ORIGINAL ARTICLE

Smoking Mostly Alone as a Risk Factor for Cannabis Use Disorders and Depressive Symptoms

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Abstract

The empirically grounded etiological models of cannabis use already include a vast range of psychological factors (within an individual), paving the ground for individualized prevention and intervention programs. However, the interpersonal (among individuals) and relational variables influencing the emergence of excessive cannabis use are less understood. Particularly, the impact of consumption context (i.e., smoking alone or with others) on cannabis use intensity in youth remains to be clarified. We evaluated how smoking mostly alone modulates cannabis use disorders (CUD) and depressive symptoms in college students. A sample of 854 individuals from France (568 women, 286 men) who used cannabis in the last 6 months completed self-report questionnaires evaluating cannabis consumption, CUD symptoms, and depressive symptoms. Mostly alone users presented higher current use frequency as well as increased CUD and depressive symptoms compared to mostly social users. Smoking mostly alone remained positively correlated with CUD and depressive symptoms, even when controlling for current use frequency. The association between smoking mostly alone and depressive symptoms was significant before adjustment for symptoms of CUD. The loss of significance of this association after control reflected the mediating effects of symptoms of CUD on the relationship between smoking mostly alone and depressive symptoms. These results suggest that smoking mostly alone constitutes a risk factor for uncontrolled cannabis use and promote the relationship between cannabis use and depressive disorders, potentially through loneliness and social isolation. Longitudinal studies are required to identify the causal mechanisms underlying the links between smoking mostly alone, cannabis use and psychopathological disorders.

Keywords Smoking alone · Cannabis use frequency · Cannabis use disorders · Depressive symptoms · College students

Cannabis is one of the most commonly used psychoactive substance among college students in Europe and the USA (Arria et al., 2017; Helmer et al., 2014) and its consumption is associated with largely established adverse academic and health outcomes (Suerken

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et al., 2016). As its legalization is becoming widespread, the identification of the psychological factors (within an individual, such as disorders, beliefs, and perception) and interpersonal factors (among individuals, such as peers opinion, conformity, and social context) underlying cannabis use disorders (CUD, a problematic pattern of cannabis use where the user is unable to stop using cannabis even if it causes clinically significant health and social impairments), and their relation with psychopathological disorders is critical to develop etiological models of cannabis use as well as effective prevention and intervention programs.

Among those factors, the social context of cannabis consumption remains under-investigated. While social use of cannabis is more widely studied, solitary use may be a predictor of more problematic consumption. Indeed, some studies reported a significant association between the number of peers using cannabis and cannabis use frequency (Chabrol et al., 2006; Schmits et al., 2015), while others reported significant association between smoking alone as a cannabis use pattern and cannabis dependence (Creswell et al., 2015; Noack et al., 2009; Piontek et al., 2011). Negative consequences of consumption were shown to be more prevalent in solitary use than in social use (Okey et al., 2022) and another study reported significant association between smoking alone, use frequency, and cannabis self-concept (the identification of the cannabis as part of the personality) (Blevins et al., 2018). During the COVID-19 pandemic, using alone was also highlighted as a strong risk factor for escalating cannabis use (Bartel et al., 2020). However, no known study has specifically evaluated the link between using cannabis mostly alone, CUD and subsequent disorders.

Cannabis use was also found associated with psychological and interpersonal factors underlying the tendency to be alone, such as loneliness (Bartel et al., 2020) and social isolation (Rhew et al., 2021; Stickley et al., 2014), themselves associated with depression (Moeller and Seehuus, 2019, Erzen & Çikrikci, 2018). Beyond its direct influence on CUD, the tendency to smoke alone could also clarify the links between cannabis use and depression among young adults, which are related to inconsistent results. On one hand, meta-analyses of longitudinal and cross-sectional studies reported significant association between cannabis use and depressive symptoms (Danielsson et al., 2016a, 2016b; Degenhardt et al., 2003; Gobbi et al., 2019; Gorfinkel et al., 2020; Halladay et al., 2020; Lev-Ran et al., 2014) after controlling for many different confounding variables. On the other hand, other studies reported no clear association between cannabis use and depressive symptoms (Feingold et al., 2017; Pedersen, 2008). This controversy may reflect that other confounding factor(s), including contextual and social ones, might influence the relationship between cannabis use and depressive symptoms.

The objectives of this study were to explore direct and indirect contributions of smoking cannabis mostly alone on cannabis use frequency, CUD symptoms, and depressive symptoms in a large college student population. We primarily hypothesized that individuals who tend to smoke mostly alone would report more CUD symptoms, as well as more depressive symptoms than participants who tend to smoke mostly shared.

Method

Participants and Procedure

The data were collected through an online survey distributed to French students before the COVID-19 pandemic. The link to the survey was shared on Facebook, on a regular weekly basis, and over a large collection of public/private groups specifically dedicated to college

students. Informed consent was obtained from all participants and they were informed that answers to the questionnaires would remain anonymous. The objectives of the study were presented to all participants at the beginning of the survey, specifying that this study focused on cannabis use, personality, and behaviors. Inclusion criteria were being at least 18 years old, being French, being a college student, and having consumed cannabis at least once during the last 6 months. No compensation was offered to take part in the study. The participants were provided with the possibility to contact one of the authors (JC) via email for further information or to receive referral. The study followed the guidelines of the Helsinki declaration and the study protocol was approved by the local ethics committee ("Ethical Approval" section below). The data collection was carried out over a period of 2 months. The final sample was composed of 871 students, 583 females (66.9%), and 288 males (33.1%) (mean age of females $= 21.2 \pm 2.4$; mean age of males $= 21.8 \pm 2.5$; age range $= 18–30$).

Measures

Smoking Alone The tendency to smoke mostly shared or mostly alone was assessed with a continuous item asking "What percentage of time do you smoke alone rather than shared?". Responses range from 1 (0–10% alone or 90–100% shared) to 10 (90–100% alone or 0–10% shared). We asked this item in a consumption context rather than asking if they spend more or less time alone on a daily basis in order to observe the tendency to smoke mostly alone under the scope of interpersonal factors, as part of a social context category. This item was used to differentiate cannabis users who mostly share (≤ 5) and those who mostly smoke alone (> 5) in order to run t-tests. We also used the 33rd and 66th percentile to constitute homogeneous groups labeled as "Mostly shared users," "Medium group," and "Mostly alone users" in order to run ANOVAs.

Cannabis Use Disorder The frequency of cannabis use and the severity of symptoms related to CUD were assessed with the CUD Identification Test-Revised (CUDIT-R; Adamson et al., 2010) in its French version (Guillem et al., 2011), which is an 8-item self-report screening tool that is sensitive and specific of CUD according to DSM-5 (American Psychiatric Association, 2013). The participants had to report the first item accessing the frequency of use and how often they had been involved in the 7 described behaviors exploring likelihood of CUD (e.g., item 1: "How often do you use cannabis?"; item 4: "How often during the past 6 months did you fail to do what was normally expected from you because of using cannabis?"). Responses range from 0 (never) to 4 (once per day or more). Higher scores indicate greater CUD likelihood. A total score of 13 is a suggested cutoff for identifying possible moderate-severe cases of DSM-5 CUD in community samples (Adamson et al., 2010; Bruno et al., 2013). Cronbach's $\alpha = 0.80$ in this study and $\alpha = 0.89$ in a previous study (Luquiens et al., 2021) which also showed that CUDIT-R is more specific than other tests for screening CUD.

Depressive Symptoms We assessed depressive symptoms with the 9-item Personality Health Questionnaire (PHQ-9; Kroenke et al., 2001) in its French version (Kroenke and Spitzer, 2002). The participants had to report how often they had been bothered by the described problems exploring likelihood of depressive disorders (e.g., item 1: "Little interest of pleasure in doing things"; item 9 "Thoughts that you would be better off dead or

hurting yourself"). Cronbach's $\alpha = 0.84$ in this study and $\alpha = 0.84$ in a previous study (Delgadillo et al., 2011).

Psychometric properties

Before constituting the final sample and following the recommendation of a previous study (Bennett, 2001), we excluded cases from analysis presenting higher than 10% of missing data for CUDIT-R and for PHQ-9 (meaning no more than 1 missing item) in order to reduce potential statistical biases. We also excluded cases that did not answer to actual use frequency and tendency to smoke mostly alone items. Little's missing completely at random (MCAR) tests were performed and concluded that values are missing completely at random ($p > 0.05$). We conducted EM imputations that did not bring any significant changes to our results. All the measures used in the current sample showed satisfactory distribution properties (skewness values from 0.05 to 0.62 and kurtosis values from -1.65 to -0.11). Constituted groups meet the homogeneity of variance assumption necessary for every variable used in the current study (Levene values at $p > 0.05$).

Statistics

We used Student's *t*-tests to compare cannabis mostly shared users and mostly alone users. We assessed bivariate relationships between variables with Pearson's *r* in the total sample. Differences between groups were tested using Fisher's analyses of variance and Tukey's post hoc tests. Mediation analyses were conducted following the steps recommended in a previous study (George & Mallery, 2010) and the unique contribution of each predictor was reported with standardized regression coefficient *β*, *t*, and *p*-value.

Results

Descriptive Statistics and Mean Comparisons

Among the 871 participants, 38% ($n = 331$) reached the CUDIT-R cut-off score of 13 for possible moderate-severe cases of DSM-5 CUD and 48% ($n = 418$) reached the PHQ-9 cut-off score of 10 for possible moderate-severe depressive symptoms. On average, they used cannabis alone rather than with other individuals 30 to 40% of the time M $(SD) = 4.23$ (3.29), and 38.8% ($n = 338$) reported to smoke more than half of the time alone. Among mostly alone users, 59.8% ($n = 202$) reached the CUDIT-R cut-off score compared to 24.2% of mostly shared users ($n = 129$). Among mostly alone users, 53.3% ($n = 180$) reached the PHQ-9 cut-off score compared to 44.7% of mostly shared users ($n = 238$). Mostly alone users had significantly higher mean scores on the actual use frequency, the CUDIT-R and the PHQ-9 scores than mostly shared users (Table 1).

Correlations and Partial Correlations

Smoking alone was positively and moderately correlated to actual use frequency and symptoms of CUD and positively and slightly correlated to depressive symptoms. Actual use frequency was positively and moderately correlated to symptoms of CUD.

Table 1 Mean comparisons between mostly shared ($n=522$) and mostly alone cannabis users ($n=322$)

Variable	Mostly shared M (SD)	Mostly alone M (SD)	$t(852)$	p
Actual use frequency	2.52 (1.59)	3.96 (1.41)	10.92	$<.001$
CUD symptoms	8.88 (5.99)	14.05 (5.90)	10.08	$<.001$
Depressive symptoms	9.71 (5.42)	10.66 (5.54)	2.02	.04

Note: CUD, cannabis use disorders; $N=854$

Symptoms of CUD were positively and moderately correlated to depressive symptoms (Table 2). We also tested whether these significant correlations were the result of the frequency of use. Indeed, the more a participant consumes, the more they could tend to spend more time consuming alone. In order to show the direct effect between smoking mostly alone and the other variables, we performed a partial correlation analysis. Controlling for actual use frequency on the relationship between smoking mostly alone, CUD symptoms and depressive symptoms revealed that smoking mostly alone was still significantly and positively correlated to CUD symptoms and depressive symptoms (Table 2).

Analysis of Variance

We performed a one-way ANOVA to compare the effect of smoking mostly alone on depressive symptoms and cannabis use disorders, between users who mostly shared ($n=285$), the medium group ($n=237$), and users who mostly smoke alone ($n=349$). We observed a main group effect for cannabis use disorders, $F(2, 868)=118.48$, $p<0.001$, and depressive symptoms, $F(2, 868)=3.50$, $p=0.03$. Post hoc tests revealed that CUD symptoms were significantly higher in the medium group ($M=8.18$, $SD=4.66$) than in mostly shared users ($M=4.18$, $SD=3.78$) ($p<0.001$, 95% C.I.$=3.04$, 4.95), as well as in mostly alone users ($M=9.78$, $SD=5.19$) than in the medium group ($p<0.001$, 95% C.I.$=0.69$, 2.52) and mostly alone users ($p<0.001$, 95% C.I.$=4.76$, 6.46). Depressive symptoms were not significantly higher in the medium group ($M=9.51$, $SD=5.67$) compared to mostly shared users ($M=9.71$, $SD=5.38$) ($p=0.91$, 95% C.I.$=-1.37$, 0.62), and in mostly alone users ($M=10.64$, $SD=5.82$) compared to mostly shared users ($p=0.10$, 95% C.I.$=-0.1.99$, 0.13) but were significantly higher in mostly alone users compared to the medium group ($p=0.04$, 95% C.I.$=0.02$, 2.24).

Table 2 Correlations and partial correlations between variables

Variable	Correlations			Partial	
	1	2	3	2	3
Smoking mostly alone	.54**	.47**	.09*	.14**	.10*
1. Actual use frequency	1	.67**	$-.02$		
2. CUD symptoms		1	.17**	1	.22**
3. Depressive symptoms			1		1

Note: *$p<.01$, **$p<.001$. CUD, cannabis use disorders. $N=854$

Multiple Regression Analyses

We conducted multiple regression analyses to test hypothetical mediation models that could blur the influence of smoking alone on our variables. In step 1 of the mediation model, the regression of smoking alone on depressive symptoms, ignoring CUD symptoms, was significant ($\beta = 0.17$, $t = 2.96$, $p = 0.003$). In step 2, the regression of smoking alone on CUD symptoms, ignoring depressive symptoms, was also significant ($\beta = 0.98$, $t = 16.73$, $p = <0.001$). In step 3, when adding the two terms in the regression predicting depressive symptoms, CUD symptoms were less significant ($\beta = 0.11$, $t = 3.12$, $p = 0.003$) and smoking alone was no longer significant ($\beta = 0.07$, $t = 1.05$, $p = 0.30$). A Sobel test was conducted and confirm partial mediation in the model ($z = 3.07$, $p = 0.002$). We observed no significant mediating effect of depressive symptoms in the relationship between smoking alone and CUD symptoms.

Discussion

This study revealed that cannabis users who smoke mostly alone present more CUD and depressive symptoms than those who smoke about half of the time or mostly with other individuals. Smoking mostly alone was significantly correlated with the frequency of use and with CUD symptoms, paralleling results from previous studies were being alone have been shown to be strongly associated with cannabis dependence (e.g., Creswell et al., 2015; Noack et al., 2009; Piontek et al., 2011). It is worth noting that social isolation may also be a consequence of CUD according to older studies (Kandel et al., 1986) and could therefore lead to more time using alone. Smoking mostly alone was also significantly correlated with depressive symptoms, targeting this factor as a main contextual variable when exploring CUD and its link with depression.

CUD symptoms were significantly correlated to depressive symptoms, as observed in previous studies (e.g., Degenhardt et al., 2003; Gobbi et al., 2019; Lev-Ran et al., 2014) and consistent with studies reporting that cannabis use may be associated with an increased risk for developing depressive disorders (Leadbeater et al., 2019; Danielsson et al., 2016a, 2016b).

Moreover, smoking mostly alone was significantly associated to depressive symptoms, but the control of CUD symptoms eliminated this association, suggesting partial mediation effect that was confirmed. This mediation effect might suggest that smoking mostly alone could increase CUD symptoms, and worsen depressive symptoms indirectly through this increasing. As no mediating effect of depressive symptoms were observed, we could hypothesize that smoking mostly alone only shared a direct effect with CUD, with no indirect effect through depressive symptoms.

While our cross-sectional results prevent any causal explanation of these links, we can hypothesize with these results that smoking mostly alone could place subjects at a higher risk of CUD and depressive symptoms and could be a potential risk factor in the relationship between these two variables. The tendency to smoke alone could lead to further isolation through the conditioning of this habit with smoking. Peers may therefore be less likely to notice the worsening of the use/disorder, leading to more difficulty in getting help and advice. Prevention and/or treatment programs that were proved to inhibit the escalation of substance use may also be less accessible and proposed.

However, we cannot reject the opposite causal hypothesis: having depressive and/or CUD symptoms could lead to being more alone and to a more frequent use of cannabis as a coping strategy, which also represents a problematic pattern. We could also argue that some college students could also be driven to hide their cannabis consumption to maintain social acceptance from their peer, as observed in alcohol consumption (Davis et al., 2010), spending more time alone as the frequency of use increases.

This study has several limitations. As the study was conducted in a student sample, the results cannot be generalized to clinical samples. In addition, we did not ask the participants if they ever suffered a disorder and/or followed a treatment. Although internet data collection methods, using online completion of self-report questionnaires have shown to be consistent with traditional methods (Gosling et al., 2004), the possibility that participant self-selection may have biased the results cannot be excluded.

This study is among the first to focus on the tendency to smoke cannabis alone rather than with other individuals and to observe the effect of this consumption habit on depressive symptoms. It identified the tendency to smoke alone as a potential key variable related to both the intensity of CUD and its associated depressive symptoms. The relationships between smoking mostly alone, CUD symptoms and psychopathological disorders could be considered a support for potential pathways to be further explored in longitudinal studies to clarify causal relationships and defining potential cofounders that could blur the influence of smoking mostly alone on cannabis use and psychopathological disorders.

This study also underlines the interest of developing intervention targeting the tendency to smoke mostly alone in youth, for both prevention and treatment of cannabis use problems. One example could be cognitive-behavioral therapies (CBT), which have already been shown to be effective for depression (Hofmann et al., 2012) and substance use disorders (Morin et al., 2017, McHugh et al., 2010), in conjunction with interpersonal psychotherapy (IPT), as proposed by older studies (Brache, 2012), and which addresses interpersonal deficits, including social isolation (Cuijpers et al., 2011). Those protocols adapted to cannabis-using patients could teach them to identify the mechanisms that led them to isolate themselves and the suffering that accompanies it while highlighting their concrete difficulties related to cannabis use in order to develop better habits, reintegrate into social situations, and reduce their consumption.

Declarations

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