

The separate and joint effects of recent interpersonal abuse and cannabis use on psychotic experiences: Findings from students in higher education in the United States

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ABSTRACT

Background: Various forms of interpersonal abuse (e.g., physical, emotional, sexual) and cannabis use across the lifespan have both been known to increase odds of psychotic experiences; however, there have been few studies examining their separate and joint effects in the United States.

Methods: We analyzed data from the Healthy Minds Study (2020-2021) and used multivariable logistic regression and interaction contrast ratios to assess separate and joint effects of interpersonal abuse (past 12 months) and cannabis use (past 30 days) on psychotic experiences (past 12 months).

Results: Students who only used cannabis had significantly greater odds of psychotic experiences (aOR: 1.70; 95% CI: 1.58-1.82), as well as those who only experienced interpersonal abuse (aOR: 2.40; 95% CI: 2.25-2.56). However, those who reported both cannabis use and interpersonal abuse had the greatest odds, exceeding the sum of these individual effects (the combined effect aOR: 3.46; 95% CI: 3.19-3.76).

Conclusions: Recent interpersonal abuse and recent cannabis use both separately and jointly increase odds of having recent psychotic experiences. Future research should continue to examine the potential interactive and additive impact of multiple known exposures, to better inform primary and secondary prevention efforts.

KEY WORDS: PSYCHOSIS; CANNABIS; INTERPERSONAL ABUSE; ADVERSITY; TRAUMA

INTRODUCTION

Psychotic experiences are expressions of the psychosis phenotype that do not meet the clinical threshold for psychotic disorder and can affect upwards of 10% of the US general adult population (Cohen & Marino, 2013; Linscott & Van Os, 2010; Staines et al., 2022), with varying prevalence depending on the measures and the populations (DeVylder et al., 2022; Oh et al., 2020). These psychotic experiences have been shown to associate with a host of mental and physical health problems (Oh et al., 2021), as well as disability (Oh et al., 2018), suicide (Yates et al., 2019) and mortality (Sharifi et al., 2015). Diathesis-stress models posit that genetic predisposition interacts with environmental factors to produce psychosis (Howes & McCutcheon, 2017; Jones & Fernyhough, 2007; Pruessner et al., 2017), including sub-threshold psychotic experiences in the general population. Psychotic experiences are associated with schizophrenia-related risk factors, such as developmental, cognitive, psychopathological, socio-environmental, and behavioral risk factors (Kelleher & Cannon, 2011).

The putative environmental factors in the diathesis-stress models have included various forms of interpersonal abuse. Substantial evidence shows that abuse, especially during childhood, is associated with the risk for psychotic experiences (Bonoldi et al., 2013), potentially by way of dissociation, emotion dysregulation, avoidance, hyperarousal, and/or negative schema (Bloomfield et al., 2021). Interpersonal abuse also activates the hypothalamic-pituitary-adrenal axis, which can dysregulate dopaminergic activity in the brain and give rise to hallucinations and delusions (Walker et al., 2008). Often, stress exposures such as interpersonal abuse are accompanied by substance use, either as a health behavior traced back to shared socio-environmental risk factors, or as a means of coping with the stress of abuse (i.e., self-medicating). Substance use may also be an indicator of social defeat, whereby adverse experiences of social exclusion sensitizes and dysregulate activity of the mesolimbic dopamine system, increasing risk of psychosis (Björkqvist, 2001; Montagud-Romero et al., 2018; Selten et al., 2013). Moreover, consistent evidence shows that cannabis use is linked to psychosis (Di Forti et al., 2019; Hasan et al., 2020; Kiburi et al., 2021; Large et al., 2011; Marconi et al., 2016; Minozzi et al., 2010; Semple et al., 2005; Zammit et al., 2002), where psychotic illness is more common in people who use cannabis compared to those who do not use cannabis, that cannabis use and risk of developing psychotic illness have a dose-dependent relation, that people who use cannabis have an earlier onset of psychotic illness than people who do not use cannabis (Hasan et al., 2020), and that cannabis use in young adulthood increase psychosis risk later in life (Hall & Degenhardt, 2008; Henquet et al., 2004).

Prior studies have explored the interactions between childhood abuse and cannabis use, given that both abuse and cannabis use can impact the dopaminergic system (Houston et al., 2008, 2011), potentially via distinct mechanisms. Interpersonal abuse (be it physical, emotional, or sexual) can be traumatic and stressful, which can elevate cortisol levels that associate with dopamine activity (Walker et al., 2008). The active ingredient of cannabis (Δ^9 -tetrahydrocannabinol) can also mediate dopamine transmission (Tanda et al., 1997). Taken together, abuse may increase susceptibility to psychotic experiences and cannabis use may further elevate vulnerability in these individuals. In the United Kingdom, Morgan and colleagues (Morgan et al., 2014) found that childhood abuse and cannabis use combined synergistically increased odds of psychotic experiences beyond the effects of each factor individually. However, to our knowledge, there are no studies based in the United States that examine the synergistic effects of more recent forms of abuse (i.e., over the past year) and cannabis use on recent psychotic experiences among young adults. Morgan and colleagues focused on childhood abuse and note the potential for recent forms of abuse to be especially impactful.

In this study, we analyzed data collected from young adults aged 18-29 enrolled in 140 colleges/universities across the United States to examine the main and synergistic (combined) effects of recent abuse and recent cannabis use on recent psychotic experiences. We hypothesized that abuse and cannabis use would be separately associated with psychotic experiences, and that abuse would combine synergistically with cannabis use to increase odds of psychotic experiences.

METHODS

Sample

We analyzed data from the Fall and Spring cohort of the 2020-2021 Healthy Minds Study (HMS), a non-probability web-based survey examining health and wellness among students enrolled in higher education in the United States. (Lipson et al., 2022) The HMS survey is administered annually as a repeated cross-section of schools, with a different set of schools every year, including community colleges, four-year colleges, and professional schools. The HMS survey uses several validated measures to provide information about the prevalence of mental health outcomes, knowledge and attitudes about mental health, and service utilization. The survey was administered at 37 institutions of higher learning (N=34,168) between September through December of 2020, and then administered again at 103 institutions (N=103,748) between January through June 2021. Students who completed the survey were entered into raffles to receive prizes. The response rate was 14%, which is comparable to other response rates from online surveys using convenience samples and panels. We restricted the sample by age (18-29) to isolate young adults and further excluded individuals who were missing data on any of the variables of interest; we used complete-case analysis, resulting in a final analytic sample of 94722. We used sample probability weights to adjust for non-response using administrative available data on full student populations at each institution, consistent with prior studies (Lipson et al., 2022). Using multivariable logistic regression, response propensity was estimated based on gender identity, race/ethnicity, academic level, and grade point average. We then assigned response propensity weights to each student who completed the survey. Students who were less likely to have completed the survey were assigned a larger weight in the analysis. Sample weights gave equal aggregate weight to each school in the national estimates rather than assigning weights in proportion to school size, so that overall national estimates were not dominated by schools in our sample with large enrollment. The HMS was approved by the Institutional Review Board Advarra, and the Institutional Review Boards at all participating campuses. A list of all participating schools as well as the HMS data are available upon request at: <https://healthymindsnetwork.org/hms/>.

Measures

Psychotic experiences (outcome). Psychotic experiences were measured using an abbreviated version of the World Health Organization Composite International Diagnostic Interview Psychosis Screen, which has been used in large global epidemiology studies (McGrath et al., 2015). Respondents were asked four questions about the following experiences: (1) A feeling something strange and unexplainable was going on that other people would find hard to believe; (2) A feeling that people were too interested in you or that there was a plot to harm you?; (3) A feeling that your thoughts were being directly interfered or controlled by another person, or your mind was being taken over by strange forces?; and (4) An experience of seeing visions or hearing voices that others could not see or hear when you were not half asleep, dreaming, or under the influence of alcohol or drugs? Respondents were then asked a single item (yes/no) about whether any of these four experiences occurred over

the past 12 months. This variable was treated dichotomously in accordance with prior studies to signify the presence of psychotic experiences (i.e., hallucinatory experiences and/or delusional ideations) (McGrath et al., 2015). We focused on 12-month psychotic experiences to minimize recall bias.

Interpersonal abuse (predictor). Young adulthood abuse was measured using three dichotomous (yes/no) items: (1) Over the past 12 months, were you kicked, slapped, punched or otherwise physically mistreated by another person?; (2) Over the past 12 months, were you called names, yelled at, humiliated judged, threatened, coerced, or controlled by another person?; and (3) In the past 12 months, has anyone had unwanted sexual contact with you? (Please count any experience of unwanted sexual contact [e.g., touching of your sexual body parts, oral sex, anal sex, sexual intercourse, and penetration of your vagina or anus with a finger or object] that you did not consent to and did not want to happen regardless of where it happened). Recent abuse was coded to reflect the presence of at least one type of abuse.

Cannabis use (predictor, moderator). Cannabis use was measured using the item that asked respondents (yes/no) whether they had used marijuana over the past 30 days.

Sociodemographic characteristics and mental health (covariates). We restricted the sample to focus on young adults further controlled for age as a continuous variable. We also adjusted for gender (cis-gender man, cis-gender woman, transgender/nonbinary/other), and race/ethnicity (White, Black, Latinx/Hispanic, Asian American/Pacific Islander, multiracial, and other). While students in higher education represent a relatively high socioeconomic stratum, there is still a socioeconomic gradient within the stratum. Education, income, and employment status may not be adequate measures of this gradient, though food insecurity has proven to be informative. Food insecurity was assessed using two items, which asked: (1) Within the past 12 months I was worried whether our food would run out before we got money to buy more; (2) Within the past 12 months the food I bought just didn't last and I didn't have money to get more. Respondents could answer: never true, sometimes true, often true. Individuals were identified as food insecure with an affirmative answer (sometimes true or often true) to either question, following the two-item screen for families at risk of food insecurity (Hager et al., 2010). We also adjusted for mental health using measures of depression and anxiety. Depression was measured using the Patient Health Questionnaire – 9 (PHQ-9; Kroenke & Spitzer, 2002). The scale ranged from 0-27, which was dichotomized (scores 15 and higher) to reflect moderately severe to severe depression. *Anxiety* was measured using the General Anxiety Disorder – 7 (GAD-7; Spitzer et al., 2006). The scale ranged from 0-21 and was dichotomized (scores 11 and higher) to reflect moderately severe to severe anxiety.

Analysis

We calculated the prevalence of abuse, cannabis use, and all covariates (total and stratified by psychotic experiences). We tested for additive interaction, we depict the synergy between abuse and cannabis use by creating the following categorical variable: (1) no abuse or cannabis use; (2) abuse only; (3) cannabis use only; and (4) both abuse and cannabis use. We adjusted for age, gender, race/ethnicity, food insecurity, depression, and anxiety. We calculated the interaction contrast ratio (ICRs), which allows use of odds ratios derived from logistic models to estimate the relative excess risk resulting from the synergy of combined exposures. Confidence intervals and P-values for ICRs were generated using the `nlcom` command in Stata SE 15.

RESULTS

The sample characteristics of the HMS have been detailed in prior studies. TABLE 1 provides the descriptive statistics and bivariate logistic regression models for all variables and their associations with psychotic experiences. Food insecurity and mental health problems (depression and anxiety) were more prevalent among people with psychotic experiences than among those without, and in unadjusted models, these factors were associated with significantly greater odds of psychotic experiences. Approximately 16.4% of the sample reported psychotic experiences over the past 12 months. Almost a third of the analytic sample reported any abuse over the past year, with emotional abuse being the most common, and physical abuse being the least. Any abuse was associated with 3.2 times greater odds of psychotic experiences. Various types of abuse varied between 2.77- and 3.2-times greater odds of endorsing psychotic experiences. The strongest associations were for emotional abuse. About one-in-five reported any cannabis use over the past 30 days, and cannabis use was associated with over double the odds of psychotic experiences.

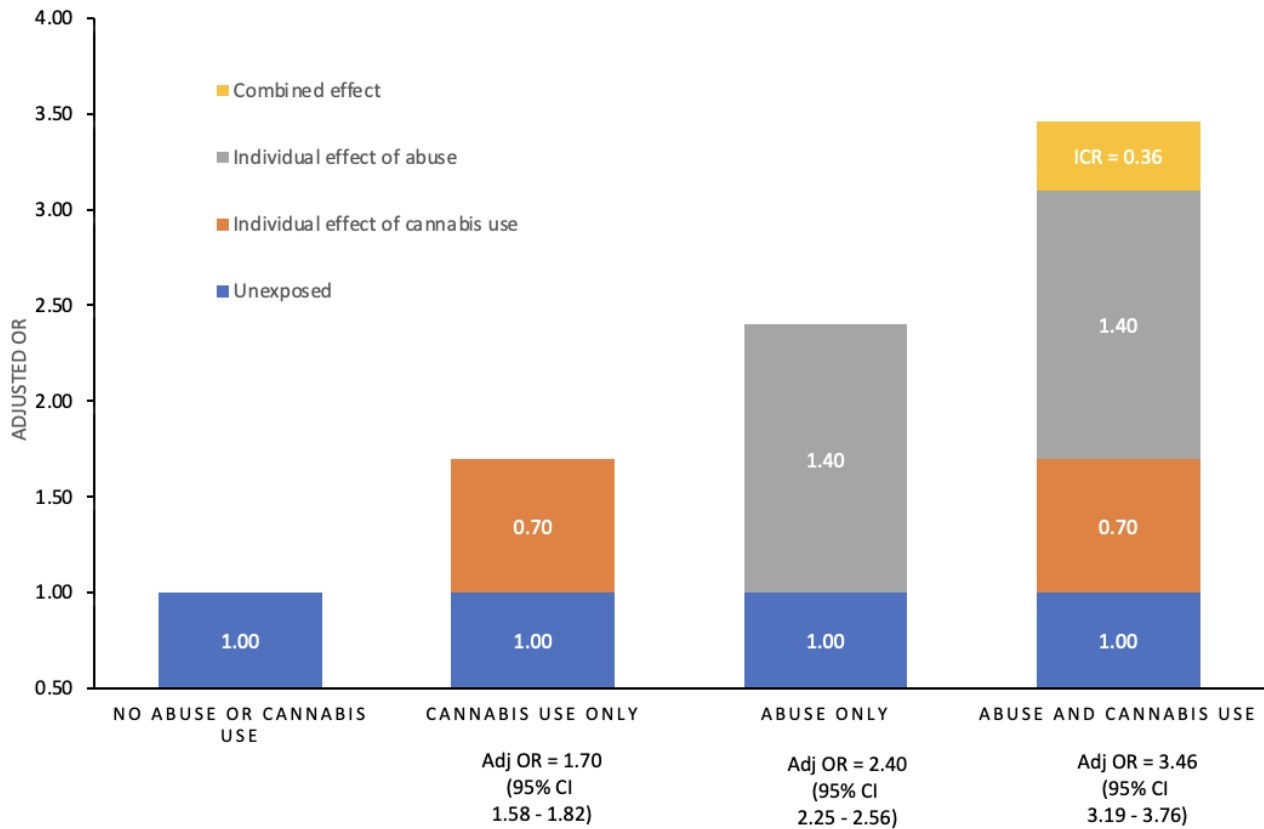
FIGURE 1 shows the synergistic effects of abuse and cannabis use on odds of psychotic experiences on an additive scale. Those who only used cannabis had significantly greater odds of psychotic experiences (aOR: 1.70; 95% CI: 1.58-1.82), and those who only experienced interpersonal abuse also had greater odds of psychotic experiences (aOR: 2.40; 95% CI: 2.25-2.56); however, those who endorsed both cannabis use and abuse had the greatest odds, exceeding sum of these individual effects (the combined effect aOR: 3.46; 95% CI: 3.19-3.76). The ICR of 0.36 (95% CI 0.07-0.66; $p=0.015$) on an additive scale indicates that the combined effect of interpersonal abuse and cannabis use is larger than the sum of the individual effects of the two exposures (i.e., 0.36 higher odds of psychotic experiences than if there were no synergy between interpersonal abuse and cannabis use).

Table 1. Descriptive statistics of analytic sample and bivariate logistic regression models predicting past-year psychotic experiences (Healthy Minds Study 2020-2021)

	Total n (%)	Any psychotic experience(s) (N = 97695)		
		No (%)	Yes (%)	Unadjusted OR (p-value)
Gender				
Man	38422 (39.33%)	32248 (39.48%)	6174 (38.54%)	1.00
Woman	56030 (57.35%)	47284 (57.89%)	8746 (54.60%)	0.97 (0.91 - 1.02)
Trans/non-binary/other	3243 (3.32%)	2145 (2.63%)	1098 (6.85%)	2.67 (2.37 - 3.02)
Race/ethnicity				
White	59458 (60.86%)	50313 (61.60%)	9145 (57.09%)	1.00
Asian American/Pacific Islander	9098 (9.31%)	7726 (9.46%)	1372 (8.57%)	0.98 (0.87 - 1.10)
Black	10624 (10.87%)	8680 (10.63%)	1944 (12.14%)	1.23 (1.10 - 1.38)
Hispanic/Latinx	7719 (7.90%)	6321 (7.74%)	1398 (8.73%)	1.22 (1.09 - 1.35)
Multiracial	9401 (9.62%)	7504 (9.19%)	1897 (11.84%)	1.39 (1.28 - 1.51)
Other Race	1395 (1.43%)	1133 (1.39%)	262 (1.64%)	1.27 (1.02 - 1.59)
Food insecurity (past 12 months)				
Food secure	67684 (69.28%)	58675 (71.84%)	9009 (56.24%)	1.00
Food insecure	30011 (30.72%)	23002 (28.16%)	7009 (43.76%)	1.98 (1.86 - 2.12)
Depression (past 2 weeks)				
No	75177 (76.95%)	66183 (81.03%)	8994 (56.15%)	1.00
Yes	22518 (23.05%)	15494 (18.97%)	7024 (43.85%)	2.01 (1.89 - 2.13)
Anxiety (past 2 weeks)				
No	62321 (63.79%)	55909 (68.45%)	6412 (40.03%)	1.00
Yes	35374 (36.21%)	25768 (31.55%)	9606 (59.97%)	3.34 (3.12 - 3.56)
Abuse (past 12 months)				
Any abuse				
No	65483 (67.03%)	58437 (71.55%)	7046 (43.99%)	1.00
Yes	32212 (32.97%)	23240 (28.45%)	8972 (56.01%)	3.20 (3.04 - 3.37)
Sexual abuse				
No	90157 (92.28%)	76617 (93.80%)	13540 (84.53%)	1.00
Yes	7538 (7.72%)	5060 (6.20%)	2478 (15.47%)	2.77 (2.57 - 2.99)
Physical abuse				
No	91126 (93.28%)	77338 (94.69%)	13788 (86.08%)	1.00
Yes	6569 (6.72%)	4339 (5.31%)	2230 (13.92%)	2.88 (2.65 - 3.14)
Emotional abuse				
No	69240 (70.87%)	61442 (75.23%)	7798 (48.68%)	1.00
Yes	28455 (29.13%)	20235 (24.77%)	8220 (51.32%)	3.20 (3.04 - 3.37)
Cannabis use (past 30 days)				
No	77977 (79.82%)	66886 (81.89%)	11091 (69.24%)	1.00
Yes	19718 (20.18%)	14791 (18.11%)	4927 (30.76%)	2.01 (1.89 - 2.13)

P<0.05 indicated in bold

FIGURE 1. Separate and joint (synergistic) effects of interpersonal abuse and cannabis use on psychotic experiences among students in higher education (aged 18-29), Healthy Minds Study, 2020-2021 (N=97695)



Abuse refers to interpersonal abuse over past 12 months. Cannabis use refers to any 'marijuana' use over the past 30 days. Psychotic experiences refer to any hallucinatory experiences or delusional ideations over the past 12 months. All models are adjusted for age, gender, race/ethnicity, depression, anxiety, and food insecurity

DISCUSSION

Main findings

In this study, we sought to extend previous research by examining the separate and joint effects of interpersonal abuse (emotional, physical, sexual, over the past year) and cannabis use (past 30 days) on odds of psychotic experiences (past year), adjusting for age, gender, race/ethnicity, food insecurity, anxiety, and depression. In terms of separate effects, we found evidence that interpersonal abuse and cannabis use were each associated with significantly greater odds of psychotic experiences. These findings comport with existing literature (Bonoldi et al., 2013; Marconi et al., 2016; Minozzi et al., 2010). In terms of joint effects, we found evidence that experiencing abuse and using cannabis together increased odds of psychotic experiences beyond either exposure individually. This aligns with a prior study among a general population sample of adults in the United Kingdom (Morgan et al., 2014). To our knowledge, our study was the first to test these main and synergistic effects in a large sample of students in higher education in the United States.

Our findings support and contribute to extant literature on psychotic experiences by examining the impact of environmental exposures and their synergies. Prior studies have focused on childhood adversities, since exposures that occur early in the developmental life course tend to shape later health outcomes (Houston et al., 2008, 2011), and could set the trajectory for future exposures to risk factors, including revictimization (Bebbington et al., 2011) and cannabis use (Halpern et al., 2018). Our study examined recent exposures to interpersonal abuse, as studies have also noted recent interpersonal abuse can be particularly impactful on psychotic experiences (Morgan et al., 2014). The pathways by which interpersonal abuse and cannabis use interact to synergistically increase odds of psychotic experiences are not well understood. The separate and combined effects of interpersonal abuse and cannabis use align with social defeat (Selten et al., 2013) and socio-developmental models (Morgan et al., 2010). It is possible that exposure to interpersonal abuse may lead to stress sensitization and cognitive biases, and in turn produce psychotic experiences (Collip et al., 2008). Moreover, interpersonal abuse can be traumatic and lead to the formation of negative schemas that underlie hypervigilance and suspiciousness (Garety et al., 2001; Kilcommons & Morrison, 2005), which can be further exacerbated by cannabis use (Freeman et al., 2015). Our findings suggest that the effects of interpersonal abuse and cannabis use are synergistic rather than overlapping, which may suggest the possibility that interpersonal abuse and cannabis use are linked to psychosis via different mechanisms. While more research is needed, the co-occurrence of interpersonal abuse and cannabis use may nonetheless signal higher clinical risk profile.

Limitations

Findings should be interpreted considering several limitations. First, in terms of design, the data were cross-sectional and did not allow us to establish the temporal order of events to make causal inferences. The relationships among interpersonal abuse, cannabis use, and psychotic experiences are difficult to disentangle; it is possible that interpersonal abuse can lead to cannabis use (via self-medication), which combine to increase odds of psychotic experiences. However, psychotic experiences can also occur throughout childhood before interpersonal abuse or initiation of cannabis. Second, in terms of the sample, the study only examined students in higher education in the United States, and findings cannot be generalized beyond this population. The HMS employed a convenience sampling strategy that yielded a large sample but with a relatively low response rate (14%). The response rate is to be expected for online convenience samples (Baker et al., 2013; Craig et al., 2013), and we attempted to account for non-response using survey weights, as done in prior studies using the dataset

(Lipson et al., 2022). However, sampling bias remains a major concern. In terms of measurement, all measures used in the study failed to elicit adequate information about severity, frequency, and context of experiences. Notably the measures cover a relatively short timeframe. Further, the HMS asked whether individuals had used 'marijuana', and this item may not have captured all forms of cannabis use. Additionally, there may have been some social desirability bias in that students may have been reluctant to disclose interpersonal abuse, cannabis use, or psychotic experiences, given that the survey was administered through the institutions of higher learning in which the students were enrolled.

Conclusion

Our findings provided evidence that interpersonal abuse and cannabis use both separately and synergistically increased odds of having psychotic experiences among students in higher education in the US. Since interpersonal abuse, cannabis use, and psychotic experiences may co-occur across contexts over time, our study highlights the importance of examining the impact and interaction of multiple exposures and their underlying (and potentially distinct) mechanisms. Prevention efforts may identify high-risk individuals and groups based on joint exposures and explore the utility of cannabis cessation support for people exposed to interpersonal abuse.

Statements and Declarations

None

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