complaint of both males and females—for example, they felt attracted to the individual the night before, but not the morning after sex. Alcohol use commonly lowered participants' standards, possibly because as one male participant pointed out—he becomes more desperate or "less picky" on alcohol. Males were more likely than females to discuss lowered standards of partner choice in

terms of appearance, although some females also implied that they were not physically attracted to their partner the following day.

> There have been times where I've had alcohol and have hooked up with girls who I wouldn't normally have when I was sober. I think alcohol makes me give less of a fuck than marijuana, but marijuana—it makes me selective in who I choose to have sex with, or, pursue. (Male, Black, 20)

> Whoever comes your way…when I'm drinking, everybody looks fine to me. Everybody looks good, and then if you wake up with somebody in the morning, then you'll be like, "Am I bugging out?" With weed I know who I'm waking up with. With drinking, you don't know. Once you start drinking, everybody looks good. (Female, Black, 34)

> When you're drunk, you might be like, "Damn, he looks mad good." Then you wake up, you're like, "What the hell did I do? Why are we naked in my bed?" I think if it was weed only I would've been, "Maybe this is a good stopping point." (Female, White, 31)

In many cases, females' "bad" decisions seemed to transcend appearance. Females in particular were more likely to report false interpretations not only about appearance or attractiveness, but also about the partner's character (e.g., career choices). One female mentioned that she continued to perceive a connection with someone (after meeting while inebriated on alcohol); however, on their first (sober) date, she experienced feelings of awkwardness and lack of compatibility. Social awkwardness (e.g., the next day after meeting while inebriated) sometimes resulted from other social issues not experienced or acknowledged while drunk. For example, lack of more meaningful (e.g., sober) conversation during an initial meeting may not lead individuals to discuss (or perhaps recall) potentially sensitive topics such as political affiliation or plans to start a family. One female said she was not attracted to her partner in the morning—not because she found him unattractive—but because he did not remember a long conversation they had about her career. Another female reported that while she felt complimented by "cheesy pickup lines" when drunk, she did not appreciate them the following day when she was sober.

Although generally most participants did not report lowering their standards on marijuana (compared to alcohol), some did explain that they found their partners more attractive while high. A couple of participants articulated differences—for example, one male stated that marijuana can enhance a potential partner's attractiveness (e.g., highlighted facial features) as well as one's surroundings, but on alcohol, they felt one was more likely to settle for someone he or she was not normally attracted to. Another participant mentioned that he became more emotionally attracted to his girlfriend on marijuana and no participants reported such an "emotional" attraction with regard to alcohol. In addition, many participants discussed attraction or sex on marijuana as being with someone they already knew—or were dating (adding to the point discussed above that marijuana is most often used with familiar individuals). Alcohol was commonly discussed in terms of having sex with strangers (or someone new); thus, situations involving sex on marijuana tend to be much different than situations involving alcohol in which individuals commonly meet strangers in social settings such as bars. However, some marijuana users—male and female—were also more likely to lower their sexual standards when high on marijuana.

> I've come to realize that somebody that I wouldn't normally fuck while I was sober, I probably would fuck them while I was high. (Male, Black, 35)

> When I'm high…the people I'm attracted to, I'm not at all attracted to sober. My partners are hotter if I've been drinking [laughs]. [They] should be called "weed goggles" because it's much worse on marijuana than on alcohol. (Female, White, 22)

Although reports of lowering sexual standards varied, one participant noted a hierarchy—that marijuana lowers one's standards more than being sober, and alcohol lowers one's standards more than marijuana. In sum, it appears that many individuals were likely to be more attracted to certain potential partners on either drug, but this appeared to be more of a "risk" with alcohol.

Feelings After Sex

Many participants reportedly experienced impaired memory regarding sexual interactions when alcohol was involved, or having sex with partners they did not previously know. This often led to reclusiveness and some participants even reported being "cold" to their partner in the morning. One female noted awkwardness upon accidentally bumping into that partner in the future. However, some participants mentioned that they were more satisfied after interactions on marijuana compared to interactions on alcohol, and this could largely be due to different social interactions beforehand.

> I feel like when you're drunk you can't remember what happened the next day. But when I'm high, I remember everything. (Female, White, 19)

> I want to cook the person something to eat (after sex) when I'm high. When I'm drunk, it's like, "I'm out of here." Or get away from me. (Male, White, 33)

A male and a female both reported desire for more sex after the first sexual episode on marijuana—a desire that does not reportedly return as often after sex on alcohol. Some participants reported feeling more satisfied after their encounters high on marijuana (compared to alcohol), and more relaxed, "chill," emotionally at ease, and able to fall asleep.

Regret

The most commonly reported feeling after sex on alcohol was regret. Both male and female participants reported regret resulting from a range of behaviors including one-night stands, "hooking up with drunk chicks," the lowering of sexual standards, and specific risky sexual interactions such as using the withdrawal method instead of a condom. Participants discussed worry about pregnancy, and one participant mentioned disappointment that he could not remember a particular sexual episode. Both males and females commonly reported that regret, shame, and embarrassment were associated with alcohol use, but this was rarely reported for marijuana. One female added that she is more likely to regret the partners she chooses on marijuana; however, she said she is more likely to regret specific sexual acts on alcohol. For example:

> When you're drunk, it's more regrets or I-wish-I-didn't-do-that type of thing. Definitely had times where I didn't use a condom. Pulling-out method, one-night stands…Just didn't feel good about that at all. (Female, White, 32)

In addition, we found that females tended to report regret in the form of shame for allowing themselves to have sex with someone they feel they would not have had sex with while sober:

> You might wake up next to someone you never intended on doing anything with them, just because you didn't have control and you were drinking so much. I was actually, the next day, thinking, what did I do? (Female, Hispanic, 26)

> When you're drunk, you might see somebody and be like, damn, he looks mad good. Then you wake up, you're like, oh, what the hell did I just do? (Female, Black, 25)

However, males tended to report regretting the women they pursued and then had sex with:

> It's almost like a shameful experience (from alcohol). I don't think I've had that same kind of experience with marijuana. It's doesn't really lower inhibitions the same way, so I don't think I'm as likely to do something that I know I'm going to regret (Male, White, 27)

> Oh, so much regret for alcohol. Sometimes I hook up with girls I wouldn't normally have while sober. I feel like weed only enhances the attraction and the connection, but with alcohol, there's lots of regret. Lots of embarrassment. (Male, Black, 20)

> I never had no regret on marijuana. Yeah, sometimes alcohol. You like, "Why the fuck I even touch this bitch?" I mean, sometimes I wake up, and I'm just like, "Wow, I could've done better than that." With weed, I never had that experience. (Male, Black, 30)

So both males and females tended to report regret after having sex on alcohol. But as previously noted, some participants feel they remember more (or everything) from sex on marijuana, and adding to this point–one participant made an interesting comparison saying that you are more likely to want to remember sex on marijuana, unlike alcohol where you hope to forget if you have not forgotten already.

Physical Experiences

General Adverse Effects

Nausea, dizziness, feeling sick (and vomiting), and blacking out were commonly reported to be associated with alcohol use. One male reported accidentally falling asleep during intercourse and another male reported having to urinate due to alcohol consumption as interfering with sex (in part because it can be difficult for a male to urinate with an erection). It appears that reported adverse alcohol experiences tend to be more physical, but adverse marijuana experiences reported tend to be more psychosocial—as one participant summarized: "I feel like weed affects your motivation, and alcohol just affects your ability."

> I've had a couple of times in the middle of intercourse (on alcohol) where I've had to stop and go hurl. But I came back and whatever. Maybe it's taking a little while longer for me to get my erection again, but five times stronger than before I threw up. (Male, White, 33)

However, adverse non-sexual experiences were certainly not limited to alcohol. For example, one male noted feeling sluggish, lazy, and sleepy after smoking marijuana. Yet this depressant effect may be more extreme with alcohol. For example, one female stated that if she drinks too much she may fall asleep instead of having sex.

Dose Effects

Sexual experiences—especially adverse experiences—appear to depend on the dose used. Many adverse experiences reported thus far have been discussed in the context of somewhat high doses (e.g., being drunk). Low doses of alcohol (e.g., 1–2 drinks) reportedly allowed some participants to be able to function rather adequately. A few participants reported that higher alcohol consumption often led to erectile dysfunction and vaginal dryness.

> Or if you drink too much, it's like your body just shuts down. I don't get any lubrication. Then I think it might even affect guys more, because I've been in situations where they've drunk too much and they can't stay hard, or they can't get hard. (Female, White, 22)

Higher levels of alcohol consumption also reportedly led to more aggressive sex (e.g., regarding initiation), or "reckless"

or unprotected sex. In comparison, many participants—male and female—reported that using too much marijuana was associated with anxiety. While "sexual laziness," reluctance to change sex positions, and even "passing out" were mentioned, many males and females reported that marijuana has an adverse effect on their mindset during sex. Specifically, females were more likely to describe anxiety in the form of paranoia, yet males were more likely to discuss these effects in terms of having their minds drift and having an experience with less-paranoid intrusive thoughts or distraction.

> You're so high (on marijuana)…you start thinking sex is weird. "What is sex?" Sometimes you're so high that you get the smallest thing in your head, and you get lost in that…I've definitely blacked out (on alcohol), probably during sex. (Female, White, 32)

> I guess there maybe is a drop-off where you get too high (on marijuana), and things are a little too intense. Being really high can sort of interfere because then you just get a little too trapped in your head; you tend to get a little more anxious. (Male, White, 27)

However, the mental effects associated with higher doses or marijuana were not always described in a negative manner; for example, one male reported "spacing out" after smoking too much marijuana, but he stated he felt it ultimately led him to last longer during sex.

Sensations of Body and Sex Organs

Participants commonly described sexual experiences with these substances in terms of sensations. Generally, participants described their bodies as more sensitive on marijuana and numb or desensitized on alcohol. A few females noted that increased sensitivity (or being more "tuned-into" their sensations) on marijuana added to the sexual experience as touch felt better or they felt more (physically—which is why some said they preferred being caressed while high). Others mentioned that they felt more comfortable, mellow or at ease on marijuana, which may have allowed sensations to feel more intense.

> Alcohol tends to be a lot more numb. Everything is sort of blunted and muted, whereas with marijuana it's intensified. Any little touch is more arousing. The body sensations, particularly on sexual organs—it's more of an intense sensation. I'd say everything just feels more sensitive…it's more intense. Even just foreplay and touching and holding each other is more pleasurable. So they are opposites. (Male, White, 27)

Other females explained that they experienced a tingly sensation on marijuana, goose bumps, or warm sensations. One male also mentioned feeling tingly "on the inside" during sex on marijuana. While most participants discussed increased body sensitivity as a positive aspect of use, one female noted that increased sensations were not always comfortable. Regardless, alcohol tended to numb sensations and marijuana tended to enhance sensations, and the sensations described above appear to be related to length and intensity of intercourse, which is described below.

Length and Intensity of Sex

In many cases, the desensitization associated with alcohol reportedly resulted in prolonged intercourse—in both males and females, and this was often described in a positive manner. Some participants reportedly enjoyed aggressive and intense sex associated with alcohol use; however, one female (below) describes how lengthy sex on alcohol can become painful.

> When you're drinking, it's like the guy won't reach his climax. It was great because it lasted like an hour and a half. He wants to keep going, [but] to the point where I'm all swollen and sore. You're going to have to switch it up, or do some oral…it begins to get painful. I like the fact that he lasts longer, but he sometimes lasts too long. Compared to when you're high—it feels so great and it might be a little shorter. (Female, Hispanic, 26)

Likewise, it was mentioned that the feeling of time can slow down on marijuana, so sex feels as if it lasts longer. For example, one female noted that intercourse might feel like an hour on alcohol, but may only be 15 min. Regardless, some males said sex lasts longer on marijuana—possibly due to increased sensitivity, pleasure, and/or emotional intensity. On the other hand, however, a few participants also noted that since sex on marijuana can feel so intense, they orgasm much quicker (than on alcohol).

> It's better being high—the sex, but it's less time. I like it to be longer, but still feel great about it. (Female, Hispanic, 26)

Another added that the overall sex act did last longer on marijuana, but due to increased foreplay—not actual intercourse.

Sexual Dysfunction

Some participants compared alcohol and marijuana in terms of sexual dysfunction. The most common dysfunction discussed was that males commonly become impotent or "less erect" after too much alcohol ("whiskey-dick;" a complaint by both sexes).

> It's harder to get hard when I'm drunk. So, alcohol, too much, definitely makes you dysfunctional. Weed, I don't think so. It only affects your motivation. (Male, Black, 20)

Some females, on the other hand, reported that they sometimes experience lack of vaginal lubrication after using marijuana, and this dysfunction was also mentioned by a male in the sample.

> I think I don't get as naturally lubricated when I smoke…and I don't think I've ever orgasmed after smoking weed and having sex. (Female, White, 22)

> Sometimes when we've been smoking more marijuana, it's harder for her to get wet. It's like the same thing as getting dry mouth, but down there. (Male, White, 19)

Beyond dysfunction of sex organs, some participants (both male and female) mentioned that alcohol or marijuana use prevented orgasm (discussed more below).

Orgasm

As discussed above, alcohol and marijuana use were often perceived to affect the intensity of sex. Likewise, using these substances could also impact orgasm. Some males and females reported that their orgasms were "magnified," longer, or more intense (with one female noting hot and cold flashes) on marijuana.

> The orgasm's more intense (on marijuana). I can feel it more. I'm also not in my head thinking about anything else. So I'm able to be mindful of everything that's happening and nothing intrudes. (Female, White, 32)

> When I'm high, it seems like my orgasms are magnified at least by five times. Much more intense. Hot and cold flashes. (Female, Black, 34)

> With alcohol, it's more like, "Alright, let's do this. Let's get my orgasm." With marijuana it's like, "Okay, let's enjoy the moment. Let's live in the moment." (Male, Black, 20)

As aforementioned, some participants mentioned sexual dysfunction with regard to orgasm. While some male participants mentioned they may have delayed orgasms on alcohol, others said they could orgasm or orgasm even more frequently on alcohol. On the other hand, some participants mentioned that the drug affected orgasm in a negative manner.

> I feel like a lot of the things that can help lead to female orgasm are forgotten when you're high on marijuana. I feel like it requires a degree of focus for me to have an orgasm…I'm never going to have that focus on marijuana. Everything feels better, but I just can't orgasm. [But] it can be harder for me to orgasm when I've been drinking. And my boyfriend, too. Like, he can still get hard, but then it's harder for both of us to finish. (Female, White, 22)

Some females also reportedly could not orgasm on marijuana due to lack of focus. For others (of both sexes), it reportedly took longer to achieve an orgasm on marijuana, again, possibly due to mindset.

Sexual Behaviors

The last theme with respect to "physical" experiences is sexual behaviors. With regard to marijuana use, some participants mentioned that there was often more foreplay and that it tended to be more euphoric (although sometimes "silly"). Some noted that they tended to explore more, sexually, while high on marijuana, and try new behaviors, as they often felt more creative and/or felt more emotion. This led some participants to engage in more self-described "freaky" behavior (such as sucking toes or "licking ass") or "loss of control," while others simply preferred to just "lay on the bottom."

> I think the more you smoke, the more lazier you might be, too. Okay, let's just keep it in one position, because we're so high and we don't want to do so much work. (Female, Hispanic, 26)

Generally, marijuana use tended to be described as leading to more tender, slow, and compassionate sexual acts, and to involve more sensation and sensuality than alcohol.

> When I'm a seductress (on marijuana), I kiss. I stroke. I rub. I'm very sensual, as opposed to when I'm drunk–I'm just like, give it to me. Ripping close off. (Female, Black, 34)

While both drugs reportedly facilitated changes in specific sexual behaviors, alcohol was often more commonly cited in terms of loss of control or acting out of the ordinary, and one participant said alcohol use leads to more experimental or "kinkier" behavior than marijuana, sometimes described as "crossing the line" (e.g., one male says he is more likely to tell women to "sit on his face"). Sex on alcohol was often described as being more casual and less emotional than sex on marijuana. Likewise, many described sex on alcohol as being more primal, "sloppy," aggressive and "uncontrollable savage" compared to marijuana. One male compared and said that sex on alcohol was more "straight to the point" to achieve quick ejaculation.

> When I'm high off of marijuana, it's more about pleasing my partner and me. You want more out of it, but you also want to give the person more. You want to satisfy the person even more. I guess it's more gentle. Sex being drunk—it's more aggressive. Sex on alcohol is more like savage sex. I go in with the mind frame of I'm going to hurt this woman. She's going to go home and she's going to tell all her friends. Sex with marijuana, it's like you want to please the person more so you want to bring more to table. (Male, White, 33)

> When I'm high, I feel more like a seductress. But when I'm drunk, I feel slutty. When I'm a seductress…I'm very sensual, as opposed to when I'm drunk, I'm just like, give it to me. Ripping clothes off. You know when you're drunk, you're saying all kinds of things you wouldn't normally say? You're willing to try much more new things. (Female, Black, 34)

It also appears that type of alcohol or marijuana used can lead to different sexual experiences and behaviors. For example, when discussing alcohol-related sexual experiences some participants mentioned specific brands of alcohol and some discussed certain

strains of marijuana as having unique sexual effects. This participant discusses sexual experiences related to a particular strain of marijuana:

> I smoked some Blue Cheese, and…I was licking ass, doing all kinds of crazy stuff I had never even thought of—sucking toes…then I smoke some regular and I just do the regular. (Male, Black, 35)

With regard to sexual risk behavior, the majority of participants felt that alcohol was riskier, sexually, than marijuana. Participants noted that sometimes "anything goes" (sexually) when they drink and are not worried about potential consequences while in the moment. Perceived riskiness of sex was largely due to reported perception of impaired judgment and lack of control of decisions and actions. Use was reportedly often associated with hasty decisions; for example, not using a condom. One male participant said that when he was drunk he sometimes thought, "Who cares about protection?" However, unprotected interactions were not always intentional. One female mentioned that she was too drunk to notice that her partner removed the condom during sex. In some situations, drinking appears to have left participants more vulnerable; for example, one female discussed being subject to sexual assault (unwanted choking) that she described as being too drunk to prevent.

> I don't think being high has ever made me more likely to do anything I consider risky. Being drunk probably affected my experience with risky sexual behavior far more. I'd be more likely to forego using protection with someone I really didn't know all that well for gratifying that immediate impulse. With weed, I don't think it's really had much of a bearing on my choice of using protection. (Male, White, 27)

> Even when I smoke weed, if I'm high on weed, I'm still able to make good decisions. It doesn't impair my judgment. Alcohol impairs your judgment, so that's the difference. (Female, Black, 30)

> (Sex is) more riskier with the alcohol. "Who cares about protection" or whatever. You don't think about safety a lot when you're drunk. You just don't think about it sometimes until the next day. And then you're like, "Oh shit, did I have unprotected sex?" (Male, White, 33)

Blacking out was also commonly reported by both sexes, or memories of the interaction were jumbled or unclear, with participants unsure whether they used birth control. One female noted that she resorted to taking Plan B the next day due to what she felt was a poor sexual decision. One participant mentioned that she does not always have the autonomy to resist or speak out against a particular sexual act when high on marijuana. Although others reported delayed reactions and noted that reactions (e.g., to potentially unwelcome behaviors) were not as delayed on alcohol. However, participants often explained that they still felt in control of the situation. A false sense of perceived control, though, could in fact leave a user more vulnerable to unwanted sexual acts. But numerous participants felt that they were still able to make good decisions on marijuana and maintain self-control, more so than when intoxicated with alcohol. Additionally, some participants reported that marijuana did not adversely affect memory of the interaction compared to alcohol. One participant felt that marijuana use was no riskier—sexually—than when sober, and one participant interestingly pointed out that marijuana use decreased his likelihood of engaging in risk behavior because while high he was too paranoid to give in.

Discussion

With the popularity of marijuana increasing in the US, and with marijuana becoming legal in some jurisdictions, it is important to investigate the potential sexual effects associated with use, in order to inform prevention and safer choices among users and potential users. Correlational studies have linked marijuana use to risky sexual behavior, but richer data were needed to investigate these associations. Few studies have examined the psychosocial and physical sexual experiences related to marijuana use, and to our knowledge, no empirical studies have compared alcohol and marijuana with regard to potential psychosocial and physical sexual experiences, which in turn may affect sexual risk behavior. We compared psychosocial and physical sexual experiences to inform prevention in an era where prevalence of use and acceptance of marijuana are increasing. We categorized topics into two overall themes—psychosocial sexual experiences and physical sexual experiences. We were able to uncover differences between alcohol and marijuana through in-depth interviews that can inform future studies as well as prevention and harm reduction efforts.

With regard to psychosocial experiences, participants commonly reported self-perception of attractiveness or sexiness associated with use of alcohol and marijuana, but more so for alcohol. Parsons et al. (2004) also found that men who have sex with men tend to feel sexier after consuming alcohol and this may facilitate sexual expressiveness, but to our knowledge, this had not yet been investigated in a heterosexual population or with regard to marijuana use. It appears that both substances facilitate feelings of self-attractiveness, but more research is needed to examine whether this directly affects risky sexual behavior. Quantitative studies tend to examine odds or risk for sexual risk behaviors in relation to substance use (e.g., Kerr, Washburn, Morris, Lewis, & Tiberio 2015), but do not examine how psychosocial variables, such as feeling sexy or attractive, may mediate or moderate these associations. Such data could help guide messaging for harm reduction interventions.

While we discovered some variations with regard to gender, both alcohol and marijuana were generally associated with sociability, loss of inhibitions, and feelings of boldness. However,

alcohol use was more commonly used for pursuing potential sex partners. Participants often reported feeling a loss of control with alcohol, whereas with marijuana, they tended to feel they maintained control, but were reportedly often quieter and less social than usual. Alcohol is commonly used to boost confidence, decrease social inhibitions, and to cope with emotions such as fear of rejection by potential sexual partners (Lewis et al., 2008; Parsons et al., 2004); however, participants did not report these reasons with regard to marijuana use. Participants also tended to discuss disinhibition on alcohol in terms of being "sloppy," yet they felt more controlled while high on marijuana. Our results confirm that alcohol is an effective social lubricant and past research has found that it diminishes anxieties about how potential sexual partners might respond (Livingston, Bay-Cheng, Hequembourg, Testa, & Downs, 2013; Parsons et al., 2004). This disinhibition on alcohol helped facilitate a social connection with others, but again, alcohol reportedly served as a more effective social lubricant than marijuana in social settings. Participants—especially males—on alcohol reportedly felt more social, outgoing, and courageous in approaching others—facilitating a potential sexual encounter.

Although males were more likely to pursue women on alcohol, females were more likely to report "accepting" potential sexual partners when inebriated on alcohol. On marijuana, participants tended to feel quieter and less social; however, a major finding of this study was that the illegality of marijuana sometimes facilitated sexual interactions as participants felt they were engaging in "forbidden" or "taboo" behavior—among both males and females. While consumption of alcohol in public is legal (but regulated) with individuals able to drink in public or in private, marijuana is generally used in more private situations (due to illegality in most states). So since marijuana cannot generally be used in public, potential partners are often limited to more intimate settings, thus facilitating potential sexual encounters (while individuals who are drinking do not have to limit themselves to private places). More research will be needed to examine such associations in light of changing legality of marijuana throughout the US.

Participants also discussed alcohol and marijuana in terms of partner choice. While some participants reported that marijuana use made them more selective in choosing a partner, many participants—both male and female—felt that their standards for choosing a partner were lowered while under the influence of alcohol. Parsons et al. (2004) also found that alcohol often plays a large role in spontaneous sexual encounters as it reportedly lowers partner selection criteria. While we found that participants on alcohol often were no longer attracted to their partner following the encounter, this adds to previous research that has found that alcohol use is related to riskier partner choice (Cooper, 2002; Dunn, Bartee, & Perko, 2003).

Interestingly, some participants reported that marijuana use actually made them more selective in choosing partners. While some reported that they felt more attracted to their partner(s) on marijuana, this effect appears to be different from the alcohol "beer goggle" effect, but possibly because individuals who use marijuana together often already know each other and are in a more private setting together. Partner choice on alcohol appears to largely depend on the social context in which individuals initially meet one another; for example, on alcohol, individuals appear to be more likely to connect with unknown casual partners (Walsh, Fielder, Carey, & Carey, 2014). So if marijuana was legal and used and shared openly in public it is unknown whether there would be a "marijuana goggle" phenomenon associated with use.

Related to partner choice, it was not surprising that marijuana use reportedly led to more post-sex satisfaction than alcohol. Users generally did not feel they experienced memory impairment or poor judgment after using marijuana, but they did feel they commonly experienced this from alcohol. The most common reported feeling after sex on alcohol was regret and regret after sexual interactions on alcohol has been reported in other studies (Livingston et al., 2013). A recent epidemiology study of a nationally representative sample of adolescents found that compared to marijuana, alcohol was much more likely to lead to regretful behavior (e.g., having sex with someone they would not normally be attracted to), especially among females (Palamar et al., 2014a). Our results add to these findings in that compared to marijuana, alcohol use reportedly leads to more regret.

With regard to physical sexual experiences, participants reported adverse effects related to both alcohol and marijuana use. Participants reported nausea, dizziness, and falling asleep during sex on alcohol, but adverse experiences on marijuana were reportedly often more mental (e.g., paranoia and lack of motivation). We must keep in mind that drug dose is likely an important factor relevant to all findings. For example, many experiences on alcohol were discussed in terms of being drunk, so it is unknown whether participants would have had similar experiences on smaller doses. Drug dose likely played a role in other physical experiences participants discussed including body sensations, length and intensity of sex, sexual dysfunction, and specific sexual behaviors.

Alcohol and marijuana reportedly led to different sensations of the body and sexual organs. Participants commonly reported increased sensitivity on marijuana and numbness while on alcohol. These changes in sensation appear to have influenced length and intensity of sex as well as orgasm. While we must keep in mind that both drugs can affect one's perception of time, participants commonly reported that the numbness associated with alcohol was associated with more extended sexual activity. However, more aggressive sex on alcohol sometimes reportedly led to sex of shorter duration. Participants reported more intense sexual activity on marijuana and sometimes an increase in duration.

Sexual dysfunction was reportedly associated with use of both alcohol and marijuana. Alcohol use was sometimes associated with an inability to achieve or maintain an erection, and alcohol reportedly made it harder to achieve orgasm in both

sexes. Previous studies have found that chronic alcohol abuse leads to higher rates of sexual dysfunction in females including inability to orgasm, lack of vaginal lubrication, and painful intercourse (Covington & Kohen, 1984). While alcohol may increase libido, it does not necessarily increase or allow for optimal performance (Parsons et al., 2004). In fact, alcohol use reportedly made it more difficult to achieve an orgasm in both sexes (which relates to length of sexual encounters previously discussed). Marijuana appeared to have a (negative) effect more on motivation than orgasm; however, use was sometimes reported to lead to vaginal dryness. Consistent with previous studies, participants did not discuss instances of impotence related to marijuana use although some discussed inhibited sexual excitement possibly due to lack of motivation (Johnson, Phelps, & Cottler, 2004; Smith et al., 2010). Ability to achieve orgasm appears to be related to participants' described sexual dysfunction. As aforementioned, length of sex is often extended on alcohol (e.g., due to numbness), and length is often extended because orgasm is delayed. Orgasms were reportedly more intense on marijuana than on alcohol; however, some females reported an inability to achieve orgasm on marijuana due to lack of proper focus.

With regard to sexual behaviors, sex on alcohol was commonly reported as being more casual and less emotional. However, many participants also described sex on alcohol as being more "out of the ordinary" or even "freaky" or "kinky." On the contrary, sex while high on marijuana was commonly described as being more compassionate and it tended to include more foreplay, with many participants experiencing increased sensuality and sensation reportedly related to sex while high on marijuana. Although we were not able to acquire enough data to determine whether participants on marijuana were less likely to use condoms, condomless sex on alcohol was reported as being a somewhat common experience, consistent with Kerr et al.'s (2015) study among college students.

One female also discussed sexual assault (unwanted choking) during an encounter involving alcohol. Alarmingly, 2 % of college students in the US report being victims of alcohol-related sexual assault or date rape (Hingson et al., 2009). Although few studies document marijuana use in cases of sexual assault, alcohol appears to be particularly problematic (Hall & Moore, 2008; Kerrigan, 2010). Research on both alcohol and marijuana needs to continue in order to inform prevention of sexual assault.

We must also keep in mind that many of the sexual situations related to use of each of these drugs likely depends on contexts of use. For example, a lot of risky or "regretful" behavior occurred with strangers or new partners while participants were inebriated on alcohol, but sex on marijuana was more common with individuals participants already knew.

Limitations

This was a small study so not enough interviews were conducted to formally compare by race/ethnicity, age, or amount used. This study's inclusion criteria were based only on marijuana use so participants were not required to have had sex on alcohol in the last 12 months. Likewise, since sex while high on marijuana while engaging in any sexual activity (not strictly vaginal or anal sex) that could result in orgasm was an inclusion criterion, eligible participants in this sample may have engaged in varying sexual acts and different acts may have varying degrees of sexual risk. Different inclusion criteria might have led to a different sample with different experience. While participants all identified as heterosexual, it is important to keep in mind that sexual orientation does not in fact limit one's sexual behaviors to the opposite sex. A larger, more systematic study should consider multiple other factors including relationship status, and as findings suggests, dose appears to be an important factor, so amount used needs to be examined in relation to specific sexual experiences in more detail. For example, adverse sexual experiences on alcohol tended to be described in terms of drunkenness, but research needs to further examine and compare dose-responses. Likewise, larger studies would benefit from directly comparing "critical incidents" involving marijuana and alcohol to truly compare drug effects as well as specific risk behavior (e.g., whether a condom is used) within the same individuals. Many participants were experienced users and extensive experience could have affected sexual effects or expectations of sexual effects. This study is also limited because type or brand of alcohol and strain and strength of marijuana may also lead to different perceived sexual effects. Finally, we realize that this is a relatively small sample, but we hope that this rich data inform large-scale future studies.

Conclusions

As marijuana use continues to become more normalized in the US, research is needed to inform prevention to ensure that users and potential users of these substances are aware of sexual experiences associated with use. Marijuana and alcohol are associated with unique psychosocial and physical experiences. While alcohol reportedly led to risker sexual behavior, both drugs appear to potentially increase risk for unsafe sex. Research is needed continue to study sexual effects and to inform prevention to ensure that users and potential users of these drugs are aware of sexual effects associated with use. Results can inform prevention and harm reduction programming that will allow us to design more realistic programs and to craft interventions, which guide users to make safer choices.

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Male–female differences in the effects of cannabinoids on sexual behavior and gonadal hormone function

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Gonadotropin

ABSTRACT

The putative role of the endocannabinoid system and the effects of cannabis use in male and female sexual functioning are summarized. The influence of cannabis intake on sexual behavior and arousability appear to be dose-dependent in both men and women, although women are far more consistent in reporting facilitatory effects. Furthermore, evidence from nonhuman species indicate somewhat more beneficial than debilitating effects of cannabinoids on female sexual proceptivity and receptivity while suggesting predominantly detrimental effects on male sexual motivation and erectile functioning. Data from human and nonhuman species converge on the ephemeral nature of THC-induced testosterone decline. However, it is clear that cannabinoid-induced inhibition of male sexual behavior is independent of concurrent declines in testosterone levels. Investigations also reveal a suppression of gonadotropin release by cannabinoids across various species. Historical milestones and promising future directions in the area of cannabinoid and sexuality research are also outlined in this review.

The use of cannabis for recreational and medicinal purposes has been documented worldwide for centuries. During this time, a large body of contradictory claims regarding the effects of cannabis on sexual functioning and behavior has accumulated. Some suggest that cannabis acts as an effective aphrodisiac, whereas the Indian Hemp Drugs Commission (1894) believed that it was toxic to sexual health. These conflicting accounts have sparked many empirical studies since the 1970s. In this review, the works of neuroscientists, endocrinologists, pharmacologists, psychologists and clinicians are integrated in an attempt to produce a comprehensive picture of the relationship between cannabis use and sexuality in males and females.

Cannabis

Despite the long history of cannabis use, serious research on cannabinoids did not begin until the last few decades of the twentieth century (Vettor et al., 2008). In the late 1960s, Δ^9-tetrahydrocannabinol (THC) was identified as the main psychoactive component of cannabis, whereas other constituents such as cannabidiol (CBD) and cannabinol (CBN) were noted to elicit other physiological effects (Isbell et al., 1967). The identification of THC became a major impetus for further cannabinoid research, evident by a notable increase of publications in this area after its discovery (Vettor et al., 2008). This boost of interest in cannabis waned as researchers were repeatedly unsuccessful in their attempt to pinpoint cannabis' mechanism of action. Initially, nonspecific pathways, such as alterations in cell membrane fluidity, were proposed as the likely mechanism, but these speculations soon led to a dead end, along with comparatively fewer publications on cannabinoids in the ensuing decade. In the late 1980s, however, a landmark study found cannabinoids displayed binding properties indicative of their interaction with a specific receptor (Devane et al., 1988) and with this finding, there was a resurgence of cannabinoid research.

The endocannabinoid system

Cannabinoid receptors

In the early 1990s, a cannabinoid receptor was genetically determined and its distribution was then mapped in the brain using in situ hybridization and radioligand binding analysis (Herkenham et al., 1991; Matsuda et al., 1990). This receptor, termed CB_1, generally exists as a presynaptic receptor and its activation inhibits neurotransmitter release from the axon terminal (reviewed in Schlicker and Kathmann, 2001). Its distribution is widespread in the brain with high densities in several brain regions, such as the striatum, hippocampus, and cerebellum, as well as moderate to low densities

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in the amygdala, midbrain, and cerebral cortex (Herkenham et al., 1991; Tsou et al., 1998). Within these brain regions, pharmacological and electrophysiological studies revealed that the CB_1 receptor is situated on terminals that release gamma-aminobutyric acid (GABA), glutamate, serotonin, dopamine, and acetylcholine, and is inferred to be regulating these types of neurotransmitters in the central nervous system (reviewed in Schlicker and Kathmann, 2001).

The distribution of CB_1 receptors throughout these brain structures positions this system to modulate sexual behavior through multiple potential mechanisms. Specifically, there are four major pathways through which cannabinoids could modulate sexual behavior given their pattern of distribution. First, CB_1 receptors within the striatum and cerebellum produce reductions in motor activity and motor incoordination (DeSanty and Dar, 2001; Patel and Hillard, 2001; Lichtman et al., 1996; Egashira et al., 2002), indicating that any effects cannabinoid exert on sexual function may in part be mediated by changes in motor function elicited by this subpopulation of receptors. Second, CB_1 receptors within corticolimbic structures (particularly the prefrontal cortex, amygdala and hippocampus) regulate stress responsivity and emotional behavior (Rubino et al., 2008; Hill et al., 2009; McLaughlin et al., 2007), indicating that cannabinoids may be able to exert effects on sexual behavior indirectly through their ability to modulate the expression of stress and anxiety. Third, CB_1 receptors are located within the dorsal raphe and ventral tegmental area, which are the nuclei containing the cell bodies for the serotonergic and dopaminergic input to the forebrain, respectively (Haring et al., 2007; Matyas et al., 2008). Activation of CB_1 receptors is capable of modulating the synaptic release of both dopamine and serotonin, two neurotransmitters which are intricately involved in the regulation of genital reflexes, sexual motivation and inhibition (Hull et al., 2004; Giraldi et al., 2004). Thus, cannabinoids may modulate sexual function through direct regulation of the synaptic release of serotonin and dopamine. Fourth, CB_1 receptors are distributed throughout neuropeptide populations within the hypothalamus and are known to regulate the release of several peptides important for sexual activity, physiology and reproductive neuroendocrinology, such as oxytocin (Sabatier and Leng, 2006) and gonadotropin releasing hormone (Gammon et al., 2005). Thus, cannabinoids may exert their effects on sexual activity through direct effects within the hypothalamus on the network of peptidergic neurons which regulate the physiological and endocrinological underpinnings of sexual activity. The possible involvement of these systems will be discussed at greater length in this review with respect to documented changes in sexual activity and reproductive neuroendocrinology.

Several years after the discovery of the CB1 receptor, evidence for a second cannabinoid receptor, CB_2, materialized when the receptor was successfully cloned from a promyelocytic cell line by Munro and colleagues (1993). CB_1 and CB_2 receptors are among the most abundant G protein-coupled receptors (GPCRs) and mainly couple to inhibitory G_i and G_o proteins (reviewed in Mackie, 2008). Despite these similarities, the two receptors diverge in important ways. Specifically, compared to CB_1, the CB_2 receptor has a more limited distribution and is primarily located in peripheral tissue, such as thymus, spleen, and immune cells (Munro et al., 1993). Although both utilize similar signal transduction pathways, their differential localization suggests that they regulate separate physiological functions.

Endogenous cannabinoid receptor ligands

The presence of endogenous receptors for THC suggested the existence of an endogenous substance that naturally binds to these receptors. The search for the first endocannabinoid ended in the 1990's when it was discovered and named “anandamide” (AEA), after the Sanskrit word, *ananda*, for bliss (Devane et al., 1992). A second endocannabinoid, 2-arachidonoylglycerol (2-AG) was found shortly after (Sugiura et al., 1995). Several other ligands have been posited as potential endocannabinoids, such as *N*-dihomo-γ-linolenoylethanolamine, *N*-docosatetraenoylethanolamine, *O*-arachidonoylethanolamine (virodhamine), oleamide, *N*-arachidonoyl dopamine and *N*-oleoyl dopamine (reviewed in Pertwee, 2005). However, the full characterization of these ligands as endocannabinoids is still not conclusive and thus, in this review, only AEA and 2-AG will be discussed as endocannabinoids.

The synthesis, transport, and metabolism of endocannabinoids are highly regulated processes (for review see Bisogno, 2008 and Ahn, et al., 2008). The synthesis of endocannabinoids is ‘on demand' following post-synaptic depolarization, increases of intracellular calcium and/or activation of various phospholipase enzymes. This is a unique synthesis process given that neuromodulators are normally produced in advance and stored in vesicles (reviewed in Mackie, 2008; Pertwee, 2008).

Furthermore, following their synthesis, AEA and 2-AG do not behave like classical neurotransmitters. They are believed to be discharged into the synapse by the post-synaptic cell to activate cannabinoid receptors on the axon terminals of the pre-synapse and inhibit neurotransmitter release. Upon receptor activation, endocannabinoids are removed by cellular uptake, possibly through the actions of a specific transporter. They are then metabolized by intracellular enzymes. Anandamide is mainly metabolized by fatty acid amide hydrolase (FAAH) and to a lesser extent by cyclooxygenase-2, lipoxygenases and cytochrome P450 (reviewed in Pertwee, 2008). 2-AG is metabolized primarily by monoacylglycerol lipase (MAGL), but also by FAAH (Dinh et al., 2002).

In addition to activating CB_1 and CB_2 receptors, endocannabinoids can also interact with other GPCRs and ion channels. They can interact with several types of potassium channels, serotonergic 5-HT_3 receptors, alpha7 nicotinic receptors and vanilloid receptor-type 1 (TRPV1) channels (Oz, 2006).

Collectively, endocannabinoids, the enzymes involved in their synthesis and metabolism, along with the cannabinoid receptors are known as the endocannabinoid system. Since the effects of cannabis are mediated via the activation of cannabinoid receptors, findings on the relationship between cannabis and sexuality can shed light on the relationship between endocannabinoids and sexuality, and vice versa. In this review, we will consider evidence involving both cannabinoids and endocannabinoids and their impact on sexual functioning and behavior in an array of species ranging from rodents to humans.

Human sexuality and cannabinoids

Women

Sexual functioning

So far, there are only a handful of scientific studies that have investigated the effects of cannabis on women's sexual behavior and they have exclusively used self-report data. Despite this shortcoming, these studies show a fairly consistent trend of beneficial effects of cannabis use on female sexual functioning. In a survey conducted by the National Commission on Marihuana and Drugs (1972), women were found to be more likely than men to report an increase in sexual desire following cannabis use. An ensuing survey conducted by Kolodny et al. (1979) which included 500 female participants found that cannabis consumption led to increased sensitivity to touch and relaxation, and as a result, sexual responsiveness, while having no concurrent effect on vaginal lubrication, orgasm frequency, or orgasm intensity. Furthermore, in contrast to data from the National Commission on Marijuana and Drugs, this study did not find increased desire in conjunction with cannabis use. A study by Koff (1974) of 345 undergraduate students seemed to reconcile these discrepant findings on sexual desire, as it found a dose-dependent effect of cannabis intake. Specifically, 71% of female participants reported increased sexual motivation after smoking one cannabis joint, but reported

decreases after larger consumption. Moreover, 43% of female participants recounted heightened sexual pleasure after cannabis intake. This positive impact of cannabis on sexual pleasure was replicated in a later interview-based study carried out by Halikas et al. (1982). In this study, 90% of women reported that cannabis use amplified sexual pleasure and satisfaction to various extents. Likewise, 40% of women also reported that cannabis improved to some degree the quality of their orgasm. One recent study that did report a negative effect of cannabis use on female sexual functioning found that it was associated with painful sex and inhibited orgasm, even after participants' sociodemographics and psychiatric diagnoses were controlled for (Johnson et al., 2004).

Nonetheless, this collection of surveys, although limited by the subjective nature of their method of data collection, overall converges on the positive effect of moderate cannabis consumption on female sexuality in two areas: sexual desire and sexual functioning, the latter including sexual satisfaction, pleasure and orgasmic quality.

Men

Sexual functioning

Unlike the studies on cannabis use and female sexuality, there is far less consistency in regards to research on cannabis use and male sexuality. With respect to positive outcomes, Tart (1970) noted that cannabis use intensified sexual arousal, increased sexual thoughts, and prolonged sexual performance. Furthermore, in an interview study conducted with 800 males between the ages of 18 and 30, Kolodny and colleagues (1979) found that 83% of men reported that cannabis consumption enhanced sexual pleasure. To follow up on this finding, Halikas and colleagues (1982) also surveyed male cannabis users. In this sample, 75% reported cannabis consumption enhanced sexual pleasure and satisfaction, 68% reported that it elevated the quality of their orgasm, and 39% reported that the duration of sexual intercourse was extended. Weller and Halikas (1978) in a later survey replicated similar results with 70% of users reporting increased sexual pleasure and satisfaction, 58% reporting enhanced orgasmic equality, and 27% reporting prolonged sexual intercourse. As these are self-report data, they are subject to multiple potential interpretations.

While these findings seem to depict cannabis as an aid to male sexuality, results on the effect of cannabis on erectile functioning are not nearly as positive. Anecdotal evidence suggesting a positive correlation between erectile dysfunction and cannabis use emerged early and from diverse locations, including North America, North Africa, and India (Chopra and Chopra, 1957; Scher, 1970). For example, Kolodny et al. (1974) noted that of the two men with erectile dysfunction in their study, one regained erectile functioning after terminating his cannabis use. Furthermore, when Cohen (1982) compared the prevalence of erectile dysfunction between daily cannabis users and a control group of men, a sizeable difference emerged, 19% and 8%, respectively. A recent study, using veno-occlusive plethysmography, documented a relationship between cannabis use and vascular erectile dysfunction in young men, which is marked by the presence of early endothelial dysfunction. This suggests that chronic cannabis use may cause early endothelial damage (Aversa et al., 2008), one possible pathway linking cannabis consumption to erectile dysfunction.

The effects of cannabis use on male sexuality appear to be dose-dependent. Abel (1981) noted this in his review published a quarter of a century ago. He concluded that a small amount of cannabis can enhance sexual activity, but larger quantities may inhibit sexual motivation. Koff (1974) provided additional evidence for this dose effect. Respondents in Koff's (1974) survey reported that one joint was more effective than two or more in increasing sexual desire and pleasure. A large sample of Indian men who were chronic cannabis users reported similar dose effects (Chopra and Jandu, 1976). Koff (1974) suggested that the noxious effect of large cannabis doses arises through a general depression of behavior rather than sex-specific effects.

Collectively, studies on male sexuality and cannabis use appear to document that cannabis intake facilitates sexual desire while simultaneously hindering erectile functioning. This is in contrast with the current literature on female sexuality and cannabis use which suggests cannabis use has positive effects on both sexual desire and functioning. These two bodies of research do share one similar finding: the effect of cannabis on both female and male sexual desire may only be positive in a moderate amount, above which the influence becomes detrimental.

Although the actual direct and indirect effects of marijuana on male and female sexual functioning are not fully understood, many speculations have been put forth in explaining the cannabinoid effects on human sexual functioning. Several researchers (e.g., Halikas et al., 1982) have proposed that cannabis exerts its positive effect on sexual functioning by increasing tactile sensitivity. However, this explanation seems unlikely, as marijuana has been reported to produce either a negative or no effect on touch sensitivity in nonsexual situations (Reese, 1977). Another possible means through which cannabis achieves its facilitatory effects may be the slowing of temporal perception, which causes enjoyable activities, such as sexual intercourse, to appear to last longer (Jarvik and Brecher, 1977; Melges et al., 1971). This perceptual manipulation may occur along with increased concentration on the present, which may also enhance the sexual experience (Melges et al., 1971). Such cannabis-induced experiential changes are also believed to promote sensate focus, bringing forth an erotic experience of the entire body, rather than specific erogenous zones (Gawin, 1978). Accordingly, some individuals reported that cannabis intake allowed them to expand their sensuality beyond the genital to the entire body during sexual intercourse, thereby enhancing their sexual pleasure (Lewis, 1970).

Other researchers believe that the positive effects of cannabis are independent of its psychoactive properties but may be merely a placebo effect, given cannabis' reputation of being an aphrodisiac. Indeed, there is evidence to suggest that the sexual experiences of cannabis users may be influenced by their expectations of the drug (Crenshaw and Goldberg, 1996). Alternatively, it is also possible that cannabis is eliciting its effects by directly stimulating regions of the brain that control sexual activity (Weller and Halikas, 1978). A more popular posited mechanism behind cannabis' influence on sexual functioning is disinhibition and relaxation (Kolodny et al., 1979, Dawley et al., 1979; McKay, 2005). This is believed to allow more focus and attention to be directed towards sexual pleasure, rendering the experience more enjoyable. Related to this explanation, Kolansky and Moore (1972) reported that cannabis consumption led to a period of sexual disinhibition in some women.

Furthermore, given the convincing body of research demonstrating a link between sexual arousal and androgens in women (e.g., reviewed in Motofei and Rowland, 2005), as well as evidence revealing an enhancement of sexual desire following androgen administration (e.g., van Anders et al., 2005), a possible mechanism behind cannabis and elevated female sexual functioning may be increased androgen levels. For example, it is possible that androstenedione, the major androgen produced by the adrenal cortex, is secreted in greater quantities following cannabis use. Previous studies found that THC increased the levels of adrenocorticotropic hormone (ACTH) as well as the adrenal steroid corticosterone in rats (Jackson and Murphy, 1997; Manzanares et al., 1999) and cortisol in humans (D'Souza et al., 2004). Together, these findings point to the strong possibility that adrenal androgens may also be boosted by THC. Existing data on testosterone levels and cannabis consumption in women are conflicting. Earlier studies reported that women who use cannabis frequently and for extended periods of time had significantly higher levels of plasma testosterone (Kolodny et al., 1977, 1979) and higher scores on specific measures of sexual activity,

such as orgasmic frequency, compared to age-matched women who had never consumed cannabis (Kolodny et al., 1977). However, a more recent study using a cross-sectional design found no difference in testosterone levels between habitual marijuana users and non-users (Block et al., 1991). It remains to be determined whether dose and temporal parameters account for the conflicting data.

There is currently insufficient evidence to characterize the relative strength of the various explanations of marijuana's influence on sexual functioning. It is possible and indeed likely that several of these mechanisms may be possible in different cannabis users or in the same individual at different times. The specific effects of cannabis use in a given person can also be influenced by the user's immediate environment, expectations, personality type, age and relationship status (Tart, 1970; Crenshaw and Goldberg, 1996). The possibility that different mechanisms are at work behind the effect of cannabis and that the effect of cannabis depends on the user's various characteristics may account for the diversity of individual differences in reported marijuana responsiveness.

Testosterone

Ho and colleagues (1970) found that radiolabeled THC accumulated in the testes of rats, suggesting that cannabinoids may affect reproductive processes. This led to a flurry of investigations on the effect of cannabis intake on testosterone levels, conducted utilizing either acute or chronic cannabinoid administration. Acute studies involved measuring participant testosterone level before and after their single cannabinoid intake. Chronic studies either compared the testosterone values of participants with different levels of personal cannabis usage or subjected participants to an extended period of cannabis administration after which their testosterone quantities were compared with their baseline levels. It is important to note that results from chronic studies involving heavy cannabis users are likely to be confounded by other types of recreational drug use. Both chronic and acute studies are summarized below in a chronological fashion.

Kolodny and colleagues (1974) first followed up on the findings from Ho and colleagues (1970) using human participants and found that chronic consumption of cannabis significantly lowered plasma testosterone levels. Moreover, when Kolodny and colleagues (1974) separated the cannabis users by intake concentration, the testosterone reduction was found to be significantly greater in heavy users (more than 10 cannabis joints per week) than moderate users (5–9 joints per week).

This discovery quickly triggered a series of subsequent studies. First, Mendelson and colleagues (1974) decided to study this effect with a different research design. They utilized a within-subjects design instead of the between-subjects design used by Kolodny and colleagues (1974). Mendelson and colleagues (1974) first subjected 27 cannabis users to a 5-day cessation period to obtain a baseline. Subsequently, his group recorded the participants' daily plasma testosterone levels during a 21-day period of cannabis use and an ensuing 4-day cessation period. Employing this design, they found no significant differences in plasma testosterone level between heavy and casual users or at any period of the study. However, they did note a trend of lower testosterone levels in heavy users. Nonetheless, all subjects, including the heavy users, exhibited plasma testosterone quantities that were well within the normal range.

Motivated by these conflicting results, Schaefer and colleagues (1975) performed another within-subject study. They recruited 12 casual cannabis users and led them through a 1-day washout, followed by placebo and either10 mg or 20 mg THC cannabis joints in the subsequent three days. On the fifth day, each participant received a 20 mg THC joint and after 90 min of smoking, plasma was collected. Although testosterone values for all the participants were found to be within the normal range and, in fact, on the high end, the researchers did find a small (8%) but significant reduction in testosterone levels 90 min following the intake of the 20 mg THC joint (Schaefer et al., 1975).

Cushman (1975) decided to use a between-subject design similar to the initial Kolodny and colleagues (1974) study, but like the previous within-subject studies, no differences were observed between cannabis smokers and nonsmokers. In Cushman's (1975) study, the male student participants who smoked an average of five cannabis joints per week, thus comparable to the moderate users in the Kolodny and colleagues (1974) study, had similar plasma testosterone values as the non-smoking controls. Again, all testosterone levels were within the normal range.

One study that may explain the discrepant findings was conducted by Kolodny and colleagues (1976). Kolodny's group measured plasma testosterone levels at 15, 30, 60, 120 and 180 min after acute cannabis exposure and compared these values to those obtained in the same individuals during a nonsmoking period. They discovered a significant plasma testosterone reduction at 30 min that continued to the 180-min time point and concluded that cannabis use may temporarily decrease testosterone production. This seems to suggest that the absence of a testosterone decline in some studies may be the consequence of an insufficient or excessive temporal lag between the last exposure to cannabis and testosterone measurement.

Taking into account the findings of Kolodny and colleagues (1976), Wall and colleagues (1978) measured plasma testosterone in eight casual cannabis users at numerous time points for 6 h following their single bolus infusion of either 10 mg THC or placebo. They observed a depression of plasma testosterone from 3.5 h to 6 h post-infusion, which seemed to resonate with findings of Kolodny and colleagues (1976). The ephemeral nature of testosterone reduction after cannabis intake was further buttressed by Cohen's (1976) study where testosterone levels were found to decrease 2–3 h after cannabis consumption. Also, Cohen (1976) documented that testosterone levels progressively dropped to 60% of baseline values after 4 weeks of cannabis smoking and returned to 84% of baseline after a 1-week cessation period, highlighting the reversible nature of the inhibitory effect of cannabis consumption on testosterone levels. Collectively, these three studies demonstrate that cannabis use does temporarily reduce testosterone levels, notwithstanding other evidence of non-significant effects.

This general consensus was challenged by a later study performed by Mendelson's group, using similar methods to their previous investigation with the important addition of an hourly measurement of plasma testosterone over a 24-h period on the last day of baseline, the twenty-first day of cannabis use and the third day of cessation. Mendelson and colleagues (1978) found, for the second time, no correlation between cannabis use and plasma testosterone fluctuations. All subjects, surprisingly, also possessed plasma testosterone levels in the higher range of normalcy. One likely explanation for this finding is that 21 days of cannabis intake is inadequate for producing a robust inhibition.

Kolodny and colleagues (1975) responded with a follow-up study, employing a similar within-subjects design to Mendelson and colleagues (1978) that entailed daily marijuana consumption of standardized potency for 8 weeks. Significant declines in testosterone levels were observed only after 5 weeks and an even greater decline was observed in subsequent weeks.

Nevertheless, two later studies did not detect an effect of cannabis use on plasma testosterone values with either acute (Cone et al., 1986) or chronic consumption (Block et al., 1991). The acute consumption study did demonstrate, however, that intake of cannabis in the form of one or two joints did produce a nonsignificant trend towards a decrease in testosterone levels (Cone et al., 1986).

Despite the lack of coherence among findings on the effect of cannabis on testosterone levels, there is one consistent finding. Specifically, all studies that have documented a statistically significant testosterone decrease after cannabis consumption have also

found that the measured testosterone levels in these users are still within the normal range, suggesting that this effect is not likely of behavioral significance.

Animal models of sexuality, cannabinoids and endocannabinoids

Females

Sexual functioning

Unlike the research on the effects of cannabinoids in women, findings in females of other species are conflicting. The first controlled study on cannabinoids and female sexual behavior in rats was conducted by Gordon and colleagues (1978) prior to the discovery of the endocannabinoid system. Gordon and colleagues (1978) demonstrated that THC failed to elicit sexual receptivity in the absence of ovarian hormones and in estrogen-treated rats, THC did not mimic progesterone. These findings indicated that THC was not exerting its influence on rodent sexual behavior by acting like an estrogen or progesterone-like substance, both of which are not critical to the endocrine mediation of human sexual behavior.

With regards to THC and sexual behavior, Gordon and colleagues (1978) found a biphasic effect: a low dose of THC facilitated lordosis and a high dose interfered with sexual receptivity in estradiol-primed female rats. This dose-dependent effect echoes the findings on women's sexuality and cannabinoids, where low levels of cannabis consumption were found to be facilitatory while heavy intake was detrimental (Koff, 1974). Furthermore, when the adrenal steroids in the female rats were removed via adrenalectomy, the facilitatory effect of THC persisted, indicating that THC was acting centrally rather than behaving like an ovarian steroid or enhancing those adrenal secretions which tend to facilitate lordosis.

Another early study also found positive effects of THC on rodent sexual behavior. Turley and Floody (1981) chose to investigate not only sexual receptivity but also proceptivity, the active sexual solicitation of a male, since this may be more relevant to women's sexual behavior. By measuring ultrasonic vocalizations and observing lordosis in estradiol-primed female hamsters, these researchers concluded that THC stimulated both sexual receptivity and proceptivity. Moreover, Turley and Floody (1981) also came to the same conclusion as Gordon and colleagues (1978), i.e. that the effects of THC were centrally instead of hormonally mediated.

A more recent study by Mani and colleagues (2001) revived the discussion of cannabinoid mediation of behavioral estrus. This research group examined in detail the mechanisms underlying the influence of cannabinoids on sexual behavior. In the first of a series of experiments, they found that intracerebroventricular administration of THC enhanced lordosis in estrogen-treated female rats to levels comparable to female rats primed with both estrogen and progesterone. Moreover, Mani and colleagues (2001) observed that the enhancing effect of THC was attenuated by blocking both progesterone receptors and dopamine $D_{1/5}$ receptors. Pharmacologically antagonizing the CB_1 receptor blocked both dopamine- and progesterone-induced sexual facilitation. These results suggest that CB_1 receptors, and not CB_2 receptors, are involved in a cross-talk circuit with dopamine and progesterone which regulates female rodents' sexual behavior. Evidence that the CB_1 receptor is found within the ventromedial hypothalamus and the medial basal hypothalamus further buttress this hypothesis as both brain regions express progesterone and dopamine receptors and are critical for sexual behavior regulation in the female rat.

Altogether these studies indicate that cannabinoids may serve as a proxy for progesterone and facilitate sexual receptivity and proceptivity in female rats. Nonetheless, two more recent studies document opposing results. Ferrari and colleagues (2000) found that a powerful cannabinoid agonist, HU210, decreased both lordosis and proceptive behaviors in estrous female rats. In a more recent study, Lopez and colleagues (2009), in addition to recording lordosis and proceptive displays, utilized a runway methodology that they deemed to be more representative of women's sexual desire. Using this methodology, Lopez and colleagues (2009) reported that the administration of AM251, a CB_1 antagonist/inverse agonist significantly stimulated sexual motivation in receptive female rats primed with both estradiol and progesterone. The same antagonist/inverse agonist also elevated lordosis and proceptivity in females given low doses of estradiol. These results are in stark contrast to those of Mani and colleagues (2001), who found that the cannabinoid antagonist, SR141716A, diminished receptivity. This discrepancy may partially be the result of several methodological differences. First, the rats in the study of Mani and colleagues (2001) were administered 2 μg of estradiol benzoate and 2 μg of progesterone (intracerebroventricularly, 30 min prior to testing), whereas those in the study of Lopez and colleagues (2009) were administered higher doses of estradiol benzoate and progesterone systemically. Perhaps more importantly, Lopez's team delivered the cannabinoid antagonist AM251 in their study whereas Mani and colleagues (2001) administered SR141716A. This is an especially notable methodological difference given that some physiological effects have been shown to be elicited by SR141716A and not AM251, such as the blocking of negative ionotropic responses to anandamide (Ford et al., 2002). Finally, Lopez and colleagues (2009) chose to assess female receptivity by using a paced mating paradigm, while Mani and colleagues (2001) utilized a non-paced mating procedure and ended their tests after the male had mounted the female ten times.

The current state of findings on the effects of cannabinoids on non-human female sexual functioning is far from reaching consensus. Previous results widely fluctuated and demonstrated both deleterious and beneficial effects of THC. Future studies in this area are certainly needed to produce a more coherent picture. Prospective studies may need to pay especially close attention to its methodological details as past conflicting results may be partially attributable to methodological differences, such as the specific antagonist used.

Gonadotropins

Studies across nonhuman species suggest that cannabinoids suppress gonadotropin release through hypothalamic blockade of gonadotropin releasing hormone (GnRH). Treatment with THC produces a reduction in LH levels in rats (Marks, 1973; Tyrey, 1978), mice (Dalterio et al., 1983), and monkeys (Smith et al., 1979). In rhesus monkeys the effect lasted up to 12 h, but could be reversed by the administration of GnRH (Smith et al., 1979). Therefore endocannabinoids may act at the hypothalamus to suppress GnRH secretion. Murphy and colleagues (1990) found that cannabinoids did not block basal GnRH secretion from hypothalami *in vitro*. This suggests that cannabinoids suppress GnRH secretion by modulating the activity of neurotransmitters involved in regulating GnRH secretion.

As a result of its effect on GnRH levels, THC has disruptive effects on cyclicity. In rats, THC was shown to block ovulation and the LH surge (Nir et al., 1973) and decrease progesterone levels during the luteal phase (Kostellow et al., 1980). In rhesus monkeys, THC administration in the follicular phase blocked ovulation and decreased levels of estrogens and gonadotropins, but co-administration of exogenous gonadotropins preserved ovulation (Asch et al., 1981). This supports the hypothesis that cannabinoids are acting at the hypothalamus to suppress GnRH. Sassenrath and Chapman (1975) found that monkeys treated with THC for 1 year had normal menstrual cycles, suggesting tolerance can develop to the disruptive effects of THC on menstruation.

Males

Sexual functioning

While some human studies have described aphrodisiac-like properties of marijuana, animal studies have typically reported inhibitory effects of cannabinoids on male sexual behavior. This discrepancy may arise because most of the human data is based on subjective self-reports rather than objective measures. Alternatively, inhibition of male sexual behavior in other species may be the result of the relatively high drug doses commonly administered to nonhuman subjects. Consistent with the dosage hypothesis, Martinez-Gonzalez and colleagues (2004) gave male rats high and low dose intraperitoneal injections of the endocannabinoid, AEA, and found that the high dose of AEA increased mount, intromission, and ejaculation latencies, but the relatively low dose of AEA had the opposite effect, slightly increasing ejaculation frequency. Although there is currently no evidence for exogenous cannabinoids facilitating male sexual behavior in nonhuman species, this study suggests that the endocannabinoid system may have both facilitatory and inhibitory functions in regulating sexual behavior.

In an early study of the effects of cannabis on sexual behavior, Merari and colleagues (1973) monitored male rats presented with receptive females and found that an intraperitoneal injection of THC interfered with copulatory behavior, increasing latency to first mount, latency to ejaculation, and latency to mount following ejaculation. This study used THC doses of 2 and 3 mg/kg. A dose as low as 0.5 mg/kg was shown to inhibit the sexual behavior of male rats, with a significant reduction in mounting and ejaculation frequency compared to vehicle-treated animals (Uyeno, 1976). Cannabinoids have also been shown to decrease the sexual behavior of mice (Cutler and Mackintosh, 1984). Male mice receiving a high dose of THC or CBN 3 times a week for 3 or 7 weeks exhibited impaired sexual motivation, with treated males taking longer to initiate sexual intercourse with receptive females (Dalterio, 1979). Although high doses of THC also suppress motor activity in mice, Frischknecht and colleagues (1982) found that repeated exposure induced tolerance to motor impairment, but not sexual impairment. This suggests that the cannabinoid-induced reduction in male sexual behavior was a result of reduced motivation for sex rather than a nonspecific effect of impaired motor function. In rats, Dhawan and Sharma (2003) showed that a high dose of THC (10 mg/kg) impaired sexual motivation and no tolerance developed following repeated administration. Thus, unlike many of the behavioral effects of cannabis, tolerance does not develop to the inhibitory effects of exogenous cannabinoids on male sexual behavior.

Studies utilizing cannabinoid receptor agonists and antagonists support an inhibitory role for cannabinoids in male sexual behavior. Ferrari and colleagues (2000) found that treatment with the potent CB1 receptor agonist, HU-210, led to a dose-dependent reduction in male rat copulation at doses that did not affect motor function. Furthermore, chronic treatment with HU-210 impaired sexual behavior at doses that had no effect when administered acutely. In line with this, Gorzalka et al., (2008b) found that administration of the CB1 receptor antagonist, AM251, led to a dose-dependent facilitation of ejaculation in male rats. Male rats given a single intraperitoneal injection of AM251 required less time and fewer intromissions to achieve ejaculation. Utilizing both agonists and antagonists, these data suggest that the endocannabinoid system negatively regulates male sexual behavior at a range of doses.

The mechanism through which cannabinoids impair male rat, mouse, or human motivation for copulation has yet to be determined. There is evidence that cannabis can decrease testosterone levels in men (Kolodny et al., 1974), but this is likely not mediating the cannabinoid-induced decreases in sexual response, as Shrenker and Bartke (1985) found that THC still led to deficits of copulation in testosterone-treated castrated mice. It is known that male rats exposed to sexually receptive females exhibit a rapid increase in noradrenergic activity in the medial basal hypothalamus and median eminence, as well as in dopaminergic activity in the medial basal hypothalamus. Murphy and colleagues (1994) showed that oral administration of THC blocked both of these responses. This suggests that reductions in hypothalamic noradrenergic and dopaminergic levels may mediate the inhibitory effects of cannabinoids on male sexual behavior, but further research is needed before solid conclusions can be drawn.

The presence of the endocannabinoid system in stress-responsive neural circuits suggests that it may play a critical role in regulating neuroendocrine and behavioral responses to stress (Gorzalka et al., 2008a). There is mounting evidence that the endocannabinoid system is involved in the stress-induced suppression of sexual behavior. Perhaps cannabinoid effects on sexual behavior and reward arise from activation of the stress system, which subsequently interferes with sexual motivation, performance, and/or arousal. Although researchers have found ways to deal with the motor-inhibitory effects of cannabinoids, it is much more difficult, but may be equally important to control for the effects of cannabinoids on anxiety and stress. Coddington and colleagues (2007) showed that blockade of the CB1 receptor blocked stress-induced suppression of male sexual behavior in *Taricha granulose*, a rough-skinned newt. Normally, exposure to acute stress or injection of corticosterone suppresses courtship clasping behaviors of male *Taricha*, but administration of the CB1 receptor antagonist, AM281, was shown to block this suppression by blocking the inhibition of spontaneous neuronal activity and sensory responsiveness in the neural circuit for clasping. In rats, chronic stress or chronic treatment with corticosterone inhibits male sexual behavior, an effect likely mediated by increased serotonergic 5-HT2A receptor activity (Gorzalka et al., 1990, 1998, 2001). Hill and colleagues (2006) showed that chronic treatment with the CB1 receptor agonist, HU-210, increased 5-HT2A receptor activity. This suggests that stress and subsequent corticosterone release leads to activation of endocannabinoid signaling, which results in increased 5-HT2A receptor activity and a suppression of male sexual activity. Involvement of 5-HT receptors may explain some of the sex differences in the effects of THC on sexual functioning, as activation of 5-HT receptor subtypes has been shown to have differential effects on the sexual behavior of male and female rats.

There are considerable data on the role of the endocannabinoid system in the inhibition of penile erections. It is well established that a group of oxytocinergic neurons in the paraventricular nucleus of the hypothalamus (PVN) regulate erectile function and copulatory behavior of males (Argiolas and Melis, 1995, 2004, 2005; Giuliano and Rampin, 2000; McKenna, 2000; Andersson, 2001; Melis and Argiolas, 2003). CB1 receptors are known to be expressed here (Herkenham et al., 1991) and Melis and colleagues (2004) demonstrated that erections could be induced in male rats by injecting the cannabinoid CB1 receptor antagonist, SR 141716A, into the PVN. Although PVN injection of CB1 receptor agonists, WIN 55,212-2 or CP 55,940, had no effect on erection, they were capable of reducing the erection-inducing effect of SR 141716A. Recently, Castelli and colleagues (2007) demonstrated that chronic intraperitoneal injection of SR 141716A actually increased the density of CB1 receptors in the PVN and that this increase correlated with an increase in the pro-erectile effect of SR 141716A injected into the PVN. Blockade of CB1 in the PVN is thought to increase penile erection by decreasing GABA release (Castelli, et al., 2007). This would increase glutamatergic neurotransmission in the PVN, signaling the oxytocinergic neurons to produce more nitric oxide (NO) via NO synthase. Increased NO would facilitate the release of oxytocin, which leads to penile erection. Consistent with this hypothesis, intra-cerebral microdialysis revealed that the pro-erectile effect of SR 141716A in the PVN occurred concomitantly with an increase in the concentration of glutamic acid, NO^{2-} and NO^{3-} in the paraventricular dialysate (Succu et al., 2006; Melis et al., 2006) and PVN injection of the glutamate receptor

antagonist, MK-801, or the NO synthase inhibitor, L-NAME, reduced the erection-inducing effect of SR 141716A. Furthermore, injection of the oxytocin receptor antagonist, $d(CH_2)_5Tyr(Me)^2$-Orn^8-vasotocin, into the lateral ventricles almost completely eliminated SR 141716A-induced penile erections (Melis et al., 2004). In summary, CB1 receptors appear to influence erectile function and sexual activity centrally by modulating paraventricular oxytocinergic neurons. There is also emerging evidence for peripheral effects of cannabinoids on penile erection.

Relaxation of cavernous smooth muscle in the corpus cavernosum is critical for inducing and maintaining penile erections. CB1 receptors have been shown to be expressed in the corpus cavernosum of the rat (Ghasemi et al., 2006) and CB1 and CB2 receptors have been shown to be expressed in the corpus cavernosum of rhesus monkeys and humans (Gratzke et al., 2009). *In vitro* studies utilizing rat and rabbit preparations reveal that relaxation of corpus cavernosum tissue is enhanced in the presence of the endocannabinoid AEA (Ghasemi et al., 2006; Vural et al., 2009). In rat tissue, CB1 and not CB2 receptor antagonists inhibited relaxation (Ghasemi et al., 2006), but in rabbits both CB1 and CB2 receptor antagonists inhibited relaxation (Vural et al., 2009). In tissue isolated from rhesus monkeys, AEA actually had the opposite effect—antagonizing relaxations of the corpus cavernosum (Gratzke et al., 2009). These *in vitro* studies suggest a peripheral role for cannabinoid signalling in sexual behavior, but highlight potential species differences in the functioning of the endocannabinoid system.

The majority of animal evidence points to an inhibitory role for the endocannabinoid system in the regulation of male sexual behavior. The aphrodisiac-like properties of cannabis described by some users is likely the result of altered perceptual processing of the sexual encounter. This effect is not readily measurable in animal models, but the role of the endocannabinoid system in physiological processes involved in the sexual response, such as erection and ejaculation, is a prospect for drug development for sexual dysfunctions.

Testosterone

Unlike human data, data from other species reveal a reduction in testosterone following cannabis exposure. In the first such study, Dalterio and colleagues (1977a) demonstrated *in vitro* that application of an exogenous cannabinoid, THC or CBN, led to a dose-dependent suppression of gonadotropin-stimulated testicular production of testosterone in tissue from mature and immature mice. Burstein and colleagues (1979) showed that THC did not interfere with the binding of gonadotropins to their receptors in the testes, but affected testosterone biosynthesis by inhibiting cholesterol esterase. Cholesterol is the precursor to all steroids and as one might expect, THC was also shown to inhibit the production of progesterone in mouse testis (Dalterio et al., 1977b). In a rat preparation, administration of CBN, CBD, and THC were all shown to inhibit testosterone production in Leydig cells, but CBN and CBD were more potent inhibitors than THC (Jakubovic et al., 1979). In addition to reducing testosterone biosynthesis, cannabinoids have also been shown to accelerate its hydroxylation by liver microsomes (List et al., 1977). These studies suggest that cannabinoids act peripherally to decrease testosterone levels by inhibiting its biosynthesis and accelerating its metabolism. Furthermore, there is evidence that cannabinoids can inhibit testosterone activity by impairing androgen binding to receptors (Dixit and Lohiya, 1975; Ghosh et al., 1981; Purohit et al., 1980).

Evidence from early *in vivo* studies suggested that THC also acts centrally to affect testosterone levels. Acute or chronic treatment of THC in male rats not only resulted in reduced levels of testosterone, but also reduced levels of luteinizing hormone (Symons et al., 1976; Kumar and Chen, 1983). More recently, Wenger and colleagues (2001) showed that AEA suppressed LH and testosterone levels in wild-type, but not CB1 knockout mice, providing evidence that the endocannabinoid system acts to suppress testosterone levels. Cannabinoid-induced reductions in testosterone are also observed in non-human primates. Rosencrantz and Esber (1980) observed reduced serum testosterone in male monkeys following either inhalation of cannabis smoke or oral ingestion of THC. Following THC injections in rhesus monkeys, Smith and colleagues (1976) observed a 65% reduction in testosterone levels that returned to baseline in only 3-days. Fujimoto and colleagues (1982) found that chronic oral administration of either THC or a crude marijuana extract (CME) to rats for 71–78 days resulted in reduced serum testosterone levels for 2–6 h after drug cessation, but this effect was gone 24 h later. Inconsistencies in the human data on testosterone and cannabis likely arise because of the relatively short time-course of the effect.

Conclusions and future directions

Findings on the effects of cannabinoids on sexuality have been accumulating for more than three decades and many aspects of this relationship have been clarified by the discovery of endocannabinoids and their receptors. In terms of women's sexual function, cannabis use has generally been reported to facilitate various aspects of sexual functioning, such as arousal and desire. Furthermore, this influence may be dose-dependent, as there is evidence suggesting that cannabis is beneficial to sexual functioning only at low doses, beyond which it can become debilitating. A similar dose-dependent relationship has also been found in the literature on cannabis consumption and male functioning. Moreover, there appears to be more conflict among the results in this research area as men report both facilitatory and incapacitating effects of their cannabis use, ranging from accounts of increased sexual desire to erectile dysfunction. Results on the influence of cannabis intake on testosterone levels in men are also mixed, revealing either a statistically significant decrease or no change in testosterone levels after cannabis consumption. A likely explanation for this inconsistency is that the reduction in testosterone levels from cannabis use is transient and too fleeting to be detected in studies that have a long temporal lag between cannabis intake and testosterone measurement. Overall, these studies do converge on one conclusion: if cannabis intake does lower testosterone levels, the magnitude of its influence is not likely to be of behavioral significance, as documented testosterone decreases still fall within the normal range in all studies to date.

Given the inherent flaws of self-report data, studies using model organisms are an important complement to findings on humans. Data using non-human species suggest that cannabinoids affect sexual behavior by acting centrally, specifically in the hypothalamus. In the area of female sexuality and THC, rodent studies have revealed both detrimental and beneficial effects on sexual receptivity and proceptivity. On the other hand, the majority of findings on male sexuality have found an inhibitory effect on sexual motivation and erectile functioning. Animal studies are also fairly consistent in reporting reductions in hormonal levels as a result of THC administration. Moreover, parallel to the human data, the THC-induced testosterone decrease was also observed to be temporary in model organisms.

Collectively, the current body of research on cannabinoids and sexual functioning has resulted in a clearer picture of their relationship. At the same time, it also points out what is missing from this picture. To date, objective measurement of the effects of cannabis on human sexual functioning has not been reported. In view of this, our laboratory is currently using the vaginal photoplethysmograph to examine empirically the relationship between marijuana use and sexual arousal, as well as the relationship between endocannabinoid levels and sexual functioning in women. Our techniques are described in Brotto and colleagues (2009).

There is practical value in understanding the endocannabinoid system's role in the sexual psychophysiology of men and women. This knowledge can lead to further advances in developing drugs for

treating sexual dysfunctions, such as arousal and desire disorders. It is also crucial for recognizing potential sexual side-effects of pharmaceutical agents that induce their effects by facilitating or antagonizing the endocannabinoid system. Given that such drugs are already being developed for treating various nonsexual disorders, insight into the endocannabinoid system is imperative.

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ORIGINAL RESEARCH—SEXUAL DYSFUNCTION

Cannabis Use and Sexual Health

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ABSTRACT

Introduction. Cannabis is the most commonly used illicit substance worldwide. Despite this, its impact on sexual health is largely unknown.

Aim. The aim of this article is to examine the association between cannabis use and a range of sexual health outcomes.

Main Outcome Measures. The main outcome measures include the number of sexual partners in the past year, condom use at most recent vaginal or anal intercourse, diagnosis with a sexually transmissible infection in the previous year, and the occurrence of sexual problems.

Methods. Method used in this article includes a computer-assisted telephone survey of 8,656 Australians aged 16–64 years resident in Australian households with a fixed telephone line.

Results. Of the 8,650 who answered the questions about cannabis use, 754 (8.7%) reported cannabis use in the previous year with 126 (1.5%) reporting daily use, 126 reported (1.5%) weekly use, and 502 (5.8%) reported use less often than weekly. After adjusting for demographic factors, daily cannabis use compared with no use was associated with an increased likelihood of reporting two or more sexual partners in the previous year in both men (adjusted odds ratio 2.08, 95% confidence interval 1.11–3.89; $P = 0.02$) and women (2.58, 1.08–6.18; $P = 0.03$). Daily cannabis use was associated with reporting a diagnosis of a sexually transmissible infection in women but not men (7.19, 1.28–40.31; $P = 0.02$ and 1.45, 0.17–12.42; $P = 0.74$, respectively). Frequency of cannabis use was unrelated to sexual problems in women but daily use vs. no use was associated with increased reporting among men of an inability to reach orgasm (3.94, 1.71–9.07; $P < 0.01$), reaching orgasm too quickly (2.68, 1.41–5.08; $P < 0.01$), and too slowly (2.05, 1.02–4.12; $P = 0.04$).

Conclusions. Frequent cannabis use is associated with higher numbers of sexual partners for both men and women, and difficulties in men's ability to orgasm as desired. **Smith AMA, Ferris JA, Simpson JM, Shelley J, Pitts M, and Richters J. Cannabis use and sexual health. J Sex Med 2010;7:787–793.**

Key Words. Cannabis; Sexual Behavior; Sexual Health; Sexual Dysfunction

Introduction

Cannabis is the most widely cultivated and used illicit drug with an estimated 147 million people or 2.5% of the world population using it annually [1]. Its use has been linked to earlier and more frequent sexual activity, having multiple sexual partners, having casual sexual partners while traveling, inconsistent contraceptive use, and being diagnosed with a sexually transmissible infection [2–7].

Despite the prevalence of cannabis use and its apparent association with adverse sexual health outcomes, the link between cannabis use and sexual health has been the subject of remarkably few population-based studies. Those studies that have been done have focused on adolescents and young adults [8–15]. It is a criminal offence to possess, cultivate or sell cannabis in all states of Australia. However, possessors of small amounts of cannabis for personal use are generally issued an infringement fine rather than being prosecuted.

The person may also be required to attend a cannabis education session. One in three Australians has ever used cannabis [16], and in many social circles it is little stigmatized [17]. As it grows easily in Australian conditions, it can be obtained cheaply and without recourse to dealers of other illicit drugs, though many users do buy from dealers [18]. Its use widened from a small counterculture minority in the 1970s to broader but not completely mainstream social groups in the 2000s. Many of the correlations found between cannabis use (lifetime or recent) and health outcomes are related to socio-demographic factors or social location (rates of use are higher among gay men and lesbians [19,20], prisoners [21], injecting drug users [18], and young people attending music festivals [19]), and to psychological factors among users such as risk-taking and psychological distress [16].

Public perception of the risks associated with cannabis use is not well understood. In one study, 27% of people aged 14 and older indicated that they were uncertain about whether there was any health problems associated with cannabis use. The health risks identified included respiratory problems, addiction and the escalation of drug use, and the risk of driving accidents [22]. Sexual health was not identified as being among the domains of cannabis-related health risk.

The present study examines the socio-demographic correlates of cannabis use in a large, population-based study of adults aged 16–64 years, and the relationship between the frequency of cannabis use and the number of sexual partners in the past year, condom use at the most recent sexual encounter, and the reporting of sexually transmissible infection and sexual difficulties.

Methods

Data came from the 2005 intake interview of the Australian Longitudinal Study of Health and Relationships [23]. This is a computer-assisted telephone interview study of Australians aged 16–64 years.

The interview covered a broad range of socio-demographic and health topics with a focus on sexual and reproductive health issues. Cannabis use was assessed with three questions: whether the participant had used cannabis at least 10 times in their life; whether they had used it in the 12 months prior to interview; and if so, whether they had used it daily, weekly, or less often.

Outcomes of interest were the number of sexual partners in the year prior to interview (none, one, two, or more), condom use at most recent vaginal intercourse (no, yes), or anal intercourse (no, yes; asked only of men who had reported having sex with other men), diagnosis with a sexually transmissible infection in the year prior to interview (no or yes to any of: chlamydia, syphilis, gonorrhea, and genital herpes), and the presence for 1 month or more of the following sexual problems: lacking interest in sex, inability to orgasm, reaching orgasm too quickly, reaching orgasm too slowly, experiencing pain during intercourse, not finding sex pleasurable, anxiety about one's ability to perform sexually, vaginal dryness (women), and trouble keeping an erection (men) [24]. Where a sexual problem was reported, the extent to which it was experienced as problematic was ascertained: not a problem, a minor problem, somewhat of a problem, or a major problem [25].

Socio-demographic factors controlled for included: age group (16–25, 26–35, 36–45, 46–55, 56–64), language spoken at home (English, other), sexual identity (heterosexual, homosexual, bisexual), educational attainment (lower secondary, secondary, post-secondary), occupation (professional, associate professional, trades, unskilled), and legal marital status (married, never married, separated, divorced, or widowed). All these factors have been identified as associated with one or more of the outcomes of interest, and analyses were conducted separately of men and women [26–30].

Statistical analysis included contingency table analysis and logistic and multinomial logistic regression and was conducted using Stata [31]. Given the survey design methodology, design-based F statistics are reported. The study was approved by the Human Ethics Committees of La Trobe University, Deakin University, and the University of New South Wales.

Results

A total of 8,656 people completed the interview with an overall response rate of 56% [23]. Of the 8,650 who answered the questions about cannabis use, 754 (8.7%) reported cannabis use in the previous year with 126 (1.5%) reporting daily use, 126 (1.5%) reporting weekly use, and 502 (5.8%) reporting use less often than weekly. Cannabis use was more commonly reported by men than by women (11.2% vs. 6.1%, $P < 0.001$), and in both men and women was more commonly reported by participants younger than 36 years (Table 1).

Table 1 Demographic correlates of the frequency of cannabis use (N)

	Women's frequency of cannabis use						
	None	Less than weekly		Weekly		Daily	
Age (4,299)	%	%	OR*	%	OR†	%	OR‡
16–25 (721)	89.71	7.05	1.35 (0.86, 2.11)	2.43	2.29 (1.03, 5.07)	0.81	0.71 (0.25, 2.01)
26–35 (829)	90.44	7.55	1.43 (0.99, 2.07)	0.70	0.66 (0.26, 1.67)	1.31	1.14 (0.50, 2.58)
36–45 (1,068)	92.35	5.39	1.00	1.09	1.00	1.17	1.00
46–55 (1,050)	97.78	1.67	0.29 (0.18, 0.48)	0.48	0.41 (0.14, 1.22)	0.08	0.06 (0.01, 0.50)
56–64 (631)	99.08	0.92	0.16 (0.07, 0.35)	0.00	—	0.00	—
Language (4,300)							
Other (183)	97.72	1.37	0.28 (0.06, 1.24)	0.91	0.94 (0.13, 6.92)	0.00	—
English (4,117)	93.68	4.66	1.00	0.93	1.00	0.73	1.00
Sexual identity (4,298)							
Heterosexual (4,192)	94.27	4.14	1.00	0.93	1.00	0.66	1.00
Homosexual (43)	82.69	17.31	4.77 (1.76, 12.94)	0.00	—	0.00	—
Bisexual (63)	73.33	21.33	6.63 (3.25, 13.53)	1.33	1.83 (0.24, 13.83)	4.00	7.83 (1.67, 36.85)
Education (4,298)							
Lower secondary (1,193)	94.48	3.35	0.75 (0.50, 1.12)	0.84	0.76 (0.35, 1.65)	1.33	2.32 (1.08, 4.99)
Secondary (2,052)	93.86	4.47	1.00	1.10	1.00	0.57	1.00
Post-secondary (1,053)	93.11	5.94	1.34 (0.94, 1.90)	0.71	0.65 (0.29, 1.48)	0.24	0.42 (0.12, 1.49)
Occupation (4,188)							
Professional (1,432)	95.40	3.67	1.00	0.52	1.00	0.41	1.00
Assoc. professional (1,630)	93.09	5.12	1.43 (0.99, 2.05)	0.97	1.90 (0.82, 4.38)	0.82	2.06 (0.83, 5.10)
Tradesperson (179)	91.63	6.51	1.85 (0.97, 3.51)	0.93	1.85 (0.40, 8.64)	0.93	2.38 (0.29, 19.46)
Unskilled (947)	92.86	4.67	1.31 (0.85, 2.01)	1.59	3.11 (1.28, 7.57)	0.88	2.22 (0.78, 6.32)
Marital status (4,300)							
Married (2,414)	97.03	2.31	1.00	0.35	1.00	0.31	1.00
Never married (1,198)	87.60	8.84	4.23 (3.00, 5.96)	2.09	6.70 (3.11, 14.42)	1.46	5.21 (2.20, 12.37)
Other (688)	93.58	4.73	2.12 (1.38, 3.25)	0.97	2.91 (1.07, 7.89)	0.73	2.43 (0.75, 7.87)
Current tobacco use (4,300)							
None (3,336)	96.93	2.48	1.00	0.35	1.00	0.25	1.00
Less than weekly (63)	73.33	26.67	14.24 (7.42, 27.32)	—	—	—	—
Weekly (65)	74.36	20.51	10.80 (5.19, 22.49)	3.85	14.32 (3.84, 53.41)	1.28	6.68 (0.79, 56.51)
Daily (836)	84.65	9.77	4.52 (3.24, 6.31)	3.09	10.11 (4.85, 21.09)	2.49	11.42 (4.70, 27.75)
Current alcohol use (4,300)							
None (1,118)	96.42	1.94	1.00	0.82	1.00	0.82	1.00
Less than weekly (1,487)	94.90	3.93	2.06 (1.23, 3.44)	0.67	0.83 (0.31, 2.26)	0.50	0.62 (0.24, 1.65)
Weekly (1,171)	90.46	7.62	4.19 (2.56, 6.85)	1.14	1.48 (0.55, 3.97)	0.78	1.02 (0.39, 2.62)
Daily (524)	92.99	4.78	2.55 (1.43, 4.57)	1.43	1.81 (0.58, 5.65)	0.80	1.01 (0.34, 3.00)
	Men's frequency of cannabis use						
	None	Less than weekly		Weekly		Daily	
Age (4,350)	%	%	OR*	%	OR†	%	OR‡
16–25 (844)	84.19	9.39	1.04 (0.72, 1.48)	3.36	2.33 (1.18, 4.62)	3.06	1.10 (0.58, 2.07)
26–35 (737)	80.88	13.01	1.49 (1.09, 2.05)	3.73	2.70 (1.43, 5.09)	2.38	0.88 (0.47, 1.66)
36–45 (960)	86.36	9.30	1.00	1.48	1.00	2.87	1.00
46–55 (1,082)	93.60	3.47	0.34 (0.23, 0.51)	1.08	0.67 (0.33, 1.38)	1.85	0.60 (0.32, 1.10)
56–64 (727)	97.94	0.80	0.08 (0.04, 0.17)	0.57	0.34 (0.13, 0.93)	0.69	0.21 (0.09, 0.52)
Language (4,351)							
Other (244)	97.26	2.74	0.34 (0.15, 0.75)	0.00	—	0.00	—
English (4,107)	88.24	7.33	1.00	2.09	1.00	2.34	1.00
Sexual identity (4,345)							
Heterosexual (4,248)	89.04	6.91	1.00	1.83	1.00	2.22	1.00
Homosexual (46)	72.73	18.18	3.22 (1.33, 7.79)	7.27	4.88 (1.65, 14.39)	1.82	1.00 (0.13, 7.50)
Bisexual (51)	77.05	11.48	1.92 (0.85, 4.36)	9.84	6.23 (1.72, 22.59)	1.64	0.85 (0.12, 6.31)
Education (4,349)							
Lower secondary (1,072)	87.78	6.30	0.83 (0.61, 1.13)	2.88	1.49 (0.88, 2.52)	3.04	1.24 (0.76, 2.00)
Secondary (2,235)	87.99	7.61	1.00	1.94	1.00	2.46	1.00
Post-secondary (1,042)	91.36	6.72	0.85 (0.62, 1.16)	1.12	0.56 (0.28, 1.10)	0.80	0.31 (0.16, 0.63)
Occupation (4,262)							
Professional (1,615)	91.48	6.66	1.00	0.88	1.00	0.98	1.00
Assoc. professional (835)	86.11	8.59	1.37 (0.96, 1.94)	2.80	3.38 (1.68, 6.82)	2.50	2.70 (1.37, 5.34)
Tradesperson (1,168)	87.01	6.92	1.09 (0.80, 1.49)	2.71	3.25 (1.77, 5.95)	3.35	3.59 (2.01, 6.44)
Unskilled (644)	86.92	7.38	1.17 (0.80, 1.70)	2.59	3.11 (1.48, 6.51)	3.11	3.33 (1.73, 6.42)
Marital status (4,348)							
Married (2,409)	93.98	4.29	1.00	0.83	1.00	0.90	1.00
Never married (1,457)	80.02	12.36	3.38 (2.60, 4.41)	3.72	5.26 (3.13, 8.84)	3.89	5.08 (2.92, 8.85)
Other (482)	88.93	5.02	1.24 (0.79, 1.92)	2.42	3.08 (1.58, 6.01)	3.63	4.27 (2.16, 8.42)
Current tobacco use (4,350)							
None (3,272)	93.30	4.97	1.00	0.97	1.00	0.76	1.00
Less than weekly (73)	75.00	20.45	5.12 (2.61, 10.05)	1.14	1.46 (0.20, 10.89)	3.41	5.55 (1.63, 18.84)
Weekly (93)	67.57	17.12	4.75 (2.66, 8.50)	13.51	19.26 (8.31, 44.67)	1.80	3.25 (0.43, 24.49)
Daily (912)	75.69	12.52	3.11 (2.38, 4.06)	4.48	5.70 (3.45, 9.42)	7.31	11.79 (7.31, 19.02)
Current alcohol use (3,451)							
None (639)	95.30	3.00	1.00	0.26	1.00	1.44	1.00
Less than weekly (1,166)	90.99	4.72	1.65 (0.92, 2.95)	1.72	6.89 (1.57, 30.24)	2.58	1.88 (0.91, 3.87)
Weekly (1,640)	85.55	9.82	3.64 (2.11, 6.28)	2.59	11.07 (2.64, 46.44)	2.03	1.58 (0.76, 3.26)
Daily (906)	87.02	8.01	2.92 (1.66, 5.14)	2.39	10.04 (2.36, 42.70)	2.58	1.97 (0.95, 4.07)

*Unadjusted odds ratio (OR) and 95% confidence interval of less than weekly use vs. no use.
†Unadjusted odds ratio and 95% confidence interval of weekly use vs. no use.
‡Unadjusted odds ratio and 95% confidence interval of daily use vs. no use.

Table 2 Adjusted odds ratios for the relationship between frequency of cannabis use and the number of sexual partners in the past year

	No partners vs. one OR* (95% CI)*	Two or more partners vs. one OR* (95% CI)*
Cannabis use		
	Women	
None	1.00	1.00
Less often than weekly	0.56 (0.31, 1.03)	2.05 (1.20, 3.49)
Weekly	0.06 (0.01, 0.47)	1.00 (0.41, 2.41)
Daily	—	2.58 (1.08, 6.18)
	$F(2, 4,269) = 5.30$; $P = 0.005$	$F(3, 4,268) = 3.47$; $P = 0.015$
	Men	
None	1.00	1.00
Less often than weekly	0.53 (0.31, 0.90)	1.95 (1.36, 2.81)
Weekly	1.04 (0.46, 2.32)	1.83 (1.01, 3.31)
Daily	1.26 (0.60, 2.65)	2.08 (1.11, 3.89)
	$F(3, 4,223) = 2.07$; $P = 0.102$	$F(3, 4,223) = 5.98$; $P < 0.001$

*Odds ratio adjusted for age group, language spoken at home, sexual identity, educational attainment, occupation, marital status, current tobacco use, and current alcohol use.
CI = confidence interval; OR = odds ratio.

However, cannabis use was reported in all age groups with daily use reported by all age groups of men and all but the oldest age group among women. There was a strong association between frequency of cannabis use and frequency of tobacco use in both men and women (Table 1). Among male daily cannabis users, 70% were daily tobacco users compared with 18% for male cannabis non-users. Among female daily cannabis users, 69% were daily tobacco users compared with 18% for female cannabis non-users. Cannabis use was also associated with a non-heterosexual identity, lower educational attainment, lower status occupation, and not being married (Table 1).

The number of sexual partners in the year prior to interview was strongly associated with the frequency of cannabis use (Table 2). Adjusted odds ratios (OR) indicate that frequent cannabis use by women was associated with an increased likelihood of reporting more than two sexual partners and a markedly reduced likelihood of reporting no partners rather than one. Among men, the relationship between frequency of cannabis use and reporting no partners rather than one was less clear, although any cannabis use was associated with a doubling of the likelihood of reporting two or more partners in the previous year compared with one partner. Among both men and women, the adjusted OR indicated no association between frequency of cannabis use and the likelihood of condom use at their most recent intercourse (Table 3). Frequency of cannabis use among men was not associated with reporting a diagnosis of a sexually transmissible infection in the previous year, but daily cannabis use among women was associated with a marked increase in the likelihood of reporting such a diagnosis (Table 4).

Table 3 Adjusted odds ratio for the association between frequency of cannabis use and condom use at the most recent experience of vaginal or anal intercourse*

	Women OR (95% CI)†	Men OR (95% CI)†
Cannabis use		
None	1.00	1.00
Less often than weekly	1.11 (0.69, 1.79)	0.85 (0.58, 1.25)
Weekly	0.53 (0.19, 1.46)	0.90 (0.45, 1.78)
Daily	0.80 (0.23, 2.72)	0.48 (0.21, 1.11)
	$F(3, 3,994) = 0.64$; $P = 0.592$	$F(3, 4,045) = 1.14$; $P = 0.330$

*Only asked of men who reported having sex with men.
†Odds ratio and 95% confidence interval adjusted for age group, language spoken at home, sexual identity, educational attainment, occupation, marital status, number of sexual partners in the previous year (one vs. two or more), relationship to sexual partner (cohabiting regular partner, no-cohabiting regular partner, casual partner), current tobacco use, and current alcohol use.
CI = confidence interval; OR = odds ratio.

Among women, there was no association between any of the sexual problems and frequency of cannabis use in the adjusted analyses (Table 5). For men, however, there were significant associations between daily cannabis use and reporting an inability to reach orgasm (OR 3.94, confidence interval [CI] 1.71–9.07; $P < 0.01$), reaching orgasm too quickly (OR 2.68, CI 1.41–5.08; $P < 0.01$), and reaching orgasm too slowly (OR. 2.05, CI 1.02–4.12; $P = 0.04$). Among the 144 men who reported an inability to orgasm,

Table 4 Adjusted odds ratio for the association between frequency of cannabis use and the diagnosis of a sexually transmissible infection in the previous year

	Women OR (95% CI)*	Men OR (95% CI)*
Cannabis use		
None	1.00	1.00
Less often than weekly	1.61 (0.33, 7.96)	1.49 (0.37, 6.00)
Weekly	—	0.83 (0.07, 9.84)
Daily	7.19 (1.28, 40.31)	1.45 (0.17, 12.42)
	$F(2, 3,005) = 2.55$; $P = 0.078$	$F(3, 3,618) = 0.15$; $P = 0.930$

*Odds ratio and 95% confidence interval adjusted for age group, language spoken at home, sexual identity, educational attainment, occupation, marital status, number of sexual partners in the previous year (one vs. two or more), current tobacco use, and current alcohol use.
CI = confidence interval; OR = odds ratio.

Table 5 Adjusted odds ratio for the association between frequency of cannabis use and sexual problems for one month or more in the previous year

	Women OR (95% CI)*	Men OR (95% CI)*
Lacked interest in sex		
Cannabis use		
None	1.00	1.00
Less often than weekly	1.18 (0.84, 1.66)	0.95 (0.68, 1.34)
Weekly	0.64 (0.32, 1.25)	1.99 (1.14, 3.47)
Daily	1.03 (0.48, 2.19)	1.05 (0.60, 1.85)
	$F(3, 4,251) = 0.94$; $P = 0.420$	$F(3, 4,248) = 2.06$; $P = 0.104$
Inability to reach orgasm		
Cannabis use		
None	1.00	1.00
Less often than weekly	0.97 (0.62, 1.53)	1.13 (0.51, 2.51)
Weekly	0.82 (0.37, 1.85)	0.70 (0.17, 2.85)
Daily	1.50 (0.63, 3.61)	3.94 (1.71, 9.07)
	$F(3, 4,240) = 0.38$; $P = 0.770$	$F(3, 4,242) = 3.69$; $P = 0.011$
Reached orgasm too quickly		
Cannabis use		
None	1.00	1.00
Less often than weekly	1.21 (0.59, 2.47)	0.87 (0.57, 1.34)
Weekly	0.33 (0.04, 2.60)	1.53 (0.67, 3.48)
Daily	1.37 (0.28, 6.68)	2.68 (1.41, 5.08)
	$F(3, 4,133) = 0.54$; $P = 0.653$	$F(3, 4,230) = 3.62$; $P = 0.012$
Reached orgasm too slowly		
Cannabis use		
None	1.00	1.00
Less often than weekly	1.30 (0.88, 1.92)	1.20 (0.71, 2.04)
Weekly	0.74 (0.32, 1.70)	1.10 (0.46, 2.65)
Daily	1.55 (0.70, 3.45)	2.05 (1.02, 4.12)
	$F(3, 4,183) = 1.16$; $P = 0.324$	$F(3, 4,229) = 1.41$; $P = 0.239$
Pain during intercourse		
Cannabis use		
None	1.00	1.00
Less often than weekly	0.93 (0.51, 1.69)	1.66 (0.70, 3.94)
Weekly	0.58 (0.12, 2.88)	3.86 (1.15, 12.98)
Daily	2.14 (0.90, 5.09)	2.17 (0.63, 7.48)
	$F(3, 4,246) = 1.20$; $P = 0.309$	$F(3, 4,089) = 2.28$; $P = 0.077$
Not finding sex pleasurable		
Cannabis use		
None	1.00	1.00
Less often than weekly	1.21 (0.77, 1.89)	0.65 (0.29, 1.45)
Weekly	0.73 (0.30, 1.81)	0.74 (0.18, 3.16)
Daily	1.79 (0.68, 4.68)	1.50 (0.61, 3.69)
	$F(3, 4,221) = 0.87$; $P = 0.456$	$F(3, 4,242) = 0.81$; $P = 0.489$
Anxiety about ability to perform		
Cannabis use		
None	1.00	1.00
Less often than weekly	1.01 (0.61, 1.68)	1.08 (0.69, 1.69)
Weekly	0.39 (0.11, 1.34)	1.45 (0.71, 2.97)
Daily	1.81 (0.73, 4.49)	1.48 (0.74, 2.96)
	$F(3, 4,248) = 1.37$; $P = 0.251$	$F(3, 4,241) = 0.71$; $P = 0.548$
Vaginal dryness		
Cannabis use		
None	1.00	
Less often than weekly	1.57 (0.96, 2.58)	
Weekly	0.61 (0.18, 2.09)	
Daily	0.85 (0.25, 2.86)	
	$F(3, 4,255) = 1.35$; $P = 0.258$	
Trouble keeping an erection		
Cannabis use		
None		1.00
Less often than weekly		1.00 (0.55, 1.83)
Weekly		1.34 (0.59, 3.06)
Daily		1.64 (0.77, 3.48)
		$F(3, 4,240) = 0.67$; $P = 0.571$

*Odds ratio and 95% confidence interval adjusted for age group, language spoken at home, sexual identity, educational attainment, occupation, marital status, number of sexual partners in the previous year (one vs. two or more), current tobacco use, and current alcohol use.
CI = confidence interval; OR = odds ratio.

there was no association between frequency of cannabis use and the extent to which inability to orgasm was experienced as problematic ($F[8.78, 1,299.10] = 1.65$, $P = 0.10$). However, among the 424 men who reported reaching orgasm too quickly, there was an association between frequency of cannabis use and the extent to which reaching orgasm too quickly was experienced as problematic such that more frequent cannabis use was associated with experiencing reaching orgasm too quickly as more problematic ($F[8.45, 3,692.91] = 2.85$, $P < 0.01$).

Discussion

Frequent cannabis use, particularly daily use, is associated with a range of health and behavioral outcomes. For example, frequent users are more likely than others to report two or more sexual partners in the previous year, as has been found in other studies [9].

Female daily cannabis users are significantly more likely than non-users to report the diagnosis of a sexually transmissible infection in the previous year. Although frequent cannabis use appears unrelated to sexual problems in women, it clearly interferes with orgasm in men and its use is associated with the delay or prevention of orgasm in some men and with orgasm too soon in others. That there is an association between frequency of cannabis use and the extent to which reaching orgasm too quickly is problematic raises the possibility that men are self-medicating with cannabis to delay orgasm.

We failed to find any association between frequency of cannabis use and trouble keeping an erection. This is consistent with the finding of Johnson and colleagues who also failed to find an association between lifetime cannabis use and "inhibited sexual excitement (i.e., lack of erection in men, lack of arousal for women)" [7] (p. 57). However, there have been reports that very high doses of cannabis have been associated with an "inability to perform" [32] (p. 23), and that this may be related to changes in plasma testosterone such that modest doses increase plasma testosterone but that high doses lower testosterone below baseline [32].

Consistent with the present article, Johnson and colleagues found an association between cannabis use and inhibited orgasm, such that a history of cannabis use was associated with being more likely to report a recent history of an inability to orgasm [7]. Halikas and colleagues also found that

cannabis use was associated with an increased duration of intercourse and a decreased number of orgasms [33].

The present study has a number of strengths and weaknesses. Its strengths include the large sample, wide age range of participants, and high response rate. Weaknesses include a reliance on self-report and the attendant possibility of a social desirability bias.

Given the high prevalence of cannabis use and the associations reported between frequent cannabis use and a range of sexual health issues, clinicians should routinely enquire about patients' cannabis use and, if frequent use is reported, take a detailed sexual history and manage the patient accordingly.

These findings could also provide useful input to health promotion and/or health education campaigns aiming to reduce frequent cannabis use.

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Perceptions of Marijuana and its Effects: A Comparison of Users and Nonusers*

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Abstract

A sample of 100 marijuana users and 77 nonusers were surveyed with respect to their perceptions of various factors related to the use of marijuana and its effects. Marijuana users and nonusers were not found to differ in terms of demographic variables, perceptions of sources influential in the decision to use marijuana, and perceived reasons for the use of marijuana. Users and nonusers were found to differ with regard to types of drugs used other than marijuana, perception of sources potentially influential in the users' decision to discontinue using marijuana, and perception of effects experienced by marijuana intoxicated persons. Nonusers were thus found to be generally cognizant of factors associated with the use of marijuana but relatively naive concerning the major effects of a marijuana high as perceived by nonusers.

Introduction

It appears that the general public in the United States is exposed to a great volume of information pertaining to the use of marijuana, particularly through mass media coverage of recent findings concerning the effects of marijuana. Moreover, various medical, anti-drug, educational, and religious organizations disseminate information pertaining to various effects of marijuana, reasons for its use, characteristics of users, and patterns of its use. In terms of exposure and access to this information, as well the increasing number of persons who have used, use, or know someone who has used marijuana, both users and nonusers of marijuana ought to be generally knowledgeable concerning the effects of marijuana and its use as reflected in these sources. Differences in the amount of knowledge between users and nonusers would of course be expected, predominantly related to the extent of exposure to this information, one's interest in the subject matter, or one's personal experience in using marijuana. However, little systematic information has been obtained concerning the effects, sensations experienced, patterns of its use, and reasons for using marijuana as perceived by nonusers.

In recent years, amid the clamor of debate concerning the consequences of using marijuana, there has been a substantial increase in scientific research on all facets of the subject. The majority of this research has been predominantly concerned with the effects of marijuana and its patterns of use among experimental, occasional, regular, and chronic users.[1] By focusing primarily on the marijuana user this research has virtually excluded an investigation of the non-marijuana users' perception of various factors related to the use of marijuana. The purpose of this study was to examine whether and to what extent users and nonusers of marijuana share similar perceptions

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of the effects of marijuana. Factors associated with the decision to use and discontinue using marijuana, norms associated with its use, effects experienced, and perceived reasons for using marijuana were also examined.

Method

This study took place at a large state university in Oklahoma, an area where marijuana use *per se* does not appear to be as prevalent as in other sections of the United States.[2] Three marijuana users agreed to act as source persons in this study and were asked to review the class roster of ten introductory level social science courses, identify persons whom they personally knew to be marijuana users, and encourage these persons to participate in this study as respondents and to assist in contacting other potential user respondents. Of 134 users contacted in this chain of referral manner, 100 agreed to participate in the study. A random sample of 130 presumed nonusers was then selected from these same courses: 77 agreed to participate in the study. In addition, all respondents were screened, based upon their response to a marijuana use-rate item which indicated: (1) self-definition as a user or nonuser of marijuana; and (2) self-assessed frequency of marijuana use over a six-month period immediately preceding the study.

Group sessions were scheduled in a university classroom during which time respondents completed questionnaires designed to elicit: (1) demographic information; (2) frequency of marijuana use; (3) other drugs used; (4) sources perceived to be influential in the decision to use and discontinue using marijuana; (5) perceived motivations in the use of marijuana; and, (6) knowledge of specified behavioral patterns and experienced effects of a marijuana high.

Findings

In terms of the demographic characteristics of marijuana users in the United States it has generally been found that single males, persons from middle and upper income families, persons who do not attend church regularly, those who major in the arts, humanities, social and behavioral sciences in college, who appear to be more politically active, who attend public high schools and colleges, and those from specific regions of the country or particular geographical locales within a specified region, are more likely to have used marijuana.[3] These associations do not, however, imply a casual relationship between specific demographic characteristics and the prevalence or incidence of marijuana use as the available data do not lend themselves to such an analysis.[4]

Respondents in this study ranged from age 17 past the age of 24, with the greatest concentration in the 19 to 20 year old age category (48 per cent of users and 43 per cent of the nonusers). In addition, 82 per cent of the users and 92 per cent of the nonusers were single, 65 per cent of the users and 70 per cent of the nonusers were in their sophomore or junior year in college, and 67 per cent of the users and 68 per cent of the nonusers were majoring in the social and behavioral sciences. There were almost three times as many males as females in both groups. The average frequency of marijuana use for a six-month period preceding this research ranged from "about every day" (1 per cent) to "once a week or more" (22 per cent) to "less than once a week but at least once a month" (72 per cent) to "only once or twice in the past six months" (5 per cent). In addition, 73 per cent of the users and 81 per cent of the nonusers resided on campus, an

Table 1. *Percentages of marijuana users and nonusers who have used other drugs at least once**

Drug	Users ($N=100$)	Nonusers ($N=77$)
Amphetamines	27	14
Barbiturates	16	9
Heroin	1	0
Opium	0	0
Cocaine	9	0
Mescaline	19	0
Psilocybin	2	0
LSD	31	0
Tranquilizers	13	23
Quaaludes	21	0

* All respondents were requested to check those drugs which they have used at least once. Therefore, the totals for users exceeds 100 per cent.

indication that the use of marijuana had become student diversified, rather than being primarily an off-campus subcultural phenomenon.

Whether or not the use of marijuana is casually related to the use of other drugs was beyond the scope of this study. Based upon the results of other studies we would, however, expect a statistical association between the use of marijuana and the extensive use of other illicit drugs.[5] Consistent with these findings, marijuana users in this study did indicate that they had used other illicit drugs, particularly LSD, amphetamines, quaaludes, mescaline, barbiturates, and tranquilizers (see Table 1). On the other hand, the only drugs ever used by non-marijuana users in this study were tranquilizers, amphetamines, and barbiturates.

At first glance the relative absence of extensive drug experimentation among non-marijuana users may appear somewhat strange, particularly in light of Hochman and Brill's research which indicates that ". . . drug use among college students is extensive, . . ."[6] Their sample of non-marijuana users, however, included persons who had never used marijuana (47.8 per cent) as well as persons who had used marijuana at least once (17.7 per cent). The difference in our findings may be partially accounted for by the inclusion of some persons who had used marijuana in the Hochman and Brill nonuser sample. In terms of the nature of the effects of the drugs used by non-marijuana users in this study there is also the possibility that these drugs were utilized for medicinal purposes and/or as part of the college experience (i.e. weight problems; inter-personal adjustment problems; craming for examinations; etc.).

Another area of interest in this study was an investigation of specific factors which appear to be influential in an individual's decision to use marijuana, as well as factors which appear to be most influential in inhibiting its continued use among users (see Table 2). Consistent with past research, users perceived peer influence to be the most important variable related to their decision to use marijuana.[7] Similarly, nonusers perceived peer influence to be the most important variable in one's decision to use marijuana.

Table 2. *Sources influential in the decision to use or not to use marijuana as perceived by marijuana users and nonusers (in %)*

Source	Users ($N=100$)	Nonusers ($N=77$)
Influential in decision to use marijuana	0	0
Church	2	1
Parents	69	69
Friends	21	16
Mass Media	8	14
School		
Influential in decision to *not* use marijuana	3	7
Church	17	31
Parents	24	17
Friends	36	32
Mass Media	21	13
School		

In light of these findings the data pertaining to sources influential in one's decision to stop using marijuana are quite interesting. Users were requested to choose the sources which they perceive would have the most influence in their decision to stop using marijuana, if they decided to discontinue its use. Nonusers were asked to choose the source which they perceive would be most influential in the users' decision to discontinue using marijuana. Based upon the previous finding, it would seem that one's peers would also be the most influential source in inhibiting the continued use of marijuana among users. This, however, was not the case. Users perceived the mass media as the source which would be most influential in their decision to stop using marijuana. Nonusers similarly perceived the mass media to be the potentially most influential source in the users' decision to discontinue using marijuana.

I was also interested in investigating reasons cited for using marijuana as perceived by marijuana users and nonusers. Users and nonusers were presented with a check-list of fifteen reasons why persons might smoke marijuana (see Table 3).[8] The data clearly indicates that both users and nonusers generally perceive pleasure as the most important reason for using marijuana. The only item of relative disagreement between users and nonusers pertains to the importance of peer pressure in one's decision to use marijuana. Nonusers perceived peer pressure to be a more important motivation for using marijuana than did marijuana users.

The last section of the questionnaire specified behavior patterns and sensations experienced by individuals who are high.[9] It could be hypothesized that users would be generally more knowledgeable than nonusers concerning the effects of marijuana because of their experience with marijuana and also their use of marijuana may lead them to seek out more information concerning its effects. Nonusers, on the other hand, would probably be relatively naive concerning the effects of marijuana because of: (1)

Table 3. *Motivations for using marijuana as perceived by marijuana users and nonusers (in %)*

Motivations	User ($N=100$)	Nonusers ($N=77$)
For pleasure	71*	61*
To feel good	29	30
To experience new sensations	18	14
For fun	13	12
To be more at ease; relax	11	5
To heighten perception of stimulation:	23*	21*
As aid in creativity	10	9
To be more alert	6	6
To express oneself better	4	3
As aid in interaction	3	3
Rebelliousness or pressure from others:	6*	18*
Because friends use marijuana	4	14
It is better than alcohol	2	0
To defy authority	0	4
Feel responsible enough to use marijuana	0	0

* Indicates total percentage in each category.

their lack of experience with marijuana; (2) a general lack of interest in reading about the use of marijuana and its effects; and, (3) their relative lack of association with users. Aside from the Hochman and Brill study there is, however, little information pertaining to the nonusers' perceptions of the effects of marijuana.[10]

The data in Table 4 indicates that users usually share marijuana with other users when smoking marijuana. In addition, users did not perceive themselves as 'needing' to be with other users when smoking marijuana, although they did indicate that they prefer to interact with other users when high. Nonusers were cognizant of the sharing aspect of marijuana use, although they did not consider it to occur as frequently as did users. On the other hand, nonusers felt that an overwhelming need exists among users to be with other users, as well as preferring to interact with other users, when smoking marijuana.

A related area of interest in this study was an investigation of users' and nonusers' perceptions of various sensations experienced by persons smoking marijuana. Users overwhelmingly felt that they became hungrier, that their mouth and throat became drier, and that time passed more slowly when they smoked marijuana. In addition, users indicated that their ability to think deeply increased, that sex was more enjoyable, that their sensitivity to taste, sound, and touch increased, and that their ability to concentrate and comprehend usually increased when smoking marijuana. On the other hand, they felt that they became generally less attentive to the conversation of others, although they did perceive themselves as being more attentive than nonusers perceived them to be. Users also did not perceive themselves as usually laughing a lot, becoming introverted, uncoordinated, or hallucinating when smoking

Table 4. *Behavioral patterns and effects of marijuana high as perceived by marijuana users and nonusers (in %)* *

Behavioral patterns and experienced effects	Users ($N=77$)			Nonusers ($N=77$)		
	Usually	Sometimes	Never	Usually	Sometimes	Never
Prefer interacting with other users	61	33	6	92	7	1
Need to interact with other users	6	13	81	68	13	19
Share marijuana with other users	67	24	9	53	47	0
Appetite increases	87	9	4	13	48	39
Dry mouth and throat	79	18	3	39	54	7
Time passes slowly	78	20	2	25	32	43
Ability to think increases	78	15	7	5	12	83
Sex more pleasurable	59	35	6	38	40	22
More sensitive to taste, sound, touch	57	38	5	61	14	25
Ability to concentrate increases	51	33	16	12	22	66
Comprehension increases**	53	24	23	1	22	77
Attentiveness increases	29	36	35	5	16	79
Laugh a lot	23	65	12	82	14	4
Become introverted	11	31	58	22	38	40
Become uncoordinated	4	15	81	29	35	36
Hallucinate	2	4	94	72	25	3

*Aside from the first three entries which are concerned with behavior patterns, the data is arranged in terms of most to least usual effects as perceived by users.
** $N=78$.

marijuana. It is however, apparent that nonusers were not generally cognizant of the frequency with which these sensations were perceived to occur among users, although they did perceive an increase in the users' sensitivity to taste, sound, and touch.

Conclusion

The study presented here casts light on several aspects of marijuana use, particularly with regard to the marijuana users' and nonusers' perceptions of various factors related to the use of marijuana and its effects.

(1) The prevailing notion that the student user of marijuana is a member of a distinctive subculture characterized by specific demographic variables is not supported by this research. Little evidence was found to suggest that the student marijuana user is any different than the nonuser in terms of age, sex, marital status, year in college, major field of study, or place of residence while attending college.

(2) The findings in this study do, however, suggest that the use of drugs by marijuana users and nonusers is rather extensive, although the types and range of drugs used by each groups differs. As noted by Blum *et al.*, this is an indication that multiple drug use is not limited to marijuana users.[11] This suggests that the student user of marijuana may be a member of nebulous subculture characterized by types of drugs used other than marijuana and that divergent drug use patterns may be more fruitfully

explained by the relationship between types of drugs used and various sociogenic factors.

(3) Users and nonusers were found to be in relative agreement with regard to their perceptions of sources influential in the decision to use marijuana and in their perceptions of motivating factors important in its use.

(4) One area of relative disagreement between users and nonusers pertained to sources perceived to be influential in the users' decision to discontinue using marijuana. Both users and nonusers perceived the mass media to be the potentially more influential source in the users' decision to stop smoking marijuana, if they were to decide to stop using it. Beyond this point there was however little agreement between these two groups in terms of the next most influential sources. This is particularly evident in terms of the nonusers' perception of parents as being almost as influential as the mass media in inhibiting the continued use of marijuana among marijuana users.

(5) The major area of disagreement between marijuana users and nonusers concerned their perceptions of specified behavior patterns of marijuana intoxicated persons, as well as the effects experienced when high. The usual effects of being high, as perceived by users in this study are generally consistent with the findings in other research. On the other hand, nonusers appear to have only a superficial knowledge of the majority of effects experienced by persons high on marijuana.

In general, users are more knowledgeable than nonusers concerning various aspects of marijuana use. Furthermore, it appears that the non-marijuana users' perceptions of the effects of marijuana are not necessarily based upon the accumulated evidence. This is particularly evident when attention is focused on the effects experienced by marijuana intoxicated persons and suggests that the effects of marijuana, as experienced and perceived by users, are somewhat at variance with popular stereotypes as expressed by nonusers. These discrepancies may be partially accounted for in terms of the nonusers' negative attitude toward the use of marijuana, their relative lack of experience with marijuana or marijuana users', or because the nonuser pays attention to only the most general type of information concerning the use of marijuana and its effects. Further investigations dealing with nonusers' attitudes toward the use of marijuana, its effects, the question of legalization, and so on, should take special note of these points.

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8 This list is comprised of reasons mentioned by marijuana users for using marijuana as reflected in the literature. See, Grinspoon, Lester. *op. cit.*, 192-241.

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Marijuana use and sexual behavior

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BRIEF REPORTS

MARIJUANA USE AND SEXUAL BEHAVIOR

Ronald A. Weller and James A. Halikas

In several anonymous questionnaire studies of college students, marijuana use has been reported to affect sexual behavior. In general, these studies show that marijuana smoking enhances sexual pleasure and increases sexual desire. Marijuana use has also been associated with more frequent sexual activity and an increased number of sexual partners. The purpose of this study was to determine the perceived effects of marijuana use on the sexual behavior and sexual practices of a sample of regular marijuana users. In contrast to other studies, subjects were not drawn exclusively from college student populations and were interviewed rather than given a questionnaire. Results, in general, confirm results of previous studies. Subjects were primarily heterosexual and sexually active. Men were more likely than women to have had multiple sexual partners. Over two thirds reported increased sexual pleasure and satisfaction with marijuana. Increased desire for a familiar sexual partner was reported by about one half. The sensations of touch and taste were particularly enhanced by marijuana. Many felt marijuana was an aphrodisiac. Marijuana use in relation to initiation of sexual activity was also assessed. Although drug use occurred prior to first intercourse for about one third of the men and women, alcohol, not marijuana, was most frequently used in this context. Most had used marijuana as a preparation for intercourse on occasion, and 20% did this on a regular basis. Possible explanations for these effects are briefly discussed.

Marijuana has the reputation of being an aphrodisiac. Jarvik and Brecher (1977) identified several possible explanations for marijuana's aphrodisiac-like effect: it (a) loosens inhibition, (b) enhances sensate focus, (c) causes a generalized increase in enjoyment (hedonism), (d) slows perception of time thus causing an enjoyable activity seemingly to last longer, (e) has a reputation for sexual enhancement (placebo effect), and (f) its use occurs under relaxed circumstances conducive to sexual activity.

Results of many studies tend to support the belief that marijuana has aphrodisiac-like effects. In one experiment, cannabis administration caused

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sexual arousal of subjects (Mayor's Committee, 1944). In another study, THC (delta-9-tetrahydrocannabinol) given under experimental conditions caused sexual thoughts to occur (Hollister, Richards, & Gillespie, 1968). North Africans believed marijuana stimulates the sexual faculties (Bouquet, 1951) and, of 1200 Indian marijuana users studied, 10% believed cannabis increases sexual excitement during intercourse (Chopra, 1969).

More recent survey studies of U.S. college students also reported a positive relationship between marijuana use and sexual behavior. For example, Robbins and Tanck (1973) found sexual desire to be more frequent among a sample of graduate psychology students on days when they used marijuana than on days they did not. Goode (1972) reported marijuana users were more likely than nonusers to engage in intercourse, engage in it earlier in life, engage in it more regularly, and have a greater variety of partners. Sensations were intensified and sex was desired more during marijuana intoxication (Tart, 1971). Sex was more pleasurable when smoking marijuana (Traub, 1977). Sexual desire and sexual enjoyment or pleasure with marijuana use were also reported by Arafat and Yorburg (1973); Dawley, Winstead, Baxter, and Kay (1974); and Koff (1974). Other researchers reporting similar findings include Brill and Christie (1974), Chopra and Jandu (1976), and Fisher and Steckler (1974).

However, most of these studies have used samples drawn only from college student populations. Moreover, respondents were not interviewed but filled out questionnaires anonymously, making the reliability and validity of responses difficult to assess. These factors limit the ability to generalize to larger populations. This investigation was conducted in an attempt to replicate the results of previous studies, with a sample not drawn exclusively from college students. In addition an interview format was used instead of an anonymous questionnaire. Different aspects of sexual behavior were also studied to give a more complete picture of sexual functioning. Effects of marijuana use on sexual performance, sexual pleasure, and sensations during sexual activity were assessed in detail. More general areas such as sexual preference, sexual practices, and sexual partners were also evaluated.

Method

Subjects

Subjects were 97 of an original sample of 100 adults from a large midwestern city, initially interviewed in 1969-1970 and reinterviewed in 1976-1977 as a part of clinical study of marijuana use. These individuals were "regular" marijuana users by self-report, not experimenters or casual users, had averaged over 2 years of marijuana use, and had used marijuana at least 50 times in a 6-month period preceding the initial study. All subjects were white and came mainly from middle-class backgrounds. Sixty (62%) were male; 37 (38%) were female. At follow-up, average age was 27.5 years. Virtually all had completed high school, and many had attended college. Over 80% were working full-time in occupations ranging from physicians to ditchdiggers. All but one (who had had discontinued use after joining a religious group that forbade its use) continued to regard themselves as marijuana users.

During the 12 months prior to follow-up, 86% had used marijuana. All but one had intentions of using it in the future. Although 14% had not used it in the past year, all had used it extensively in the past and were knowledgeable about marijuana's effect on their sexual activity. Since the responses of this group of 14% showed no significant differences from remaining subjects, they were included in the analysis. None of the subjects had gone longer than 24 months without using marijuana. Overall, these 97 users averaged 6-8 years of use. Marijuana use for the most part continued to be frequent—23% were daily users and about half were using marijuana weekly.

At the time of the original data collection, marijuana use was less common than now, and laws restricting its use were more strictly enforced. As a result some effort was required to locate subjects who were willing to be interviewed. To obtain as broad-based a sample as possible, three source individuals with access to different groups of marijuana users were asked to refer subjects. When interviewed, subjects were asked to refer additional subjects. Although not ideal, this sample was broader-based than a sample consisting only of college students. Results and detailed description of the methodology of this initial study have been published (Halikas, Goodwin, & Guze, 1971, 1972).

Interview Schedule

A structured interview was used, composed of closed-ended questions. Some answers required a yes or no response, whereas others required the subject to quantify or rate a particular phenomenon which was coded by the interviewer. Thus, interviewer interpretation was minimized, resulting in more standardized responses. The interview contained questions to allow cross-validation and to assess the reliability of the interview. Questions addressed the effect of marijuana on sexual performance, sexual enjoyment, and the senses; sexual orientation, sexual practice, and sexual partners; the role of marijuana, alcohol, and other drugs in initiation of sexual activity and in preparation for sexual activity. After the study was about one third completed, additional questions on sexual matters were added. Thus, for these variables, information was available from only 65 subjects. In addition to information on marijuana use and sexuality, general demographic information was elicited from all subjects. Preliminary work indicated interview questions were understandable to subjects. Response consistency was excellent in trial interviews.[1]

Procedure

All subjects gave informed consent and were paid $20.00 for participation. Interviews were conducted using the interview schedule described above. Interview format allowed for the establishment of rapport, clarification of study objectives, and explanation of questions as they arose, thus minimizing ambiguous or invalid results. In general rapport was good, and subjects cooperated well with the interviewer. Cross-validation of certain interview items indicated that reliable responses were obtained. Responses corresponded well with information obtained in a previous interview study of these

[1]A copy of the interview schedule is available from the first author.

subjects. These facts also indicate that the information obtained in this study was valid.

Results

A summary of marital and several sexual behavior characteristics is contained in Table 1. These marijuana users were sexually active, with 70% reporting more than one sexual partner in the past year. Sexual orientation was primarily heterosexual. A number of users reported postpubertal homosexual experiences, but most did not consider these of consequence. Only 12% considered themselves homosexual or bisexual. There was only one significant difference between males and females: Men were significantly more likely to have had more than five sexual partners in the past year (49% vs. 25%).

Table 1

Sexual Background of Subjects

	User Males ($n = 60$) %	User Females ($n = 37$) %	Users Total ($N = 97$) %
Ever married	48	56	52
Currently married	32	35	33
Extramarital sexual experience	11	23	17
First heterosexual intercourse prior to age 18	50	46	49
More than one sexual partner in past year	78	75	77
Five or more sexual partners in past year	49	25[a]	40
Partner swapping or group sex ever	5	5	5
Post-pubertal homosexual experience	22	32	26
Bisexual or homosexual preference	12	13	12

[a] $\chi^2(1\ N = 97) = 4.4, p < .05$.

In Table 2 marijuana's reported enhancement of sexual activities is summarized. Over two thirds reported increased sexual pleasure and satisfaction with marijuana use. Other parameters of sexual enjoyment, such as emotional closeness, physical closeness, and increased enjoyment of snuggling were all enhanced. Quality of orgasm and duration of intercourse were also enhanced by marijuana, with men significantly more likely than women to report this. Increased number of orgasms and ability to repeat orgasms were reported, but not frequently. Approximately one half felt marijuana had an aphrodisiac effect on them.

About half of both sexes reported increased desire for sexual relations with a familiar partner while using marijuana. However, 43% of the men reported an increased desire for an unfamiliar partner, whereas only 13% of the women reported such a desire while using marijuana, $p < .001$. Desire for multiple partners or homosexual partners as an effect of marijuana was not reported by most users. All those reporting a desire for partners of the same sex while using marijuana were homosexuals or bisexuals. Marijuana also affected the

Table 2

Reported Marijuana Enhancement of Sexual Activities

	Men (n = 60) %	Women (n = 37) %
Physiologic		
Quality of orgasm	58	32[a]
Duration of intercourse	27	8[b]
Number or orgasms	12	16
Ability to repeat	14	3
Partner Preference		
Desire for familiar partner	50	60
Desire for unfamiliar partner	43	13[c]
Desire for multiple partners	12	3
Desire for homosexual partner[d]	7	3
Sexual Enjoyment	(n = 40)	(n = 25)
Sexual pleasure and satisfaction	70	76
Emotional closeness and intimacy	46	63
Feeling of physical closeness	51	56
More snuggling	34	56
Marijuana is an aphrodisiac	44	50
Sensual Effects		
Touching	59	57
Taste	23	33
Smell	23	7
Hearing	17	11
Sight	11	7

[a] $\chi^2(1\ N = 97) = 6.1; p$ .025.
[b] $\chi^2(1\ N = 97) = 5.0; p$ .05.
[c] $\chi^2(1\ N = 97) = 9.4; p$ .001.
[d] All those reporting increased desire for partner of same sex were either homosexual or bisexual.

senses during sexual activity, with touch and taste being most often reported as enhanced.

The effects of alcohol, marijuana, and other drugs (a category that combined stimulants, sedatives, hallucinogens, and narcotics) on the initiation of sexual activity were compared and are summarized in Table 3. One third had used some drug immediately prior to their first sexual experience. Alcohol was more frequently used than both marijuana and other drugs. One half felt drug use had made them more willing to have intercourse the first time. About one half of both men and women had had unwanted intercourse (intercourse they did not seek and later regretted) at some time following drug use. Other drugs—not alcohol or marijuana—preceded unwanted intercourse most frequently. Many (32%) had never used drugs prior to intercourse other than alcohol and marijuana. Currently, they were more likely to use marijuana before intercourse than alcohol or other drugs. In fact, 76% had used marijuana as a preparation for intercourse, and 20% used it regularly for this purpose.

Table 3

Reported Effect of Marijuana, Alcohol, and Other Drugs on Initiation of Sexual Activity

	Male Users ($n = 60$) %	Female Users ($n = 37$) %	Total Users ($N = 97$) %
Marijuana prior to first intercourse	7	8	7
Alcohol prior to first intercourse	22	24	23
Other drugs prior to first intercourse	3	3	3
Any drug prior to first intercourse	32	35	33
Intoxicant made more willing on first intercourse[a]	50	50	50
Marijuana led to unwanted intercourse	11	5	9
Alcohol led to unwanted intercourse	13	16	14
Other drugs led to unwanted intercourse	22	27	24
Unwanted intercourse secondary to drugs	46	48	47
Never marijuana prior to intercourse	3	0	2
Never alcohol prior to intercourse	7	3	5
Never other drugs prior to intercourse	29	38	32
Alcohol prior to intercourse > 25%	9	17	12
Marijuana prior to intercourse > 25%	24	24	24
Other drugs prior to intercourse > 25%	0	3	1
Marijuana part of preparation for intercourse ever[b]	80	71	76
Marijuana as part of preparation for intercourse > 25%[b]	20	21	20

[a]Includes only those using intoxicants before first intercourse, $n = 32$.
[b]Includes reduced number of users answering question, $n = 65$.

Discussion

In general, these regular marijuana users report that marijuana use enhanced their sexual lives. Almost all had used marijuana prior to intercourse, and many had incorporated marijuana use into part of their preparation for intercourse on a routine basis. There were some significant sex-related differences in the extent various parameters were enhanced. This may correspond to underlying male/female differences in sexual response or differences in sexual expectations between the sexes. There was not a significant increase in the reported number of orgasms experienced or ability to repeat intercourse. Despite reported enhancement of sexual experience and early use of marijuana by many of these subjects, marijuana did not play a large role in initiating first sexual activity.

Explanations for the apparent aphrodisiac-like effects of marijuana have been previously discussed. However, there may be other explanations as well. For example, some constituent of marijuana may have a direct stimulating effect on centers in the brain that control sexual activity. Marijuana has been shown to alter plasma testosterone in mice (Dalterio, Bartke, & Mayfield, 1981) and men (Kolodny, Masters, Kolodner, & Toro, 1974). Further research

is needed to determine what effects such altered testosterone levels may have on sexual pleasure and behavior in humans.

The sample for this study consisted of young, white, middle-class adults who had used marijuana regularly. Results should be generalizable to similar groups. This study is not directly comparable to previous studies because of design differences. In this study, subjects were not exclusively college students. Also an interview format was used instead of anonymous questionnaires. However, results of questionnaire studies of college students are compatible with the current study; that is, individuals who use marijuana report a positive effect on sexual activity. However, to date there has been little work studying marijuana's effect on the sexual behavior of other groups, such as older marijuana users, lower-class marijuana users, or marijuana users in various minority groups. The results of this study may not be generalizable to such groups. Further work is needed to determine if the effects of marijuana on sexual behavior reported here are seen in broader populations.

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Issue Consultants

The following individuals, in addition to members of the Editorial Board, have recently served as reviewers. Their advice is greatly appreciated.

Susan Bond	Douglas E. Mould
Edward Brecher	Diane Phillis
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Gale Golden	David A. Shore
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Joseph LoPiccolo	Josephine F. Singer
Allan Mazur	Charles Winick

Editor's Comment

I also want to thank Rebecca L. Sargent for her many contributions to the *Journal* during the past 4 years. She was hired as a part-time typist at the beginning of her freshman year at Syracuse University. Although her title never changed (and the remuneration improved very little), she became an errand runner, proofreader, copy editor, editorial assistant, co-worker, and friend, not to mention a student member of SSSS. Her independence, initiative, and sense of responsibility have been of inestimable value to me over the years. I shall miss her greatly as she moves on to graduate school next year. I, personally and on behalf of SSSS, wish her happiness and success in her endeavors.

Cross-over Cannabis Scientific Research Related to Cannabis Treating Female Orgasmic Difficulty/Disorder (FOD) Co-morbid Conditions of Post Traumatic Stress Disorder (PTSD) and Anxiety

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NOTE: Hypervigilance, anxiety, and post-traumatic stress disorder are responses of the amygdala (Rabinak et al., 2020) and commonly impair sexual response (Corretti & Baldi, 2007; Yehuda et al., 2015).

Summary: Randomized double-blinded, placebo-controlled study found that in adults with PTSD, Δ9-tetrahydrocannabinol (THC) lowered threat-related amygdala reactivity, increased medial prefrontal cortex (mPFC) activation during threat, and increased mPFC - amygdala functional coupling. Low doses of THC can produce anxiolytic effects, reduce threat-related amygdala activation, and enhance functional coupling between the amygdala and medial prefrontal cortex and adjacent rostral cingulate cortex (mPFC/rACC) during threat processing in healthy adults.

Conclusions: These preliminary data suggest that THC modulates threat-related processing in trauma-exposed individuals with PTSD, which may prove advantageous as a pharmacological approach to treating stress- and trauma-related psychopathology

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Summary: The Releaf App® mobile software application (app) data was used to measure self-reported effectiveness and side effects of medical cannabis used under naturalistic conditions. Releaf App® responders used cannabis to treat myriad health symptoms, the most frequent relating to pain, anxiety, and depressive conditions. Significant symptom severity reductions were reported for all the symptom categories, with mean reductions between 2.8 and 4.6 points (ds ranged from 1.29–2.39, ps < 0.001). On average, higher pre-dosing symptom levels were associated with greater reported symptom relief, and users treating anxiety or depression-related symptoms reported significantly more relief (ps < 0.001) than users with pain symptoms.

Conclusion: Patient-managed cannabis use is associated with clinically significant improvements in self-reported symptom relief for treating a wide range of health conditions, along with frequent positive and negative side effects.

Stith, S. S., Vigil, J. M., Brockelman, F., Keeling, K., & Hall, B. (2018). Patient-reported symptom relief following medical cannabis consumption. *Frontiers in Pharmacology*, *9*. https://doi.org/10.3389/fphar.2018.00916

Summary: Results: At low doses, THC can enhance the extinction rate and reduce anxiety responses. Both effects involve the activation of cannabinoid type-1 receptors in discrete components of the corticolimbic circuitry, which could counterbalance the low "endocannabinoid tonus" reported in PTSD patients. The advantage of associating CBD with THC to attenuate anxiety while minimizing the potential psychotic or anxiogenic effect produced by high doses of THC has been reported. The effects of THC either alone or combined with CBD on aversive memory
reconsolidation, however, are still unknown.

Conclusions: Current evidence from healthy humans and PTSD patients supports the THC value to suppress
anxiety and aversive memory expression without producing significant adverse effects if used in low doses or when
associated with CBD. Future studies are guaranteed to address open questions related to their dose ratios,
administration routes, pharmacokinetic interactions, sex-dependent differences, and prolonged efficacy.

Citation: Raymundi, A. M., da Silva, T. R., Sohn, J. M. B., Bertoglio, L. J., & Stern, C. A. (2020). Effects of Δ9-tetrahydrocannabinol on aversive memories and anxiety: A review from human studies. *BMC Psychiatry, 20*(420). https://doi.org/10.1186/s12888-020-02813-8

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Psychopharmacology
https://doi.org/10.1007/s00213-020-05499-8

ORIGINAL INVESTIGATION

Cannabinoid modulation of corticolimbic activation to threat in trauma-exposed adults: a preliminary study

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Abstract

Rationale Excessive fear and anxiety, coupled with corticolimbic dysfunction, are core features of stress- and trauma-related psychopathology, such as posttraumatic stress disorder (PTSD). Interestingly, low doses of Δ^9-tetrahydrocannabinol (THC) can produce anxiolytic effects, reduce threat-related amygdala activation, and enhance functional coupling between the amygdala and medial prefrontal cortex and adjacent rostral cingulate cortex (mPFC/rACC) during threat processing in healthy adults. Together, these findings suggest the cannabinoid system as a potential pharmacological target in the treatment of excess fear and anxiety. However, the effects of THC on corticolimbic functioning in response to threat have not be investigated in adults with trauma-related psychopathology.

Objective To address this gap, the present study tests the effects of an acute low dose of THC on corticolimbic responses to threat in three groups of adults: (1) non-trauma-exposed healthy controls (HC; $n = 25$), (2) trauma-exposed adults without PTSD (TEC; $n = 27$), and (3) trauma-exposed adults with PTSD ($n = 19$).

Methods Using a randomized, double-blind, placebo-controlled, between-subjects design, 71 participants were randomly assigned to receive either THC or placebo (PBO) and subsequently completed a well-established threat processing paradigm during functional magnetic resonance imaging.

Results In adults with PTSD, THC lowered threat-related amygdala reactivity, increased mPFC activation during threat, and increased mPFC-amygdala functional coupling.

Conclusions These preliminary data suggest that THC modulates threat-related processing in trauma-exposed individuals with PTSD, which may prove advantageous as a pharmacological approach to treating stress- and trauma-related psychopathology.

Keywords Cannabinoid · Prefrontal cortex · Amygdala · PTSD · Threat processing

Introduction

Self-medication with *Cannabis sativa* to relieve negative affective symptoms, like anxiety, is common in individuals with posttraumatic stress disorder (PTSD) and related disorders (Bolton et al. 2009; Bowles 2012; Bujarski et al. 2012; Boden et al. 2013; Walsh et al. 2017; O'Neil et al. 2017). Cannabis exerts its anxiolytic effects via the psychoactive component, Δ^9-tetrahydrocannabinol (THC), which acts as an agonist on cannabinoid type-1 receptors (CB1Rs) in the brain (Viveros et al. 2005a). Importantly, the engagement of the endocannabinoid (ECB) system in the brain plays a critical role in fear-related learning and memory (Ruehle et al. 2012). For instance, animal models show that acute systemic THC administration reduces the behavioral expression of fear following exposure to a stressor (e.g., physical restraint; Patel et al. 2005). Conversely, CB1R blockade via systemic

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pharmacological administration of a CB1R antagonist or CB1R genetic deletion increases anxiety-related behaviors in the elevated plus maze (Haller et al. 2002) and interferes with successful extinction of conditioned fear responses (Marsicano et al. 2002; Chhatwal et al. 2005; Pamplona and Takahashi 2006; Bitencourt et al. 2008; Lin et al. 2009). Given that fear and anxiety are central features of PTSD and other stress-related pathologies, these observations have prompted interest in using THC and other ECB modulators to alleviate PTSD symptoms (Trezza and Campolongo 2013; Patel et al. 2017).

Corticolimbic brain regions, including the amygdala, medial prefrontal cortex and adjacent rostral anterior cingulate cortex (mPFC/rACC), are involved in threat processing; however, individuals with PTSD often display dysfunction within and between these regions. This dysfunction is thought to be a mechanism by which acute stress responses following trauma exposure persist and develop into psychopathology (Etkin and Wager 2007; Fenster et al. 2018). The amygdala, for instance, which encodes threat-related information and generates fear responses (LeDoux 2000), is hyperactive in PTSD in response to trauma-related imagery (Shin et al. 1997, 2004), combat-related sounds or smells (Liberzon et al. 1999; Pissiota et al. 2002; Vermetten et al. 2007), trauma-related photographs or words (Driessen et al. 2004; Neumeister et al. 2017), and threatening facial expressions (Rauch et al. 2000; Shin et al. 2005; Williams et al. 2006; Bryant et al. 2008; Simmons et al. 2011; Stevens et al. 2013; Killgore et al. 2014; Badura-Brack et al. 2018). Exaggerated amygdala reactivity is likely due, in part, to insufficient top-down regulation from the mPFC/rACC, consequently leading to hyperarousal and an inability to suppress attention and responses to trauma-related stimuli (Pitman et al. 2001; Liberzon and Martis 2006; Garfinkel and Liberzon 2009; Fenster et al. 2018; Andrewes and Jenkins 2019). Indeed, lower functional connectivity between the amygdala and mPFC/rACC during threat processing has been reported in patients with PTSD relative to healthy individuals (Stevens et al. 2013; Wolf and Herringa 2016).

Interestingly, CB1Rs are highly abundant in these regions of the corticolimbic system (Tsou et al. 1998; Marsicano and Lutz 1999; Patel et al. 2017) and recent neuroimaging studies in healthy adults show that THC modulates activity in the amygdala and mPFC/rACC. Specifically, an acute oral low dose of THC (7.5 mg) reduced amygdala reactivity, but enhanced coupling between the amygdala and mPFC/rACC, to social threat (i.e., fearful and angry facial expressions), as compared to placebo (PBO; Phan et al. 2008; Gorka et al. 2015). These findings suggest that pharmacological enhancement of ECB signaling may help to address corticolimbic dysfunction in PTSD and other stress-related disorders. However, it should be noted that others have reported that administration of THC, particularly at a higher dose (10 mg), increases amygdala activation (Bhattacharyya et al. 2010, 2017) and modulates activation in frontal and parietal regions (Fusar-Poli et al. 2009), while increasing levels of anxiety and autonomic arousal to fearful faces (Fusar-Poli et al. 2009; Bhattacharyya et al. 2010, 2017). These divergent findings highlight the complexity of THC's effect on threat responding that may be bimodal, such that low doses of THC may be anxiolytic (Wachtel et al. 2002), whereas higher doses of THC are typically anxiogenic (D'Souza et al. 2004; Genn et al. 2004; Viveros et al. 2005b; Bhattacharyya et al. 2015, 2017). To date, the effects of THC on corticolimbic responses to threat have only been conducted in healthy individuals. Thus, it is unclear whether the observed effects of THC on corticolimbic function and functional connectivity would replicate in individuals with trauma exposure who are at risk for developing PTSD and/or meet criteria for PTSD.

To address this gap, the present study tests the effects of an acute oral low dose of THC on corticolimbic activation and functional coupling to social threat in three groups of adults: (1) non-trauma-exposed healthy controls (HC), (2) trauma-exposed adults without PTSD (TEC), and (3) trauma-exposed adults with PTSD (PTSD).

Materials and methods

Participants

Eighty-six right-handed individuals met pre-screening eligibility and were enrolled in the present study. Of the 86, a total of 15 were subsequently excluded (see Fig. 1 for summary); thus, $N = 71$ participants were included in our final analyses (20–45 years of age; 36 females; see Table 1). Participants were recruited from the Detroit community via print and online advertisements and flyers. Full exclusionary criteria, comorbid psychiatric conditions, and daily medication usage are presented in Online Resource 1. All participants gave written informed consent after explanation of the experimental protocol, as approved by the Wayne State University Institutional Review Board. Of note, this study is part of a larger study investigating the effects of THC on fear extinction in participants with PTSD (NCT02069366).

Trauma-related psychopathology

The Life Events Checklist for DSM-5 (LEC-5) was used to identify potentially traumatic events in the participants' lifetime (Weathers et al. 2013a) and total number of different types of traumatic events experienced and witnessed were used as an index of trauma load. A total of 65 of the $N = 71$ participants endorsed prior trauma exposure, and of these, $N = 46$ had endorsed a traumatic event that met Criterion A per the Diagnostic and Statistical Manual of Mental Disorders (DSM-

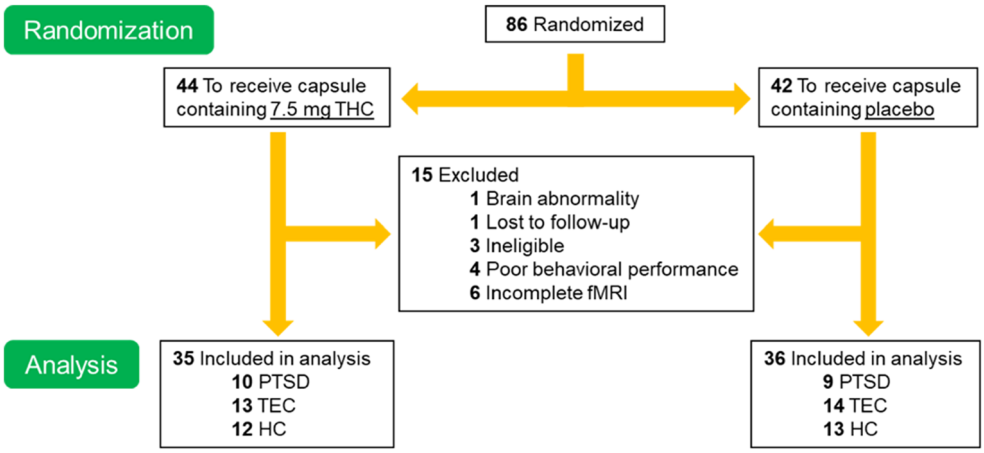

Fig. 1 Screening and randomization breakdown of the present study. Eighty-six individuals that met inclusion criteria were randomized to THC or PBO. Of the 86, a total of 15 were subsequently excluded for the following reasons: 3 were ineligible based on participation criteria (i.e., positive drug screening, recently diagnosed mood disorder after enrollment), 4 had poor behavioral task performance (< 50% accuracy for shapes trials), 6 had incomplete functional magnetic resonance imaging (fMRI) data (i.e., did not complete scan or task, scanner malfunction), 1 participant's structural MRI showed a brain abnormality, and 1 participant was lost to follow-up. Seventy-one participants had complete and reliable data to use for analyses. PTSD posttraumatic stress disorder, TEC trauma-exposed controls, HC healthy controls, PBO placebo, THC Δ^9-tetrahydrocannabidiol

5; American Psychiatric Association 2013). Of the 46 Criterion A-exposed individuals, 22 were classified as meeting criteria for PTSD using The Clinician-Administered PTSD Scale for Diagnostic and Statistical Manual of Mental Disorders (CAPS-5; Weathers et al. 2013b), by either meeting CAPS-5 diagnostic criteria or having CAPS-5 PTSD

Table 1 Participant demographics

	THC ($n = 35$)				PBO ($n = 36$)				p value
	PTSD ($n = 10$)	TEC ($n = 13$)	HC ($n = 12$)	Total	PTSD ($n = 9$)	TEC ($n = 14$)	HC ($n = 13$)	Total	
Age (mean years, SD)	26.00 (5.46)	28.31 (7.42)	24.33 (2.53)	26.29 (5.69)	23.33 (3.08)	26.43 (7.08)	26.85 (6.66)	25.81 (6.17)	0.852
Gender (n, female)	9	5	5	*19*	5	8	4	*17*	0.552
Race (n)									0.803
African American	2	4	0	*6*	1	3	2	*6*	
Asian	1	3	5	*9*	1	4	4	*9*	
American Indian/Alaskan Native	0	1	0	*1*	0	0	0	*0*	
Caucasian	6	5	7	*18*	6	5	7	*18*	
More than one race	1	0	0	*1*	1	1	0	*2*	
Other	0	0	0	*0*	0	1	0	*1*	
Hispanic or Latino (n)	1	1	0	*2*	0	1	2	*3*	0.468
PTSD severity (CAPS-5)									
Total severity score (mean, SD)	33.60 (10.95)	2.69 (5.15)	–	*11.60* (*15.76*)	34.11 (6.83)	4.00 (6.08)	–	*11.11* (*15.15*)	0.993
Number of clinically significant symptoms (mean, SD)	11.20 (2.57)	0.92 (2.29)	–	*3.83* (*5.19*)	12.33 (2.87)	1.14 (2.03)	–	*3.83* (*5.60*)	0.618
Cannabis use									
Used in the past 30 days (n)	3	3	1	*7*	2	1	0	*3*	0.189
Occasions (mean, SD)	2.00 (1.00)	1.00 (1.00)	10.00 (0.00)	*3.00* (*3.21*)	17.00 (18.00)	1.00 (0.00)	–	*11.67* (*15.95*)	0.446
Occasions lifetime (n)									0.288
Never	1	5	7	*13*	4	5	7	*16*	
1–10	1	4	2	*7*	1	4	4	*9*	
11–50	6	1	1	*8*	2	5	1	*8*	
51–100	0	2	0	*2*	0	0	0	*0*	
< 100	2	1	2	*5*	2	0	1	*3*	

Items in italics either refer to the highest category of demographics (age, gender, race, ethnicity, PTSD severity, or cannabis use) or the total number of participants/mean age across the three subgroups (PTSD/TEC/HC). Reported p values are between-drug group comparisons

THC Δ^9-tetrahydrocannabinol, *PBO* placebo, *PTSD* posttraumatic stress disorder, *TEC* trauma-exposed control, *HC* healthy control, *CAPS-5* Clinician-Administered PTSD Scale for DSM-5

symptom severity scores ≥ 25. Twenty-four participants did not reach criteria for PTSD diagnosis or had severity scores < 25 and, thus, were labeled as TEC. Nineteen participants endorsed at least one traumatic event on the LEC-5 without any meeting Criterion A per the DSM-5. These participants, plus six that denied any exposure to a traumatic event over their lifetime, were therefore labeled as HC ($N = 25$). Importantly, HC, TEC, and PTSD groups did not differ in age, gender distribution, or race/ethnicity (p's > 0.4) (see Online Resource 1 for analyses comparing trauma load between groups). In addition, analyses comparing PTSD symptom severity and number of PTSD symptoms between PTSD and TEC were conducted and results can be found in Online Resource 1.

Drug groups

Participants were randomized to receive either THC (dronabinol; 7.5 mg capsule; Ascend Laboratories, LLC, Parsippany, NJ) or a matching capsule containing only dextrose (PBO). This dose was previously found to reduce amygdala reactivity to threat in healthy volunteers, without affecting activity in primary visual or motor cortices (Phan et al. 2008). Importantly, the drug was administered evenly across groups ($\chi^2(2) = 0.116$, $p = 0.944$) and individuals receiving THC vs. PBO did not differ in sociodemographic factors or PTSD symptom severity (see Table 1, Fig. 1). Self-reported cannabis use did not significantly differ between drug groups and did not affect the behavioral or brain results (see Online Resource 1).

Procedure

Participants ingested a capsule containing either PBO ($N = 36$) or THC ($N = 35$) by mouth approximately 120 min prior to the fMRI scan, which corresponds to the anticipated peak drug effects (Wachtel et al. 2002). The study's principal investigator (CAR) performed drug randomization, and participants and research staff were blinded to the contents of the capsule and subsequent drug grouping.

Threat processing task

During fMRI scanning, participants completed an emotional face processing task developed by Hariri and colleagues (Hariri et al. 2002) that has been shown to reliably elicit threat-related amygdala responses. This social threat task has been extensively used in previous pharmacological fMRI studies (Hariri et al. 2002; Paulus et al. 2005; Tabbert et al. 2005) and consists of photographs of angry, fearful, and happy facial expressions of an equal number of adult male and female actors. During a given trial, participants were presented with a trio of faces selected from the validated Gur stimulus set (Gur et al. 2002). Participants were instructed to select which one of two bottom faces matched the expression of the top target face. The third, distracter face, was a neutral face. All three faces in a given trial were of different actors.

The task was administered in a block design, such that six blocks of each target expression (angry, fearful, happy) were presented. To allow for amygdala reactivity to return to baseline, blocks of shapes matching trials were interleaved with emotion blocks. During shapes trials, participants were instructed to match simple geometric shapes (i.e., circles, rectangles, or triangles). Of note, no target stimuli were repeated within or across blocks. This task design allows us to explore valid contrasts of social threat (angry and fearful faces) vs. shapes and non-threat (happy faces vs. shapes). The task lasted a total of 12 min, broken into two 6-min runs, with a total of 36 blocks (18 emotional faces, 18 shapes). Block order was counterbalanced across runs, and each 20-s block consisted of four 5-s trials.

Behavioral data

Accuracy and reaction time were measured for each condition. We performed a drug (PBO vs. THC) × group (PTSD vs. TEC vs. HC) × condition (threatening faces vs. non-threatening faces vs. shapes) ANOVA to test for main effects or interactions on accuracy and reaction time, using SPSS software (IBM SPSS Statistics 26). When needed, for each analysis, we applied the Greenhouse-Geisser correction (if the probability of Mauchly's test of sphericity was less than 0.05). Significant main effects and interactions were followed up by t tests, and all results were considered significant at $p < 0.05$ (two-tailed), Bonferroni corrected for multiple comparisons.

Subjective anxiety ratings and drug effects

We collected subjective anxiety ratings using the State-Trait Anxiety Inventory (STAI state anxiety; Spielberger 1983) and Visual Analog Scales (VAS; Folstein and Luria 1973) (see Online Resource 1 for details regarding these measures and results (Figs. S1 and S2)).

fMRI

Data collection MRI data were collected on a 3-T Siemens MAGNETOM Verio scanner with a 32-channel head coil at the Wayne State University MR Research Facility (see Online Resource 1 for scanning parameters).

Preprocessing fMRI data were analyzed using SPM8 software (Wellcome Department of Cognitive Neurology, London, UK; http://www.fil.ion.ucl.ac.uk/spm). The following preprocessing steps were applied, in order: (1) distortion correction, (2) realignment to the first image, (3) slice timing

correction, (4) coregistration, (5) normalization to MNI space, (6) reslicing, and (7) spatial smoothing (6-mm FWHM Gaussian kernel). Data from 71 participants met criteria for high quality and scan stability with minimum motion correction and were subsequently included in the analyses (Online Resource 1).

Anatomically defined left and right amygdala were tested separately and defined using the AAL atlas (Tzourio-Mazoyer et al. 2002; Fig. 2a). For better anatomic localization in the amygdala, we also examined activation within cytoarchitectonically defined amygdala subregions (basolateral [BL], centromedial [CM], superficial [SF], amygdalostriatal [AStr]) as defined in the SPM Anatomy Toolbox (Eickhoff et al. 2005; Amunts et al. 2005; Fig. 2b). The mPFC/rACC was defined using a 10-mm radius sphere centered on coordinates reported in a previous study of acute THC administration in healthy adults during social threat ($x = 14$, $y = 42$, $z = 12$; Gorka et al. 2015; Fig. 2c). All coordinates in this report are given in MNI convention.

Analysis See Online Resource 1 for first-level model details. Following Phan et al. (2008), individual contrast maps for threatening (angry, fear) faces > shapes and non-threatening (happy) faces > shapes were estimated in SPM8 and subsequently submitted to second-level analyses in a random-effects statistical model (Friston et al. 1998). The first principal component of the activation within each region of interest

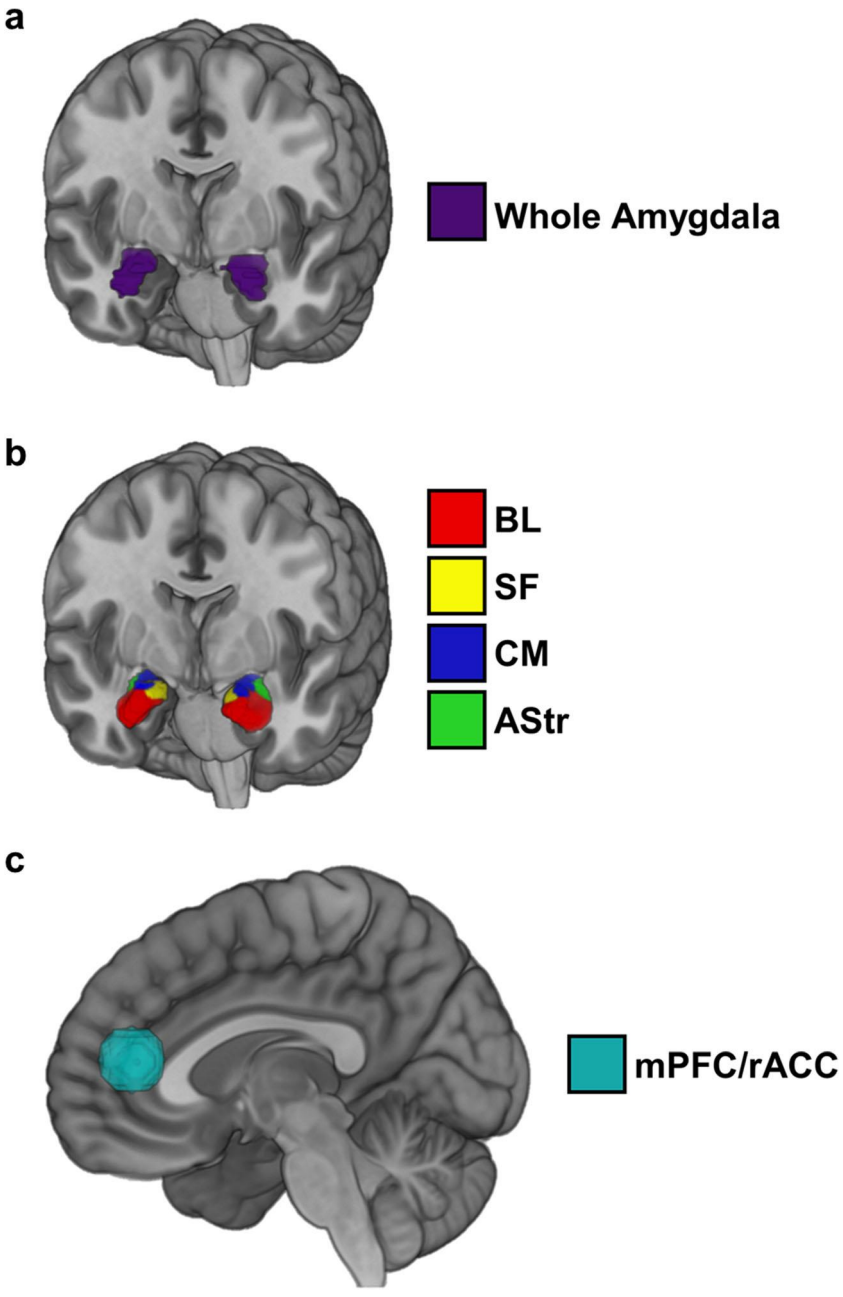

Fig. 2 Anatomically defined left and right amygdala using the AAL atlas (Tzourio-Mazoyer et al. 2002) (**a**), cytoarchitectonically defined amygdala subregions as defined in the SPM Anatomy Toolbox (Eickhoff et al. 2005; Amunts et al. 2005) (**b**), and mPFC/rACC defined using a 10-mm radius sphere centered on coordinates reported in a previous study of acute THC administration in healthy adults during social threat ($x = 14$, $y = 42$, $z = 12$; Gorka et al. 2015) (**c**). BL basolateral subdivision, SF superficial subdivision, CM centromedial subdivision, AStr amygdalostriatal subdivision, mPFC/rACC medial prefrontal cortex/rostral anterior cingulate cortex

(ROI) for the contrasts threatening faces vs. shapes and non-threatening faces vs. shapes was extracted for each participant.

For each ROI, a drug (PBO vs. THC) × group (PTSD vs. TEC vs. HC) × condition (threatening faces (vs. shapes) vs. non-threatening faces (vs. shapes)) repeated measures ANOVA was performed on the extracted first principal component β-estimates across the ROI, using SPSS software. When needed, for each analysis, we applied the Greenhouse-Geisser correction (if the probability of Mauchly's test of sphericity was less than 0.05). Significant main effects and interactions were followed up by *t* tests, and all results were considered significant at $p < 0.05$ (two-tailed), Bonferroni corrected for multiple comparisons. Within SPM8, a complementary whole-brain corrected threshold $pFWE < 0.05$ was used for exploratory purposes (see Online Resource 1 for whole-brain results).

Functional connectivity Functional connectivity of the mPFC/rACC was assessed using a generalized psychophysiological interaction analysis (gPPI; McLaren et al. 2012) in SPM8. First, we created an mPFC/rACC seed region using the same mPFC/rACC ROI described above for the activation analysis, and deconvolved the time series of that seed region with the HRF to put the seed time series in "neuronal space." Then, we created interaction terms (PPI) by multiplying the deconvolved time series from the mPFC/rACC with the onset times for threatening faces (vs. shapes) and non-threatening faces (vs. shapes). These PPIs were then used in a whole-brain regression, to obtain estimates of whole-brain voxelwise connectivity with the seed region during the task conditions. gPPI estimates were extracted from individual participant contrast images for mPFC/rACC connectivity during threat and non-threat using the anatomically defined left and right amygdala and cytoarchitectonically defined amygdala subregions described above. These gPPI estimates were entered into repeated measures ANOVAs using SPSS software. When needed, for each analysis, we applied the Greenhouse-Geisser correction (if the probability of Mauchly's test of sphericity was less than 0.05). Significant main effects and interactions were followed up by *t* tests, and all results were considered significant at $p < 0.05$ (two-tailed), Bonferroni corrected for multiple comparisons. Within SPM8, a complementary whole-brain corrected threshold $pFWE < 0.05$ was used for exploratory purposes (see Online Resource 1 for whole-brain results).

Results

fMRI

Activation A drug (THC, PBO) × group (HC, TEC, PTSD) × condition (threatening faces vs. shapes, non-threatening faces vs. shapes) ANOVA showed a significant main effect of condition in bilateral whole amygdala (left: $F(1,65) = 5.131$, $p = 0.027$; right: $F(1,65) = 4.396$, $p = 0.040$; Fig. 3a), which was further localized to the BL subdivision (left: $F(1,65) = 6.090$, $p = 0.016$; right: $F(1,65) = 4.538$, $p = 0.037$) and left AStr ($F(1,65) = 4.456$, $p = 0.039$). Compared to non-threatening faces (vs. shapes), amygdala responding (bilateral BL, left AStr, bilateral amygdala as a whole) was greater to threat (vs. shapes). There was also a significant main effect of group in the BL subdivision of the left amygdala ($F(2,65) = 5.032$, $p = 0.009$; Fig. 3b). Compared to the HC group, the TEC group showed greater left BL activation across conditions ($p = 0.007$); however, there were no differences between TEC and PTSD or PTSD and HC ($ps > 0.05$). Importantly, there was a significant main effect of drug in the BL and SF subdivisions of the left (BL: $F(1,65) = 7.182$, $p = 0.009$; SF: $F(1,65) = 4.740$, $p = 0.033$) and right (BL: $F(1,65) = 4.511$, $p = 0.037$; SF: $F(1,65) = 8.614$, $p = 0.005$) amygdala (Fig. 3c). Overall, THC *decreased* bilateral BL and SF activation compared to PBO.

There was a significant drug × group interaction in the mPFC/rACC ($F(2,65) = 4.887$, $p = 0.011$; Fig. 3d). Follow-up *t* tests showed that within the PBO group, the TEC group showed higher mPFC/rACC activation compared to both PTSD ($t(21) = 2.987$, $p = 0.007$) and HCs ($t(17.737) = 2.468$, $p = 0.024$). There was no difference in mPFC/rACC activation between the PTSD and HC groups that had received PBO. Notably, within the PTSD group, THC *increased* mPFC/rACC activation compared to PBO ($t(17) = 2.945$, $p = 0.009$). There were no significant differences in mPFC/rACC activation between PTSD, TEC, and HC groups that had received THC or between THC and PBO within the TEC and HC groups ($ps > 0.05$).

Finally, there was a significant three-way interaction (drug × group × condition) in the AStr subdivision of the right amygdala ($F(2,65) = 5.995$, $p = 0.004$; Fig. 3e). Follow-up *t* tests showed that within the PTSD group, THC *decreased* right AStr response to threat relative to PBO ($t(17) = 2.161$, $p = 0.045$). In the HC group, THC *decreased* right AStr response to non-threat relative to PBO ($t(23) = 2.662$, $p = 0.011$). There were no significant differences in AStr activation between drug groups within the TEC group for either condition (threat, non-threat) and no significant between group (HC, TEC, PTSD) differences for either condition ($ps > 0.05$). In our a priori regions of interest (i.e., mPFC/rACC, amygdala, and subregions), there were no significant drug × condition or group × condition interactions ($ps > 0.05$).

Functional connectivity A drug (THC, PBO) × group (HC, TEC, PTSD) × condition (threatening faces vs. shapes, non-threatening faces vs. shapes) ANOVA showed a significant main effect of group on functional connectivity between the

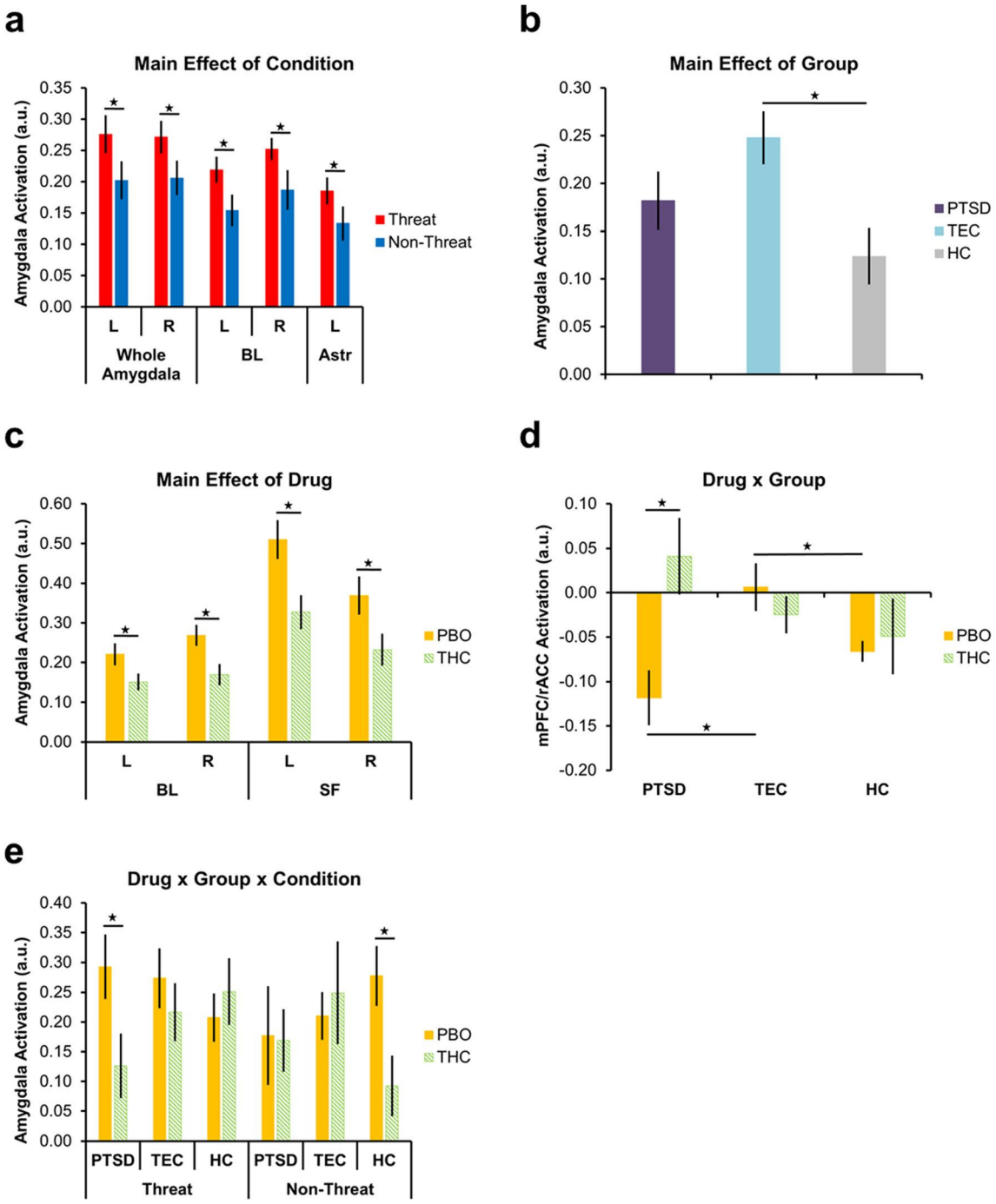

Fig. 3 Significant main effect of condition on right and left amygdala activation as a whole, the BL subdivision of the left and right amygdala, and the AStr subdivision of the left amygdala (**a**), main effect of group on activation in the BL subdivision of the left amygdala (**b**), main effect of drug on activation in the BL and SF subdivision of the left and right amygdala (**c**), drug × group interaction on activation in the mPFC/rACC (**d**), and drug × group × condition interaction on activation in the AStr subdivision of the right amygdala (**e**). Stars indicate significant within- and between-group differences in corticolimbic activation. Error bars represent standard error of the mean. L left, R right, BL basolateral subdivision, AStr amygdalostriatal subdivision, SF superficial subdivision, mPFC/rACC medial prefrontal cortex/rostral anterior cingulate cortex, PTSD posttraumatic stress disorder, TEC trauma-exposed control, HC healthy control, PBO placebo, THC Δ^9-tetrahydrocannabidiol, a.u. arbitrary units

mPFC/rACC and the right amygdala as a whole ($F(2,65) = 3.823$, $p = 0.023$; Fig. 4a). Compared to TEC, the PTSD and HC groups showed greater functional connectivity between the mPFC/rACC and right amygdala, as a whole, across conditions ($ps < 0.020$); however, there were no differences between PTSD and HC ($p > 0.05$). There was also a significant

group × condition interaction for mPFC/rACC functional connectivity with BL and SF subdivisions of the right amygdala (BL: $F(2,65) = 4.946$, $p = 0.010$; SF: $F(2,65) = 4.115$, $p = 0.021$; Fig. 4b). The group × condition interaction was driven by *increased* functional connectivity between the mPFC/rACC and right BL and SF to non-threat in the HC group compared to the TEC group (BL: $t(50) = 3.030$, $p = 0.004$; SF: $t(50) = 2.237$, $p = 0.030$). There were no significant

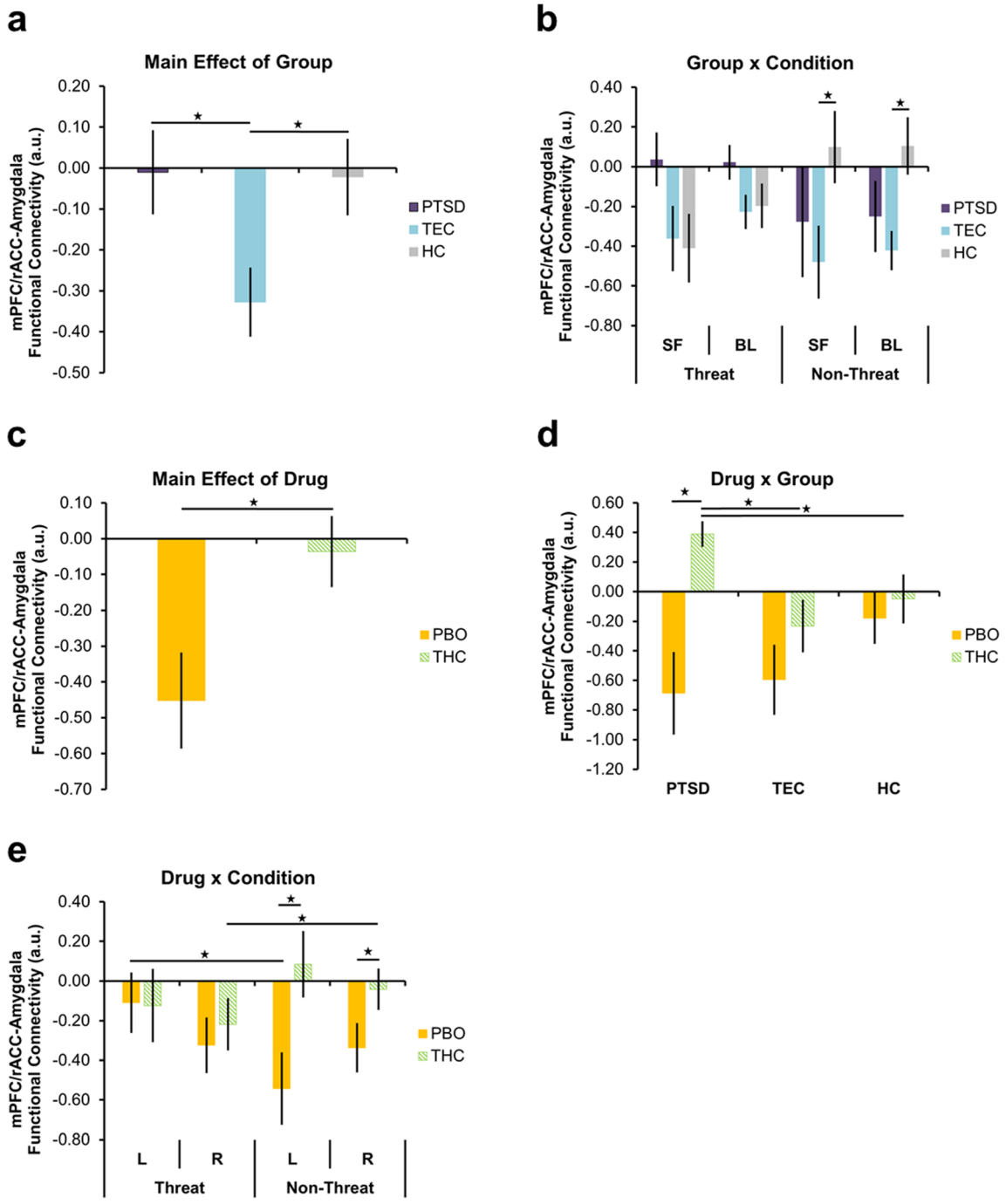

Fig. 4 Significant main effect of group on functional connectivity between the mPFC/rACC and right amygdala as a whole (**a**), group × condition interaction on functional connectivity between the mPFC/rACC and SF and BL subdivisions of the right amygdala (**b**), main effect of drug on functional connectivity between the mPFC/rACC and SF subdivision of the right amygdala (**c**), drug × condition interaction on functional connectivity between the mPFC/rACC and SF subdivision of the left and right amygdala (**d**), and drug × group interaction on functional connectivity between the SF subdivision of the right amygdala (**e**). Stars indicate significant within- and between-group differences in corticolimbic functional connectivity. Error bars represent standard error of the mean. L left, R right, mPFC/rACC medial prefrontal cortex/rostral anterior cingulate cortex, SF superficial subdivision, BL basolateral subdivision, PTSD posttraumatic stress disorder, TEC trauma-exposed control, HC healthy control, PBO placebo, THC Δ^9-tetrahydrocannabidiol, a.u. arbitrary units

differences to non-threat between PTSD and TEC or PTSD and HCs, nor to threat between any groups (*p*s > 0.05).

There was a significant main effect of drug on functional connectivity between the mPFC/rACC and the SF subdivision of the right amygdala ($F(1,65) = 8.181$, $p = 0.006$; Fig. 4c). Overall, THC *increased* functional connectivity between the mPFC/rACC and right SF compared to PBO. Moreover, there was a significant drug × condition interaction on mPFC/rACC functional connectivity with the SF subdivision of the left and right amygdala (left: $F(1,65) = 7.070$, $p = 0.010$; right: $F(1,65) = 7.675$, $p = 0.007$; Fig. 4d). Compared to PBO, THC *increased* functional connectivity between the mPFC/rACC and bilateral SF during the non-threat condition (left: $t(69) = 2.525$, $p = 0.014$; right: $t(59.556) = 3.165$, $p = 0.002$). There was no significant difference in mPFC/rACC-SF connectivity between THC and PBO during the threat condition (*p*s > 0.05). In the PBO group, mPFC/rACC-left SF functional connectivity to threat was *increased* compared to non-threat ($t(35) = 2.385$, $p = 0.023$), whereas, within the THC group, mPFC/rACC-right SF functional connectivity to threat was *decreased* compared to non-threat ($t(34) = 2.258$, $p = 0.030$).

Finally, there was a significant drug × group interaction for mPFC/rACC functional connectivity with the SF subdivision of the right amygdala ($F(2,65) = 3.719$, $p = 0.030$; Fig. 4e). Follow-up *t* tests showed no difference in mPFC/rACC-right SF functional between the groups (i.e., PTSD, TEC, HC) that received PBO (*p*s > 0.05). However, within the THC group, the PTSD group showed *increased* mPFC/rACC-right SF functional connectivity compared to both TEC ($t(21) = 2.869$, $p = 0.009$) and HCs ($t(16.381) = 3.039$, $p = 0.008$). Notably, within the PTSD group, THC *increased* mPFC/rACC-right SF functional connectivity compared to PBO ($t(9.539) = 3.673$, $p = 0.005$). There were no significant differences in mPFC/rACC-SF connectivity between THC and PBO within the TEC and HC groups (*p*s > 0.05). In our a priori regions of interest, there was no significant main effect of condition and no significant three-way interactions for mPFC/rACC-SF connectivity (*p*s > 0.05).

Behavioral

Accuracy A drug (THC, PBO) × group (HC, TEC, PTSD) × condition (threatening faces vs. non-threatening faces vs. shapes) ANOVA showed a significant main effect of condition on accuracy ($F(1.717,111.606) = 21.910$, $p < 0.001$). There were no significant main effects of drug or group, and no group or drug interactions on accuracy (*p*s > 0.05). Follow-up *t* tests revealed that accuracy was higher for non-threatening faces as compared to both threatening faces and shapes trials (*p*s < 0.001).

To test whether the observed main effect of condition remained significant within trauma-exposed participants alone, we ran two additional ANOVAs. First, we ran a drug (THC, PBO) × group (TEC, PTSD) × condition (threatening faces vs. non-threatening faces vs. shapes) ANOVA. The main effect of condition remained significant ($F(1.618,67.960) = 10.760$, $p < 0.001$). We found similar results when we took out the "group" factor and ran a drug (THC, PBO) × condition (threatening faces vs. non-threatening faces vs. shapes) ANOVA across trauma-exposed participants (i.e., TEC + PTSD; main effect of condition, $F(1.588,69.860) = 10.312$, $p < 0.001$).

Reaction time A drug (THC, PBO) × group (HC, TEC, PTSD) × condition (threatening faces vs. non-threatening faces vs. shapes) ANOVA showed a significant main effect of condition ($F(1.419, 92.234) = 149.226$, $p < 0.001$), such that reaction time was slower for threatening faces as compared to non-threatening faces and shapes trials (*p*'s < 0.001). In addition, reaction time to non-threatening faces was significantly slower as compared to shapes trials ($p < 0.001$). There were no significant main effects of drug or group and no significant drug or group interactions for reaction time (*p*s > 0.05).

As we did for accuracy, we ran two additional ANOVAs to test whether the observed main effect of condition remained significant within trauma-exposed groups. First, we ran a drug (THC, PBO) × group (TEC, PTSD) × condition (threatening faces vs. non-threatening faces vs. shapes) ANOVA. The main effect of condition remained significant ($F(1.473, 61.3863) = 93.007$, $p < 0.001$). We found similar results when we took out the "group" factor and ran a drug (THC, PBO) × condition (threatening faces vs. non-threatening faces vs. shapes) ANOVA across trauma-exposed participants (i.e., TEC + PTSD). The main effect of condition ($F(1.471,64.709) = 101.832$, $p < 0.001$) was significant. Interestingly, the drug × condition interaction became significant in the trauma-only subsample ($F(1.471, 64.709) = 3.713$, $p = 0.042$).

To further explore these potential drug effects in trauma-exposed individuals, we calculated a difference score, comparing reaction time to threatening–non-threatening (i.e., happy faces), with higher values indicating a slower response for threatening (vs. non-threatening) faces. We found that, relative to PBO, THC administration resulted in a faster response to threatening (vs. non-threatening; $t(44) = 2.121$; $p = 0.040$) faces (see Fig. 5). Similar results were observed for threatening faces vs. shapes ($F(1,44) = 5.337$; $p = 0.026$), suggesting that THC may reduce the observed slowing of response to threatening faces vs. non-threatening faces or shapes. There was no significant difference between drug groups for non-threatening faces vs. shapes ($F(1,44) = 1.559$; $p = 0.218$).

Discussion

We assessed the effects of an acute low dose of oral THC on threat-related corticolimbic activity and coupling in a

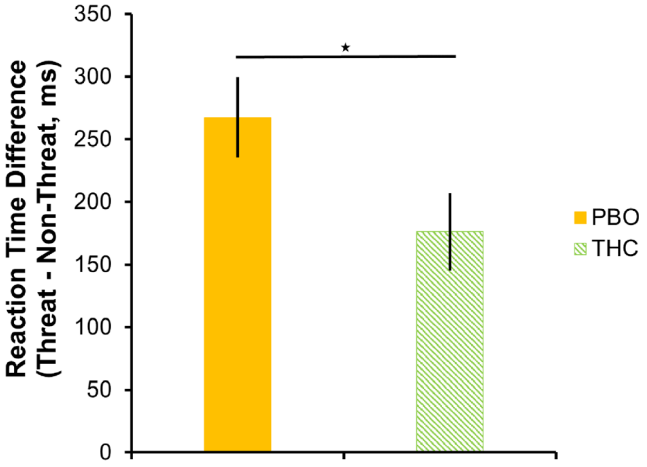

Fig. 5 Within trauma-exposed individuals (PTSD + TEC), relative to PBO, THC administration is associated with less slowing of response to threatening vs. non-threatening faces. Slowing in reaction time to threatening faces was calculated by subtracting reaction time to non-threatening faces from threatening faces, such that higher values indicate a slower response. Star indicates a significant between-group difference. Error bars represent standard error of the mean. PBO placebo, THC Δ^9-tetrahydrocannabidiol

preliminary study of Criterion A trauma-naïve and trauma-exposed adults, both with and without PTSD. Consistent with previous findings in healthy adults, we found that, within the PTSD group, THC attenuated amygdala activation, increased mPFC/rACC activation, and increased corticolimbic functional connectivity to threat compared to PBO (Phan et al. 2008; Gorka et al. 2015).

The amygdala is a region with a high density of CB1Rs and responds to threatening and other biologically relevant stimuli in the environment (Gläscher and Adolphs 2003; Goossens et al. 2009). Notably, we found that the modulatory effects of THC were localized to the BL, SF, and, in PTSD specifically, the AStr subdivisions of the amygdala. Amygdala subregions have distinct circuitry and specialized roles in emotion and threat-related processing (Hurlemann et al. 2008; Goossens et al. 2009; Kamprath et al. 2011; Boll et al. 2011). For instance, the BL integrates sensory information regarding threats and relays this information to the CM, which modulates physiological responses associated with fear and anxiety via dense interconnections with hypothalamic and midbrain regions (LeDoux 2000; Robinson et al. 2010; Pessoa 2011; Bzdok et al. 2013). Like the BL, the AStr subdivision also receives sensory information regarding threats and is interconnected with the BL and CM (Shammah-Lagnado et al. 1999; Wang et al. 2002). Indeed, rodent studies suggest that connections between the lateral amygdala and AStr subdivision are responsible for fast and accurate transmission of information that is critical for initial emotional reactivity (i.e., reflex; Wang et al. 2002). In contrast, information flow from the lateral amygdala to the BL, which is comparatively slower and less efficient, has been suggested to be important in facilitating signal integration and learning (Wang et al. 2002). The CM subdivision is involved in linking contextual information to emotional facial expressions in order to decipher the significance of the faces for the observer (Boll et al. 2011). Specifically, CM activation is greater in response to angry faces when the observer is told the anger is directed at him or her, than when the observer is told that the anger is directed at another person (Boll et al. 2011). Similarly, the SF is also involved in processing socially relevant stimuli, such as facial expressions (Hurlemann et al. 2008; Goossens et al. 2009; Eickhoff et al. 2011; Bzdok et al. 2013). Given that the administered task involved social threat, it is not surprising that we observed modulatory effects on BL, SF, and AStr amygdala subdivisions since they are largely involved in processing the socioemotional aspects of the stimuli.

Whereas THC blunted threat-related amygdala reactivity in the PTSD group, THC *increased* activation in the mPFC/rACC—a key region in emotion regulation, attentional control, and conflict monitoring (Etkin et al. 2011). A modulatory effect of THC on mPFC reactivity is consistent with the reported dense expression of CB1Rs in frontal regions (Tsou et al. 1998). In addition, increased amygdala-mPFC/rACC coupling has been reported in healthy individuals during threat processing following administration of THC (Gorka et al. 2015). Similarly, we found that THC (vs. PBO) *increased* mPFC/rACC-amygdala functional connectivity in the PTSD group, which is consistent with the known top-down control of the mPFC/rACC over amygdala reactivity (Quirk et al. 2003; Quirk and Beer 2006; Yizhar and Klavir 2018). For instance, mPFC/rACC activity increases while amygdala activity decreases during downregulation of negative affect, highlighting the oppositional role of these structures (Urry et al. 2006; Ochsner et al. 2012; Kohn et al. 2014; Buhle et al. 2014). Activation of CB1Rs in prefrontal brain regions terminates stress and threat-related behavioral responses, suggesting a mechanism by which prefrontal brain regions exert top-down inhibitory control of the amygdala (Hill et al. 2011).

Our behavioral analyses showed, overall, that accuracy was reduced and reaction times slowed when processing threatening faces relative to non-threatening faces or shapes. Interestingly, in trauma-exposed individuals alone, THC administration reduced the observed slowing of response to threatening faces vs. non-threatening faces or shapes. This finding may reflect a normalization of behavioral responses to threat that accompanies the observed THC-related modulation of underlying corticolimbic circuitry.

Limitations of this study warrant mention. First, although the fMRI session and task were approximately timed to occur

during peak blood levels of THC and its metabolites (120 min following ingestion), we did not collect blood samples to confirm that THC and its metabolites were at peak levels at the time of scanning. However, we did collect subjective drug effect ratings from participants across several time points following capsule administration to estimate peak subjective THC effects (Online Resource 1). Relative to PBO, those who received THC reported significantly higher ratings on "feeling a drug effect" and "feeling high" at 120- to 240-min post-drug administration, the latter time point being after the task was completed. Second, we examined acute effects of a single, low dose of THC on corticolimbic reactivity and behavior. There is differential sensitivity to the effects of THC and other cannabinoid modulators between individuals (Henquet et al. 2006; Bhattacharyya et al. 2012; Atakan et al. 2013) that cannot be controlled for by using the same dose across individuals. However, we were interested in replicating and extending previous studies, which used the same acute dose of THC in healthy participants (Phan et al. 2008; Gorka et al. 2015). Third, we included individuals with a wide history of self-reported cannabis use—from denying any use to reporting over 100 uses during their lifetime—rather than limiting our sample to non-users, as previous cannabis use could affect the ECB system (Colizzi et al. 2018; Colizzi and Bhattacharyya 2018). However, we re-ran all analyses in only participants that had reported no prior use of cannabis and our findings did not change. Self-reported prior cannabis use also did not affect self-reported anxiety and drug-effect ratings in the present study. Additionally, ECB changes associated with cannabis use can reverse rapidly starting within 2 days following abstinence (D'Souza et al. 2016). In our study, all participants had to screen negative on a urine drug test in order to participate, which means that if they did use cannabis, they would have had to abstain using anywhere from 3 to 30+ days prior to participating in the study (Verstraete 2004).

Together, these preliminary findings add to the growing body of literature suggesting that pharmacologic modulation of the ECB may be a promising approach for addressing corticolimbic dysfunction, which is a core feature of PTSD and stress-related psychopathologies.

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Compliance with ethical standards

All participants gave written informed consent after explanation of the experimental protocol, as approved by the Wayne State University Institutional Review Board.

Conflict of interest The authors declare that they have no conflicts of interest.

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RESEARCH ARTICLE Open Access

Effects of Δ^9-tetrahydrocannabinol on aversive memories and anxiety: a review from human studies

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Abstract

Background: Posttraumatic stress disorder (PTSD) may stem from the formation of aberrant and enduring aversive memories. Some PTSD patients have recreationally used *Cannabis*, probably aiming at relieving their symptomatology. However, it is still largely unknown whether and how *Cannabis* or its psychotomimetic compound Δ^9-tetrahydrocannabinol (THC) attenuates the aversive/traumatic memory outcomes. Here, we seek to review and discuss the effects of THC on aversive memory extinction and anxiety in healthy humans and PTSD patients.

Methods: Medline, PubMed, Cochrane Library, and Central Register for Controlled Trials databases were searched to identify peer-reviewed published studies and randomized controlled trials in humans published in English between 1974 and July 2020, including those using only THC and THC combined with cannabidiol (CBD). The effect size of the experimental intervention under investigation was calculated.

Results: At low doses, THC can enhance the extinction rate and reduce anxiety responses. Both effects involve the activation of cannabinoid type-1 receptors in discrete components of the corticolimbic circuitry, which could couterbalance the low "endocannabinoid tonus" reported in PTSD patients. The advantage of associating CBD with THC to attenuate anxiety while minimizing the potential psychotic or anxiogenic effect produced by high doses of THC has been reported. The effects of THC either alone or combined with CBD on aversive memory reconsolidation, however, are still unknown.

Conclusions: Current evidence from healthy humans and PTSD patients supports the THC value to suppress anxiety and aversive memory expression without producing significant adverse effects if used in low doses or when associated with CBD. Future studies are guaranteed to address open questions related to their dose ratios, administration routes, pharmacokinetic interactions, sex-dependent differences, and prolonged efficacy.

Keywords: *Cannabis*, Cannabidiol, Fear extinction, THC, Memory reconsolidation

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Background

Posttraumatic stress disorder

The formation of intense and long-lasting aversive memories after threatening or stressful events affects the individual's quality of life when it triggers the development of posttraumatic stress disorder (PTSD [1, 2];), which is categorized on the DSM-5 as a trauma- or stressor-related disorder [3]. After a traumatic event exposure, PTSD patients gradually present characteristic symptoms, such as increased anxiety, hyperarousal, and avoidance of cues associated with the trauma. The inappropriate expression of fear-related responses in non-risky situations is also frequent. Moreover, intrusive thoughts, nightmares, and resistance to extinguish the aversive/traumatic memory have been reported [4–6].

Fear memory extinction and reconsolidation

Fear extinction is a form of inhibitory learning that suppresses the expression of the original aversive/traumatic memory. As a consequence, individuals express less fear responses. In both laboratory animals and healthy humans, prolonged and repeated exposures to conditioned cues without presenting the aversive stimulus can induce it [7, 8]. Preclinical studies have shown that the extinction process requires activity and plasticity in several interconnected brain regions, including the infralimbic and prelimbic subregions of the medial prefrontal cortex [homologous to the human ventromedial prefrontal (vmPFC) and dorsal anterior cingulate (dACC) cortices, respectively], and some amygdala nuclei [9–11]. Specific PTSD psychotherapies (e.g., prolonged exposure therapy) are based on extinction learning [12]. Patients suffering from this psychiatric condition, however, often present extinction impairments [10, 13] accompanied by a hypoactive vmPFC [14, 15], hyperactive dACC and amygdala [14, 16–18], and a smaller and hypofunctional hippocampus [14, 18, 19]. The abnormal functioning of these brain regions could explain not only the hyperarousal and extinction deficits but also the increased responsiveness to trauma-unrelated stimuli leading to fear overgeneralization [20–22]. Noteworthy, over time, the original aversive/traumatic memory can spontaneously reemerge, which also limits the efficacy of the extinction approach [23].

Upon recall, a consolidated memory can become labile again and, thus, its content is destabilized and gradually reconsolidated after that, being susceptible to intervention-induced changes during this period. In both laboratory animals and healthy humans, short exposure to conditioned cues can induce memory destabilization and reconsolidation [24]. The neural substrate regulating this process and that underlying extinction is thought to be overlapping, yet distinct [24, 25]. Besides, the relative contribution of a given brain region in each case may vary. For instance, the rodent prelimbic cortex (dACC in humans) is more involved in aversive memory reconsolidation than extinction [11, 25–27]. The age and intensity of the memory are factors that influence the chance of destabilization upon retrieval in both laboratory and clinical settings [28–31]. Unlike extinction, however, changes in the original aversive/traumatic memory-related outcomes are permanent; therefore, impairing fear memory reconsolidation could have value for treating PTSD [32–35].

In preclinical studies, fear conditioning is a standard procedure for investigating the process of fear memory extinction and reconsolidation. It has a translational value from laboratory animals to healthy humans, and onwards to anxious/PTSD patients. However, the stimuli, the primary outcome measures, and the populations typically used differ between animal and human studies [36]. Besides, whereas in humans it is possible to assess the explicit and implicit aversive memory components, in laboratory animals, only implicit memory-related behavioral, autonomic, and hormonal measures can be assessed [37]. It should also be acknowledged that a strong aversive memory is not necessarily maladaptive. It is indispensable to evaluate not only qualitative but also quantitative aspects to infer whether the selected experimental protocol has indeed simulated one or more PTSD symptoms or features [37]. Similar considerations presumably apply while testing and modeling anxiety in rodents and humans [38, 39] and, thus, the interpretation and extrapolation of basic and clinical findings are not straightforward (Fig. 1).

Evidence for the role of the endocannabinoid system in PTSD and its treatment

A low "endocannabinoid tone" has been reported in PTSD patients. Relative to healthy controls, they present reduced circulating concentrations of anandamide and 2-arachidonoylglycerol (2-AG), and lower hair concentration of palmitoylethanolamide (PEA), oleoylethanolamide (OEA) and stearoylethanolamide (SEA) [40–42]. They also have up-regulated cannabinoid type 1 (CB1) receptor expression in the hippocampus, dACC, and amygdala, an alteration more pronounced in women than men [40]. The genetics research focusing on variants in the genes of the CB1 receptor and the fatty acid amide hydrolase (FAAH) enzyme, which metabolizes anandamide, has shown corresponding findings. A specific variant resulting in high expression of CB1 receptors can increase the risk of developing PTSD or anxiety-related disorders [43, 44]. However, studies in healthy volunteers have shown that a genetic variant resulting in a lower FAAH activity can influence stress reactivity and fear extinction, being protective against PTSD or anxiety-related disorders [45–47]. Despite the

advance in understanding PTSD neurobiology, the selective serotonin reuptake inhibitors (SSRIs) are mostly used to manage PTSD symptoms, with some benefit at best. Accordingly, most reviews have concluded that the benefit and effect sizes of these drugs are small [48–50]. Besides, PTSD comorbidities include anxiety and substance use disorders, making an effective treatment with SSRIs and psychotherapies even more challenging [51].

There is evidence relating *Cannabis* use in PTSD patients to relaxation, sleep improvement, attenuation of hyperarousal and anxiety [52–54], and reduced values in the Clinician Administered Posttraumatic Scale (CAPS [55];). Similarly, the results of open-label [56], populational [57], and double-blind placebo-controlled [56] studies have shown the benefits of using Δ^9-tetrahydrocannabinol (THC), its synthetic version dronabinol or its analog nabilone to manage insomnia and nightmares in PTSD patients. However, contradictory results have also been reported, leading some authors to question the value of this *Cannabis*-based approach [58–61]. Differences in dose, route of administration, treatment regimen, level of THC tolerance, and current and past stress may account for the mixed findings above-mentioned [62]. Of note, the potential effects of THC/dronabinol or nabilone on aversive memory extinction and reconsolidation are under investigation. In contrast, it is still unknown whether cannabidiol (CBD), the main compound of *Cannabis* devoid of psychotomimetic effects, can impair the reconsolidation of aversive memories and facilitate their extinction in humans [63, 64], although its anxiolytic action has already been reported [65–68]. Similarly, associating THC with CBD could be therapeutically advantageous, but studies focusing on extinction or reconsolidation of aversive/traumatic memories are still incipient.

Based on the above, the present review aims to discuss the effects of THC, its synthetic version dronabinol, or its analog nabilone when administered alone and combined with CBD, on the extinction of aversive memories and anxiety, a common PTSD symptom, in healthy humans and PTSD patients.

Methods

Design

A qualitative systematic review of the research literature was carried out to identify relevant studies addressing the topics of our review.

Study eligibility

Types of studies

Studies presenting primary data from controlled trials in healthy adults, anxious or PTSD patients that evaluated the effects of THC or its association with CBD on fear-related memories or anxiety responses, and published in English were included. The focus was on memory extinction/reconsolidation and anxiety-related responses.

Search strategy

Medline, PubMed, Cochrane Library and Central Register for Controlled Trials databases were searched using the keywords and MeSH terms [Δ^9-tetrahydrocannabinol/THC or THC and cannabidiol/THC and CBD] and [Fear extinction/memory extinction/fear memory/memory reconsolidation or anxiety] for human studies and controlled trials published between 1974 and July 2020 in the English language. The reference lists of articles included and previous systematic reviews were checked for relevant publications. Primary studies presenting data from oral or smoked THC or THC plus CBD effects on fear-related memory or anxiety were identified.

Data abstraction

Abstracts were identified and independently analyzed by two reviewers. Three reviewers independently conducted data extraction and coding disagreements arising were discussed, and consensus coding applied. The following information was extracted for each study: age, gender, the health status of subjects, drug(s) used, doses and its management, protocols adopted, and the main results found. Figure 2 depicts the summary of the search process and the study exclusion criteria.

Effect size calculation

Means, standard errors, and the number of subjects per group ("n") were collected to calculate the effect size of treatment in the selected studies (raw data are summarized in Table S1 and S2). When the study presented only the standard deviation as the dispersion measure, the standard error was calculated using the following formula: standard deviation divided by the square root of "n". When the means and the dispersion measure were depicted in the figure only, the measure tool from the Adobe Acrobat Reader® software was used to calculate them.

The effect size of behavioral results was calculated using the formula for Cohen's *d* to reflect the mean-difference (± 95% confidence interval) between two groups. A $d \geq 0.5$ and ≤ 0.8 was considered a medium effect size while a large one happened when $d > 0.8$ [69]. When the study did not present the dispersion measure or mention the "n" per group, the effect size was not calculated. The *d* values were all presented as positive values, and when the study presented repeated time points of the evaluated parameter, the *d* expressed in the text was the highest achieved.

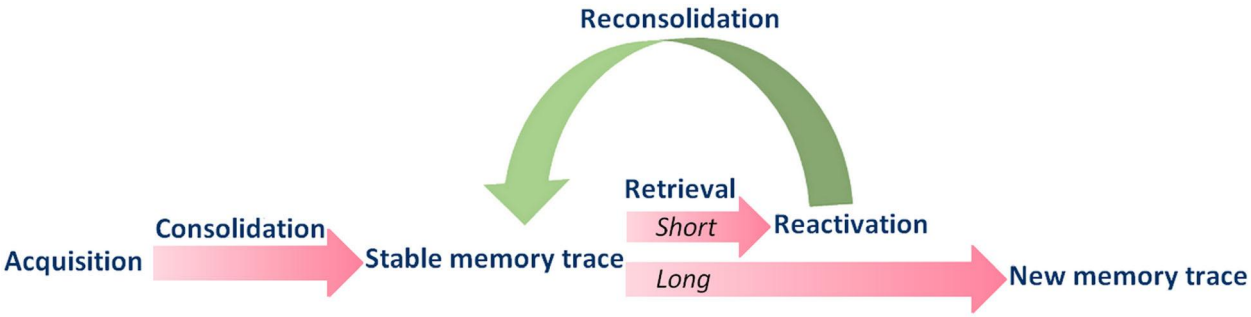

Fig. 1 The process of aversive memory formation, extinction, and reconsolidation. Immediately after an emotionally relevant experience, the acquired memory undergoes the gradual process of consolidation. Upon retrieval, a brief but sufficient conditioned stimulus exposure event induces memory reactivation or destabilization. In other words, the stable memory trace becomes labile again and, thus, its emotional content is modifiable until the reconsolidation stage is ended. Based on this, drugs aiming at interfering with reconsolidation can be administered after memory reactivation. After a prolonged or repeated period of memory retrieval, the extinction process is triggered, leading to the formation of a new memory trace that competes and inhibits the original aversive memory, reducing fear responses. Drugs that potentiate/facilitate memory extinction are usually administered before extinction learning. Other phases (e.g., consolidation) of memory extinction can also be targeted, although it has scarcely been explored. As reviewed here, low doses of THC attenuate aversive memory expression through anxiety reduction, extinction facilitation, and reconsolidation impairment (currently shown in laboratory animals only)

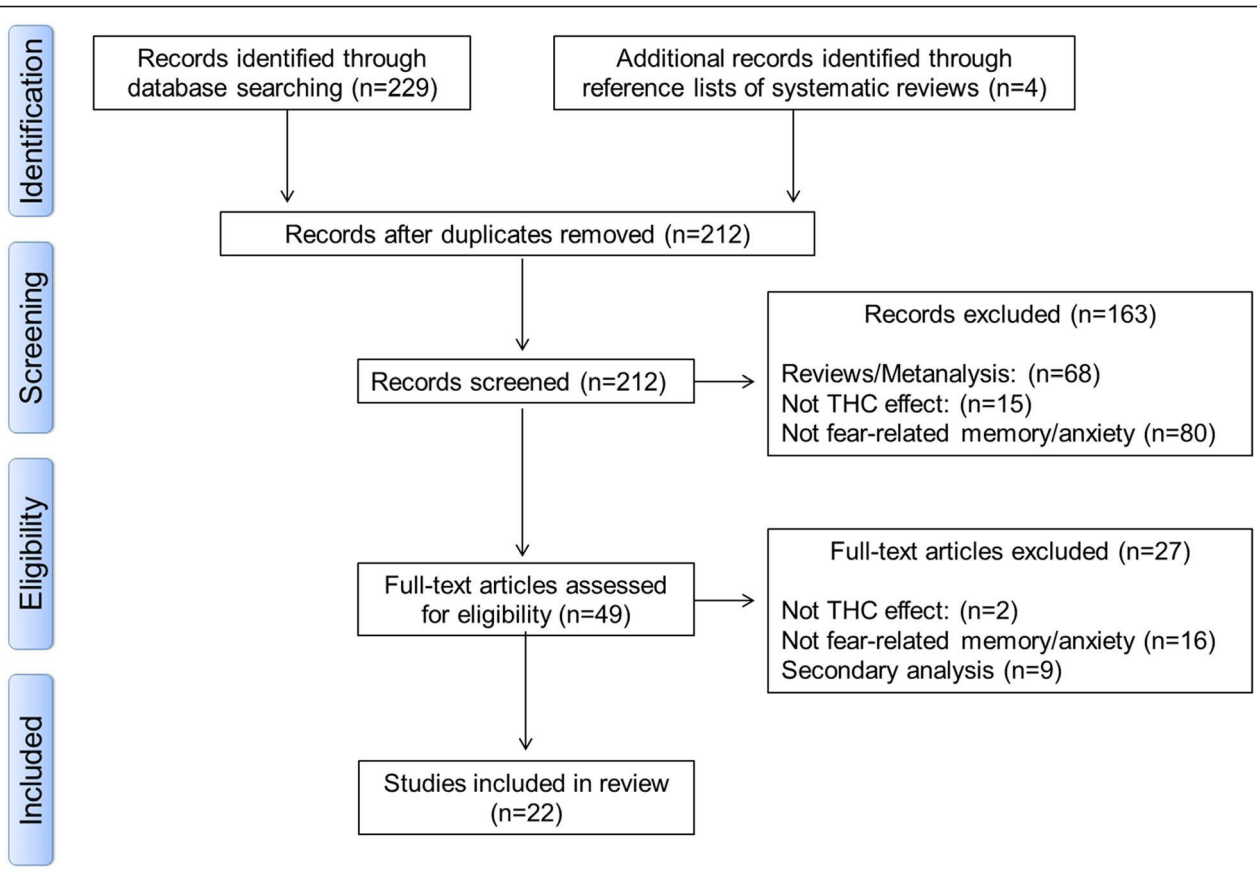

Fig. 2 Flowchart of the study selection procedure

Table 1 The effects of THC or its synthetic analogs on fear extinction and emotional memory processing

Drug, dose, treatment regimen, and route of administration	Study's design	Study's details and outcome measures	Main results	Sex	Age in years	Health status	Cannabis consume	Reference
Dronabinol 7.5 mg, acute, 2 h prior to EL, v.o.	Randomized, double-blind, placebo-controlled	Image presentation associated with sound presentation and SCR	↓ SCR 24 h after EL	♂ ♀	21–45	Healthy	Non-users	[70]
Dronabinol 7.5 mg, acute, 2 h prior to EL, v.o.	Randomized, double-blind, placebo-controlled,	fMRI scanning, resting-state functional connectivity analysis, and SCR	↑ vmPFC and hippocampus activation during EMR; ↓ Amygdala activity during early extinction learning; ↔ SCR	♂ ♀	21–45	Healthy	Non-users	[71]
Dronabinol 7.5 mg, acute, 2 h prior to EL, v.o.	Randomized, double-blind, placebo-controlled,	fMRI scanning and Resting-state functional connectivity analysis	↓ Recovery of fear after 24 h; ↓ Amygdala-hippocampus static functional connectivity; ↑ Amygdala-vmPFC dynamic functional connectivity	♂ ♀	21–45	Healthy	Non-users	[72]
Dronabinol 7.5 mg, acute, 2 h prior to EL, v.o.	Randomized, double-blind, placebo-controlled,	fMRI scanning and SCR	↓ vmPFC and amygdala responses and ↑ functional coupling between the vmPFC, hippocampus and dACC 1 week later; ↓ SCR in first extinction trials; ↓ SCR in EMR 24 h later; ↔ 1 week after the EL	♂ ♀	21–45	Healthy	Non-users	[73]
Dronabinol 10 mg, acute, 2 h prior to EL, v.o.	Double-blind, placebo-controlled,	FPS and SCR	↓ SCR during EL ↔ FPS	♂ ♀	18–30	Healthy	Non-users	[74]

Legend: ↑ = increase; ↓ = reduction; ↔ no changes; ♂ = male; ♀ = female; v.o.: via oral; *EL* Extinction learning; *EMR* Extinction memory recall; *FPS* Fear-potentiated startle; *vmPFC* Ventromedial prefrontal cortex; *dACC* Dorsal anterior cingulate cortex; *fMRI* Functional magnetic resonance imaging; *SCR* Skin conductance response

Results

Effects of THC/dronabinol on aversive memory extinction or reconsolidation

Table 1 summarizes the main findings from the five double-blind studies investigating the effects of an acute administration of dronabinol on aversive memory extinction in healthy men and women. Neither studies nor clinical trials investigating the THC/dronabinol effects on aversive/traumatic memory reconsolidation were identified.

Oral administration of 7.5 mg of dronabinol before fear extinction potentiated ($d = 0.81$) the extinction process in subjects submitted to a cued fear conditioning, as inferred by a reduced skin conductance response (SCR) during extinction recall 24 h later [70]. In a similar study [71], there were no dronabinol-induced SCR changes during extinction recall, even though it increased the activation of the vmPFC and hippocampus. In a subsequent study, dronabinol (7.5 mg/kg) attenuated the recovery of fear 24 h after extinction, and during a post-extinction resting period, the drug-treated subjects presented altered state brain dynamics (lowered amygdala-hippocampus static functional connectivity and increased amygdala-vmPFC dynamic functional connectivity) that were associated with a better extinction recall (d not calculated [72];).

Dronabinol effects on extinction have already been evaluated at a more remote time point. In the study by Hammoud et al., 2019 [73], subjects received 7.5 mg of this drug before extinction learning, and the retention test was performed both one and 7 days later. Dronabinol reduced the SCR during the extinction session ($d = 0.55$) and the retention test on day 1 ($d = 0.55$), but not on day 7. In the last case, however, the drug-treated group presented a significant increase in the functional coupling among the vmPFC, hippocampus, and dACC, which was associated with lower spontaneous recovery of fear. Moreover, healthy volunteers submitted to a neutral face presentation associated with an aversive sound and treated with 10 mg of dronabinol before extinguishing that association presented a transient reduction in SCR ($d = 0.58$), but unaltered fear-potentiated startle response [74].

In summary, in four of five studies, dronabinol induced significant changes in extinction-related autonomic or behavioral responses, with medium to large effect sizes (i.e., from 0.55 to 0.81). Therefore, this acute pharmacological intervention is associated with clinically relevant effects. There were no sex-dependent differences in dronabinol-induced facilitating effects on aversive memory extinction. However, such action will possibly require periodic associations of drug administration with extinction to be preserved. Noteworthy, the effects of repeated THC/dronabinol administration on aversive/traumatic memory extinction are still unknown. Despite the current knowledge about aversive memory reconsolidation and the well-documented role of the endocannabinoid system in this process in laboratory animals [75, 76], no human studies have addressed this question yet.

Effects of THC/dronabinol plus CBD on aversive memory extinction or reconsolidation

No human studies or clinical trials investigating the effects of associating THC with CBD on aversive/traumatic memory extinction or reconsolidation were identified. However, they are foreseen since the combination of THC and CBD presents advantages in comparison with THC/dronabinol alone, such as fewer and less intense adverse effects and greater safety [77, 78]. Accordingly, in the studies evaluated, whereas 10–15 mg of THC often induce psychosis in either healthy or susceptible individuals, measured by Positive and Negative Psychotic Syndrome Scale (PANSS) general scores ($d =$ from 0.84 to 2.52 [79–83];), 50 mg of THC associated with CBD in a dose ratio of ~ 1:1 (nabiximols, Sativex®) no longer produced that psychotomimetic effect [78, 84]. The antipsychotic effect of CBD, which can also counteract some other undesired effects related to CB1 receptor activation by THC, probably explains this pattern of results [85, 86]. However, some studies have indicated that CBD might not counteract the THC psychotic effect (for a review, please see [87, 88]).

Effects of THC/dronabinol or its analog nabilone on anxiety-related responses

Table 2 summarizes the main findings from the 17 studies investigating the effects of THC/dronabinol or nabilone on anxiety in healthy humans and patients with PTSD or anxiety disorders.

Oral administration of 2.0 mg of nabilone to healthy subjects with no history of *Cannabis* consumption produced no changes in the anxiety state measured by the Hopkins Symptom Checklist Scores [89]. In contrast, 7.5 mg of THC decreased both stress reactivity, measured by the Visual Analog Scales (VAS) in the Trier Social Stress Test ($d = 0.82$), and amygdala activation when viewing fearful faces [90, 91]. THC (7.5 mg) also increased subjective reports of "high", but neither impairments in task performance nor changes in anxiety, sedation, and arousal, as measured by the State-Trait Anxiety Inventory (STAI) and the Profile of Mood State (POMS), were reported [90, 91]. When administered orally at doses ≥10 mg, THC was reported to increase the anxiety state, as measured by STAI ($d =$ from 0.93 to 2.52 [79–83, 92];), Visual Analogue Mood Scale (VAMS; $d = 0.63$ [79];), POMS ($d = 1.32$ [91];), subjective reports [91] or SCR during presentation of neutral and fearful faces ($d =$ from 0.92 to 1.42 [81, 83];). This anxiogenic

Table 2 Effects of THC, dronabinol, nabilone or THC and CBD on anxiety-related responses

Drug(s), dose(s), treatment regimen, and route of administration	Study's design	Main results	Sex	Age in years	Health status	Cannabis consume	Reference
THC 10 mg, acute, v.o.	Randomized, double-blind, placebo-controlled	↑ anxiety on VAMS	♂	18–42	Healthy	Non-users	[79]
THC 10 mg, acute, v.o.	Pseudorandomized, double-blind, placebo-controlled	THC ↑ anxiety on STAI and VAMS; ↑ SCR and left amygdala activity viewing fearful faces	♂	20–42	Healthy	Non-users	[80]
THC 10 mg, acute, v.o.	Pseudorandomized, double-blind, placebo-controlled	↑ anxiety on STAI; ↑ CB1 activation in right amygdala while viewing fearful faces	♂	23.79 ± 4.45	Healthy	Non-users	[81]
THC 10 mg, acute, v.o.	Randomized, double-blind, placebo-controlled	↑ anxiety on STAI in both groups; ↑ left fusiform gyrus, and ↓ left precuneus, cuneus and posterior cingulate activity in Cannabis users	♂	26 ± 5.6	Healthy	Users and non-users	[82]
THC 10 mg, acute, v.o.	Randomized, double-blind, placebo-controlled	THC ↑ anxiety on STAI, ↑ SCR, ↑ activity of right inferior, right superior and left medial frontal gyrus and ↓ left precuneus during the processing of fearful faces	♂	18–35	Healthy	Non-users	[83]
Nabilone 2.0 mg, acute, v.o.	Randomized, double-blind, placebo-controlled	↔ anxiety during a non-traumatic psychological stress	♂	18–30	Healthy	Non-users	[89]
Dronabinol 7.5 mg, acute, v.o.	Randomized, double-blind, placebo-controlled	↔ anxiety; ↓ amygdala reactivity viewing fearful faces	♂ ♀	18–28	Healthy	Non-users	[90]
Dronabinol 7.5 or 12.5 mg, acute, v.o.	Randomized, double-blind, placebo-controlled	7.5 mg ↓ stress reactivity on VAS; 12.5 mg ↑ stress reactivity and anxiety on POMS	♂ ♀	18–40	Healthy	Non-users	[91]
THC 0.5 mg/kg + CBD 1.0 mg/kg, acute, v.o.	Double-blind, placebo-controlled	THC ↑ anxiety on STAI; CBD ↓ the THC effects	♂ ♀	20–38	Healthy	Non-users	[92]
THC 30 mg + CBD 15, 30 or 60 mg, acute, v.o.	Double-blind, placebo-controlled	THC ↑ anxiety; CBD 30 or 60 mg ↓ most of the effects of THC	♂	adults	Healthy	Non-users	[93]
THC ~ 14 mg, acute, via inhalation (smoked)	Double-blind	↔ anxiety on MAACL-T; ↓ SCR and forearm blood flow	♂	18–29	Healthy	Users	[94]
THC 1.8% or 3.6% + CBD 0.2% or 1.0%, acute; smoked	Randomized, double-blind, placebo-controlled	THC 3.6% ↑ anxiety; THC 3.6% + CBD 1.0% ↔ anxiety; THC 3.6% + CBD 0.2% ↑ anxiety; THC 1.8% ↔ anxiety; THC 1.8% + CBD 1.0% ↑ anxiety; THC 1.8% + CBD 0.2% ↔ anxiety	♂ ♀	21–45	Healthy	Users	[95]
THC 5.0 or 15 mg; "low" Sativex® (THC 5.4 mg + CBD 5.0 mg CBD); or "high" Sativex® (THC 16.2 mg + CBD 15 mg); acute, v.o. and oromucosal	Randomized, double-blind, placebo-controlled	↑ anxiety with THC 5 or 15 mg; ↔ anxiety with "low" Sativex® ↑ anxiety with "high" Sativex®	♂ ♀	18–45	Healthy	Users	[96]
Nabilone 1.0, 2.0, 4.0 or 5.0 mg, acute, v.o.	Single-blind, placebo-controlled	1.0 and 2.0 mg ↓ anxiety on POMS	♂ ♀	adults	Anxious	Non-users	[97]

Table 2 Effects of THC, dronabinol, nabilone or THC and CBD on anxiety-related responses *(Continued)*

Drug(s), dose(s), treatment regimen, and route of administration	Study's design	Main results	Sex	Age in years	Health status	Cannabis consume	Reference
Phase 1: nabilone 1.0–10 mg; Phase 2: nabilone 1.0 mg; 28 days t.i.d. administration	Phase 1: Open-label Phase 2: Double-blind, placebo-controlled	↓ anxiety	♂ ♀	19–41	Anxious	Non-users	[98]
THC 5.0 mg, 21 days t.i.d. administration, v.o.	Open-label	↓ anxiety and improved global symptoms	♂ ♀	adults	PTSD	Non-users	[99]
Dronabinol 7.5 mg, acute, v.o.	Randomized, double-blind, placebo-controlled	THC ↓ amygdala activation during threatening faces on PTSD patients and during non-threatening faces on healthy controls; ↑ mPFC/rACC-amygdala functional connectivity ↔ anxiety on STAI	♂ ♀	20–45	PTSD, trauma exposed, and healthy controls	Non-users	[100]

Legend: ↑ = increase; ↓ = reduction; ↔ = no change; ♂ = male; ♀ = female; v.o. = oral route; *t.i.d.* Twice in day; *mPFC* Medial prefrontal cortex; *rACC* Rostral anterior cingulate cortex; *STAI* STATE Trait Anxiety Inventory; *VAMS* Visual Analogue Mood Scale; *VAS* Visual Analogue Scale; *POMS* Profile of Mood State; *SCR* Skin conductance response

THC action has been associated with increased activation of CB1 receptors in the right amygdala [80, 81]. It was also accompanied by increased activation in frontal and parietal areas [83].

In healthy subjects with a history of *Cannabis* consumption, smoking a cigarette containing 1.8% (~ 15 mg) of THC produced no changes in the anxiety state [94, 95]. In contrast, either smoking 3.6% of THC or its oral intake of 5.0 to 15 mg increased the anxiety state measured by STAI and VAS (*d* not calculated [82, 95, 96];). Similarly, 10 mg of THC given orally increased the anxiety state measured by STAI in both *Cannabis* users and non-users (*d* not calculated), but the induction of psychotic symptoms was less intense in the former group [82]. Of note, the brain areas influenced by THC in users and non-users of *Cannabis* differed significantly [82, 83]. The explanation for the varying pattern of results is still under debate.

In anxious patients, oral administration of 1.0 or 2.0 mg of nabilone attenuated (d not calculated) the anxiety response measured using POMS, an effect accompanied by increased heart rate. At doses of 4.0 and 5.0 mg, nabilone produced orthostatic hypotension without further anxiety reduction (*d* not calculated [97];). Reduced anxiety was also reported in a study (*d* not calculated; 100) divided into two phases: the first being open-label with five patients receiving nabilone on an escalating dose regimen starting with 1.0 mg and not exceeding 10 mg, for 28 days; and the second being double-blind, placebo-controlled with 20 patients receiving nabilone 1.0 mg twice a day for 28 days. The adverse effects reported were drowsiness and dry mouth and eyes [98].

In an open-label study using PTSD patients [99], orally administering 5.0 mg of THC twice a day for 21 days improved their anxiety ($d = 1.16$) and global state. A recent double-blind study [100] investigated PTSD patients, trauma-exposed individuals, and healthy controls acutely treated with THC (7.5 mg). No significant changes were found in the anxiety state, but THC lowered threat-related amygdala reactivity, increased mPFC activation during the threat, and increased mPFC-amygdala functional coupling in PTSD patients [100].

In summary, in most of the studies above described, THC/dronabinol or nabilone induced statistically significant effects on anxiety-related responses, with medium to large effect sizes (i.e., from 0.63 to 2.52). However, the outcome (anxiolytic or anxiogenic effect) depends on the dose, regimen of treatment, and psychiatric status. When considered, there were no sex-related differences in drug-induced effects on anxiety.

Effects of THC/dronabinol plus CBD on anxiety-related responses

As detailed in Table 2, four double-blind studies evaluated the effects of associating THC with CBD on anxiety in healthy users and non-users of *Cannabis* [92, 93, 95, 96]. CBD was able to attenuate the anxiogenic effect of THC when given in a THC:CBD dose ratio of 1:1 or 1:2 (d = from 4.33 to 4.59), but not 1:0.5 or 1:0.33 [92, 93, 95]. Of note, the THC-induced increase in heart rate frequency was reduced in the presence of CBD ($d = 3.41$; THC:CBD dose ratio of 1:2 and d = 1.90 THC:CBD dose ratio of 1:1 [91];). Furthermore, the use of a THC:CBD dose ratio of ~ 1:1 high Sativex® (THC 16.2 mg + CBD 15 mg), but not low Sativex® (THC 5.4 mg + CBD 5 mg) induced an increase in anxiety state (*d* not calculated [96];). Besides, High Sativex induced higher "feeling anxious" parameters (measured by VAS) than Low Sativex ($d = 0.58$ [96];). Smoking a cigarette containing THC 3.6% (~ 30 mg) and CBD 1.0% (~ 8.5 mg) was associated with less anxiety (*d* not calculated) than the one containing only THC 3.6%. In contrast, smoking a cigarette with THC 1.8% (~ 15 mg) alone produced no changes in anxiety, but it was increased when the same THC dose was associated with CBD 1.0% [95].

In summary, CBD attenuates or even prevents the anxiogenic action produced by higher THC doses when given in a dose similar to or higher than that of THC. This outcome, however, depends on their absolute quantity and route of administration. Importantly, no study has already evaluated the effect of chronic use of CBD and THC on anxiety. When considered, there were no sex-related differences in THC-induced effects on anxiety, as well as in the potential counteracting CBD action.

Discussion

The facilitating effects of dronabinol (7.5–10 mg) in humans undergoing aversive memory extinction agree with laboratory animal data showing that the activation of CB1 receptors plays a crucial role in fear memory extinction [101–104]. For instance, THC and CBD treatment facilitates extinction acquisition and recall, respectively [101, 105]. The action of dronabinol above mentioned is also in line with human studies investigating the THC effects on procedures involving threat perception recognition, such as the emotional face-matching task, the facial emotion recognition, and the recognition of emotional pictures. At a dose range from 7.5 to 15 mg, it reduced the threat perception, the recognition of emotional pictures, and fear and anger faces [106–109]. THC also enhanced the functional connectivity of specific brain areas, such as the amygdala with both rostral anterior cingulate and medial prefrontal cortices, during the emotional face-matching task and extinction recall [106]. This pattern of results suggests that THC/dronabinol interferes with aversive memory processing and its extinction. Of note, impairments in recognition of non-emotional pictures were found after

administering 15 mg of THC [110], indicating that high THC doses can affect neutral memory processing.

The studies focusing on aversive memory extinction in healthy humans and laboratory animals are compelling. However, future studies are guaranteed to examine the effects of acute and chronic THC/dronabinol administration on the extinction of traumatic memories. Currently, there are two double-blind and placebo-controlled study investigating THC effects on extinction learning in PTSD patients (ClinicalTrials.gov Identifier: NCT03008005; ClinicalTrials.gov Identifier: NCT04080427). The preliminary results indicate that PTSD patients treated with THC (7.5 mg) exhibited better recall of the extinction of a cued aversive memory, an effect accompanied by increased hippocampal activation [111]. Although this result agrees with that reported in healthy subjects, the traumatic memory was not evaluated and, thus, whether and how THC can attenuate its expression is still unknown. Moreover, as early mentioned, the extinction's ability to suppress the original aversive/traumatic memory is thought to be temporary. Based on this, it would be interesting to investigate whether THC/dronabinol can hinder or even prevent extinction-related features that limit its clinical usefulness, such as renewal, reinstatement, and spontaneous recovery over time. Furthermore, some studies report that the long-term use of *Cannabis* by individuals with PTSD is associated with worse clinical outcomes [61, 112], however, investigating the effects of THC either alone or combined with CBD on PTSD symptoms at clinical settings cannot be directly compared with smoking cannabis in an uncontrolled environment, and possibly in a recreational manner. For more details, see 113.

No sex-dependent differences in THC-induced effects on extinction were identified. Women who have PTSD present more CB1 receptor expression and lower hair concentrations of PEA, OEA, and SEA, than men [40, 42]. The CB1 receptor density has been inversely correlated with anandamide and other endocannabinoid levels, implying that men had a high concentration of endogenous ligands, which might be a factor contributing not only to the increased risk of developing stress-related disorders but also to symptom severity in women [40]. In blood samples, the availability of CB1 receptors is also higher in women than men [113]. In rodents, gonadal hormones (e.g., estradiol) regulate the CB1 receptor density [114], transcription [115], and signal transduction [116], which ultimately influences the content of endocannabinoids [117] and their CB1 receptor affinity [118]. Estradiol can facilitate the fear extinction process [119, 120]. Moreover, 4 out of 5 of the studies [70–73] have reported that women that were not taking hormonal contraceptives were tested during their follicular phase only to avoid between-group effects of sex hormones. When female participants were included in the studies, they were performed about 1 week before menses onset (based on self-reports of last period and cycle length), when the estrogen level is low. This is likely a factor contributing to the lack of significant sex-dependent differences in THC effects on extinction. Of potential relevance to the present discussion are results showing that a deficient conversion of progesterone to its neuroactive metabolite allopregnanolone, which facilitates GABA action on $GABA_A$ receptors, in women with PTSD was associated with resistance to extinguish the fear memory [121, 122]. Moreover, pregnanolone, a precursor of progesterone, is a negative allosteric modulator of CB1 receptors [123]. How the interplay between steroid hormones and the endocannabinoid system contributes to fear extinction is currently under investigation. Altogether, studies support sex-dependent fluctuations in some endocannabinoid system constituents involved in extinction processing. However, animal studies have been traditionally performed almost exclusively in males. Similarly, human studies do not frequently compare THC effects on men and women. In any case, complementary analyses are guaranteed.

No human studies investigating THC effects on aversive memory reconsolidation were identified. The number of animal studies focusing on this question is still scarce, although their findings are promising. In a dose range from 0.3 to 10 mg/kg, the acute and systemic treatment with THC impaired the reconsolidation of specific and recent contextual fear memories in adult male rats, an effect dependent on prelimbic cortex CB1 receptor activation [124]. The acute treatment with 5.0 (but not 50) mg/kg of THC similarly impaired the reconsolidation of a recent cued fear memory in male rats [125]. Future studies should address whether THC can impair the reconsolidation of more remote and generalized aversive memories in both male and female animals. Noteworthy, mixed results have been reported with other drugs (e.g., propranolol) targeting aversive memory reconsolidation in rodents versus healthy humans [30, 33, 126–130], which suggests the existence of some boundary conditions, such as the strength, age, and specificity of the memory to be pharmacologically "fine-tuned". Fortunately, animal findings indicate that the use of behavioral and pharmacological strategies can surmount these constraining factors [29, 131].

THC has been pointed out as a therapeutic cannabinoid for several brain diseases [132]. However, it is also the main responsible for the recreational use of *Cannabis* and its psychotomimetic effect, restricting *Cannabis* therapeutic use. Besides, some THC effects are commonly biphasic and dose-dependent [133]: low doses have potential therapeutic value in cognitive and anxiety disorders while high doses cause harmful effects, and are related to the reported side

effects resulting from direct activation of CB1 receptors [51, 131]. This supraphysiological action can lead to a rapid down-regulation of these receptors [134, 135], potentially resulting in tolerance and addiction [136, 137]. CBD, on the other hand, has a safer profile because it is not a psychotic-precipitating substance, and its effects are mediated via indirect CB1 receptor activation and non-cannabinoid mechanisms as well [138, 139].

No human studies have yet investigated the effects of combining THC with CBD on aversive/traumatic memory extinction or reconsolidation. As early mentioned, however, this association could be advantageous. Accordingly, administering both THC and CBD in a subeffective dose impaired either contextual or cued fear memory reconsolidation in adult male rats [124, 125]. In both cases, the THC:CBD dose ratio was 1:10, and combining THC with CBD allowed the use of 3-fold lower doses of them in the study by Stern et al. [124].

Regarding the effects of THC, dronabinol or nabilone on anxiety in subjects with no history of *Cannabis* use, orally taken doses ≥10 mg increased the anxiety level (and often produced a psychotic effect) while lower doses produced either no changes or anxiety reduction. Although the anxiogenic and psychotic effects of THC could have clinic impact (their effect sizes are as large as the ones calculated here for extinction facilitation and anxiety reduction), the dose range in which the beneficial and detrimental THC effects predominates is not necessarily the same. Therefore, its therapeutic value depends on the dose. Another aspect to keep in mind is the treatment regimen. Repeated administration of 1.0 or 5.0 mg of THC reduced anxious symptoms in anxious or PTSD patients, but acute treatment produced minor or no effects. In *Cannabis* users, the effects on anxiety are more variable because of the influence of the previous emotional state of individuals, how long have they used *Cannabis*, and when in life they started its use. Of note, inhalation is an alternative route to deliver THC. THC bioavailability after oral administration is around 10% [140], and after smoking, 25% of it reaches systemic circulation [141]. Based on that, a given smoked dose of THC will produce higher blood concentration than orally and, thus, the anxiogenic effect would be more frequent. However, in both studies in which this question was addressed indirectly, the subjects were previous *Cannabis* users, possibly having some degree of tolerance to the anxiogenic effect of THC. Besides, chronic users of *Cannabis* present altered anxiety levels relative to non-users [142]. Thus, the downregulation of CB1 receptors and differences in anxiety's baseline could also have influenced THC effects in *Cannabis* users.

The biphasic effects of THC on anxiety have also been shown in laboratory animals. Low doses of THC (e.g., 0.3 mg/kg) did not alter the anxiety response in rodents tested in the elevated plus-maze, but doses between 1.0 and 10 mg/kg produced an anxiogenic-like effect [143]. In another study, THC doses ranging from 0.075 to 1.5 mg/kg produced an anxiolytic-like effect [144]. Interestingly, the anxiolytic and anxiogenic effects of THC can arise from different brain areas: infusing low doses into the ventral hippocampus or medial prefrontal cortex induced an anxiolytic-like response while higher doses had no effect or even produced an anxiogenic-like effect. In contrast, the same low THC dose infused into the basolateral amygdala increased the anxiety response, but higher doses were ineffective. Both effects relied on the activation of CB1 receptors [145], which are located on glutamatergic and GABAergic neurons. It is hypothesized that THC reduces glutamate levels in low doses and raises glutamate levels in high doses (the latter action is associated with inhibition of GABA-releasing neurons [146];). Furthermore, Bedse et al. [147] demonstrated in mice that the 2-AG depletion-induced anxiety-like behavior after stress exposure was counteracted by the administration of 0.25 mg/kg THC. Overall, these findings confirm the bidirectional effects of THC on anxiety, despite the varying dose range associated with anxiolytic and anxiogenic effects [148]. Of note, at doses ranging from 3.0 to 10 mg/kg in rats, and from 10 to 20 mg/kg in mice, THC also produced sedative-like effects [143]. The neural basis underlying THC effects on anxiety and sedation are under investigation.

Associating CBD with THC could be advantageous as CBD can minimize or even counteract some adverse effects of THC, such as the anxiogenic and psychotic effects. Oral administration of THC plus CBD in a dose ratio 1:2 attenuated the THC-associated anxiogenic effect. When using a similar THC:CBD ratio, the THC-associated anxiogenic effect was no longer observed with the use of low, but not high, doses of these drugs, a result that also depended on the previous *Cannabis* use history of participants. In humans, oral pretreatment with CBD 600 mg attenuated the psychotic symptoms induced by THC 10 mg [80]. Similarly, 400 mg, but not 4.0 mg, of CBD vaporized attenuated the intoxication produced by THC 8.0 mg [149]. Preclinical studies with animals also demonstrate that co-administration of THC:CBD in 1:5 and 1:10, but not 1:1, dose ratio can counteract the THC-induced anxiogenic-like effects and impairments in social interaction [150, 151]. Based on the above, the combined strategy seems to be as complex as using THC alone.

There is evidence suggesting that CBD interferes with the pharmacokinetics of THC. Indeed, CBD can inhibit the hepatic metabolism of THC [152, 153]. As a result, co-administering an equal dose of CBD doubled the brain THC amount, 30 min later, in adolescent male rats

and, thus, this association produced an anxiogenic-like effect [154]. Similarly, female mice receiving a THC:CBD dose ratio of 1:2 presented an anxiogenic-like effect [155]. However, studies using proportionally more CBD than THC and performed in adult rodents and monkeys found a reduction in THC anxiogenic action [156–158], indicating that the hepatic biotransformation of THC may vary according to the animal's age. In men, independent of dose ratio, the oral co-administration of CBD with THC did not alter the plasmatic THC concentration [80, 96, 159]; in women, the intake of a THC:CBD dose ratio of 1:0.5 induced a tendency of increasing both THC and its active metabolite (11-OH-THC) in the plasma, suggesting potential sex-dependent differences in THC and CBD metabolism [159]. Altogether, CBD can interfere with the pharmacokinetics of THC, but the dose, animal species, sex, and proportion of these drugs influence if CBD will potentiate or antagonize THC effects.

Conclusions

THC, dronabinol or nabilone could help with hyperarousal symptoms, insomnia, anxiety, and extinction deficits related to PTSD [51]. Indeed, despite the limited number of published studies, available data suggest that low doses of THC potentiate fear memory extinction in healthy volunteers and reduce anxiety responses in anxious and PTSD patients without inducing a psychotic effect. High doses of THC, however, do not facilitate fear memory extinction and are related to clinically relevant anxiogenic and psychotic effects in healthy volunteers. Overall, laboratory animal data corroborate human findings.

There is a lack of studies with PTSD patients using THC alone and associated with CBD focusing on aversive memory extinction and reconsolidation. Further, most studies evaluated the acute effects of THC or THC plus CBD. Therefore, it is unknown whether chronic treatment is still advantageous. Besides, some studies do not address potential sex-dependent differences in THC-induced effects, which would provide further information on whether or not it is a potential issue in humans. Animal data have shown the detrimental effects of THC following high doses. Based on that, human studies have selected an appropriate dose range of THC and, thus, neither worsening of PTSD symptoms nor strengthening of aversive memories after the use of THC has been reported. Few studies have investigated the effects of associating THC with CBD in varying dose ratios yet. Altogether, the findings encourage future controlled studies evaluating the effects of low doses of THC to attenuate aversive/traumatic memory expression in PTSD patients.

Supplementary information

Supplementary information accompanies this paper at https://doi.org/10.1186/s12888-020-02813-8.

Additional file 1 Supplementary Table 1. Raw data used for calculate the effect sizes of behavioral parameters from studies detailed in Table 1.

Additional file 2 Supplementary Table 2. Raw data used for calculate the effect sizes of behavioral and autonomic parameters from studies detailed in Table 2.

Abbreviations

2-AG: 2-Arachidonoylglycerol; Caps: Clinician administered posttraumatic scale; CB1: Cannabinoid type 1 receptor; CBD: Cannabidiol; dACC: Dorsal anterior cingulate cortex; FAAH: Fatty acid amide hydrolase; mPFC: Medial prefrontal cortex; OEA: Oleoylethanolamide; PANSS: Positive and negative psychotic syndrome scale; PEA: Palmitoylethanolamide; POMS: Profile of mood state; PTSD: Posttraumatic stress disorder; SEA: Stearoylethanolamide; SCR: Skin conductance response; SSRIs: Selective serotonin reuptake inhibitors; STAI: State trait anxiety inventory; THC: Δ^9-tetrahydrocannabinol; VAS: Visual analog scale; vmPFC: Ventromedial prefrontal cortex

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Authors' contributions

CAS, LJB, and AMR designed the sections and contents of the review manuscript. CAS supervised the organization to distribute the writing tasks among the authors and participated in manuscript writing. AMR, JBS, TRS, LJB, and CAS performed the literature searches and participated in the manuscript writing. All the authors critically reviewed and approved the final version of the manuscript.

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Availability of data and materials

All data generated or analyzed during this study are included in this published article [and its supplementary information files].

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Patient-Reported Symptom Relief Following Medical Cannabis Consumption

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Background: The Releaf App™ mobile software application (app) data was used to measure self-reported effectiveness and side effects of medical cannabis used under naturalistic conditions.

Methods: Between 5/03/2016 and 12/16/2017, 2,830 Releaf App™ users completed 13,638 individual sessions self-administering medical cannabis and indicated their primary health symptom severity rating on an 11-point (0–10) visual analog scale in real-time prior to and following cannabis consumption, along with experienced side effects.

Results: Releaf App™ responders used cannabis to treat myriad health symptoms, the most frequent relating to pain, anxiety, and depressive conditions. Significant symptom severity reductions were reported for all the symptom categories, with mean reductions between 2.8 and 4.6 points (ds ranged from 1.29–2.39, *p*s < 0.001). On average, higher pre-dosing symptom levels were associated with greater reported symptom relief, and users treating anxiety or depression-related symptoms reported significantly more relief (ps < 0.001) than users with pain symptoms. Of the 42 possible side effects, users were more likely to indicate and showed a stronger correlation between symptom relief and experiences of positive (94% of sessions) or a context-specific side effects (76%), whereas negative side effects (60%) were associated with lessened, yet still significant symptom relief and were more common among patients treating a depressive symptom relative to patients treating anxiety and pain-related conditions.

Conclusion: Patient-managed cannabis use is associated with clinically significant improvements in self-reported symptom relief for treating a wide range of health conditions, along with frequent positive and negative side effects.

Keywords: pain, anxiety, depression, cannabis, marijuana, quality of life, symptom management, side effects

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INTRODUCTION

Medicinal cannabis use is expanding rapidly in the United States, with thousands of new users daily, particularly older patients and people with significant health concerns, treating many different symptoms (Centers for Disease Control and Prevention, 2016; Han et al., 2016). Most patients have a wide variety of medicinal cannabis products available to them, ranging from traditional flower to edibles and tinctures. Naturalistic observational studies are generally well-suited for capturing how patients manage their treatment decisions in real-life, and how patient-managed cannabis therapies may contribute to symptom relief and potential side effects from use. Observational research designs allow patients to use the myriad *Cannabis* strains and cannabis-derived formulations (e.g., concentrates, tinctures, edibles, topicals, suppositories, toothpaste) made at home and/or commercially available and widely used in society, and can incorporate the breadth of health conditions for which medical cannabis has been sanctioned for use at the state-level. Lastly, observational studies also circumvent research barriers associated with cannabis' Schedule I status under United States federal law, which makes randomized controlled trials (RCTs) challenging to conduct (Stith and Vigil, 2016; National Academies of Sciences, Engineering, and Medicine, 2017).

Since its release in 2016, the commercially developed Releaf App^{TM} application (app; Releaf App, 2018) has been the only publically available, incentive-free patient educational software program designed for recording how individual cannabis usage sessions may correspond to immediate changes in primary symptom intensity levels and experienced side effects. This electronic assessment tool enables patients to monitor and manage their cannabis consumption decisions under naturalistic conditions while avoiding the limitations of retrospective survey collection methods (e.g., memory bias, social desirability effects). We used the Releaf App^{TM} repository of over 2,830 patients and 13,368 individual cannabis administration sessions to examine two research questions: How does cannabis used under naturalistic conditions affect user-experienced symptom relief and side effects? Does the magnitude of experienced symptom relief and the prevalence of side effects vary across symptom categories? The results have clinical relevance for understanding how patient-managed medical cannabis therapies may correspond to changes in symptom intensity and potential side effects among people using cannabis for treating distinct health conditions (Hill and Weiss, 2016; Rubin, 2017).

MATERIALS AND METHODS

Study Design

A naturalistic observational research design, approved by the Institutional Review Board at the University of New Mexico, was used to analyze the Releaf App^{TM} user-submitted data recorded between 5/03/2016 and 12/16/2017. Releaf App^{TM} is a cross-platform (iOS and Android) mobile and tablet app backed by a secure cloud programming interface for capturing, processing, and storing anonymized user data. Out of 4,369 total users and 23,373 user interactions, we included only cannabis consumption sessions with reported starting symptom levels greater than 0 (on a 0–10, 11-point scale) and ending symptom levels reported within 90 min of the start of the session, resulting in a final sample of 2,830 users and 13,638 individual sessions for analysis. The Releaf App^{TM} measures 27 possible negative symptom categories and 42 possible side effects. Symptoms were ultimately derived from qualifying conditions across medical cannabis programs in the United States, along with a few suggested by dispensaries and patients. The side effects (called "feelings" within the app) were crowd-sourced among Releaf App^{TM} developers, beta testers, dispensaries, and patients, and included 19 positive, 12 negative, and 11 context-specific side effects available for selection. **Supplementary Tables S1, S2** in the **Supplemental Appendix** provide descriptive statistics for all symptoms and side effects.

User sessions consist of a series of electronic instructions for recording characteristics of the cannabis medication (e.g., strain, potency, formulation), pre-dosing symptom severity rating along an 11-point visual analog facial pain scale from 0 (no detectable symptom level) to10 (severe), the timing of cannabis consumption, a post-dosing symptom severity rating, and the option to indicate any of the 42 listed side effects at any time during the session. Among our primary sample of users, 2,332 users reported side effects during 10,535 sessions.

Study Outcomes

Our goal was to calculate changes in patient-perceived symptom severity, the prevalence of positive and negative side effects associated with cannabis consumption, and whether the reported-effects differs depending on the symptom for which users were seeking treatment. We measured changes in symptom relief by subtracting the ending symptom level from the beginning symptom (possible range from −10 to 10). (**Supplementary Figure S1** in the **Supplemental Appendix** provides a frequency table for each level of symptom relief.) Side effects were recorded as {0,1} variables for whether the user selected that side effect from the menu. We categorize the side effects as positive, negative, or context-specific and then convert these categories of side effects into {0,1} outcomes, count outcomes and outcomes measuring the portion of total available side effects in that category a user selected.

Statistical Analysis

We use means comparisons and least squares regression models to estimate the absolute and relative symptom changes and side effect profiles resulting from the cannabis user sessions. We also created an *adjusted symptom relief profile score*, the mean change in symptom levels plus the absolute number of listed negative side effects, to provide a relative metric of cost-benefit tradeoffs associated with cannabis use. Due to the small user counts for some of the reported symptoms, the large number of possible symptoms, and to facilitate interpretation in our regression analysis, we aggregate the most commonly reported symptoms across three broad symptom categories that included: Anxiety Symptoms (agitation/irritability, anxiety, insomnia, stress, and muscle spasms), Pain Symptoms (ten pain categories), and

Depression Symptoms (depression). The remaining types of symptoms are less frequently reported or not clearly categorized. We also report the full regression results for the three categories of side effects (positive, negative, and context-specific) and the sign for regressions of symptom relief on the full range of 42 side effects. Standard errors are clustered at the user level to control for heteroskedasticity and arbitrary correlation.

RESULTS

Figure 1 shows the starting and ending symptom severity levels, the change in levels, the Cohen's d of the difference, and the adjusted symptom relief profile score for each of the 27 discrete symptom categories. For all symptoms, the null hypothesis that the starting symptom severity level is less than or equal to the ending symptom severity can be rejected at the $p < 0.001$ level. Using the adjusted symptom relief measure (symptom relief plus negative side effects), all but users with convulsions, dizziness, excessive appetite, or tremors experienced a net improvement in their symptom severity levels. Even for these symptoms, the adjusted mean symptom relief score still indicates a net benefit from use and the lack of a statistically significant change likely relates more to the small number of observations rather than the lack of an effect, given that these symptoms together constituted less than 3% of users and less than 1% of our sample. For all other symptoms, the null hypothesis of an increase or no change in the adjusted symptom relief score can be rejected at the $p < 0.001$ level.

Table 1 provides additional information on starting and ending symptom severity levels, mean symptom relief, and the prevalence of positive, negative, and context-specific side effects by the aggregated symptom categories (anxiety, pain, and depression symptoms). For completeness, we include a fifth column including the remaining discrete symptom categories which did not fall under the three aggregated symptom categories. Little variation exists in starting and ending symptom levels and the symptom relief experienced, with the average user reporting a symptom decrease of 3.7. With regards to side effects, those with depression have a higher probability of reporting negative or context-specific side effects. The most common positive side effects are "relaxed" (64%), "peaceful" (54%), and "comfy" (38%), the most common negative side effects are "dry mouth" (23%), "foggy" (22%), and "forgetful" (13%) and the most common context-specific side effects are "high" (32%), "sleepy" (27%), and "thirsty" (27%).

Table 2 examines how symptom relief varies across the broader symptom categories, with the constant representing the mean adjusted symptom change for the omitted category, (patients with pain-related symptoms). The first two regressions shown in **Table 2** indicate that people with anxiety and depression report greater relief from using cannabis than people with chronic pain, and users with higher starting symptom levels report greater symptom relief. (The effects of cannabis on anxiety and depression symptoms are not statistically different from each other, although they are both greater than the effect of cannabis on pain-related symptoms). Negative responses or increases in symptom severity do occur, but the intercept in combination with the starting symptom level predicts that increases in symptom severity levels predominantly occur among users with starting symptoms equal to one. The third column in **Table 2** shows that cannabis is more effective for anxiety and depression symptoms than for pain-related symptoms among patients reporting higher

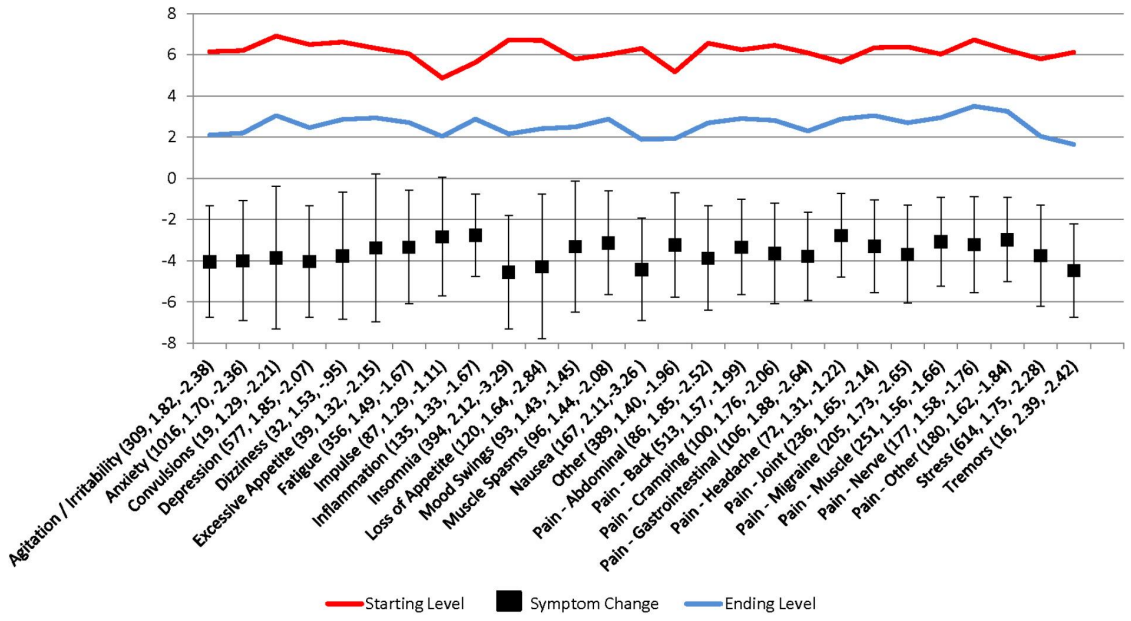

FIGURE 1 | Patient-reported symptom relief following medical cannabis consumption. Values in parantheses are the symptom category sample size, Cohen's d, and adjusted symptom relief score (symptom relief + number of negative side effects), respectively.

TABLE 1 | Descriptive statistics – symptom levels and experienced side effects.

	Overall	Anxiety symptoms	Pain symptoms	Depression symptoms	Other
N Sessions	13638	5343	4267	1440	2588
N Users	2830	1679	1223	577	1026
Starting symptom level	6.2 ± 2.2	6.2 ± 2.3	6.3 ± 2.0	6.5 ± 2.2	5.8 ± 2.4
Ending symptom level	2.5 ± 2.2	2.2 ± 2.2	3.0 ± 2.1	2.5 ± 2.2	2.4 ± 2.3
Symptom relief	−3.7 ± 2.6	−4.0 ± 2.8	−3.3 ± 2.3	−4.0 ± 2.7	−3.4 ± 2.8
Better	94.2%	94.8%	94.7%	95.4%	91.6%
Same	2.7%	2.4%	2.8%	2.4%	3.2%
Worse	3.1%	2.8%	2.5%	2.2%	5.2%
Any positive side effect	94.4%	94.7%	94.5%	93.9%	94.2%
Any negative side effect	60.0%	60.0%	58.9%	65.5%	58.8%
Any context-specific side effect	76.2%	75.2%	75.9%	80.1%	76.6%
# of positive side effects	4.6 ± 3.2	4.6 ± 3.2	4.4 ± 3.1	4.8 ± 3.4	4.8 ± 3.4
# of negative side effects	1.4 ± 1.7	1.4 ± 1.7	1.3 ± 1.6	1.6 ± 1.9	1.3 ± 1.7
# of context-specific side effects	2.0 ± 1.9	2.0 ± 1.9	1.9 ± 1.9	2.1 ± 1.9	2.0 ± 1.9
% of positive side effects	24%	24%	23%	26%	25%
% of negative side effects	11%	11%	10%	13%	10%
% of context-specific side effects	20%	20%	19%	21%	20%

Symptoms designated as treatable with benzodiazepines (Anxiety Symptoms) include agitation/irritability, anxiety, insomnia, muscle spasms, and stress. Symptoms associated with Opioid treatment (Pain Symptoms) include all ten pain conditions. Depression is the only symptom designated as treatable with antidepressants.

TABLE 2 | Reported symptom relief for users treating anxiety, pain, and depression.

	Outcome = symptom relief		
	(1)	(2)	(3)
Constant (opioid mean)	−3.309***	1.120***	0.355**
	(−3.459 to −3.160)	(0.804 to 1.436)	(0.034 to 0.675)
Anxiety symptoms	−0.704***	−0.763***	0.365*
	(−0.944 to −0.465)	(−0.953 to −0.574)	(−0.062 to 0.792)
Depression symptoms	−0.723***	−0.563***	0.643*
	(−1.060 to −0.385)	(−0.817 to −0.310)	(−0.021 to 1.308)
Starting symptom level (1–10)		−0.706***	−0.582***
		(−0.757 to −0.656)	(−0.639 to −0.525)
Anxiety*start			−0.181***
			(−0.259 to −0.102)
Depression*start			−0.189***
			(−0.305 to −0.074)
Observations	11,050	11,050	11,050
R^2	0.018	0.372	0.377

*Each column represents a separate regression. The omitted category is symptoms treatable with an opioid medication. Robust standard errors are clustered at the user level. The coefficients are reported in line with the variable names with confidence intervals below. Coefficients are reported with 95% Confidence Intervals below. ***$p < 0.01$, **$p < 0.05$, *$p < 0.10$.*

symptom severity levels (A graphical representation of this relationship is presented in **Supplementary Figure S2** in the **Supplemental Appendix**).

In order to take advantage of the full range of symptom categories available to Releaf App™ users, we also ran regressions including dummy variables for each of the symptoms, using back pain as the omitted category. After controlling for starting symptom level, clustering the standard errors at the user level, and using a statistical significance threshold of $p < 0.05$, our results indicate that patients report greater symptom relief for treating agitation/irritability, anxiety, depression, excessive appetite, insomnia, loss of appetite, nausea, gastrointestinal pain, stress, and tremors than they do for treating back pain. Patients reported less symptom relief for treating impulsivity, headache, and nerve pain as compared to relief for treating back pain. The symptom relief for the other discrete symptom categories was indistinguishable from the reported symptom relief associated with back pain.

Table 3 explores whether patients using cannabis to treat pain, anxiety, or depressive symptoms differ in their experiences of positive, negative, or context-specific side effects. Chows tests (Chow, 1960) showed that users with anxiety-related symptoms

TABLE 3 | Differences in side effect profiles across symptom categories.

	Outcome = side effect type		
	Positive	**Negative**	**Context-specific**
		Any	
Constant (opioid mean)	0.966***	0.496***	0.695***
	(0.942 to 0.989)	(0.428 to 0.565)	(0.637 to 0.753)
Anxiety symptoms	0.001	0.013	−0.006
	(−0.012 to 0.015)	(−0.033 to 0.059)	(−0.049 to 0.037)
Depression symptoms	−0.006	0.066**	0.042*
	(−0.029 to 0.017)	(0.002 to 0.131)	(−0.005 to 0.090)
Starting symptom level	−0.003*	0.015***	0.010**
	(−0.007 to 0.000)	(0.007 to 0.024)	(0.002 to 0.019)
		Number	
Constant (opioid mean)	4.583***	1.081***	1.652***
	(4.013 to 5.154)	(0.768 to 1.395)	(1.356 to 1.947)
Anxiety symptoms	0.182	0.077	0.077
	(−0.100 to 0.465)	(−0.104 to 0.257)	(−0.113 to 0.268)
Depression symptoms	0.476*	0.324**	0.134
	(−0.010 to 0.962)	(0.053 to 0.596)	(−0.187 to 0.454)
Starting symptom level	−0.035	0.036**	0.044**
	(−0.142 to 0.072)	(0.000 to 0.072)	(0.003 to 0.085)
		Percent of possible	
Constant (opioid mean)	0.241***	0.083***	0.165***
	(0.211 to 0.271)	(0.059 to 0.107)	(0.136 to 0.195)
Anxiety symptoms	0.01	0.006	0.008
	(−0.005 to 0.024)	(−0.008 to 0.020)	(−0.011 to 0.027)
Depression symptoms	0.025*	0.025**	0.013
	(−0.001 to 0.051)	(0.004 to 0.046)	(−0.019 to 0.045)
Starting symptom level	−0.002	0.003**	0.004**
	(−0.007 to 0.004)	(0.000 to 0.006)	(0.000 to 0.009)

*The first panel uses {0,1} outcomes for the presence of side effects in each category, the second uses the count of side effects reported by category, and the third uses the number of reported side effects for each category divided by the total number of possible side effects a user could select in that category. Robust standard errors are clustered at the user level. Coefficients are reported with 95% Confidence Intervals below. ***$p < 0.01$, **$p < 0.05$, *$p < 0.10$.*

are no more or less likely than those with pain symptoms to report any of the three categories of side effects. Individuals with depression, however, are more likely to report negative and context-specific side effects than positive side effects. Higher starting symptom levels are also associated with more negative or context-specific side effect reporting and this relationship persists whether the side effect profile is defined as any of the side effects from that category of side effects, the number of side effects by category, or the percent of possible side effects in a category.

Table 4 tests whether different types of side effects are associated with differences in symptom relief. The results are robust across specifications; reporting positive or context-specific side effects is associated with greater symptom relief, while reporting negative side effects is associated with less symptom relief. For example, based on Column (4), a person with a starting symptom level of 5 who reports 100% of negative side effects would experience a 0.5 point increase in symptom severity on a 1–10 scale, whereas a similar user who does not report any negative side effects would experience 2.2 points of symptom relief, highlighting the importance of adjusting for starting symptom severity level and side effect profiles when evaluating the overall effectiveness of cannabis as a treatment modality.

DISCUSSION

This is the largest observational study to measure immediate changes in patient-reported symptom severity ratings and experienced side effects in real-time from using cannabis under naturalistic conditions. Building on previous research showing that cannabis may be an effective substitute for opioids (Hurd, 2016; Vigil et al., 2017) and other classes of prescription medications (e.g., sedatives; Piper et al., 2017; Stith et al., 2017), we provide evidence that cannabis is used to treat many different types of symptoms for which conventional pharmaceutical medications are typically prescribed, and that the magnitude of reported symptom relief and side effect profiles from using cannabis varies for people with different symptoms.

TABLE 4 | Association of positive, negative, and context-specific side effects with symptom relief.

	Outcome = symptom relief			
	(1)	(2)	(3)	(4)
	Any {0,1}		Percent of possible in category	
Positive	−1.100***	−1.344***	−2.345***	−2.899***
	(−1.360 to −0.841)	(−1.578 to −1.111)	(−3.046 to −1.643)	(−3.653 to −2.145)
Negative	0.174**	0.336***	2.311***	2.772***
	(0.015 to 0.334)	(0.192 to 0.480)	(1.461 to 3.161)	(2.045 to 3.498)
Context-specific	−0.339***	−0.239***	−0.781**	−0.417
	(−0.540 to −0.138)	(−0.413 to −0.065)	(−1.495 to −0.068)	(−0.931 to 0.096)
Starting symptom level		−0.660***		−0.666***
		(−0.710 to −0.610)		(−0.724 to −0.608)
Constant	−2.307***	1.894***	−3.098***	1.100***
	(−2.625 to −1.989)	(1.441 to 2.348)	(−3.372 to −2.824)	(0.818 to 1.382)
Observations	10,535	10,535	10,535	10,535
R^2	0.015	0.349	0.036	0.376

*The first two columns measure use the existence of each category of side effect as independent variables, while the second two columns use the percent of possible in each category of side effects. The second and fourth columns include the starting symptom level. In all four regressions, the outcome is the change in symptom severity. Robust standard errors are clustered at the user level. Coefficients are reported with 95% Confidence Intervals below. ***$p < 0.01$, **$p < 0.05$, *$p < 0.10$.*

The Releaf App™ users consumed cannabis to treat a wide range of health symptoms, the most frequent relating to pain, anxiety, or depression. Clinically and statistically significant reductions in patient-reported symptom severity levels existed in every single symptom category, suggesting that cannabis may be an effective substitute for several classes of medications with potentially dangerous and uncomfortable side effects and risky polypharmaceutical interactions, including opioids, benzodiazepines, and antidepressants (Weich et al., 2014; Centers for Disease Control and Prevention, 2016; Fontanella et al., 2016; Rudd et al., 2016; Sharma et al., 2016). Higher pre-dosing symptom levels were generally associated with greater post-dosing symptom relief and users treating an anxiety-related symptom or depression showed stronger symptom relief than users treating a pain symptom, even though depression is not a condition approved for medical cannabis use in most states.

Similar to clinical reviews showing that cannabis is associated with numerous, yet generally non-serious side effects (Wang et al., 2008; Whiting et al., 2016), positive and context-specific side effects were more commonly reported than negative side effects by the Releaf App™ users, with the most frequent reported side effects being positive (relaxed, peaceful, comfy) and the least frequent side effects being negative (paranoid, confused, headache). Positive side effect reporting was associated with the greatest reported symptom relief, followed by context-specific side effects, while negative side effects were associated with lower reported symptom relief. In general, patients treating depression were more likely to indicate a negative side effect than patients treating anxiety- or pain-related symptoms, though even users who reported only negative side effects reported significant decreases in moderate to severe symptom intensity levels after using cannabis.

One of the most striking patterns in the current results was the breadth of symptoms that appeared to improve following cannabis consumption. This pattern of responses could have been a function of characteristics of the software user interface (e.g., symptom intensity scale range), manner in which responders interacted with their mobile device (e.g., visual attention to common symptom severity levels), or with the systemic nature by which phytocannabinoids may affect the human mind and body. According to the endocannabinoid deficiency theory, many mental and physical health disturbances result from the dysregulation of the body's innate endocannabinoid system (ECS; Smith and Wagner, 2014; Di Marzo et al., 2015; Karhson et al., 2016; Russo, 2018), often described as a master network of chemical signals that promote somatic and psychological homeostasis, or psychobiological state-efficiency (Bermudez-Silva et al., 2010; Silvestri and Di Marzo, 2013; Acharya et al., 2017). The ECS consists of natural ligands (e.g., anandamide and 2-AG) and receptors (CB1 and CB2) that appear to play a major role in efficient regulation of a wide range of systems that include sleep, feeding (e.g., gut permeability and adipogenesis), libido and fertility, pain perception, motivation, happiness, anxiety, learning and memory, social functioning, autoimmune responses, cellular redox, and cancer pathophysiology (Valvassori et al., 2009; Muccioli et al., 2010; Abdel-Salam et al., 2012; Cani, 2012; Burstein, 2015; Du Plessis et al., 2015; McPartland et al., 2015; Karhson et al., 2016; Pava et al., 2016; Tegeder, 2016; Turcotte et al., 2016; Androvicova et al., 2017; Sierra et al., 2018). In other words, unlike conventional pharmaceutical approaches, which largely target specific neurotransmitter sites (e.g., monoamine neurotransmitter hypothesis; Delgado, 2000; Ng et al., 2015), cannabis may act to improve a broad spectrum of symptoms by regulating homeostatic functioning, perhaps best described as a system-modulating rather than symptom-modulating form of therapy.

Notwithstanding the strengths of the naturalistic research design and the potential implications of the study's findings,

the study was limited primarily by the lack of a control group, e.g., non-cannabis users with the same symptom using a mobile device to indicate their immediate symptom intensity levels. There is also the potential confound of user-selection bias and exclusion of users that failed to complete sessions or even use the Releaf App^{TM} due to a lack of symptom relief or negative side effects. (It is possible that selection bias could have worked in the opposite way, excluding patients that are already satisfied with their cannabis choices and therefore choose not to use the software app). This study chose to focus on the existence of symptom relief and side effects rather than offer clinical guidance as to which cannabis products offer preferential symptom relief and side effects profiles. As such we did not include product characteristics, e.g., routes of administration, quantity and method of ingestion, and cannabinoid content, all of which are likely crucial for understanding how cannabis affects symptom relief and side effect manifestation. We only show that, on average, most cannabis users experience symptom relief. Future research will benefit by incorporating these contextual factors into measurements of patient decisions and by dissecting how fundamental characteristics of the cannabis products themselves affect immediate and longer term changes in symptom relief and potential adverse consequences.

Patients with certain health conditions such as neurological disorders (e.g., multiple sclerosis, seizures, epilepsy, headache) may face differential risks for experiencing adverse effects or exacerbating their symptoms, for instance, depending on the amount of delta-9-tetrahydrocannabinol they consume, and caution should be used for patients considering using highly potent cannabis products (Solimini et al., 2017). Complicating matters are the allogamous (variable) and unstable nature of the *Cannabis* plant and the inherent inconsistencies in the chemical contents across plant batches and derived formulations, which are affected by genetic characteristics, but also environmental, cultivation, and storage conditions (Thomas and Pollard, 2016; Pacifici et al., 2017, 2018). These factors present challenges for both medical cannabis consumers and researchers as patients never have continuous access to cannabis products with precisely consistent chemotypes. Cannabis-based products (e.g., dried flower vs. oils) can differ in their dose reliability, and researchers have offered guidelines for dosing titration and experimental usage (Kahan et al., 2014; Pichini et al., 2018). However, until federal laws currently restricting pharmacodynamics research in the United States are reformed (Stith and Vigil, 2016) investigators still have tremendous opportunities to develop and incorporate innovative assessment tools, like the Releaf App^{TM}, into observational research designs for measuring how patients experience self-directed cannabis treatment in their normal everyday lives outside of clinical settings.

AUTHOR CONTRIBUTIONS

JV and SS conceived the study. FB, KK, and BH independently designed and developed the Releaf App^{TM} and server infrastructure as part of their effort to help create an education tool for medical cannabis patients. SS conducted the analyses. JV and SS drafted the manuscript. All authors contributed substantially to its intellectual content and revision.

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All authors had access to the data in the study and take responsibility for the integrity of the data and the accuracy of the data analyses.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fphar.2018.00916/full#supplementary-material

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The Sex Therapists Using Pot to Help Patients Find Their 'Full Sexual Potential'

While weed is not a traditional tool in mainstream sex therapy, a handful of California sexologists have begun informally incorporating cannabis into their practices, arguing the drug can help patients relax, feel less inhibited, and achieve orgasm.

By Maria Yagoda

April 20, 2017, 3:25pm

According to thousands of people who swear by stoned sex, marijuana enables more present, embodied, and pleasurable sexual experiences. I've spoken with several people, women especially, who've found that smoking is the only way they can get out of their heads enough to orgasm.

"As someone who can often have a difficult time enjoying sex, discovering high sex in college was huge," says a 26-year-old woman named Rebecca. "It upped my libido and kind of gave me an excuse to be weird."

While weed is not a traditional tool in mainstream sex therapy, both because it's still illegal in most states and because its sexual side effects have not been widely studied, a handful of California sexologists and therapists have begun informally incorporating cannabis into their practices, suggesting their clients try masturbating while high.

Diana Urman, a Bay Area sexologist, recommends weed to clients who are having trouble orgasming or who have never experienced an orgasm, even after decades of sexual activity.

"Now that [weed is] legal in California, my job is easier," Urman says. "Marijuana allows people to be more present in their bodies and more whole. It slows you down."

Urman, who has a PhD in human sexuality, sometimes observes dramatic changes when clients who have experienced difficulty orgasming try masturbating—and eventually having sex with a partner—while stoned.

"My clients can feel a lot of anxiety about not being able to let go or be fully present in their bodies, which creates a disconnect between mind and body," she says. "Weed often improves people's abilities to self-pleasure and, as a result, feel more connected to partners."

The ideal, of course, is to eventually access that connectedness without substances. Seth Prosterman, a certified sex therapist in San Francisco, views weed as a sort of stepping stone.

"While pot can help bring out our most sexy selves, disinhibit us, or relax us during sex, I would highly recommend that people learn to be in the moment and deeply feel and connect with their partners without using enhancing drugs," Prosterman says. "Pot can give us a glimpse of our sexual potential. Working towards our sexual potential, with our partners, is part of developing a higher capacity for intimacy, passion, and deep connection."

While the disinhibiting effects of weed are regularly recognized by sex professionals, marijuana is still not widely recommended as a tool. Sunny Rodgers, a professional sex coach based in Los Angeles, says she's never suggested a client incorporate weed in their sex life, though adds, "I *have* had people tell me how great sex is when they can be high and ultra-relaxed."

When I ask Rodgers if she knows any professionals who do recommend weed to clients, she responds, "I've asked around and not a single coach or counselor I spoke with has recommended weed." Urman, who regularly recommends weed, finds this to be a systemic problem: "The usefulness of marijuana is not commonly understood among sex therapists."

For people struggling to find joy or pleasure in sex, weed can inject a playfulness that is otherwise hard to access, Urman says. In Gabby Bess's story on the role of weed in relationships, a man says he prefers to be with a partner who smokes and recounts a whimsical weed-fueled sexual experience he had with his girlfriend.

It upped my libido and kind of gave me an excuse to be weird.

"I remember one time she was smoking a joint while I was going down on her, and she said something along the lines of, 'This is how couples should smoke together,'" he says. "I remember blowing smoke on her clitoris while she came. Kinda hot!"

While there aren't many studies exploring the link between marijuana and sexual pleasure, there are a handful in which participants have offered anecdotal evidence. In the 2003 study "Cannabis Effects and Dependency Concerns in Long-Term Frequent Users," 54 percent of the 104 "experienced" marijuana users surveyed said smoking weed had the effect of sexual stimulation. (Ninety-five percent of respondents said it made them feel relaxed, while 86 percent said the drug made them feel comfortable.) Another Canadian study, from 2008, "Understanding the Motivations for Recreational Marijuana Use Among Adult Canadians," nearly half of the 41 adult participants said that marijuana enhanced their sexual experiences, with effects including increased libido, control, and sensitivity. Most recently, a small 2016 study in the *Archive of Sexual Behavior* comparing sex on weed and sex on booze found that sexual experiences with marijuana resulted in more pleasure (and fewer regrets) than drunk sex.

While Urman has never seen a client's sex life instantly transform after incorporating marijuana, she has observed that weed can be a catalyst on the path to having orgasms, individually or with a partner.

"It's a slow process, especially for someone who hasn't been orgasmic for their whole life. It's not like at some point they were orgasming and then stopped," she says. "But I have found their ability to self-pleasure has dramatically increased while using marijuana."

Rebecca, who had never had difficulties making herself come solo, found that smoking upped her (still pretty low) chances of getting off during sex. But there was always the possibility that weed would make things worse.

"It became kind of a crutch where, for a while, I would have to smoke literally before every time I had sex," she says. "As I got more and more anxious and depressed, it became worse, because if I was in a good place, great, but if I was in a bad place, I would get stuck there. It's very easy to get stuck in your head when high, which is dangerous for sex. You end up just internally freaking out about your relationship or how weird you're being or the fact that your vagina won't get wet. Because [weed] can also give you dry vagina, like dry mouth."

In his practice, Prosterman has found that the weed–sex combo is a bad idea for people who get anxious when they're high—but you probably guessed that.

"Any increase in anxiety will potentially interfere with sexual functioning, so for some people, weed can be an inhibiting factor in sex," he says. As with most sex advice, it's about figuring out what works best for you. "The main thing is to know how weed affects you *prior* to trying to use it for enhancing a sexual experience."

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MARIJUANA MOMENT

Marijuana Improves Sex And Could Help Close 'Orgasm Inequality Gap' Between Men And Women, New Study Indicates

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10 months ago

on
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By
Ben Adlin

Yet another study has found evidence that cannabis can lead to better sex, with participants reporting heightened desire, more intense orgasms and sharpened sensory perception.

The paper, published Friday in the Journal of Cannabis Research, was led by Amanda Moser of East Carolina University, now a Denver-based sexologist specializing in combining cannabis and sex.

Results of Moser's online survey of 811 adults who've used cannabis found greater perceived sexual functioning and satisfaction regardless of age or gender: More than 70 percent of people said using cannabis before sex increased desire and improved orgasms. Another 62.5 percent said cannabis enhanced their pleasure while masturbating.

But Moser and co-authors say the study's findings are especially relevant for women's pleasure. The results "suggest that cannabis can potentially close the orgasm inequality gap," they write, referring to past findings that women who have sex with men are typically less likely to orgasm than their partners.

"Women may be more likely to orgasm when using cannabis before sexual encounters, which could contribute to equity in the amount of sexual pleasure and satisfaction experienced by both women and men," the study says.

Past studies have found that while more than 90 percent of men report usually having orgasms during intercourse, fewer than 50 percent of women do. "To me that's a problem," Moser told Marijuana Moment in 2019, shortly after her survey was conducted.
To recruit participants, Moser posted the survey on social media and shared links with medical marijuana and legal cannabis advocacy organizations. Respondents were excluded if they were under 18 or hadn't ever used cannabis.

Majorities of respondents identified as white (78.9 percent), female (64.9 percent) and college-educated (80.1 percent). Nearly a quarter (23.1 percent) identified as LGBTQIA+. Ages ranged from 18 to 85, and 73.7 percent said they were in a monogamous relationship.

The survey included questions on cannabis use and its effects on participants' perceived senses of smell, taste and touch. It also asked about a dozen questions regarding marijuana's influence on specific aspects of sex and arousal. "This comprehensive scale moves beyond the physiological effects (e.g., achieving an erection) and incorporates overall sexual functioning and satisfaction," the study says. Most respondents (62.8 percent) reported using cannabis daily. About 6 in 10 (58.9 percent) said they used cannabis intentionally before engaging in sex.

Many findings, the authors write, were consistent with existing literature. Both men and women, for example, reported heightened desire and orgasm intensity. Women said they were better able to have multiple orgasms.

"These results align with the increased relaxation when using cannabis," the study says. "Those who use cannabis report being more relaxed, whether mental or physical, which would improve overall sexual functioning and pleasure."

More than 70 percent of respondents said cannabis enhanced their senses of taste and touch. While that much might be clear to anyone who's ever had the munchies, the

study's authors note that taste and touch are also "two senses that are heavily used during sexual intercourse."

One area where the survey results break from past studies is men's ability to maintain and achieve an erection with cannabis. While some research indicated that cannabis could inhibit that ability, the men polled in Moser's study reported no such difficulties. "However, due to the self-report nature of this survey, social desirability may have prevented them from reporting erectile issues," the paper says.

Indeed, a fundamental limitation of the study is its reliance on self-reported recollections of cannabis users. "Participants were asked to retrospectively self-report based on many years," it says, "which would result in recall bias." It notes that "results are measuring participants' perceptions of the effects of cannabis rather than the collection of physiological data."

Moser points out that sexual satisfaction was improved by an especially wide margin when participants purposefully used cannabis before sex.

"These results may be because of the mental mindset that using cannabis will increase pleasure due to the aphrodisiac notions of cannabis rather than a true physiological effect," Moser acknowledges. "However, the relaxation effects of cannabis may contribute to increased desire or reduced inhibitions that might contribute to increased sexual functioning and satisfaction."

The study's findings may have implications for treating medical dysfunctions, especially with women, Moser says. "Women with vaginismus (i.e., painful intercourse) may benefit from the muscular relaxation and increased sexual functioning that results from cannabis use, while women with decreased desire could also see possible benefits."

Becky Lynn, a women's health specialist and professor of obstetrics and gynecology at Saint Louis University in Maryland, was the lead author of a 2019 study with similar findings. In that survey of women at an OB/GYN practice, women who said they used marijuana before sex were more than twice as likely to report satisfactory orgasms.

"I have seen [cannabis] used in women with chronic pain disorders that lead to painful sex, women who experience difficulty with orgasm or an inability to orgasm, and women who use it to improve their libido, which may not match their partner's libido," Lynn told Weedmaps at the time.

A 2020 study in the journal Sexual Medicine, meanwhile, found that women who used cannabis more often had better sex.

Numerous online surveys have also reported positive associations between marijuana and sex. One study even found a connection between the passage of marijuana laws and increased sexual activity.

Yet another study, however, cautions that more marijuana doesn't necessarily mean better sex. A literature review published in 2019 found that cannabis's impact on libido may depend on dosage, with lower amounts of THC correlating with the highest levels of arousal and satisfaction. Most studies showed that marijuana has a positive effect on women's sexual function, the study found, but too much THC can actually backfire.

"Several studies have evaluated the effects of marijuana on libido, and it seems that changes in desire may be dose dependent," the review's authors wrote. "Studies support that lower doses improve desire but higher doses either lower desire or do not affect desire at all."

CITATION: Adlin, B. (2023, January 23). *Marijuana improves sex and could help close "orgasm inequality gap" between men and women, New Study indicates*. Marijuana Moment. https://www.marijuanamoment.net/marijuana-improves-sex-and-could-help-close-orgasm-inequality-gap-between-men-and-women-new-study-indicates/

INDEPENDENT

NewsHealth

Cannabis could improve orgasms for women, study finds

Study finds women who used marijuana before sex were twice as likely to say they had 'satisfactory' orgasms

Maya Oppenheim

Women's Correspondent

Friday 12 April 2019 21:19 BST

Around a third of women in the US have used cannabis before sex and those who do say they experienced increased desire and better orgasms, a study has found.

The study published in journal *Sexual Medicine* found women who used marijuana before sex were twice as likely as those who did not to say they had “satisfactory” orgasms.

While women who regularly used the drug were twice as likely as occasional users to have satisfying orgasms.

Researchers noted that marijuana use has been on the rise among adults in the US as a growing number of states pass laws which legalise it for both medical and recreational purposes.

The study surveyed 373 female patients at an obstetrics and gynaecology practice in an academic medical centre in Saint Louis, Missouri. Overall, 127 women, or 34 per cent, reported using marijuana before sexual activity.

Researchers note there is a dearth of research that has looked at the drug's impact on sexual health – despite the fact cannabis is thought to act on the cannabinoid receptor in the brain which is involved in sexual function.

Marijuana has long been linked to an increase in sexual activity among teenagers - in the same way that alcohol and recreational drugs also have. Earlier research has also tied marijuana to unsafe sex and higher rates of sexually transmitted diseases.

But this study, carried out by Dr Becky Lynn of Saint Louis University School of Medicine and colleagues, focused on the link between cannabis and women's satisfaction with their sex lives, sex drive, orgasms, lubrication and pain during intercourse.

Overall, 197 women in the study, or about 52 per cent, did not use cannabis at all. Another 49 women, or 13 per cent, used the drug but did not do so before having sex.

"What's new about this study is that marijuana is framed as being useful for sex," said Joseph Palamar, a population health researcher at NYU Langone Medical Centre in New York who was not actually involved in the study.

He added: "Typically, drugs are investigated as risk factors for sex. I think this paper signifies that times are changing".

The study found women who did use cannabis before sex appeared to have more lubrication and less pain during intercourse than women who did not. However, the differences were too small to rule out the possibility they were down to chance.

Limitations of the study include its small size and that is was not a controlled experiment designed to prove whether or how cannabis might directly impact sexual health.

CITATION: Oppenheim, M. (2019, April 12). *Cannabis could improve orgasms for women, study finds*. The Independent. https://www.independent.co.uk/news/health/marijuana-sex-women-weed-cannabis-smoke-orgasm-a8867756.html

Forbes

Can Marijuana Lead To Stronger, More Orgasms During Sex? Here's What This Study Showed

Bruce Y. Lee

Senior Contributor

Feb 18, 2023,01:23pm EST

A study recently published in the Journal of Cannabis Research found that over 40% of the women ... [+]

Talk about getting into the weeds. A study recently published in the *Journal of Cannabis Research* came to an interesting conclusion: that cannabis could potentially be used to treat sexual dysfunctions. In the study, which was an online survey of 811 people, over 70% of respondents reported increased sexual desire and orgasm intensity with marijuana use. And over 40% of the women surveyed indicated "increased ability to have more than one orgasm per sexual encounter." Now, these results may sound dope. But before you ditch the haircut, the candles, the steady paycheck, or anything else that may enhance sexual arousal in favor of the ganja, consider the limitations of this study.

This study entailed administering an online survey to a convenience sample of adults ages 18 years and older who had indicated histories of cannabis use. In fact, 62.6% of the respondents reported using cannabis on a daily basis with 59.8% intentionally using cannabis before engaging in sex. Now, this probably wasn't a typical sample of people. A convenience sample doesn't mean that these were folks found outside a convenience store. It meant that the research team from East Carolina University (Amanda Moser, MS, Sharon M. Ballard, PhD, and Jake Jensen, PhD) and North Carolina State University (Paige Averett, PhD) simply chose folks who happened to be conveniently available rather than a random sample from all-comers, so to speak. So it's difficult to tell how biased this sample may have been. Thus, results from this survey may not really represent what the general population might say.

Survey respondents did range in age from 18 to 85 years. But it did skew younger with an average age of 32.11. They were predominantly White (78.9%) and college-educated (80.1%) with 64.9% identifying as female. Close to a quarter (23.1%) of the respondents identified as LGBTQIA+. Nearly three-quarters (73.7%) of the respondents indicated that they were in monogamous sexual relationships.

The survey asked folks a bunch of questions about their cannabis use as well as their sensuality and ... [+]

The survey asked folks a bunch of questions about their cannabis use as well as their sensuality and experiences, functioning, and levels of arousal during sex, including masturbation. This included specific questions about achieving orgasms and maintaining erections and lubrication.

Of the 811 respondents, 601 felt that cannabis either slightly or significantly increased their sexual desire with such perceptions being higher for women than men. And 582 believed that cannabis slightly or significantly increased the intensity of their orgasms with no clear difference between men and women. Cannabis seemed to help folks feel like they were more masters of their own domain too, so to speak, with a majority of respondents (507 or 62.5%) reporting either slightly or significantly increased pleasure while masturbating.

So did the research team get a sense of what might have been going on here? Well, 71.9% of respondents did report slight or significant increases in the sense of taste with cannabis use. In this case, increases in taste didn't mean that they started dressing like Anne Hathaway. Rather, they had a heightened sensitivity to tasting things with their tongues and mouths. A similar percentage (71.0%) of respondents reported slight or significant increases in touch.

This also might have been a "relax do do it" situation, too, as 87.7% of respondents reported slight-to-significant increases in relaxation during sex. Two tents may be helpful in camping, but being too tense is not going to help you orgasm and enjoy sex. Thus, it would make sense that relaxation could help enhance sex.

Speaking of relaxation, the survey results did address one standing concern that men may have about cannabis and their penises. There is the belief that the muscle relaxation properties of cannabis could decrease the ability of a penis to achieve and maintain an erection. Of course, an erection isn't a muscle-bound thing. Your penis, if you have one, doesn't have that much muscle so don't try lifting a barbell with it. Instead, an erection is blood filling

the corpora cavernosa of the penis like air in a balloon animal thing. Well, based on the survey results, it wasn't hard to see that cannabis didn't seem to bring any erection fraud to the respondents. Most of the male respondents indicated no decrease in the ability to achieve (93.4%) or maintain (92.4%) an erection.

The survey results did address one standing concern that men may have about cannabis and their ... [+]

Of course, this study was far from avocado toast, meaning that it was far from perfect. Again, it was a convenience sample of cannabis users. So it could have selected for people who already believed that marijuana enhanced their sex lives. As you can imagine, if you already believe that something, like dressing up like Captain America, will aid your sex life, there's a decent chance that it will via the placebo effect.

Furthermore, survey responses don't always reflect what people truly feel or experience. Whenever you ask someone a question that includes the word "erection," you may not always get an honest answer. For example, if you were to ask someone in the supermarket, "Where do you keep the cauliflower and are you able to maintain an erection," chances are you will find the answer to only one of those things.

It would have been more accurate to have directly observed all of the study participants during sex, but that could have been really creepy and resulted in a lot of, "Hey, schmoopie, who's that person with the tablet in the room with us?" questions followed by, "Oh, it's just for some study that I signed up for so that I could get money to buy you dinner."

The study also didn't include any objective measures of arousal and orgasms. These would include physiological data like heart rate and body temperature or the number of times one utters something like, "Don't stop", "Oh, my gosh,", "Oh, Jason Mamoa," or "linguini" during sex. Uttering "linguini" during sex, though, could mean that the person is really excited or just really hungry.

Moreover, the survey did not ask about a number of other things that may have affected the sexual experience. For example, there was no sense of what medications and other substances each person was taking. And speaking of marijuana, it wasn't clear what the person was eating as well. There are other things that can affect sex, too, such as amount of physical activity, general health, job satisfaction, the presence of a support network, the level of interest between the partners, the number of pillows on the bed, and whether "Slave to Love" by Bryan Ferry is playing in the background.

Finally, the survey didn't measure the dosage of marijuana used. Naturally, a gram of marijuana would be quite different from 100 metric tons. Accordingly, future studies may want to help establish how the dosage of marijuana may relate to the aforementioned effects.

While this study is not the first to show associations between marijuana use and increased sensation and relaxation, it doesn't necessarily mean that you should discard other means of increasing sexual excitement and start using marijuana. It's still not clear what repeated use of marijuana may eventually do to your body. For example, studies have suggested that cannabis use could potentially have long-term effects on your brain, as summarized by the National Institute for Drug Abuse (NIDA). And while sacrificing your brain for your penis and vagina may seem like a fair trade, you should wait for more

studies to truly determine what this trade-off may be. Nevertheless, this study does raise the possibility that cannabis could eventually be helpful for those with true sexual dysfunction that can't otherwise be solved. That's assuming that other options have been weeded out already.

CITATION: Lee, B. Y. (2023, February 20). *Can marijuana lead to stronger, more orgasms during sex? here's what this study showed*. Forbes. https://www.forbes.com/sites/brucelee/2023/02/18/can-marijuana-lead-to-stronger-and-more-orgasms-during-sex-heres-what-this-study-showed/

Psychology Today

Why Women Benefit More From Cannabis Use

Pain relief may be linked to estrogen levels.

Posted May 27, 2022 | _Reviewed by Vanessa Lancaster

Written by Gary Wenk, Ph.D.

KEY POINTS

- Women respond differently to cannabis than men.
- The behavioral and neurobiological effects of cannabis in females have different magnitudes depending on the level of sex hormones.
- Females may be more sensitive to the pain-relieving and euphoric effects of cannabis than males.
-

Women respond differently to cannabis than men. Females report experiencing a greater "High" than male participants when given a relatively low dose of THC (0.015 mg/kg). Females tend to progress to tolerance and dependence faster than males after initiation of regular cannabis use.

Cannabis use is associated with improved sexual function among females, but not males. A recent study demonstrated that cannabis helps women orgasm who have difficulty having orgasms, enhances the frequency and quality of women's orgasms, and, of clinical relevance, helps women orgasm who have a female orgasmic disorder.

The behavioral and neurobiological effects of cannabis in females have different magnitudes depending on the level of sex hormones. Recent studies have investigated the interaction between fluctuations in the levels of the female sex hormones estrogen and prolactin and exogenously administered cannabinoids.

It is well known that cannabis increases prolactin release in males, causing gynecomastia (aka, man-boobs); in contrast, cannabis has no direct effect on prolactin levels in females. Female sex hormone fluctuations, especially estrogen, alter the function of the brain's endocannabinoid system in a region-dependent manner.

While the number of cannabinoid receptors in the limbic system (a collection of brain regions that control emotional responses) does not fluctuate, the responsiveness of the CB1 receptor, the receptor responsible for allowing us to experience euphoria, becomes much greater when estrogen levels are increasing.

When estrogen levels in the blood become elevated, the pituitary levels of the brain's endocannabinoid transmitters, 2-AG and AEA, are also significantly elevated. Taken together, these neurobiological changes might explain why women experience a greater level of euphoria at lower doses of THC.

No one currently understands the neurological mechanisms underlying these region-specific changes, and less is known about the effects of administering exogenous cannabinoids to cycling females.

One recent study reported that administration of a relatively small dose of THC induces a greater degree of anti-nociception (pain reduction) when estrogen levels are elevated. This anti-nociceptive action also correlates with a time when the endocannabinoid receptors in the PAG (a brainstem region responsible for blocking incoming pain signals) are more responsive, and endogenous levels of endocannabinoid neurotransmitters are elevated.

Estrogen does not bind directly to the brain's endocannabinoid receptors; however, it clearly interacts with how cannabinoids, both exogenous and endogenous, influence brain function. For example, 2ithin the hippocampus, a brain region responsible for forming new memories, estrogen acts at its receptor to increase the release of the endocannabinoid AEA, which, paradoxically, increases the activity within this brain region.

The importance of these changes remains on how the brain consolidates memories to be determined. Overall, due to the regular fluctuation in sex hormones, particularly estrogen, females may be more sensitive to the pain-relieving and euphoric effects of cannabis than males.

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Medium

Some Women Are Using Weed to Have Better Sex

Studies suggest women are using marijuana as a libido enhancer. Does it work?

Keren Landman, MD·

Illustration: Felicity Marshall

When Becky Lynn got a call from a California police station that her teenage daughter was in a car accident, she ran out of the house in the clothes she had on: tie-dye shorts and a T-shirt emblazoned with the modern portmanteau, “Cannaboss.” Both were souvenirs from April’s National Cannabis Festival, where Lynn, a gynecologist specializing in sexual medicine, appeared on one of the panels interweaved with yoga classes in the festival’s wellness pavilion.

Her daughter was mortified by her getup, but otherwise fine. And while Lynn wasn't worried about the medicolegal consequences of appearing in marijuana merch in public — especially in a state where it's legal — she understood her daughter's chagrin.

"It's so not me," she says. "I'm a physician, I'm a scientist — I'm not a stoner. But I dunno — your teenager is always going to be embarrassed by you."

While she may not use marijuana herself, Lynn has a keen interest in how cannabis might help the women she sees in her St. Louis, Missouri office. Her interest was first piqued when several women confided to her that they used marijuana to improve their libido, and that they believe it helps them achieve otherwise elusive orgasms. "When I looked in the scientific literature, there really wasn't much data at all," she says. "I looked on the internet — it was exactly the opposite."

The discrepancy led her to do her own study, and in March 2019, that study became one of the largest to describe how some women are using marijuana for better sex: of nearly 400 women completing her anonymous questionnaire,127 said they used the drug before sex, and reported better sex drives and more than twice the odds of satisfactory orgasms compared to non-users. Lynn's study doesn't irrefutably prove marijuana leads to better sex for women, but it demonstrates women aren't waiting on proof to use it that way. "Women do think that it can improve the sexual experience, improve drive, improve orgasm, lessen pain," says Lynn.

CITATION: Landman, K. (2019, October 31). *Some women are using weed to have better sex*. Medium. https://elemental.medium.com/some-women-are-using-weed-to-have-better-sex-f6a2dd223109

Cannabis Increases Your Orgasm Intensity And Helps With Multiple Orgasms, Study Finds

Male and female cannabis users all reported stronger orgasms whilst high.

JAMES FELTON

Senior Staff Writer

It's unclear if the aphrodisiac effect would counteract the stench of weedy sheets. Image credit: Olena Yakobchuk/Shutterstock.com

A study investigating sex and cannabis has found that cannabis users report better orgasms while high, as well as an increased libido, and sense of taste and touch.

Researchers, publishing their results in a recent study, asked 811 participants aged 18 to 85 years old a number of questions relating to their sex lives and cannabis use. Not noting much difference between the sexes and age groups, over 70 percent of the participants reported increased desire and orgasm intensity while high. Forty percent of the women, meanwhile, reported an "increased ability to have more than one orgasm per sexual encounter", according to the authors.

Over half of the people surveyed said that they had used cannabis intentionally prior to sexual encounters, suggesting they believe it to increase libido or pleasure. However, due to the nature of the study (a survey) the researchers were unable to delineate whether increased pleasure from sex was from actual effects of the drug or a placebo.

"Those who reported intentionally using cannabis before sex had significantly higher scale scores than those who reported not intentionally using cannabis before sex," the team wrote in their discussion.

"This can be interpreted as those who intentionally used cannabis before sex perceived a greater benefit to their sexual functioning and satisfaction compared to those who do not intentionally use cannabis before sex. These results may be because of the mental mindset that using cannabis will increase pleasure due to the aphrodisiac notions of cannabis rather than a true physiological effect."

However, they also write that the relaxation effects of cannabis "may contribute to increased desire or reduced inhibitions that might contribute to increased sexual functioning and satisfaction", citing similar studies that have found improvement of sexual function after cannabis use, as well as longer times spent on foreplay. Those in the study who reported masturbating reported increased pleasure doing so while high.

One seemingly-unrelated finding of the study is that cannabis users reported an increased sense of taste and touch. The team writes that the question was included due to the use of the senses during sex.

"The enhancement of taste and touch could increase overall sexual functioning and satisfaction because these are two senses that are heavily used during sexual intercourse", they write, adding that no increased sense of smell was reported.

Though the team note a number of limitations, including that doses were not recorded by participants and that it wasn't comparative with people who don't use cannabis, the team believes the findings could be useful to explore, including possibly using cannabis to treat sexual dysfunction.

The study is published in the Journal of Cannabis Research.

CITATION: Felton, J. (2023, January 25). *Cannabis increases your orgasm intensity and helps with multiple orgasms, study finds*. IFLScience. https://www.iflscience.com/cannabis-increases-your-orgasm-intensity-and-helps-with-multiple-orgasms-study-finds-67254

WELLNESS

Study: could cannabis help close the ‘orgasm gap’?

Over 40% of women said cannabis increased their ability to have multiple orgasms during sex.

Published
10 months ago

on
3rd February 2023

By
Sarah Sinclair

Over 70% of men and women reported that cannabis increases desire.

Cannabis appears to increase sex drive and satisfaction, and may help close the gender gap when it comes to sexual pleasure, say those behind a new study

Researchers at East Carolina University and North Carolina State University in the US have suggested that cannabis could help to close the so-called ‘orgasm gap’ by increasing desire, satisfaction and orgasm intensity in both men and women.

The research team, led by Amanda Moser, a sexologist and cannabis researcher, investigated the effects of cannabis on sexual functioning and satisfaction, given the lack of science in this area to date.

They surveyed over 800 adults between the ages of 18 – 85-years-old. The majority of participants were female, white/caucasian and most said they were in a monogamous relationship. Almost a quarter of the participants identified as LGBTQIA+.

Participants were asked a series of questions related to sex and cannabis use, including its effect on desire, satisfaction, masturbation and orgasm intensity.

Over half reported using cannabis daily for recreational and medicinal purposes and intentionally used cannabis before engaging in sex.
Cannabis was shown to have a 'positive influence on perceived sexual functioning and satisfaction' regardless of gender or age.
Over 70% of men and women reported that cannabis 'slightly or significantly increases desire'. In contrast to previous research, men perceived either 'no effect or an increased ability to achieve and maintain an erection' when using cannabis.
In addition, over 70% of men and women reported that cannabis 'slightly or significantly increased orgasm intensity', with over 40% of women saying cannabis increased their ability to have multiple orgasms during sex.
"The relaxation effects of cannabis may contribute to increased desire or reduced inhibitions that might contribute to increased sexual functioning and satisfaction," the authors state.

Closing the 'orgasm gap'

They go on to say that these findings, along with further research, could have implications in the treatment of conditions such as vaginismus (which causes debilitating pain during sex) and in increasing libido. Low libido, or lack of sex drive, is a common symptom of many physical and mental health conditions and is experienced by many women during menopause.
According to Moser and colleagues, cannabis could even help close the 'orgasm gap' – a term coined to highlight the disparity in orgasms between men and women'.
Research shows that men are statistically more likely to orgasm per sexual encounter compared to women. More than 90% of men report reaching orgasm 'usually or always' during sex, compared to less than 20% of women. Over 80% of women say they don't orgasm from intercourse alone.
"Women may be more likely to orgasm when using cannabis before sexual encounters, which could contribute to equity in the amount of sexual pleasure and satisfaction experienced by both women and men," the authors say.
They concluded: "Overall, cannabis use tends to have a positive influence on perceived sexual functioning and satisfaction for individuals despite gender or age and cannabis might help to decrease gender disparities in sexual pleasure."

Four theories support a hypothesis that cannabis may be a treatment for female orgasmic disorder

The Journal of Sexual Medicine
Volume 19, Issue 5, Supplement 2, May 2022, Pages S209-S210

S Mulvehill [1], J Tishler [2]

https://doi.org/10.1016/j.jsxm.2022.03.476Get rights and content

Introduction
Cannabis helps women orgasm who have difficulty orgasming and enhances the frequency and quality of women's orgasm. Studies have not yet shown if cannabis helps women orgasm who have female orgasmic disorder (FOD). Up to 41% of women worldwide suffer from FOD and the percentage of women suffering from FOD has not changed in 50 years.

Objective
The objective of this literature review is to present theories that support a hypothesis that cannabis may help women who have lifelong, acquired, or situational FOD. There is only one empirically validated treatment for lifelong FOD and no empirically validated treatments for acquired or situational FOD.

Method
Literature Review

Results

The dishabituation theory presents that Δ9-Tetrahydrocannabinol (THC), causes a dishabituating effect. Information processing of higher brain structures under the influence of THC reduces the routine represented by habits. Multiple studies have established the habits of cognitive distraction during sexual activity may distract a woman from her sensations and ability to orgasm. The theoretical rationale for the dishabituation theory proposes that THC could dishabituate the habit of being cognitively distracted and may explain why women who had never experienced an orgasm discovered they could orgasm when using cannabis before sex and why women who reported difficulty experiencing orgasm said it was easier to experience orgasm while using cannabis before sex. Neuroplasticity theory is a broad theory to describe how the human brain grows, changes, and rewires. Cannabis and endocannabinoids, the cannabinoids created by the human body, are increasingly recognized for their roles in neural development processes, including brain cell growth and neuroplasticity. The theoretical rationale for the neuroplasticity theory is that this theory may explain why some women *learn* to orgasm while using cannabis before sex and, once they learned to orgasm, found that they no longer required cannabis. The multi-modal treatment theory proposes that cannabis can treat multiple symptoms and conditions simultaneously. Multi-modal treatment is a broad area of study that involves combining two or more modalities targeting different aspects of a disease. The theoretical rationale for the multi-modal treatment theory is that this theory may explain why women who use cannabis for *any reason* may decrease their FOD. One researcher found that cannabis use decreased sexual dysfunction by up to 21% and that the reason women used cannabis had little to do with sexual functioning. The amygdala reduction theory proposes that cannabis can reduce the activity in the amygdala, a part of the brain associated with fear responses to threats. Hypervigilance, anxiety, and post-traumatic stress disorder (PTSD) are responses of the amygdala and commonly impair sexual response. The theoretical rationale for the amygdala reduction theory is that reduced amygdala activity can positively affect FOD. A reduction in anxiety associated with a sexual encounter could improve experiences and lead to improved orgasm and satisfaction.

Conclusion

Theories and anecdotal evidence from the existing body of cannabis, sex and women's orgasm research support that cannabis may be a treatment for FOD. Research needs to be conducted to evaluate cannabis as a treatment for FOD.

Disclosure

Work supported by industry: no. A consultant, employee (part time or full time) or shareholder is among the authors (Dr. Tishler is President and COO of inhaleMD, Inc. he is one of my dissertation advisors).

CITATION: Mulvehill, S., & Tishler, J. (2022). 220 four theories support a hypothesis that cannabis may be a treatment for female orgasmic disorder. *The Journal of Sexual Medicine*, *19*(Supplement_2). https://doi.org/10.1016/j.jsxm.2022.03.476

EDMONTON JOURNAL

Trouble reaching orgasm? Science says smoking weed can help

In a new study, 68 per cent participants responded that sex post-cannabis was "more pleasurable" than sex without it

Emma Spears

Published Aug 01, 2019 • Last updated Jan 24, 2020 • 1 minute read

With approximately 80 to 90 per cent of women reporting difficulty achieving orgasm via vaginal intercourse alone, plenty are looking for the secret to sexual satisfaction.

Trouble reaching orgasm? You're not alone. With approximately 80 to 90 per cent of women reporting difficulty achieving orgasm via vaginal intercourse alone, many are looking for the secret to sexual satisfaction – and it might just involve sparking up a nice, fat, pre-coitus joint.

In a new study by researchers at St Louis University published last month in Sexual Health, approximately 400 participating women were asked to compare their sexual activities with and without having consumed cannabis prior to engaging.

The primary outcome was satisfaction in the sexual domains of drive, orgasm, lubrication, dyspareunia, and overall sexual experience. The secondary outcome was the effect of the frequency of marijuana use on satisfaction," reads the study.

From the 400 participating women:

- 68 per cent responded that sex post-cannabis was “more pleasurable” than sex without having consumed the drug;
- 60 per cent of participants reported feeling an “increase in sex drive”;
- 52 per cent responded that the experienced an “increase in satisfying orgasms” after a toke.

The majority of women polled reported “increases in sex drive, improvement in orgasm, decrease in pain, but no change in lubrication,” according to the study’s authors.

With approximately 80 to 90 per cent of women reporting difficulty achieving orgasm via vaginal intercourse alone, many are looking for the secret to sexual satisfaction.

About half of all respondents described themselves as non-users of cannabis, with most describing themselves as heterosexual and Caucasian.

“Marijuana appears to improve satisfaction with orgasm,” researchers conclude. “A better understanding of the role of the endocannabinoid system in women is important, because there is a paucity of literature, and it could help lead to the development of treatments for female sexual dysfunction.”

CITATION: Spears , E. (2019, August 1). *Trouble reaching Orgasm? Science says smoking weed can help*. Edmonton Journal. https://edmontonjournal.com/cannabis-health/trouble-reaching-orgasm-science-says-smoking-weed-can-help

Boston MAGAZINE

Women, Weed, and Sex: What You Need to Know

A new reason to swing by your neighborhood dispensary? Research suggesting that marijuana may heighten women's experience in the bedroom.

by **EMILY KUMLER**. *4/15/2019, 4:58 p.m.*

Photo via Getty Images

Amanda, a Boston-based healthcare professional, has been experimenting with marijuana on and off for six years. She isn't looking to get stoned; rather, she's been using the drug to help her sleep and eat better, but over the years she's realized one interesting side effect.

"I am definitely hornier if I smoke or if I take an edible," Amanda says. "It really makes my sex drive better." As newly legal recreational pot shops continue to pop up across Massachusetts, this week on my podcast, "Empowered Health with Emily Kumler," we explore how women experience this drug differently than men, as well as a lesser-known use of cannabis: as a female aphrodisiac.

Becky Lynn, who sees women with problems ranging from low libido to painful sex to difficulty with orgasm as director of the Center for Sexual Health at Saint Louis University, first noticed this trend among patients a couple years ago. “[They] would come to me and they would say, ‘Well, you know, if I smoke marijuana or use marijuana, then I can have an orgasm or my libido’s better,’” she told me on-air this week. When she couldn’t find much research on the topic, she decided to conduct her own study. Enlisting the help of her fellow practitioners in a university practice that treats women for all kinds of reasons, Lynn surveyed 300 female patients. “What we found was that the majority of women noted that [marijuana products] did improve the overall sexual experience,” she said. “It did improve libido, it lessened pain, it improved their orgasm.”

I wondered: What is it about marijuana that is helping women, in particular, enjoy sex more? Rebecca Craft, a professor of psychology at Washington State University who researches the effects of drugs on behavior, may have the answer. In one study, Craft found that female rodents experienced about a 25 percent increase in sensitivity to the pain-relieving effects of THC (the active ingredient in cannabis) during ovulation, when their estrogen levels were rising. When the estrogen dropped and progesterone levels came up, their sensitivity to THC dropped and became similar to that of male rodents.

Though Craft was clear that her work in rodents doesn’t conclusively translate to humans, she said it’s well established that women experience a heightened sensitivity to pleasurable stimuli during ovulation as well. “I would say definitely when [estrogen is] really peaking during ovulation, for example, there’s more dopamine activity in that pathway, and this makes females more sensitive to all types of rewarding stimuli, including food, drugs, and sex,” she said. “Presumably it evolved to make us more amenable to social interaction…when we’re most likely to be able to become pregnant.”

Lynn, for her part, believes the link between weed and increased female sex drive has to do with three things THC does to the mind and body: It “reduces your anxiety, so you might feel more comfortable, and it slows down the perception of time and causes heightened sensations,” she said. “So whatever touch you’re feeling seems bigger in your mind.”

Like so many health issues, though, everyone I spoke with for this piece mentioned that there is scant clinical research on women’s sexual health, and that hopefully more interest will lead to more research, which will give us concrete answers in the future.

In the meantime, Amanda will continue frequenting dispensaries (she particularly loves the Brookline location of NETA) to help with her sleep, her appetite—and her romps between the sheets. “Pretty much every time that I smoke or if I take an edible, I’ll definitely be more in the mood and everything feels better and it’s just a better experience,” she says.

CITATION: Kumler, E. (2019, April 15). *Women, Weed, and Sex: What You Need to Know*. Boston Magazine. https://www.bostonmagazine.com/health/2019/04/15/women-weed-sex/

September 20, 2023

Board of Medicine

RE: New Professional Recommendations for Medical Marijuana Treatment -Female Orgasmic Difficulty/Disorder (FOD)

Dear Board of Physicians,

I am petitioning the Board to add female orgasm difficulty/disorder (FOD) as a condition for

treatment in your State Medical Cannabis Program.

Up to 41% of women experience sexual problems in the National Health and Social Life survey of 3000 women. In the PRESIDE study over 31,000 women were surveyed. Again, 44% had sexual dysfunction and 20% had problems with orgasm. This is more than will experience glaucoma, Parkinson's, Crohn's and other approved conditions. Currently there are no conventional medications that can help.

Cannabis to improve sexual function in men and women has received a lot of attention in the last 10 years. Study after study has revealed there is improved enjoyment, sensation, pleasure and orgasm.

I have been certifying patients for Cannabis and studying the various benefits for 5 years. I am a Board-certified OBGYN (30 years) and practice Sexual Medicine (18 years).

Please consider the addition of Female Orgasmic Disorder to the list of approved conditions.

If I can be of further service or answer any questions, please do not hesitate to contact me.

Sincerely,

Maureen Whelihan MD FACOG

USF '93 UF-Shands Jax '97

CANNASEXUAL

Ashley Manta, MA
Sex and Relationship Coach
Women's Cannabis Project www.womenscp.org
ashley@ashleymanta.com
1-484-947-6153

November 9, 2023

To Whom It May Concern:

This letter is my personal testimonial in support of female orgasmic difficulty/disorder becoming a condition of treatment for medical cannabis.

As a sexual assault survivor with a diagnosis of vaginismus and PTSD, I spent a significant portion of my sexually active adulthood struggling with pain with penetration and difficulty accessing orgasm due to my trauma. After seeing countless specialists and being prescribed a range of ineffective treatments including lidocaine cream, dilators, and antidepressants, I moved to California so I would have access to medical cannabis. Using cannabis, both topically and via inhalation, allowed me to both enjoy sex without pain and access orgasm reliably for the first time.

Cannabis is medicine, and for the millions of women suffering from orgasmic difficulty/disorder, a beacon of hope in an otherwise dreary outlook for their intimate lives. Cannabis made such a profound difference in my life that I became a vocal (and internationally recognized) advocate for utilizing cannabis to improve sexual experiences, especially for women who have a history of trauma-related disorders.

Please approve the petition to add female orgasmic difficulty to your state's condition of treatment for medical cannabis.

Sincerely,

Ashley Manta

Ashley Manta, MA

Female Orgasm Research Institute
Proven Pathways to Orgasm

Suzanne Mulvehill, PhD
Clinical Sexologist, Executive Director
Female Orgasm Research Institute
www.femaleorgasmresearch.org
info@femaleorgasmresearch.org
+1 561 526 6690
+39 375 5078 140

November 8, 2023

To Whom It May Concern:

This letter is my personal testimonial in support of female orgasmic difficulty/disorder becoming a condition of treatment for medical cannabis.

I saw four sex therapists over a period of more than thirty years to help me overcome my orgasm difficulty, yet, and unfortunately, talk therapy and the exercises the therapists suggested did not help my orgasm problem. I secretly suffered from the feelings of inadequacy and shame that accompanied my orgasm problem for decades.

After trying cannabis in 2018, to my own surprise, I discovered that cannabis helped me not only orgasm, but helped me develop a new sense of myself, a new confidence in who I am as a woman. It also helped me heal psychological wounds of childhood sexual abuse, and emotional abuse in my marriage, that I am sure contributed to my decades-long orgasm problem.

Please approve the petition to add female orgasmic difficulty to your state's condition of treatment for medical cannabis.

Sincerely,

Suzanne Mulvehill, PhD

inhaleMD

September 18, 2023

New Mexico Medical Cannabis Advisory Board
Medical Cannabis Program
1474 Rodeo Road., Suite 200
Sante Fe, NM 98505

Dear New Mexico Medical Cannabis Advisory Board Members,

I write to support the petition to add female orgasm difficulty/disorder (FOD) as a condition of treatment for the state of New Mexico's Medical Cannabis Program. FOD is an under-reported public health problem of enormous proportion. Over 41% of women will experience this problem.[1] This is vastly more than will experience high blood pressure [2] or diabetes.[3] Women with FOD reported 24% more mental health issues, 52.6% more PTSD, 29% more depressive disorders, 13% more anxiety disorders, and 22% more prescription drug use than women without FOD. Women with sexual abuse histories and FOD (38.6%, n=74/202) reported 32.9% more sexual abuse histories than women without FOD (27.6%, n=51/185).

Unfortunately, despite the pervasive and pernicious effects of Female Orgasm Difficulty/Disorder, there are no conventional medications that can help.[4] Cannabis for female sexuality has actually been researched for over 50 years. Study after study has revealed that cannabis helps women with this issue. [5-16] Yet no state has yet put FOD on their list of approved indications. I hope that New Mexico will be the leader.

I have been a practicing Cannabinoid Specialist for over 12 years. I am faculty at both Harvard Medical School and MassGeneral Brigham Hospital. My research focus is on cannabinoids for human sexuality. In my practice, I have been prescribing medical cannabis to patients who have FOD and can attest that women report benefit from cannabis in ways no other medication or program can match.

If I can be of further service or answer any questions, please do not hesitate to contact me.

Warm Regards,

Jordan Tishler, MD
Harvard Medical School
President, Association of Cannabinoid Specialists
CEO, inhaleMD

617-477-8886 Phone & Fax
www.inhaleMD.com

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inhaleMD

September 20, 2023
Board of Physicians
Connecticut Department of Consumer Protection
Medical Marijuana Program
450 Columbus Blvd, Suite 901
Hartford, CT 06103-1840

RE: Section I: Professional Recommendations for Medical Marijuana Treatment
Female Orgasmic Difficulty/Disorder (FOD)

Dear Board of Physicians,

I write to support the petition to add female orgasm difficulty/disorder (FOD) as a condition of treatment for the state of Connecticut's Medical Cannabis Program. FOD is an under-reported public health problem of enormous proportion. Up to 41% of women will experience this problem.[1] This is vastly more than will experience high blood pressure [2] or diabetes.[3] Unfortunately, despite the pervasive and pernicious effects of Female Orgasm Difficulty/Disorder, there are no conventional medications that can help.[4] Cannabis for female sexuality has actually been researched for over 50 years. Study after study has revealed that cannabis helps women with this issue. [5-16] Yet no state has yet put FOD on their list of approved indications. I hope that Connecticut will be a leader.

I have been a practicing Cannabinoid Specialist for over 12 years. I am faculty at both Harvard Medical School and MassGeneral Brigham Hospital. My research focus is on cannabinoids for human sexuality. In my practice, I have been prescribing medical cannabis to patients who have FOD and can attest that women report benefit from cannabis in ways no other medication or program can match.

If I can be of further service or answer any questions, please do not hesitate to contact me.

Warm Regards,

Jordan Tishler, MD
Harvard Medical School
President, Association of Cannabinoid Specialists
CEO, inhaleMD

References

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Medical Marijuana Program

RE: Professional Recommendations for Medical Marijuana Treatment Female Orgasmic Difficulty/Disorder (FOD)

Dear Medical Cannabis Regulators,

I write to support the petition to add female orgasm difficulty/disorder (FOD) as a condition of treatment for the state's Medical Cannabis Program. FOD is an under-reported public health problem of enormous proportion. Up to 41% of women will experience this problem.[1] This is vastly more than will experience high blood pressure [2] or diabetes.[3]

Unfortunately, despite the pervasive and pernicious effects of Female Orgasm Difficulty/Disorder, there are no conventional medications that can help.[4] Cannabis for female sexuality has actually been researched for over 50 years. Study after study has revealed that cannabis helps women with this issue. [5-16] Yet no state has yet put FOD on their list of approved indications. I hope that Connecticut will be a leader.

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If I can be of further service or answer any questions, please do not hesitate to contact me.

Warm Regards,

Jordan Tishler, MD
Harvard Medical School
President, Association of Cannabinoid Specialists
CEO, inhaleMD

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