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Cannabis use disorder uniquely predicts educational impairment in college students over and above other mental health disorders

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ABSTRACT

Objective: The impact of cannabis use disorder (CUD) on education functioning and GPA was examined within the context of co-occurring alcohol use disorder (AUD), major depressive disorder (MDD), and post-traumatic stress disorder (PTSD). **Participants:** Undergraduates ($N = 210$) who reported using cannabis within the past six months were recruited. **Methods:** Hierarchical multiple regression analyses were used to determine whether CUD symptom severity and presence of probable CUD diagnosis predicted educational impairment and current GPA, over and above other mental health conditions. **Results:** CUD symptom severity, but not probable CUD, significantly predicted greater educational impairment, over and above probable PTSD and MDD, which were also significant predictors. CUD symptom severity, but not probable CUD, significantly predicted lower GPA. **Conclusion:** In addition to other common mental health conditions, CUD may be an important area of assessment and intervention for university counseling centers to foster student academic success.

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Cannabis is being rapidly legalized across the United States,[1] yet there is much to be understood about its impact, including on educational functioning in college students. Cannabis is the most common illicit drug of choice among college students, with over 40% reporting using cannabis within the past year.[2] Further, nearly one in 10 (9.4%) college students meet criteria for cannabis use disorder (CUD),[3] with symptoms of CUD highest among past-month cannabis users. Cannabis use is linked with lower educational functioning, including significantly reduced time spent studying, lower grade point average (GPA), longer time to graduation, and increased risk of dropping out of college.[4–7] In addition, CUD is associated with greater number of skipped classes and failure to graduate from college.[8,9] Reasons for these worse outcomes are currently unclear; however, there is evidence that heavy cannabis use affects both acute cognitive impairment and, albeit more inconsistently, affects motivation/reward,[10–13] both of which could be pathways to impaired learning and reduced educational persistence.[14,15] While cognitive impairments associated with cannabis use are acute and reduce substantially with abstinence,[16,17] heavy cannabis use can result in residual detriments in cognitive processing speed and executive functioning.[18] Further, students with multiple mental health co-morbidities that frequently co-occur with cannabis may be at even greater risk for struggling academically.

Cannabis use and CUD often do not occur in isolation and are frequently complicated by co-occurring alcohol misuse and other mental health disorders (i.e., depression, post-traumatic stress disorder [PTSD]),[19,20] which likewise negatively impact educational outcomes in college students. Approximately 33% of college students report engaging in problematic drinking in the past year,[2] with binge drinking associated with greater numbers of missed classes, lower GPA, increased odds of perform poorly on exams, and dropping out of college.[21,22] Longitudinal data further indicate that college students with co-occurring heavy alcohol use and heavy cannabis use have significantly lower GPA than their sober/low-substance use counterparts over two years of enrollment.[23]

Prevalence rates in college students range from 12%-35% for PTSD,[24,25] and 11%-18% for major depressive disorder.[26,27] PTSD and depression have independently been shown to negatively affect academic outcomes, including GPA and educational impairment.[28–31] Further, PTSD symptoms are positively associated with more frequent cannabis use and the development of CUD.[32] Cannabis use is nearly twice as prevalent among those with depression,[33] and meta-analytic data on longitudinal studies indicate that heavy cannabis users are at significantly greater odds for developing depression.[34] Yet, despite high rates of these commonly co-occurring disorders in college students, there are no published studies examining the unique impact of CUD versus other mental health disorders on GPA and educational impairment in college students. CUD is of particular relevance because these students may be at the greatest risk for educational impairment due to direct cognitive effects and symptoms of addiction, but also because cannabis can exacerbate mental health symptoms. In a sample of college students who met DSM-5 criteria for CUD ($N = 99$), 57% endorsed craving, a symptom that is significantly associated with less time studying and lower academic motivation in

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college students.[6,35] Further, individuals with high PTSD symptoms are more likely to use cannabis to cope with sleep and other problems, and individuals with CUD are less responsive to PTSD treatment than those without the disorder.[36,37] Finally, young adults who report using cannabis to cope with physical and mental health symptoms were at greater risk for developing CUD, and experienced greater psychological distress and depression.[38]

The purpose of the present study was to address the current gap in the scientific literature by examining CUD as a predictor of educational impairment and GPA, after taking other mental health symptoms into account. The study further expands knowledge by examining two educational outcomes in order to speak to both impairment within post-secondary education environments as well as academic performance. It was hypothesized that CUD, measured both continuously (symptom severity) and dichotomously (presence/absence of disorder), would predict greater educational impairment over and above the impact of demographic covariates (age, gender), presence of probable AUD, MDD, and PTSD. CUD was measured in both manners (continuously, dichotomously) to better understand whether there were differential influences based on severity vs. probable disorder threshold. A similar relationship was also hypothesized with regards to GPA; greater CUD symptom severity or presence of the disorder would result in significantly lower GPA, after accounting for covariates, probable AUD, MDD, and PTSD.

Method

Participants

Students ($N = 647$) enrolled at The University of Texas at San Antonio were recruited between October 2020 through January 2021 to complete a survey study. Students were recruited through introduction to psychology courses and other social science courses that offered extra credit for study participation. Students were eligible if they were at least 18 years of age, and willing to allow researchers to access their academic transcripts. Participants were excluded if they were unwilling or unable to complete the informed consent or allow access to their academic transcripts. Of those who completed the survey, 232 (35.9%) reported using cannabis within the past six months and were included in the analyses. Thus, this method captured students who had recently used cannabis, and who may be conceptually different from never users (n = 298; 46.1%) or past-history users (n = 117; 18.1%). Non-binary gendered participants ($n = 3$ identified as 'Other' and $n = 1$ identifying as transgender) were excluded from analyses, as there were too few participants to adequately compare to participants who identified as male or female. Logic tests on cannabis use data indicated 11 participants provided invalid responses (i.e., reported using a particular form of cannabis despite reporting they did not currently use cannabis), who were therefore excluded. Finally, listwise deletion removed 7 additional participants with missing data. Thus, 210 participants were included in the analyses reported hereafter.

Materials

Demographics

The demographic questionnaire collected information on participants' age, gender, race, and student classification (i.e., college level based on number of total credit hours earned; freshman, sophomore, junior, and senior).

Probable AUD

The Alcohol Use Disorders Identification Test-Revised (AUDIT-R)[39] is a 10-item self-report measure that identifies probable alcohol dependence and severity. It assesses four domains, including alcohol consumption, drinking behavior, adverse reactions, and problems related to alcohol. Responses to questions range from 0 to 4, with higher scores indicating more problematic alcohol use. Example items include: "How often during the last year have you found that you were unable to stop drinking once you had started?", "How often during the last year have you had a feeling of guilt or remorse after drinking?", and "How often do you have a drink containing alcohol?" The AUDIT demonstrates good internal consistency ($\alpha = .80 - .93$).[40] A cutoff score of 8 or higher for women or 9 or higher for men was used to indicate probable alcohol AUD.[41] Cronbach's alpha in the current study was .77.

Probable MDD

The Patient Health Questionnaire-9 (PHQ-9)[42] is a 9-item self-report measure used to measure severity of depression symptoms during the past two weeks. Items are rated from zero (*not at all*) to three (*nearly every day*), with higher scores indicating more severe symptoms of depression. Questions ask how often respondents have been bothered by the following: "feeling down, depressed and hopeless", "thoughts that you would be better off dead, or of hurting yourself", and "feeling bad about yourself". The PHQ-9 has high internal consistency,[43] and demonstrates convergent validity with other measures of depression.[42] A cutoff score of 10 or greater was used to indicate current probable major depressive disorder.[44] Cronbach's alpha in the current study was .93.

Trauma exposure

The Life Events Checklist-5 (LEC-5)45 was used to assess exposure to potentially traumatic event(s) and is an 18-item self-report measure that includes potentially traumatic events, such as natural disaster, sexual assault, physical assault, transportation accident, and combat exposure. Participants rate the extent of personal exposure to the events on a six-point nominal scale: 1 (*happened to me*), 2 (*witnessed it*), 3 (*learned about it*), 4 (*part of my job*), 5 (*not sure*), and 6 (*doesn't apply*). The measure has high convergence other measures assessing potentially traumatic events.[46]

Probable PTSD

The PTSD Checklist for DSM-5 (PCL-5)[47] is a 20-item self-report measure designed to assess PTSD symptoms based on criteria in DSM-5. The PCL-5 has excellent psychometric

characteristics for PTSD screening and is also used as an indicator for PTSD symptom severity.[48] Example questions include: "In the past month, how much were you bothered by avoiding memories, thoughts, or feelings related to the stressful experience?", and "In the past month, how much were you bothered by repeated, disturbing, and unwanted memories of the stressful experience?" Responses range from 0 (*not at all*) to 4 (*extremely*) and total scores ranging from 0-80; higher scores indicate greater PTSD symptom severity. The PCL-5 has strong internal consistency (α = .75 – .96), convergent (r = .74 – .85) and discriminant validity (r = .31 – .60), and test-retest reliability (r = .82 – .84).[49–51] Cronbach's alpha in the current study was .96. College students who reported experiencing at least one potentially traumatic event on the LEC-5 and had a PCL-5 score of 31 or greater were categorized as having current probable PTSD.[52]

Probable CUD

The Cannabis Use Disorder Identification Test-Revised (CUDIT-R)[53] is an 8-item self-report measure assessing four domains: cannabis abuse, consumption, dependence, and psychological features. Items include "How often do you use cannabis?", and "How often during the past 6 months did you fail to do what was normally expected from you because of using cannabis?". Item responses range from 0 to 4, with higher scores indicating CUD symptom severity. The CUDIT-R has a good internal consistency (α = .91).[53] Cronbach's alpha in the current study was .79. For the current study, a cutoff score of 10 or higher was used to estimate current probable CUD.[54] Although lower cutoff scores have been identified in college students, cf.[55] this marker has been validated in two separate samples, including in partnership with a clinical interview to verify CUD.[54]

Educational impairment

The Inventory of Psychosocial Functioning - Educational Subscale (IPF-ES) is a 15-item self-report measure used to assess functional impairment within the domain of education.[56] Participants rate the extent to which they engaged in education-related behaviors within the last 30 days. Example items include, "I got along with classmates and/or instructors", "I had trouble remembering what the instructor said", and "I attended class regularly". Items are rated on a 7-point scale ranging from 1 (*never*) to 7 (*always*), with higher total scores indicating greater difficulty. The IPF-ES demonstrates excellent internal consistency within veterans (Cronbach's alpha =.86 – .90).[56] Cronbach's alpha in the current study was .81.

GPA

Participant's current overall GPA was obtained by requesting student transcript data through the university's Office of Institutional Research.

Procedure

The Institutional Review Board (IRB) approved the study materials and procedures prior to the initiation of the study. All study materials were administered through Qualtrics, an online survey platform. Participants interested in participating were screened via self-report items to determine eligibility. Eligible participants were redirected to a separate Web page to provide informed consent. Participants who agreed to participate were then redirected to the survey. Contact information was collected in a separate survey to protect privacy. Participants were encouraged to complete the survey in one sitting, yet had the ability to pause and return to the questionnaire within 24 hours of starting. After completing the study, participants recruited through the introductory psychology research subject pool received one hour of research credit, and those recruited through other social science classes received extra credit in an amount determined by their instructor.

Data analysis

Four individual hierarchical regression analyses were conducted to determine the separate associations of CUD (measured continuously and dichotomously) versus other probable diagnoses on educational outcomes. Demographics (age, gender) were entered into the first step, followed by probable AUD in Step 2, probable MDD and PTSD in Step 3, and then CUD severity or diagnosis in Step 4. The first analysis was conducted with educational impairment (IPF-ES) as the outcome, and the second with transcript-verified GPA. Assumptions for normality, linearity, and homoscedasticity were met for all multiple regression analyses.

Results

Demographic and sample characteristics are displayed in Table 1. The sample was primarily female (71.0%), and on average 19.64 years old (SD = 3.40). In terms of ethnicity and race, the majority identified as Hispanic (70.0%) and White (75.7%). Students were largely freshman (54.3%), followed by sophomore (22.9%), juniors (12.9%), and seniors (10.0%). Approximately 20.0% of the sample met criteria for probable AUD, with mean AUDIT-R total scores at 4.59 (SD = 3.00) for men, and 5.03 (SD = 4.23) for women. The average AUDIT-R total score for those with probable AUD was 11.12 (SD = 3.02). Approximately 39.5% met criteria for probable MDD and 42.5% for probable PTSD; average total scores across all students for the PHQ-9 were 9.51 (SD = 7.58) and PCL-5 were 27.30 (SD = 21.97). Average PHQ-9 total scores for those with probable MDD were 17.49 (SD = 5.12), and average PCL-5 total scores for those with probable PTSD were 48.51 (SD = 11.83). Approximately 37.0% of the sample met criteria for probable CUD. Mean CUDIT-R total scores were 8.95 (SD = 6.09) across all students. Those who were classified as having probable CUD had an average CUDIT-R total score of 15.46 (SD = 4.63), which was well above the cutoff score of 10 for probable diagnosis. Across all students, the average GPA was 3.11 (SD = 0.71) and IPF-ES total scores averaged at 33.08 (SD = 11.95), with the latter indicating moderate educational impairment.[56] Educational impairment and GPA had a significant negative

Table 1. Sample characteristics.

Variable	No CUD ($n = 149$)	CUD ($n = 61$)	p
Age	19.67 (3.76)	19.59 (2.69)	.862
Gender			
Female	100 (75.8%)	49 (62.8%)	< .05
Male	32 (24.2%)	29 (37.2%)	< .05
Hispanic or Latino (Yes)	96 (72.7%)	51 (65.4%)	ns
Race			
American Indian/ Alaskan Native	5 (6.3%)	0 (0.0%)	ns
Asian	6 (7.6%)	2 (4.0%)	ns
Native Hawaiian/ Pacific Islander	1 (1.3%)	1 (2.0%)	ns
African American	7 (8.9%)	5 (10.0%)	ns
White	54 (68.1%)	39 (78.0%)	ns
Other	4 (5.1%)	3 (6.0%)	ns
More than One Race	2 (2.5%)	0 (0.0%)	ns
College Classification			
Freshman (0-29 semester credit hours)	72 (54.5%)	42 (53.8%)	ns
Sophomore (30-59 semester credit hours)	28 (21.2%)	20 (25.6%)	ns
Junior (60-89 semester credit hours)	19 (14.1%)	8 (9.8%)	ns
Senior (90 + semester credit hours)	13 (9.4%)	8 (11.5%)	ns
Average Frequency of Current Cannabis Use			
Less than once a year	10 (7.6%)	1 (1.3%)	< .05
Once a year	6 (4.5%)	0 (0.0%)	ns
Once every 3-6 months	45 (34.1%)	4 (5.1%)	< .05
Once every 2 months	11 (8.3%)	1 (1.3%)	< .05
Once a month	10 (7.6%)	2 (2.6%)	ns
2-3 times a month	16 (12.1%)	5 (6.4%)	ns
Once a week	5 (3.8%)	2 (2.6%)	ns
Twice a week	7 (5.3%)	4 (5.1%)	ns
3-4 times a week	10 (7.6%)	19 (24.4%)	< .05
5-6 times a week	5 (3.8%)	7 (9.0%)	ns
Once a day	5 (3.8%)	12 (15.4%)	< .05
More than once a day	2 (1.5%)	21 (26.9%)	< .05
Primary Form of Cannabis			
Marijuana	86 (65.2%)	57 (73.1%)	ns
Concentrates	31 (23.5%)	18 (23.1%)	ns
Edibles	15 (11.3%)	3 (3.8%)	ns
Primary Method Ingest Cannabis			
Joints	28 (21.2%)	10 (12.8%)	ns
Blunts	26 (19.7%)	15 (19.2%)	ns
Hand Pipe	14 (10.6%)	10 (12.8%)	ns
Bong	13 (9.8%)	17 (21.8%)	< .05
Hookah	1 (0.8%)	0 (0.0%)	ns
Vaporizer (e.g., vape pen)	31 (23.5%)	21 (26.9%)	ns
Edibles	16 (12.1%)	1 (1.3%)	< .05
Other	3 (2.3%)	4 (5.1%)	ns
Substance Use/Mental Health Symptoms			
CUDIT-R Total Score	5.11 (2.54)	15.46 (4.63)	< .001
Probable AUD	26 (19.7%)	16 (20.5%)	ns
Probable MDD	53 (40.2%)	30 (38.5%)	ns
Probable PTSD	52 (39.4%)	37 (47.4%)	ns
Educational Outcomes [M (SD)]			
IPF-ES Total Score	31.93 (11.44)	35.01 (10.56)	.054
GPA	3.16 (0.68)	3.01 (0.75)	ns

Note. CUD = probable cannabis use disorder (total score of 10 or greater on CUDIT-R); ns = not significant ($p > .05$).

correlation, albeit the strength of the relationship was small ($r = -.25$, $p < .001$).

Predictors of educational impairment

Results from the hierarchical regressions are displayed in Table 2. For the continuous model (Model 1) younger age, but not gender, was a significant negative predictor of educational impairment in Step 1 and remained significant in all steps, $\beta = -.13$, $p < .05$. Probable AUD did not significantly predict educational impairment when entered at Step 2. In Step 3, probable MDD ($\beta = .17$, $p < .05$) and PTSD ($\beta = .25$, $p < .01$) had significant positive associations with educational impairment. In Step 4, greater CUD symptom severity significantly predicted higher educational impairment ($\beta = .21$, $p < .01$), as did age ($\beta = -.13$, $p < .05$) and probable PTSD ($\beta = .25$, $p < .01$), but probable MDD, probable AUD, and gender did not. The final model accounted for approximately 19% of the variance in educational impairment, and was a significant improvement above previous models, $F(1, 203) = 10.24$, $p < .01$.

A subsequent hierarchical regression (Model 2) was repeated with probable CUD diagnosis coded dichotomously (yes/no). Younger age was a significant negative predictor of educational impairment in all but Step 4, while gender was a significant predictor ($\beta = -.16$, $p < .05$) in Step 3 and in the final model. Probable AUD ($\beta = .11$, $p = .11$) in Step 2 was not significant when entered; however, in Step 3 both MDD ($\beta = .17$, $p = .047$) and PTSD ($\beta = .25$, $p < .001$) were significant positive predictors of educational impairment. In

Table 2. Summary of hierarchical regression results for predictors of educational impairment.

	Step 1			Step 2			Step 3			Step 4		
Independent variable	B	SE B	Beta	B	SE B	Beta	B	SE B	Beta	B	SE B	Beta
Model 1												
Age	−0.46	0.23	−0.14*	−0.48	0.23	−0.14*	−0.41	0.21	−0.13*	−0.42	0.21	−0.13*
Gender	−1.99	1.69	−0.08	−2.44	1.7	−0.10	−4.36	1.62	−0.18**	−3.16	1.63	−0.13
Probable AUD				3.11	1.94	0.11	1.04	1.85	0.04	0.592	1.82	0.02
Probable MDD							3.77	1.88	0.17*	3.16	1.84	0.16
Probable PTSD							5.93	1.90	0.26**	5.54	1.86	0.25**
CUD symptom severity										0.38	0.12	0.21**
Adjusted R^2			0.02			0.02			0.15			0.19
ΔR^2			0.03			0.01			0.14			0.04
F of ΔR^2			2.74			2.59			16.83***			10.24**
Model 2												
Age	−0.46	0.23	−0.14*	−0.48	0.23	−0.14*	−0.41	0.21	−0.13*	−0.41	0.21	−0.12
Gender	−1.99	1.69	−0.08	−2.44	1.7	−0.10	−4.36	1.62	−0.18**	−4.01	1.64	−0.16*
Probable AUD				3.11	1.94	0.11	1.04	1.85	0.04	1.06	1.85	0.04
Probable MDD							3.77	1.88	0.17*	3.95	1.88	0.17*
Probable PTSD							5.93	1.90	0.26**	5.58	1.91	0.25**
Probable CUD (Y/N)										2.14	1.49	0.09
Adjusted R^2			0.02			0.02			0.15			0.16
ΔR^2			0.03			0.01			0.14			0.01
F of ΔR^2			2.74			2.59			16.83***			2.05

Note. Predictor variables were coded as: Male = 1, Female = 2; probable alcohol use disorder (AUD) = 1; probable major depressive disorder (MDD) = 1; probable post-traumatic stress disorder (PTSD) = 1; probable cannabis use disorder (CUD) =1.
*$p < .05$.
**$p < .01$.
***$p \leq .001$.

the final step, gender (β = −.16, $p < .05$), probable MDD (β = .17, p < .05), and probable PTSD (β = .25, $p < .01$) were significant predictors of educational impairment, however probable CUD (β = −.09, $p = .151$) was not. The final model accounted for approximately 16% of the variance in educational impairment, but did not offer a significant improvement over previous models, $F(1, 203) = 2.05$, $p = .151$.

Predictors of GPA

Two hierarchical models were examined to determine the relationships between CUD symptom severity/probable CUD and GPA (see Table 3, Models 3 and 4). In contrast to the prior analyses, age, gender, and probable AUD, MDD, and PTSD were not significant predictors. CUD symptom severity was the only significant predictor (β = −.15, $p < .05$), but the final model accounted for only 1% of the variance in GPA, $F(1, 203) = 4.09$, $p < .05$. In the dichotomous model probable CUD was no longer a significant predictor in the model (β = −.10, $p = .155$), and the final model accounted for less than 1% of the variance in GPA, $F(1, 20) = 2.04$, $p = .155$.

Discussion

The aim of the present study was to determine whether CUD severity and probable diagnosis were predictive of educational impairment and GPA over and above demographics and other common mental health disorders (probable AUD, MDD, and PTSD). CUD symptom severity, in particular, is a useful nomenclature for consideration within academic settings because it likely reflects students who could be at greater risk for struggling academically due to symptoms of addiction, and subsumes myriad types, strains, and potencies of cannabis products. That is, when rising to the level of CUD (vs. cannabis use) students could experience correspondingly worse mental health symptoms[36,38] and cognitive impairment.[18] Furthermore, using diagnostic criteria for CUD circumvents the psychometric challenge of assessing quantity or dosage of varying strains of cannabis to which is a challenge to the research field in accurately measuring cannabis use.

Findings indicated that only CUD symptom severity negatively predicted educational impairment, even after accounting for probable AUD, MDD, and PTSD. With regards to probable CUD diagnosis, despite the clinical relevance of using a cutoff score to define presence of probable CUD, it was not a significant predictor of educational impairment or GPA. It is possible that the use of a dichotomous variable for CUD reduced power to detect significant effects. The unique contribution of CUD symptoms to greater educational impairment and lower GPA could be due to multiple factors associated with cannabis use, including acute and residual cognitive impairment and the exacerbation of mental health symptoms leading to worse education functioning.[36–38]

Consistent with the published literature,[28,31] probable MDD and PTSD (in the dichotomous model) were the only other significant predictors of educational impairment, with more severe depression and PTSD symptoms associated with greater impairment., In contrast to prior published studies,[21,22] probable AUD did not significantly predict educational impairment or GPA. Reasons for this discrepancy are unclear but could be related to differences in college samples across studies, the use of self-report vs. diagnostic interviews to assess mental health disorders, or low symptoms of AUD (i.e., low AUDIT-R scores) in the current sample.

Patterns of findings differed when using educational impairment versus GPA as the primary outcome, and when using a continuous versus dichotomous assessment of CUD. In the case of GPA, CUD symptom severity was a significant negative

Table 3. Summary of hierarchical regression results for predictors of current GPA.

	Step 1			Step 2			Step 3			Step 4		
Independent Variable	B	SE B	Beta	B	SE B	Beta	B	SE B	Beta	B	SE B	Beta
Model 3												
Age	−0.01	0.01	−0.03	−0.01	0.01	−0.03	−0.01	0.02	−0.03	−0.01	0.01	−0.03
Gender	0.11	0.11	0.07	0.10	0.11	0.06	0.11	0.11	0.07	0.06	0.11	0.04
Probable AUD				0.12	0.12	0.07	0.12	0.13	0.07	0.14	0.13	0.08
Probable MDD							−0.09	0.13	−0.06	−0.08	0.13	−0.06
Probable PTSD							0.02	0.13	0.02	0.04	0.13	−0.03
CUD Symptom Severity										−0.02	0.01	−0.15*
Adjusted R^2			0.00			0.00			−0.01			0.01
ΔR^2			0.01			0.00			0.00			0.02
F of ΔR^2			0.63			0.92			0.25			4.30*
Model 4												
Age	−0.01	0.01	−0.03	−0.01	0.01	−0.03	−0.01	0.02	−0.03	−0.01	0.01	−0.03
Gender	0.11	0.11	0.07	0.10	0.11	0.06	0.11	0.11	0.07	0.09	0.11	0.06
Probable AUD				0.12	0.12	0.07	0.12	0.13	0.07	0.12	0.13	0.07
Probable MDD							−0.09	0.13	−0.06	−0.10	0.13	−0.07
Probable PTSD							0.02	0.13	0.02	0.05	0.13	0.03
Probable CUD										−0.15	0.10	−0.10
Adjusted R^2			0.00			0.00			−0.01			−0.01
ΔR^2			0.01			0.00			0.00			0.01
F of ΔR^2			0.63			0.92			0.25			2.04

Note. Predictor variables were coded as: Male = 1, Female = 2; probable alcohol use disorder (AUD) = 1; probable major depressive disorder (MDD) = 1; probable post-traumatic stress disorder (PTSD) = 1; probable cannabis use disorder (CUD) =1.
*$p < .05$.
**$p < .01$.
***$p \leq .001$.

predictor, but probable CUD diagnosis was not. However, the variance explained by CUD and mental health predictors for overall current GPA was very small (1%) and substantially lower than the subjective measure of student's educational impairment. It may be that a dichotomous variable combined with GPA, which is influenced by multiple extraneous factors (e.g., socio-economic status, presence of learning disabilities, academic self-efficacy, previous overall GPA) over a long period, could be less sensitive than measuring educational impairment in real time (i.e., attending class, trouble remembering, etc.). Thus, although GPA is a traditional measure of educational performance, it may not be sensitive enough to capture educational struggles that exist outside of final grades. These findings highlight the importance of multi-method assessment when evaluating educational outcomes.

Strengths of this study include its assessment of both educational impairment and GPA, use of psychometrically strong measures of CUD and other mental health disorders, and inclusion of an ethnically diverse (70% Hispanic) sample. Despite these strengths, several limitations are noteworthy. Foremost, due to the sample size and the cross-sectional nature of the study, it was not possible to test for interaction effects, reciprocal relationships, or determine causality. It is possible CUD interacts with and has bidirectional relationships with problematic alcohol use, MDD, and PTSD, resulting in overall worse educational impairment. It is also possible that educational impairment preceded CUD and other mental health conditions. Prospective, longitudinal research to understand dynamic relationships among CUD, co-occurring conditions, and educational outcomes is critical. While college students engaging in moderate-heavy alcohol and low marijuana use experience temporary deficits in GPA compared to sober students, students engaging in moderate-high usage of both substances have consistently lower GPA than sober students over time.[23] Second, although psychometrically-established, self-report measures introduced the possibility that rates of disorders were under- or over-estimated.[57,58] Third, the analyses included probable AUD, MDD, and PTSD, and did not include other common mental health conditions among college students (e.g., anxiety disorders, stimulant "study drug" or other drug use).[2,59] Fourth, while assessing CUD symptoms circumvented the issue of measuring cannabis use with regards to type, form of ingestion, and potency, the heterogeneity of use within the current sample make it difficult to parse out whether these factors differentially effect educational impairment and academic outcomes. Finally, findings might not generalize to other non-Hispanic or nonwhite college student samples.

In the context of the rapid legalization of cannabis and growing availability of cannabis-related products, research is essential to understand the impact of CUD, alone and in combination with other common mental health disorders, on educational impairment. Findings generally suggest that CUD is uniquely associated with educational challenges. Importantly, many young adults may not realize cannabis is addictive and need to be educated about its potential consequences.[60] Such public health initiatives are critical given the potential personal, familial, economic, and societal consequences when college students do not succeed academically. Further, university counseling centers and campuses will need to be strategically positioned to address cannabis use, prevent and/or treat CUD and co-occurring disorders, and mitigate educational challenges through scientifically informed treatment targets.

Conflict of interest disclosure

The authors have no conflicts of interest to report. The authors confirm that the research presented in this article met the ethical guidelines, including adherence to the legal requirements of the United States and received approval from the Institutional Review Board of the University of Texas at San Antonio.

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