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Original Article

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Cannabis Use in Inpatients With Schizophrenia Spectrum Disorders at a Community Hospital

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Abstract

Background: Cannabis is the second most used recreational drug in the United States and one of the most used substances in patients with schizophrenia spectrum disorder (SSD). Unfortunately, the increased use is likely to continue as more states legalize recreational use of cannabis. Although the association between cannabis and schizophrenia has been studied extensively, the understanding of the relationship is still evolving. In this study, we sought to determine the prevalence and potential factors associated with cannabis use (CU) among inpatients with SSD at a community teaching hospital.

Methods: We performed a retrospective review of the electronic medical charts of patients discharged from the psychiatric unit of our hospital from July 1, 2017 through October 31, 2017. Patients were included in this study if: 1) They were ≥ 18 years old; 2) They had discharge diagnosis of SSD; and 3) They had urine drug testing performed. Pertinent sociodemographic and clinical variables, including substance use status and hospital length of stay (LOS), were abstracted. Univariate frequencies and summary statistics were performed. Odds ratios (ORs) were determined by logistic regression analysis of bivariate and multivariate analyses.

Results: Three hundred sixty-five (52.2%) patients had a discharge diagnosis of SSD, and only 322 had urine toxicology result for cannabinoids and were included in analysis. Of the 322 patients, 41.5% (n = 133) screened positive for cannabinoids. Of the 133 patients, 78% were African American, 15% were Hispanic and 5% were White; 77% were male and the median age was 36 years. Bivariate analyses showed tobacco use (OR: 2.8, 95% confidence interval (CI): 1.7 - 4.6), alcohol use (OR: 3.4, 95% CI: 2.9 - 7.0), younger age (OR: 2.8, 95% CI: 1.8 - 4.5), male gender (OR: 2.9, 95% CI: 2.2 - 3.2), unemployment (OR: 3.91, 95% CI: 3.49 - 7.35), homelessness (OR: 3.18, 95% CI: 2.76 - 3.84) and LOS (OR: 3.46, 95% CI: 2.93 - 4.31) were significantly associated with CU. Result of multivariate analysis was similar to that found in bivariate analysis.

Conclusions: CU appears to be prevalent among patients with SSD. Clinicians and public health professionals are encouraged to understand the health implications of its use in patients with mental illness especially against the backdrop of current marijuana laws.

Keywords: Cannabis; Marijuana; Substance use disorder; Schizophrenia; Schizophrenia spectrum disorders; Public health

Introduction

Cannabis is the second most used recreational drug in the United States after alcohol [1]. Nearly a fifth of 10th graders and more than a fifth of high school seniors reported vaping marijuana in the past year according to the Monitoring the Future survey [2]. Similarly, the prevalence of marijuana use has increased significantly among adults in the US [3-5]. The increased use is likely to continue as more states legalize recreational use of cannabis, as vaping devices become more popular, and because of the perception that cannabis is harmless. This belief is prevalent and increasing among all age groups [1, 5]. Among people with schizophrenia, cannabis has always been more prevalent than in the general population [6, 7]. Currently, usage is also increasing among people with schizophrenia [8].

The association between cannabis and schizophrenia has been studied extensively but the understanding of the relationship is still evolving [9, 10]. It is true that transient psychosis can follow cannabis use (CU) [11]. It has also been shown that cannabis users are significantly more predisposed to developing psychosis compared to non-cannabis users [12]. The effect of cannabis on the emergence of psychosis is dependent on the age at onset of use, degree of use, the use of very potent varieties and genetic predispositions [1, 13, 14]. Individuals who use cannabis early, those who consume greater amounts over

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time and those who use the more concentrated varieties have higher risks of psychosis [1, 13, 14]. Genetically, carriers of specific variants of the AKT1 and COMT genes who use cannabis are at higher risks of developing schizophrenia [15, 16]. Nonetheless, caution is advised when attributing the causality of a complex condition like schizophrenia to just one factor [12]. Overall, consistently, CU has been found to increase relapse rates, predispose to more hospitalizations, increase positive symptoms and increase suicidality in patients with schizophrenia [17, 18].

Several reasons have been mentioned for the considerable use of cannabis among schizophrenia patients. They include self-medication such as to reduce anxiety and improve sleep which are the primary illness effects, and to improve socialization [6, 7]. Neurobiologically, theories to consider include what Menne et al described as a complex bidirectional relationship [7]. In this regard, it is thought that individuals who develop schizophrenia are also predisposed to substance use. Therefore, chronic use begins and develops after disease onset. This hypothesis proposes that this relationship subsists on the shared dopaminergic pathway of substance use and schizophrenia [7]. Another major reason that has been proposed for substance use generally among patients with psychotic disorders is the effect of environmental factors [7]. These factors include privation, decline in functioning and a disproportionate exposure to dangerous situations which accumulate to increase the predisposition of schizophrenic patients to use substances [7].

Obviously, the importance of CU to the prognosis of psychotic disorders cannot be overemphasized and understanding of the reasons for use is vital in the management of patients. In this study, we decided to determine the prevalence and potential factors associated with CU among inpatients with schizophrenia spectrum disorder (SSD) at a community teaching hospital.

Materials and Methods

This was a retrospective review of the charts of patients discharged from the Psychiatric Unit of Interfaith Medical Center from July 1, 2017 through October 31, 2017. Patients were included in this study if: 1) They were ≥ 18 years old; 2) They had discharge diagnosis of SSD; and 3) They had urine drug testing performed. Data abstracted from the electronic medical record of patients included socio-demographic information (i.e. age, race, sex, employment status and living arrangement), length of hospital stay (LOS), 30-day hospital readmission status, urine toxicology result (for alcohol, amphetamine, benzodiazepine, cannabis, cocaine, opioids and synthetic cannabinoids) and self-reported use of tobacco.

Continuous variables were further recoded into categorical variables as follows: age was recoded into two age categories based on the mean age of patients of 42 years (i.e. aged 18 to 42 years = 1; patients aged 43 years or older = 2); 30-day hospital readmission status was recoded as "1" for no rehospitalization within 30 days following discharge and "2" for patients that were readmitted at least once within 30 days of discharge; LOS was recoded as "1" for those discharged by day 12 of hospital stay and "2" for those with hospital stay longer than 12 days; 12 days was chosen based on the mean LOS of patients.

Univariate frequencies and summary statistics were used to describe the study population and summarize the response and independent variables. Odds ratios (ORs) were determined by logistic regression analysis of bivariate and multivariate analyses. A P-value of less than 0.05 was considered statistically significant for all analyses in the study and all P-values were reported as two-tailed. SAS software version 9.4 (SAS Institute, Cary, NC) was used for data analysis. All variables in the bivariate analysis were included in the multivariate analysis. Accordingly, multivariate analysis was done adjusting simultaneously for age, LOS, race, sex, employment status, marital status, living arrangement, readmission status and other substance use such as tobacco, amphetamine, alcohol, cocaine and synthetic cannabinoid use. Due to a lack of sufficient cases in the study population, covariates such as amphetamine use disorder, benzodiazepine use disorder and opioid use disorder were excluded from analysis. Further, since 100% of patients with any co-occurring substance use (CSU) were also positive for CU, the variable CSU was not included in the regression analysis, as an appropriate point estimate for CU/CSU association cannot be determined.

We recognize that ignoring multicollinearity can have a detrimental impact on the generalizability and accuracy of a multivariate model. To check for multicollinearity in our final model, we performed tolerance test, variance inflation test and eigenvalue and condition index comparison test using the Tol, VIF and Collin model options (SAS 9.4). In assessing the calibration of our model, we used the deviance-Pearson (D-P) goodness of fit statistics. The model evaluation measures carried out in this study should provide enough assurance that the logistic regression model we used has been checked for goodness of fit. Institutional review board approval was obtained for this study.

Results

Of a total of 698 discharges, 365 (52.2%) had a discharge diagnosis of SSD, and only 322 had urine toxicology result for cannabinoids (excluding synthetic cannabinoids) and were included in analysis. Out of the 322 patients, 41.5% (n = 133) screened positive for cannabinoids (Table 1). Of these, 78% were African American, 15% identified as Hispanic, 5% were White and 2% were Other race. Further, 77% of the participants were male and 0.8% identified as transfemale. The median age of cases was 36 years (interquartile range (IQR): 19, standard deviation (SD): 11)), which was significantly lower than the median age of non-cannabis users of 46 years (IQR: 22, SD: 14). Additionally, the median LOS of cases (11 days, IQR: 7, SD: 13) was lower than the median LOS for non-users (12 days, IQR: 9, SD, 10).

In bivariate analyses (Table 2), tobacco use (OR: 2.8, 95% confidence interval (CI): 1.7 - 4.6), alcohol use (OR: 3.4, 95% CI: 2.9 - 7.0), younger age (i.e. ages 18 - 42) (OR: 2.8, 95% CI: 1.8 - 4.5), male gender (OR: 2.9, 95% CI: 2.2 - 3.2), unemployment (OR: 3.91, 95% CI: 3.49 - 7.35), homelessness

Table 1. Characteristics of Baseline Study Population by Cannabis Use (CU)[a]

Variables	Cannabis users (41.5%, n = 133)	Non-cannabis users (58.5%, n = 189)	Total (100%, n = 322)
Age group (%, n)			
Young adults (18 - 42)	66.9 (89)	41.8 (79)	52.2 (168)
Older adults (≥ 43)	33.1 (44)	67.2 (110)	47.8 (154)
Median age (IQR, SD)	36 (19, 10.7)	46 (22, 13.5)	< 0.0001[b]
Mean length of stay, days (IQR, SD)	11 (7, 13.2)	12 (9, 10.1)	0.0268[b]
Gender (%, n)			
Male	77.4 (103)	64.0 (121)	69.6 (224)
Female	21.8 (29)	34.9 (66)	29.5 (95)
Transfemale	0.75 (1)	1.1 (2)	1.0 (3)
Race (%, n)			
African American	78.2 (104)	76.2 (144)	77.0 (248)
White	5.2 (7)	8.5 (16)	7.1 (23)
Hispanic	15.0 (20)	11.6 (22)	13.0 (42)
Others	1.5 (2)	3.7 (7)	2.8 (9)
Employment status (%, n)			
Unemployed	97.7 (130)	95.8 (181)	96.6 (311)
Employed	2.3 (3)	4.2 (8)	3.4 (11)
Marital status (%, n)			
Single	95.5 (127)	95.3 (180)	95.3 (307)
Married	4.5 (6)	4.8 (9)	4.7 (15)
Living arrangement (%, n)			
Homeless	53.4 (71)	49.2 (93)	50.1 (164)
Domiciled	46.6 (62)	50.8 (96)	49.1 (158)
Readmitted within 30 days (%, n)			
Yes	12.0 (16)	15.3 (29)	14.0 (45)
No	87.9 (117)	84.7 (160)	6.0 (277)
Tobacco use (%, n)			
Yes	74.4 (99)	49.7 (94)	60.0 (193)
No	24.1 (32)	45.0 (85)	36.3 (117)
Amphetamine use (%, n)			
Yes	2.3 (3)	1.6 (3)	1.9 (6)
No	97.7 (130)	97.9 (185)	97.8 (315)
Alcohol use (%, n)			
Yes	43.6 (58)	34.4 (65)	38.2 (123)
No	54.9 (73)	61.9 (117)	59.0 (190)
Cocaine use (%, n)			
Yes	31.2 (42)	24.3 (46)	27.2 (88)
No	68.4 (92)	75.7 (143)	72.7 (234)
Synthetic cannabinoid use (%, n)			
Yes	6.0 (8)	3.2 (6)	4.3 (14)
No	70.2 (94)	61.9 (117)	65.3 (211)
Opioids use (%, n)			
Yes	3.0 (4)	5.3 (10)	4.3 (14)

Table 1. Characteristics of Baseline Study Population by Cannabis Use (CU)[a] - *(continued)*

Variables	Cannabis users (41.5%, n = 133)	Non-cannabis users (58.5%, n = 189)	Total (100%, n = 322)
No	97.0 (129)	179 (94.7)	95.7 (308)
Co-occurring substance use (%, n)			
Yes	100 (133)	59.8 (113)	76.4 (246)
No	0 (0)	40.2 (76)	23.6 (76)
Benzodiazepine use (%, n)			
Yes	1.5 (2)	4.8 (9)	3.4 (11)
No	98.5 (131)	95.2 (180)	96.6 (311)

[a]Note that all patients included in this study were diagnosed with schizophrenia spectrum disorder (SSD). [b]Based on Wilcoxon two-sample test, and all other analyses are based on χ^2 test. IQR: interquartile range; SD: standard deviation.

(OR: 3.18, 95% CI: 2.76 - 3.84) and LOS (OR: 3.46, 95% CI: 2.93 - 4.31) were significantly associated with CU. A significant association was also observed between patients' 30-day readmission status and CU (OR: 0.8, 95% CI: 0.39 - 0.95). In multivariate analysis, where all covariates in the unadjusted model were included, all the variables that were significantly associated with CU in the bivariate analyses remained (Table 3).

The multicollinearity investigations indicated that no collinearity is present in the data. In reviewing tolerance, we want to make sure that no values fall below 0.1. In our investigation, the lowest tolerance value was 0.72 for cocaine. Therefore, there is no threat of multicollinearity indicated through our tolerance analysis including for age and sex. Regarding variance inflation analysis, the number to look out for is anything above the value of 10 for each variable included in the final model. In our analysis, our highest observed value was 1.4 for alcohol, indicating a lack of multicollinearity in the final model. According to the eigenvalue and condition index comparison test, one should look for an indication of multicollinearity if one or more of the eigenvalues are small (close to zero) and the corresponding condition index number is large. In our assessment of this specific test, none of our eigenvalues and condition index association match this description. The results from the D-P goodness of fit (d = 219.84, χ^2 = 223.47, df = 209) also indicated that the values for deviance (d) and Pearson Chi-square (χ^2) are not too much larger than their degrees of freedom [19], indicating that the fitted model cannot be rejected and leads to the conclusion that the model fits well (Table 4).

Discussion

This study found that approximately half of the patients with SSD use cannabis. With regard to associated factors, there was a significant odds of exposure to tobacco, alcohol and cocaine among the patients with SSD who used cannabis. The finding in this study is similar to other studies showing a relatively high prevalence of CU among patients with SSD. Margolese et al [20], for example, reported a current and lifetime prevalence of CU among 147 patients with SSD presenting to an outpatient psychiatry service in Canada of 32.0% and 38.4%, respectively. Koskinen et al's [21] metaanalysis of 35 eligible studies published from 1996 through 2008 found the median rate of cannabis use disorder (CUD) in patients with schizophrenia of 27.0% (range 0.0-65.6%). In a 2016 prevalence study of approximately 463,000 Danish with a psychiatric disorder, it was found that about 37% of the 53,035 patients with schizophrenia used any substance; 13.2 % used cannabis [22]. Analysis of data obtained by Hasin et at [23] from a national representative sample of 36,309 US adults in 2012 and 2013 (the National Epidemiologic Survey on Alcohol and Related Conditions-III), revealed a slightly lower prevalence of CUD in the general US population and also that the 12-month and the lifetime prevalence of DSM-5 CUD were 2.5% and 6.3%, respectively. Cannabis exposure in the US population in general is, however, higher with an estimated 14% reporting using cannabis in the past year in 2015/2016 [24]. Same year, the prevalence of CU among NYC adults was 16%. The emergence of permissive cannabis laws across the United States may invariably increase cannabis exposure and the prevalence of dual diagnosis of SSD and CUD with the attendant negative ramifications [4].

Regarding the use of multiple substances, we found that patients with SSD who had positive cannabis exposure had a higher odds of using other substances compared with non-cannabis exposed patients with SSD. The adjusted odds of cocaine, tobacco and alcohol use ranged from about 1.5 to 3 times higher among those with CU compared with those without. Even though recent studies relating the concurrent use of other substances with cannabis in patients with SSD are not robust, few studies show a higher prevalence of multiple substance use among SSD patients [25]. This is possibly because patients who use multiple substances are influenced by the ultimate shared effect of substances on the brain reward circuitry [10]. Individual and environmental factors: coping with anxiety/psychotic symptoms (e.g. because of the purported antipsychotic property of cannabidiol in cannabis), for social reasons, for recreation and easy access to certain substances may also play a role in the pattern of substance use in SSD [6, 26-28].

Other factors such as younger age, male gender, unemployment, homelessness and LOS that were found to be associated with positive CU in inpatients with SSD in this study support what have been reported in the scientific literature [21,

Table 2. Unadjusted Odds Ratios (ORs) of Cannabis Use in Relation to Sociodemographic Factors, Substance Use Status and Hospital Length of Stay, 95% Confidence Intervals (CIs) and P Values From Bivariate Logistic Regression Models (n = 322)[a]

Variables	Unadjusted OR[b]	95% CI	P-value
Age			
Young vs. older adults	2.82	1.77 - 4.47	< 0.0001
Gender			
Male vs. female	2.94	2.16 - 3.22	0.0110
Race			
African American vs. White	1.65	0.66 - 4.16	0.2873
Hispanic vs. White	2.08	0.70 - 6.09	0.1824
Others vs. White	0.65	0.11 - 3.97	0.6436
Employment status			
Unemployed vs. employed	3.91	3.49 - 7.35	0.0443
Tobacco			
Smokers vs. non-smokers	2.80	1.71 - 4.59	< 0.0001
Marital status			
Single vs. married	1.10	0.37 - 3.05	0.9167
Living arrangement			
Homeless vs. domiciled	3.18	2.76 - 3.84	0.0205
Readmitted within 30 days			
Yes vs. no	0.75	0.39 - 0.95	0.0195
Alcohol use			
Yes vs. no	3.43	2.90 - 6.96	0.0267
Cocaine use			
Yes vs. no	4.44	3.87 - 5.35	0.0321
Synthetic cannabinoid use			
Yes vs. no	1.66	0.56 - 4.95	0.3636
Hospital length of stay			
> 12 days vs. 0 - 12 days	3.46	2.93 - 4.31	0.0021

[a]Note that all patients included in this study were diagnosed with schizophrenia spectrum disorder (SSD). [b]Note that 42 missing cases for cannabis use were removed from analysis (i.e. 364 - 42 = 322).

29-31]. In the aforementioned meta-analysis by Koskinen et al [21], for example, CUD in patients with a lifetime diagnosis of schizophrenia was more prevalent in the younger age group (age less than 30 years; median current and lifetime prevalence of CUD were approximately 40% and 45%, respectively), and most were males [21, 29]. Additionally, there are studies supporting the increased prevalence of CUD in patients with SSD who experience psychosocial stressors such as unemployment and homelessness [28].

Regarding LOS, current studies show mixed findings [30-32]. For example, while some researchers found no association between dual diagnosis and LOS [30], other studies reported shorter LOS [30, 31]. Furthermore, those with cannabis exposure had lower odds of being readmitted within 30 days of discharge. Although the reason for the decreased risk of readmission in SSD patients who use cannabis is unclear, we hypothesize that psychoeducation on substance use that was offered during hospitalization could have played a role [33].

Limitation

This study has some limitations including those related to retrospective review of medical charts. For example, we were limited by the quality of information provided in the charts. Also, we did not determine whether patients who denied current CU and screened negative for cannabinoids ever/never used cannabis. We also did not characterize CU based on the severity, the duration of psychosis and the type of SSD (e.g. schizophreniform versus schizophrenia versus schizoaffective disorders); hence, systematic differences relating to substance/cannabis use pattern among groups could not be deduced. Additionally, tobacco use disorder was determined

Table 3. Adjusted Odds Ratios (ORs) of Cannabis Use in Relation to Sociodemographic Factors, Substance Use Status and Hospital Length of Stay, 95% Confidence Intervals (CIs) and P Values From Multivariate Logistic Regression Model (n = 322)

Variables[a]	Adjusted OR	95% CI	P-value
Age			
Young vs. older adults	3.36	1.96 - 5.76	< 0.0001
Gender			
Male vs. female	1.98	1.10 - 3.57	0.0223
Race			
African American vs. White	1.15	0.40 - 3.30	0.7901
Hispanic vs. White	1.07	0.31 - 3.66	0.9117
Others vs. White	0.32	0.04 - 2.59	0.2870
Employment status			
Unemployed vs. employed	2.29	1.53 - 6.90	0.0382
Tobacco			
Smokers vs. non-smokers	2.76	1.55 - 4.91	0.0006
Marital status			
Single vs. married	1.08	0.31 - 3.70	0.9084
Living arrangement			
Homeless vs. domiciled	2.19	1.71 - 2.99	0.0151
Readmitted within 30 days			
Yes vs. no	0.78	0.38 - 0.91	0.0334
Alcohol use			
Yes vs. no	1.68	1.35 - 2.14	0.0340
Cocaine use			
Yes vs. no	2.99	2.54 - 3.83	0.0184
Synthetic cannabinoid use			
Yes vs. no	1.07	0.25 - 2.98	0.8251
Hospital length of stay			
> 12 days vs. 0 - 12 days	2.41	1.83 - 3.39	0.0132

[a]All covariates in the unadjusted model (i.e. regardless of statistical significance) were included in the multivariate analysis.

based on self-reporting. However, studies have shown that self-reported tobacco use is reliable [34]. Further, we only focused on cannabis exposure as we could not retrospectively determine whether cases met the Diagnostic and Statistical Manual of Mental Disorders, 5th Edition (DSM-5) criteria for CUD. The study by Hasin et al, however, showed that approximately 30% of individuals who use cannabis later on develop CUD [4], which suggests a significant positive correlation.

A strength of this study is the relatively large sample size which makes it likely that small differences between the study variables were detected.

Table 4. Deviance and Pearson Goodness-of-Fit Statistics

Criterion	Value	df	Value/df	Pearson χ^2
Deviance	219.84	209	1.05	0.0017
Pearson	223.47	209	1.10	0.1179

Conclusion

The findings from this study support what has been reported in the scientific literature that the CU in patients with SSD is a major clinical and public health problem. Given that SSD accounts for over 50% of adults in psychiatry inpatient units in New York City, psychiatry units provide an opportunity to target effective interventions that address substance use in this population [35]. Clinicians and public health professionals are encouraged to understand the health implications of CU in patients with mental illness especially against the backdrop of current marijuana laws.

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The authors have no financial disclosure.

Conflict of Interest

The authors declare no conflict of interest.

Informed Consent

Not applicable.

Author Contributions

Olaniyi Olayinka contributed to the design of the study, data collection, interpretation of the data, helped to write the final draft of the manuscript, and has full access to all the data in the study as the primary author of the manuscript. CO contributed to the design of the study, data collection and helped to write the final draft of the manuscript. BA contributed to the design of the study and helped with data analysis and interpretation. Olalekan Olaolu contributed to the design of the study, data collection and helped to write the manuscript. OP, DE, JK and TT contributed to the design of the study and helped with data collection. VJ contributed to the study design, helped with data collection and the writing of the manuscript. LV supervised the writing of the final draft of the manuscript. TO contributed to the study design and supervised the writing of the final draft of the manuscript. JH contributed to the design of the study and supervised the writing of the final draft of the manuscript.

Data Availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

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