The impact of cannabis use on male sexual function: A 10-year, single-center experience

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Abstract

Introduction: Despite increasing consumption rates in much of the world, the impact of cannabis use on various components of male sexual function remain poorly established. The purpose of this study was to further evaluate the relationship between cannabis use and reproductive and sexual function using a large patient cohort from a single academic andrology clinic.
Methods: This is a historical cohort study from a single academic center andrology clinic. Patients from 2008–2017 were included. Intake questionnaires provided baseline demographic information, as well as data regarding substance use and various sexual function parameters. Subjects were categorized as cannabis users or non-users. Cannabis users and non-users were compared using descriptive statistics and Chi-squared tests, and regression analyses were performed to test for association.
Results: A total of 7809 males were included in the study; 993 (12.7%) were cannabis users and 6816 (87.3%) were non-users. Cannabis users had a higher mean Sexual Health Inventory for Men (SHIM) score (21.9±4.4 vs. 21.2±4.8, $p<0.001$) and mean serum total testosterone (13.4±12.0 nmol/L vs. 12.6±11.8 nmol/L, $p=0.04$) than non-users, although they also had a higher rate of positive Androgen Deficiency in the Aging Male (ADAM) scores (52% vs. 46%,

p<0.001). Cannabis users also reported higher sexual frequency compared to non-users (8.8 events/month vs. 7.8 events/month, p<0.05). On multivariate analysis, cannabis use was not associated with SHIM score or serum testosterone concentration. Cannabis use was associated with positive ADAM scores.
Conclusions: Cannabis use was not associated with clinically significant deleterious effects on male sexual parameters in this cohort.

Introduction

Cannabis is the most widely consumed drug in the world, with an estimated 188 million people having used it in 2017, or approximately 3.8% of the world's population.[1] Consumption rates have increased significantly in the United States in recent years, from 9.9% of the population aged 15-64 in 2007 to 15.3% in 2017. This is in the context of widespread changes to the regulation of both medical and non-medical cannabis use in recent years. As of July 2019, 33 states had approved cannabis use in some form, with 11 states having passed laws legalizing its recreational use.[2] In Canada, the Cannabis Act came into effect in October 2018, officially legalizing recreational cannabis use nationwide.[3]

Given these trends, it is imperative that the medical impact of short- and long-term cannabis use be understood to help counsel patients regarding the potential deleterious impact of cannabis. As the majority of cannabis users are men of reproductive age, the effects of this drug on reproductive and sexual health are of particular interest.[4]

Despite increasing research on the subject, the association between cannabis use and male sexual function remains controversial. A large number of studies have focused on the potential negative impact of cannabis use on fertility, largely based on impaired semen parameters. In their recent systematic review, Payne et al found that cannabis use was associated with reductions in sperm count and concentration, motility, and viability.[5] However, less attention has been paid to the impact on male sexual function. Two recent reviews have highlighted the lack of large population-based cohort studies, with much of the evidence on this topic derived from animal and in vitro studies.[5,6] These reviews both concluded that while there is compelling evidence for a negative impact of cannabis on semen parameters, its effects on hormonal and sexual function are less clear.

This study was conducted to further evaluate the relationship between cannabis use and reproductive and sexual function using a large patient cohort from a single academic andrology clinic.

Methods

This study was conducted using a cohort of patients from a single Canadian academic center andrology clinic. All data was prospectively collected. Institutional Review Board approval was

obtained. The cohort included men who attended this clinic for evaluation of infertility from 2008-2017. All men attending this clinic completed a patient intake questionnaire, from which baseline demographic and self-reported substance use and sexual function information was obtained. Self-reported erectile function was assessed using the Sexual Health Inventory for Men (SHIM). Symptoms of androgen deficiency were assessed using the Androgen Deficiency in the Aging Male (ADAM) questionnaire. Men who reported use of cocaine, heroin, ecstasy, or lysergic acid diethylamide (LSD) were excluded from analysis.

Summary statistics for baseline clinical factors and sexual health and function parameters were reported, stratified by marijuana use. Differences between users and non-users for each clinical factor and parameter were assessed using the Wilcoxon rank-sum test and Chi-square test. Confounders for regression models were selected a priori and included age (continuous), smoking frequency (none, <1 PPD, 1 PPD, 2 PPD, >2 PPD) and alcohol consumption (none, <1 drinks/week, 2 drinks/week, 3 drinks/week, 4+ drinks/week). Univariate and multivariate linear regressions were used to model the association between marijuana use and total SHIM score, total ADAM score, and serum testosterone levels, adjusting for the aforementioned confounders. All statistical tests were two-sided and a p-value of less than 0.05 was considered statistically significant. Analyses were conducted using R version 3.6.0.

Results

7,809 male patients were included in this retrospective analysis. Of these, 993 (12.7%) were self-reported cannabis users and 6,816 (87.3%) were non-users. Table 1 shows the baseline patient demographics both as an overall cohort and separated by cannabis use. The mean age of the cohort was 37.2 years (standard deviation [±] 7.2 years), with cannabis users younger than non-users (34.8 ± 6.5 years vs. 37.5 ± 7.2 years, p<0.001). Both cigarette use (38% vs. 14%, p<0.001) and alcohol consumption (75% vs. 52%, p<0.001) were more common among cannabis users.

Table 2 shows the sexual function and testosterone parameters as an overall cohort and separated by cannabis use. Cannabis users had a higher mean SHIM score than non-users (21.9 ± 4.4 vs. 21.2 ± 4.8, p<0.001), though this difference is arguably not clinically significant. Rates of self-reported 'erectile problems' were similar between cannabis users and non-users (23% vs. 22%, p=0.23). Positive ADAM scores signifying potential androgen deficiency were more common in cannabis users vs. non-users (52% vs. 46%, p<0.001), Mean serum testosterone concentration was higher in cannabis users than non-users (13.4 ±12.0 nmol/L vs. 12.6 ± 11.8 nmol/L, p=0.04). Cannabis users reported higher mean sexual frequency compared to non-users (8.8 ± 5.1 encounters/month vs. 7.8 ± 4.9 encounters/month, p<0.05).

Table 3 demonstrates the univariate and multivariate linear regression models for SHIM score. Cannabis use was not found to be associated with SHIM score on multivariate analysis. Cigarette smoking was associated with lower SHIM scores in the subgroups of <1 PPD (mean estimate -0.40, CI -0.71- -0.09, p=0.01) and >2 PPD (mean estimate -3.6, CI -4.69 - -2.41, p<0.001). Alcohol consumption of all degrees was associated with a minor increase in SHIM

score, and this association was not dose-dependent. Table 4 demonstrates the univariate and multivariate logistic regression models for ADAM score, with ADAM score modeled as a dichotomous variable (positive or negative). Cannabis use was associated with increased odds of a positive ADAM score (odds ratio 1.29, CI 1.12-1.48, p<0.001). Cigarette smoking was associated with a positive ADAM score in the subgroups of <1 PPD (odds ratio 1.32, CI 1.16-1.51, p<0.001), 1 PPD (odds ratio 1.94, CI 1.39-2.72, p<0.001), and >2 PPD (odds ratio 1.69, CI 1.05-2.71, p=0.03). Alcohol consumption was not associated with ADAM score in most subgroups.

Table 5 shows the univariate and multivariate linear regression models for serum testosterone concentration. On multivariate analysis, none of the included covariates (age, cannabis use, cigarette use, alcohol consumption) were associated with serum testosterone levels.

Discussion

The present study did not identify an association between cannabis use and SHIM score or mean serum testosterone concentration. Cannabis use was associated with mildly higher ADAM scores and an overall positive ADAM result.

Kolodny et al provided early evidence for an association between cannabis use and testosterone. These authors found that mean testosterone was lower in chronic heavy cannabis users compared to non-users, and that this decrease was dose-dependent.[7] Similar findings were demonstrated in a clinical study by Cohen et al and several animal studies.[8–10] However, the majority of other clinical studies have failed to demonstrate an association between cannabis use and testosterone. Until recently, these studies had small sample sizes with less than 200 subjects. The first large cohort study to examine this relationship was by Gundersen et al, who examined over 1,200 subjects and found that testosterone levels were actually increased in cannabis users compared to non-users.[11] The 2017 study by Thistle et al involving over 1,500 men did not find any difference in testosterone between cannabis ever-users and never-users, though they did note a relationship between time since last use of cannabis and testosterone, with hormone concentrations higher in men with more recent use.[12] In the present study, mean serum testosterone was indeed higher in cannabis users compared to non-users, though it must be noted that this association was lost in the regression modelling. Our study represents the largest cohort to date to examine the relationship between cannabis use and testosterone levels, and reaffirms the findings of previous large cohort studies that cannabis use does not negatively impact testosterone levels.

The relationship between cannabis use and sexual function has proven more difficult to delineate for a variety of reasons. Studies assessing sexual function are often based on patient self-reporting and are therefore subject to bias. Moreover, a global picture of sexual function is comprised of numerous components such as libido, erectile function, and ability to achieve orgasm, and each of these may be affected differently by cannabis use. Animal studies have shown that rats exposed to delta-9-etrahydrocannabinol (THC), the active component in

cannabis, exhibited reduced copulatory behaviour.[13–15] In contrast, human studies have shown more positive effects of cannabis on libido. In a literature review of the self-reported effects of cannabis use, 51.3% of subjects self-reported increased sexual arousal with cannabis use, and 73.5% reported increased sexual pleasure.[16] In a large national survey-based study involving over 50,000 subjects, Sun et al demonstrated increased sexual frequency among cannabis users compared to never-users, an association that persisted after controlling for various socioeconomic and anthropomorphic factors.[17] Interestingly, these findings were demonstrated in women as well as men. The specific impact of cannabis use on female sexual function was examined by Lynn et al, who found that self-reported improvement in sex drive and orgasm was associated with cannabis use before sex.[18] Similar to previous human studies, cannabis users in our cohort reported increased sexual frequency compared to non-users.

While cannabis may increase libido, there is now evidence that it may also be associated with erectile dysfunction. A recent meta-analysis examining the relationship between cannabis use and erectile dysfunction found that cannabis users were almost four times as likely to suffer from erectile dysfunction compared to controls (odds ratio 3.83, p=0.02).[19] This meta-analysis included 5 studies involving over 3,300 subjects. In comparison the present study included over 7,000 subjects and found that rates of erectile dysfunction, as determined by a SHIM score ≤21, were increased in cannabis non-users. Furthermore, though the difference was not clinically significant, mean SHIM score was higher in cannabis users. While, these results may be confounded by the increased mean age of the non-user group, multivariate analysis including age as a covariate did not identify an association between cannabis use and SHIM score. Various studies have attempted to identify an etiology for a potential negative impact of cannabis on erectile function. Aversa et al found that in men with organic erectile dysfunction, cannabis users were more likely to have signs of endothelial dysfunction on penile duplex ultrasonography.[20] However, when assessing these findings, it is impossible to differentiate the effect of smoking from the effect of cannabis itself. With the increasing availability of cannabis oils and edible products, the potential harmful effects of smoking can be eliminated from the cannabis experience. As well, in the first study to identify cannabinoid receptors in nitric oxide synthase-containing nerves in human cavernosal tissue, the cannabinoid agonist anandamide antagonized cavernosal relaxation.[21] Conversely, evidence for a central effect of cannabis on erections was demonstrated by Melis et al, who found that injection of a cannabinoid antagonist into the paraventricular nucleus of the hypothalamus in rats induced erection.[22] Overall, the impact of cannabis use on erectile function in humans remains unclear, but the results of this study certainly provide support for lack of a significant negative effect.

The primary strength of the present study is the large size of the study cohort despite the single-center setting. However, this study does have certain notable limitations. Primary among these is the binary categorization of cannabis use into users and non-users. Lack of quantification of cannabis use by dose and frequency prevents establishment of a potential dose-dependent relationship between cannabis use and any of the study outcomes. Similarly, this study did not

evaluate method of consumption or type of cannabinoid product consumed. As well, the overall rate of cannabis use of 12.4% was rather low, and it must be noted that our cohort included only infertile men who may have read about the potential harms of cannabis on fertility on their own, thereby introducing selection bias and potentially limiting the generalizability of our results. Another major limitation is the retrospective, non-randomized nature of the study. Additionally, while the large sample size in this study was a strength of this research, significance values might also be somewhat inflated due to the high N leading to type 1 errors. Finally, much of the data was self-reported, introducing the risk of reporting bias. This may account for the lack of dose-dependent relationships that may be expected between alcohol consumption and SHIM score, as well as alcohol and tobacco consumption and ADAM score.

Conclusions

In conclusion, the present study provides compelling evidence against significant deleterious effects of cannabis use on male sexual function. Further studies, particularly large randomized controlled trials, are needed to establish causation of cannabis use on levels of testosterone and other reproductive hormones, semen parameters, sexual function, and fertility.

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Figures and Tables

Table 1. Baseline clinical information				
Covariate	**Full sample (n=7809)**	**Cannabis non-users (n=6816)**	**Cannabis users (n=993)**	**p**
Age				**<0.001**
Mean (SD)	37.2 (7.2)	37.5 (7.2)	34.8 (6.5)	
Median (min, max)	36 (17,79)	36 (17,79)	34 (18,67)	
Ethnicity				**<0.001**
African-Canadian	429 (5)	369 (5)	60 (6)	
Asian	1242 (16)	1204 (18)	38 (4)	
Caucasian	3778 (48)	3148 (46)	630 (63)	
Hispanic	177 (2)	158 (2)	19 (2)	
Indo-Canadian	277 (4)	249 (4)	28 (3)	
Middle Eastern	481 (6)	449 (7)	32 (3)	
Native-Canadian	73 (1)	56 (1)	17 (2)	
Unspecified	1352 (17)	1183 (17)	169 (17)	
Smoking				**<0.001**
No	6482 (83)	5863 (86)	619 (62)	
Yes	1327 (17)	953 (14)	374 (38)	
Smoking frequency				**<0.001**
None	6482 (83)	5863 (86)	619 (62)	
<1 PPD	1083 (14)	767 (11)	316 (32)	
1 PPD	151 (2)	106 (2)	45 (5)	
2 PPD	21 (0)	19 (0)	2 (0)	
>2 PPD	72 (1)	61 (1)	11 (1)	
Alcohol use				**<0.001**
No	3513 (45)	3269 (48)	244 (25)	
Yes	4296 (55)	3547 (52)	749 (75)	
Alcohol frequency (drinks/week)				**<0.001**
None	3513 (45)	3269 (48)	244 (25)	
<1	2733 (35)	2249 (33)	484 (49)	
1	644 (8)	547 (8)	97 (10)	
2	452 (6)	341 (5)	111 (11)	
3	230 (3)	196 (3)	34 (3)	
4+	237 (3)	214 (3)	23 (2)	

PPD: packs per day; SD: standard deviation.

Table 2. Sexual health and function parameters				
Covariate	**Full sample (n=7809)**	**Cannabis non-users (n=6816)**	**Cannabis users (n=993)**	**p**
Total SHIM score				**<0.001**
Mean (SD)	21.3 (4.8)	21.2 (4.8)	21.9 (4.4)	
Median (min, max)	23 (0, 25)	23 (0, 25)	24 (1, 25)	
Missing	**55**	**52**	**3**	
SHIM <21				**<0.001**
≤21	2813 (36)	2518 (37)	295 (30)	
>21	4941 (64)	4246 (63)	695 (70)	
Missing	**55**	**52**	**3**	
SHIM severity				**<0.001**
<8	227 (3)	204 (3)	23 (2)	
8–11	224 (3)	205 (3)	19 (2)	
12–16	597 (8)	537 (8)	60 (6)	
17–21	1765 (23)	1572 (23)	193 (19)	
>21	4941 (64)	4246 (63)	695 (70)	
Missing	**55**	**52**	**3**	
Erection problems (No/Yes)				0.23
No	5953 (78)	5213 (78)	740 (77)	
Yes	1665 (22)	1439 (22)	226 (23)	
Missing	**191**	**164**	**27**	
Erection problems				0.49
No	5953 (78)	5213 (78)	740 (77)	
Sometimes	1265 (17)	1089 (16)	176 (18)	
Mostly	257 (3)	223 (3)	34 (4)	
Always	143 (2)	127 (2)	16 (2)	
Missing	**191**	**164**	**27**	
ADAM score				**0.028**
Mean (SD)	1.6 (2.2)	1.6 (2.2)	1.7 (2.2)	
Median (min, max)	1 (0, 10)	0 (0, 10)	1 (0, 10)	
Missing	**53**	**50**	**3**	
Positive ADAM score				**<0.001**
No	4162 (54)	3682 (54)	480 (48)	
Yes	3594 (46)	3084 (46)	510 (52)	
Missing	**53**	**50**	**3**	
Serum testosterone				**0.04**
Mean (SD)	12.7 (11.8)	12.6 (11.8)	13.4 (12)	
Median (min, max)	11 (0, 273.2)	11 (0, 273.2)	12 (0, 123.4)	

ADAM: Androgen Deficiency in the Aging Male; SHIM: Sexual Health Inventory for Men; SD: standard deviation.

Table 3. Univariate and multivariate linear regression models of SHIM score

	Univariate			Multivariate		
Covariate	**Estimate (95% CI)**	**p**	**Global p**	**Estimate (95% CI)**	**p**	**Global p**
Age	-0.08 (-0.10, 0.07)		**<0.001**	-0.07 (-0.09, -0.06)		**<0.001**
Cannabis			**<0.001**			0.09
Cannabis non-users	Reference			Reference		
Cannabis users	0.75 (0.43, 1.06)			0.28 (-0.05, 0.6)		
Smoking frequency			**<0.001**			**<0.001**
None	Reference			Reference		
<1 PPD	0.01 (-0.3, 0.31)	0.97		-0.40 (-0.71, -0.09)	**0.011**	
1 PPD	-0.49 (-1.27, 0.28)	0.21		-0.61 (-1.37, 0.15)	0.12	
2 PPD	0.20 (-1.9, 2.29)	0.85		0.40 (-1.65, 2.44)	0.70	
>2 PPD	-3.57 (-4.69, -2.45)	**<0.001**		-3.60 (-4.69, -2.51)	**<0.001**	
Smoking			0.10			
No	Reference					
Yes	-0.24 (-0.52,0.04)					
Alcohol frequency (drinks/week)			**<0.001**			**<0.001**
None	Reference			Reference		
<1	1.82 (1.59, 2.06)	**<0.001**		1.68 (1.44, 1.92)	**<0.001**	
1	2.22 (1.82, 2.62)	**<0.001**		2.09 (1.7, 2.49)	**<0.001**	
2	1.48 (1.01, 1.94)	**<0.001**		1.49 (1.02, 1.95)	**<0.001**	
3	1.81 (1.18, 2.43)	**<0.001**		1.95 (1.32, 2.57)	**<0.001**	
4+	1.51 (0.89, 2.13)	**<0.001**		1.66 (1.04, 2.28)	**<0.001**	
Alcohol use			**<0.001**			
No	Reference					
Yes	1.83 (1.62, 2.04)					

CI: confidence interval; PPD: packs per day; SHIM: Sexual Health Inventory for Men.

Table 4. Univariate and multivariate linear regression model of ADAM scores						
	Univariate			Multivariate		
Covariate	**Estimate (95% CI)**	**p**	**Global p**	**Estimate (95% CI)**	**p**	**Global p**
Age	1.02 (1.02,1.03)		**<0.001**	1.03 (1.02, 1.03)		**<0.001**
Cannabis			**<0.001**			**<0.001**
Cannabis non-users	Reference			Reference		
Cannabis users	1.27 (1.11,1.45)			1.29 (1.12, 1.48)		
Smoking frequency			**<0.001**			**<0.001**
None	Reference			Reference		
<1 PPD	1.32 (1.16,1.51)	**<0.001**		1.32 (1.16, 1.51)	**<0.001**	
1 PPD	2.00 (1.43, 2.79)	**<0.001**		1.94 (1.39, 2.72)	**<0.001**	
2 PPD	1.00 (0.42, 2.42)	0.99		1.02 (0.42, 2.47)	0.97	
>2 PPD	1.62 (1.01, 2.59)	**0.04**		1.69 (1.05, 2.71)	**0.03**	
Smoking			**<0.001**			
No	Reference					
Yes	1.39 (1.24, 1.57)					
Alcohol frequency (drinks/week)			0.16			0.05
None	Reference			Reference		
<1	0.96 (0.86, 1.06)	0.38		0.95 (0.86, 1.06)	0.38	
1	0.80 (0.68, 0.95)	**0.01**		0.80 (0.68, 0.95)	**0.01**	
2	0.90 (0.74,1 .10)	0.31		0.83 (0.68, 1.01)	0.07	
3	0.85 (0.65, 1.11)	0.24		0.77 (0.58, 1.01)	0.06	
4+	1.02 (0.78,1.33)	0.89		0.93 (0.71, 1.21)	0.58	
Alcohol use			0.08			
No	Reference					
Yes	0.92 (0.84,1.11)					

CI: confidence interval; PPD: packs per day.

Table 5. Univariate and multivariate linear regression model of serum testosterone concentration						
	Univariate			**Multivariate**		
Covariate	**Estimate (95% CI)**	**p**	**Global p**	**Estimate (95% CI)**	**p**	**Global p**
Age	0.0013 (-0.05, 0.05)		0.96	0.0074 (-0.05, 0.06)		0.78
Cannabis			0.15			0.36
Cannabis non-Users	Reference			Reference		
Cannabis users	0.79 (-0.29, 1.86)			0.52 (-0.6, 1.65)		
Smoking frequency			0.33			0.47
None	Reference			Reference		
<1 PPD	1.13 (0.1, 2.17)	**0.032**		1.02 (0.04, 2.08)	0.061	
1 PPD	0.19 (-2.42, 2.8)	0.89		0.14 (-2.49, 2.76)	0.92	
2 PPD	-0.13 (-6.84, 6.58)	0.97		0.0049 (-6.71, 6.72)	1.00	
>2 PPD	-0.07 (-3.76, 3.62)	0.97		-0.02 (-3.71, 3.68)	0.99	
Smoking			0.05			
No	Reference					
Yes	0.94 (-0.01, 1.89)					
Alcohol frequency			0.30			0.35
None	Reference			Reference		
<1	0.08 (-0.71, 0.87)	0.84		-0.05 (-0.86, 0.76)	0.91	
1	1.46 (0.08, 2.84)	**0.04**		1.37 (-0.02, 2.76)	0.05	
2	0.82 (-0.84, 2.49)	0.33		0.58 (-1.1, 2.27)	0.50	
3	0.61 (-1.67, 2.88)	0.60		0.43 (-1.85, 2.71)	0.71	
4+	-0.82 (-2.92, 1.29)	0.45		-0.94 (-3.05, 1.18)	0.39	
Alcohol use			0.37			
No	Reference					
Yes	0.32 (-0.39, 1.04)					

CI: confidence interval; PPD: packs per day.