



Emotion dysregulation in relation to cannabis use and mental health among young adults

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ABSTRACT

Background: Emotion dysregulation (ED) is a transdiagnostic variable that accounts for the onset and maintenance of mental health disorders. The interplay between ED, cannabis use and mental health has not been appraised in the young adult population and whether there are sex-dependent effects has yet to be examined. This study looked at whether ED mediates the association between past-month cannabis use and mental health, while considering sex as a moderator.

Methods: 2,762 (64.2% women) undergraduate Spanish students completed an online battery. Among others, they fulfilled the Depression Anxiety Stress Scale-21 (DASS-21) and the Difficulties in Emotion Regulation Scale (DERS-28). A two-way ANOVA assessed the effects of sex and past-month cannabis use on participants' DASS-21 scores. A set of moderated mediations tested whether the indirect effect of past-month cannabis use on DASS-21 through DERS differed by sex.

Results: Past-month cannabis female users showed higher levels of depression, anxiety and stress ($M = 51.10$, $SD = 26.72$) than did men [$M = 33.76$, $SD = 20.31$]; $F(1, 2758) = 5.119$, $p = .024$, $\eta^2 p = .002$]. In female young adults only, the effect of past-month cannabis use on mental health was mediated by ED (total score), non-acceptance of emotional responses, lack of emotional control, difficulties in engaging in goal-directed behavior, and lack of emotional clarity (all p 's < 0.005).

Conclusions: Findings indicate the importance of considering ED in assessment and intervention practices. Interventions targeting ED may be particularly effective for female young adult cannabis users.

1. Introduction

Transition from high school to university constitutes a critical developmental stage during young adulthood (Miller and Racine, 2022). Challenges that accompany this newfound stressful period include the need for the adjustment to a new environment and higher independence, combined with academic pressure (Barbayannis et al., 2022; van Rooij et al., 2018). As a consequence, externalizing problems such as substance use may emerge during this period, especially among first-year college students (Cho et al., 2015; Conley et al., 2014).

Cannabis constitutes the most prevalent illicit drug used in college campuses (Suerken et al., 2014) and young adults generally (Romm et al., 2022). It is of interest that cannabis use escalates at a higher rate among university students aged between 18 and 21 years, compared to their non-college counterparts (Bravo et al., 2019; White et al., 2005). Specific risk factors for cannabis use in college campuses include

descriptive (i.e., overestimation of cannabis use of others) and injunctive norms (i.e., overestimations of peers' approval of cannabis use) (Montes et al., 2021), peer pressure, and academic stress (Welsh et al., 2019).

In the US college population, the annual prevalence of cannabis use has reached its historic highest rate (i.e., 43% in both 2018 and 2019), with 5.9% of university students using it on a daily basis (Schulenberg et al., 2020). Prevalence of cannabis use in emerging adults is high in Europe, and Spain is amongst the top five countries with the highest levels of cannabis use in young adults (Centre and for Drugs and Drug Addiction, 2022). This country also reports high levels of cannabis use in university students, with research revealing a lifetime cannabis use prevalence of 22%, which raises to 31.9% when considering binge drinkers (Herrero-Montes et al., 2019). Moreover, a cross-cultural study showed that Spanish university students experience more negative consequences of cannabis use when compared to students from other nationalities, both English and non-English speaking (Bravo et al.,

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2019). Amongst others, the following consequences of cannabis use were noted: spending too much time using cannabis, impact on mental health, difficulties cutting down and/or stopping cannabis use, and neglecting obligations (work and/or school). Cigarette smoking is a driver of cannabis dependence in young people who use cannabis and tobacco (Hindocha et al., 2015), and using tobacco mixed with cannabis is the preferred pattern of administration for Spaniards (Spanish Monitoring Centre for Drugs and Addictions, 2022).

Research on the effect that cannabis use has on the mental health of young adults has been conclusive (Rochat et al., 2022; Scholes-Balog et al., 2013; Sznitman et al., 2022; Wang et al., 2022); but the nature of this association remains unclear (Kuhns et al., 2022; Pacheco-Colón et al., 2019). Despite such studies differing in several methodological aspects (i.e., different types of depression and anxiety measures, university vs. non-university samples, samples of selected vs. unselected cannabis users, etc.), such heterogeneous findings suggest that other factors may be interacting in the interplay between cannabis use and anxiety and depression during young adulthood (Grunberg et al., 2015).

Emotion regulation (i.e., extrinsic and intrinsic processes and abilities involved in monitoring, evaluating, and modulating emotional experiences in the pursuit of goal-directed behavior) is one of such candidate variables (Gratz and Roemer, 2004; Gross, 2015a). Emotion regulation is a transdiagnostic variable associated with many psychiatric disorders that frequently co-occur with substance use (Vintró-Alcaraz et al., 2022; Weiss et al., 2022). Nevertheless, the role of ED in the association between mental disorders and cannabis use has not been previously considered within young adults. One study conducted among an adult community sample of cannabis users showed that ED moderated the relationship between stress and problematic cannabis use (Cavalli and Cservenka, 2021). The same finding was obtained in a sample of young adult women when considering several substances jointly, including cannabis (Tull et al., 2015).

Sex may also impact on the interplay between cannabis use and mental health, but the direction is not clear either [see (Prieto-Arenas et al., 2022) for a review]. In community samples of adults, some studies show that cannabis use is associated with higher psychological distress and suicidal thoughts and attempts in females (Goldstein et al., 2012; Halladay et al., 2019), but other studies report similarly high prevalence rates of mental health disorders and unmet treatment needs across both sexes (Park and Wu, 2017), while a few show no sex effects (Calakos et al., 2017). Findings are also heterogeneous within samples of adolescents. While some studies show that cannabis use is linked to poorer mental health in males compared to females (Assari et al., 2018; Crane et al., 2015), other studies suggest the opposite is true (Fernández-Artamendi et al., 2021). Furthermore, the interplay between ED and sex and how it may affect the cannabis use-mental health pairing has not been previously considered in young adults, despite recent meta-analytical evidence showing that the direction of the sex effects on substance use appears to differ by the specific emotion regulation ability being considered (Weiss et al., 2022).

Against this background, the present study sought to (1) assess the main and interactive effects of cannabis use and sex on mental health in a sample of undergraduate young adults, and (2) examine whether ED mediates the association between regular cannabis use and mental health, while considering sex as a potential moderator.

2. Materials and methods

2.1. Participants

Participants were 2,762 undergraduate young adults aged 18–25 years (85% in first and second year of studies; 64.2% women) recruited from three communities in Spain (The Balearic Islands, the Principality of Asturias, and Aragon) during September–November 2021. All participants were recruited from university colleges and vocational schools using print (flyers, posters) and mass media advertising (radio, tv,

Instagram and Twitter).

Initially, 2,980 participants were recruited and completed the assessment battery. Based on the eligibility criteria, a total of 121 were discarded due to being aged 26 or over. An additional 22 failed attentional control checks (see subsection 2.2), and 75 were duplicated cases. This left a total sample of 2,762 young adults (see Table 1 for participants' descriptive characteristics).

2.2. Procedure

All participants were recruited from university colleges and vocational schools through an intentional sampling. A total of three university colleges and 12 vocational schools were invited to participate. The coordinators of university degrees and vocational school centers were contacted to ask for collaboration and initiate the assessments in the classroom during teaching hours. Print flyers, posters, and mass media advertising (radio, tv, Instagram and Twitter) were used as well. After being accepted for participation, research assistants surveyed participants using tablets (Lenovo® Tab M7). Participants completed an online

Table 1
Participants' descriptive characteristics.

	Total (N = 2,762)	Men (n = 990)	Women (n = 1,772)	Statistic	p
Age (years) ^a	19.47 ± 1.64	19.48 ± 1.69	19.46 ± 1.61	0.212 ¹	0.832
Study year (%)				35.373 ²	<0.001
1st year	42.0	46.0	39.8		
2nd year	42.7	35.8	46.6		
3rd year	3.6	4.7	2.9		
4th year	3.0	2.9	3.0		
Vocational training	8.7	10.6	7.7		
Weekly allowance (€)	59.75 ± 143.44	68.39 ± 180.29	54.93 ± 117.72	2.111 ¹	0.035
Working status (%)				4.928 ²	0.085
Unemployed	82.8	84.84	81.6		
Part time	15.5	13.54	16.7		
Full time	1.7	1.62	1.7		
Relatives with current or former substance use problems (%) yes)	13.6	35.9	64.1	<.001 ³	1.000
Past-month cannabis use (% yes)	11.5	15.1	9.5	18.413 ³	<0.001
Number of joints/day ^a	0.45 ± 1.11	0.42 ± 0.95	0.48 ± 1.24	-0.477 ¹	0.634
Cannabis grams/ week ^a	2.98 ± 6.66	3.03 ± 7.97	2.87 ± 5.13	0.225 ¹	0.822
CUDIT-R among cannabis users	7.08 ± 5.94	6.87 ± 5.54	7.24 ± 6.20	-0.550 ¹	0.582
CUDIT-R ≥ 8 (%)	34.8	35.57	34.32		
CUDIT-R < 8 (%)	65.1	64.43	65.68		
DERS total score	65.01 ± 21.21	59.67 ± 18.79	68.06 ± 21.86	-10.719 ¹	<0.001
Non-acceptance of emotional responses DERS subscore	15.69 ± 7.73	13.91 ± 6.98	16.67 ± 7.93	-9.582 ¹	<0.001
Lack of emotional control DERS subscore	18.12 ± 7.90	16.11 ± 6.68	19.27 ± 8.31	-11.025 ¹	<0.001
Difficulties in engaging in goal- directed behavior DERS subscore	11.57 ± 4.42	10.80 ± 4.30	12.03 ± 4.43	-7.205 ¹	<0.001
Lack of emotional clarity DERS subscore	9.33 ± 3.44	10.08 ± 3.72	10.43 ± 3.89	-2.315 ¹	0.021
Lack of emotional awareness DERS subscore	10.29 ± 3.84	8.76 ± 3.38	9.66 ± 3.45	-6.692 ¹	<0.001
DASS-21 score	39.05 ± 24.91	31.78 ± 22.10	43.27 ± 25.68	-12.488 ¹	<0.001

battery assessment (<https://metajovenes.es/>), which took approximately 45 min to fill in. Research assistants were present during the assessments in classrooms and checked there was no interaction between participants. To verify sufficient effort and attention to the task, four attentional control items (e.g., for this question choose “true”) were included within the battery assessment. Response options for attentional checks followed the response option scales at next preceding. Participants were required to provide at least two out of four correct responses.

The protocol study (#191CER21) was reviewed and accepted by the Local Ethics Committee of the academic institution that received the funding. Before the study began, participants provided written informed consent.

2.3. Instruments

Participants completed the computerized survey, which gathered data on sociodemographic characteristics (i.e., age, sex, academic grade, weekly money available, working status and the presence of parents with current or former substance use disorders). Regarding their cannabis use, they were asked whether they had used cannabis within the previous month as well as their frequency of daily use in terms of number of joints per day and grams consumed in a usual week within the previous month. Participants who self-reported past-month cannabis use also fulfilled the Spanish validation (Mezquita et al., 2022) of the Cannabis Use Disorders Identification Test-Revised (CUDIT-R; Adamson et al., 2010), comprised by 8 items assessing consumption, cannabis problems, physical dependence, and psychological consequences of cannabis use. Scores range from 0 to 32 points, with a cut-off score of ≥ 8 being indicative of hazardous use. The Spanish validation of the CUDIT-R has shown good internal consistency in past-month cannabis users ($\alpha = 0.81$).

The Spanish validation (Daza et al., 2002) of the Depression Anxiety Stress Scale-21 (DASS-21; Lovibond and Lovibond, 1995), is a 21-item instrument that was used to measure depression, anxiety and stress symptom severity based on a 4-point Likert scale. Scores for each subscale range from 0 to 42 points, with higher scores reflecting more severe symptoms. We computed a total score that is indicative of emotional distress. The decision to use the DASS-21 total score, instead of each of the three individual factors (stress, anxiety, and depression), was due to both statistical and theoretical rationales. The structure of the DASS-21 is essentially unidimensional in Spanish college students (see Valencia, 2019). Also, from a clinical standpoint, focusing on emotional distress rather than on each of the three symptoms separately makes it relevant, as more recent intervention approaches are more interested in mechanistic psychological processes than in specific symptoms (Hayes et al., 2020).

The Spanish version (Hervás and Jódar, 2008) of the Difficulties in Emotion Regulation Scale (DERS; Gratz and Roemer, 2004) was employed to assess ED. The DERS contains 36 items scored on a 5-point Likert scale ranging from 36 to 180, with higher scores indicating greater ED. The Spanish validation includes 28 items that are distributed into five related facets (one less than in the original version), namely: lack of emotional control (this subscale combines items of two subscales from the original version: the impulsive control difficulties subscale and the limited access to emotion regulation strategies scale), non-acceptance of emotional responses, difficulties in engaging in goal-directed behavior, lack of emotional clarity and lack of emotional awareness. The Spanish validation of the DERS has demonstrated good internal consistency ($\alpha > 0.73$) for each of the five subscales (Hervás and Jódar, 2008).

2.4. Data analysis

Chi-squared tests and independent-samples *t* tests were used to evaluate sex differences in sociodemographic and cannabis use variables.

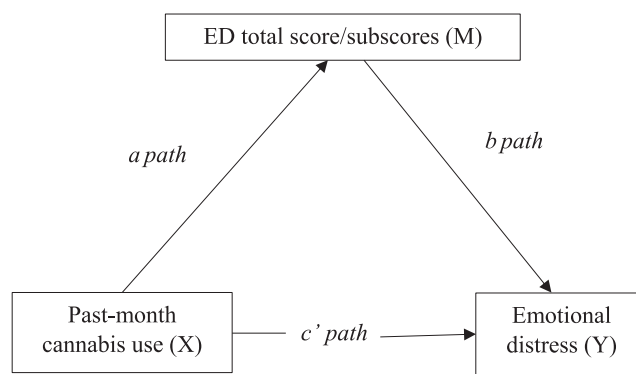
In order to address whether sex (men vs. women), past-month cannabis use (yes vs. no) and their interaction affect emotional distress, a preliminary two-way between-groups analysis (ANOVA) was performed. To ensure that differences in depression, anxiety and stress were not only due to the unequal sex distribution of these disorders in the general population, but also to cannabis use, a series of post-hoc independent-samples *t*-tests were performed. Effect sizes of principal comparisons were calculated via the partial eta squared (η^2p) statistic or Cohen's *D*, as appropriate. In addition, a total of 6 simple mediation and 6 moderated mediation analyses were conducted with the macro-PROCESS v4.2 for SPSS (Hayes, 2018). Figure 1 shows the general simple mediation and moderated mediation pathway models. The mediation analyses were conducted using model 4 in PROCESS and tested the indirect effect of yes vs. no past-month cannabis use [independent variable (X)] on emotional distress [dependent variable (Y)] through ED (total score) (Model 1) or subscores [one model per each of the ED subscales (Models 2–6); mediator (M)]. The moderated mediation analyses were performed through model 7 in PROCESS and looked at potential conditional indirect effect of sex [moderator (W)] on the pathway between past-month cannabis use [independent variable (X)] and the ED total score or subscores [mediator (M)]. Bootstrapping (with 10,000 resamples) was implemented to reduce Type I error (Hayes, 2018). The confidence level set for all the analyses was 95% and the statistical package employed was the SPSS (V25; SPSS, Inc., Chicago, IL). Fig. 1a.Fig. 1b.

3. Results

3.1. Main and interactive effects of sex and regular cannabis use on emotional distress

Correlations between the study variables are shown in supplementary Table 1. Past-month cannabis use and emotional distress were significantly correlated at a small magnitude. The association between ED and mental distress was only significant for females, and cannabis use was only associated with ED (except for lack of emotional awareness) in women, but not men.

The two-way between-groups ANOVA revealed a significant main effect of sex [$F(1, 2758) = 92.948, p < .001, \eta^2p = .033$], past-month cannabis use [$F(1, 2758) = 14.583, p < .001, \eta^2p = .005$] and their interaction [$F(1, 2758) = 5.119, p = .024, \eta^2p = .002$] on emotional distress. Fig. 2 shows mean emotional distress scores by sex and past-month cannabis use status. Specifically, women showed higher emotional distress ($M = 43.09, SD = 25.52$) than men [$M = 31.83, SD = 22.04, t(2304.20) = -12.147, p < .001, \text{Cohen's } D = 0.47$]. Past-month



Note. ED = Emotional dysregulation.

Fig. 1a. Mediation model for past-month cannabis use (X), DERS total score/subscales (M), and DASS-21 score (Y). *c'* represents the direct effect, *a* and *b* the indirect effects.

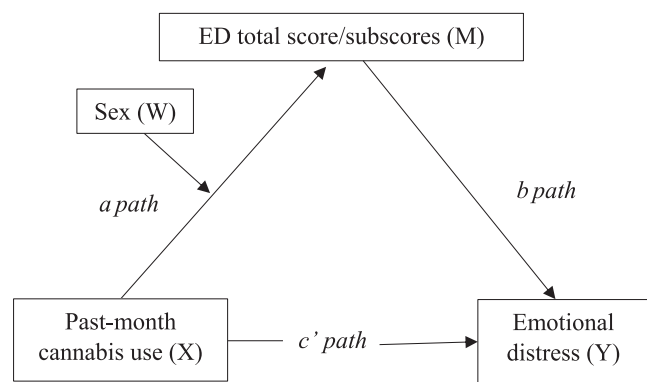


Fig. 1b. Moderated mediational pathway model for past-month cannabis use (X), sex (W), DERS total score/subscales (M), and DASS-21 score (Y). *c'* represents the direct effect, *a* and *b* the indirect effects.

cannabis users also scored significantly higher on emotional distress ($M = 42.97, SD = 25.42$) than non-users [$M = 38.54, SD = 24.81, t(2760) = -2.988, p = .003, \text{Cohen's } D = 0.17$]. Significant differences were found between women cannabis users ($M = 51.10, SD = 26.72$) and women non-users on the emotional distress total score [$M = 42.24, SD = 25.25, t(1770) = -4.313, p < .001, \text{Cohen's } D = 0.34$]. Within the subset of men, there were no significant differences between past-month cannabis users ($M = 33.76, SD = 20.31$) and non-users on emotional distress [$M = 31.49, SD = 22.32, t(988) = -1.158, p = 0.247$].

3.2. Mediation analyses

The mediation analyses summary is presented in Table 2. The results revealed a statistically significant effect of past-month cannabis use on emotional distress. Furthermore, the direct effect of past-month cannabis use on emotional distress in the presence of lack of emotional control as a mediator was also found significant (see Model 3).

3.3. Moderated mediational analyses

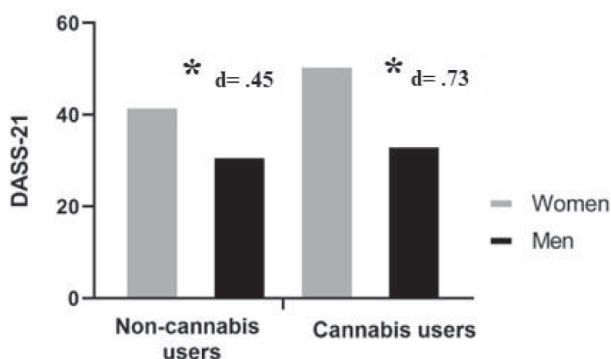
The indirect effect of past-month cannabis use (yes vs. no) on emotional distress through both ED (i.e., DERS total score) (Model 1)

and 4 of the 5 ED subscales (Models 2–5; i.e., non-acceptance of emotional responses, lack of emotional control, difficulties in engaging in goal-directed behavior, and lack of emotional clarity) differed by sex. Table 3 shows the main results of the 6 moderated mediational models. As regards to Model 1 that tests the influence of ED (total score) as a mediator, the conditional indirect effects showed that past-month cannabis use is indirectly associated with higher emotional distress through higher ED (total score) only among females. The same pattern of results showing that the conditional indirect effects are only significant for women is observed for the following ED subscale mediators: non-acceptance of emotional responses, lack of emotional control, difficulties in engaging in goal-directed behavior, and lack of emotional clarity (see Table 3 Models 2–5).

4. Discussion

This study examined the effect of cannabis use on mental health (i.e., depression, anxiety, and stress), and the mediating effect of ED between past-month cannabis use and mental health by sex among undergraduate young adults. Two major findings stand out: (1) women cannabis users showed higher levels of depression, anxiety, and stress than men cannabis users; and 2) there was a direct and mediating effect (via ED) of cannabis use on mental health, where the association was only significant for females.

Consistent with previous studies (Danielsson et al., 2016; Fernández-Artamendi et al., 2018; Hellemans et al., 2019), young women cannabis users showed particularly high levels of depression, anxiety, and stress than men. Several factors may contribute to explain this finding. Men and women differ in both the prevalence and clinical manifestation of psychiatric disorders. At present, there is cumulative research which support the finding that women manifest depressive and anxiety disorders to a greater extent than men (see Altemus et al., 2014 for a review). In this relationship, social determinants (e.g., differences in social roles) seem key to account for enhanced sensitivity to life stress events (Afifi, 2007), probably due to perceptions of affective-relevant stimuli as more arousing than men (Rubinow & Schmidt, 2019). An additional explanation of the sex differences in the pathway between cannabis use and emotional distress may be self-medication, as it is possible that those females with more severe anxiety, stress and depression may be using cannabis for coping purposes (Kuhns et al., 2022). This has important implications as people with mental health disorders report lower levels



Note. DASS-21 = Depression Anxiety Stress Scale-21.

Statistically significant differences at a p value $< .05$ are indicated with an asterisk. Effect sizes are denoted by d (i.e., Cohen's D). Effect sizes are deemed as small ($d = 0.2$), medium ($d = 0.5$), and large ($d = 0.8$) based on benchmarks suggested by Cohen (1988).

Fig. 2. Emotional distress in women and men non-cannabis users and cannabis users. Note. DASS-21 = Depression Anxiety Stress Scale-21. Statistically significant differences at a p value < 0.05 are indicated with an asterisk. Effect sizes are denoted by d (i.e., Cohen's D). Effect sizes are deemed as small ($d = 0.2$), medium ($d = 0.5$), and large ($d = 0.8$) based on benchmarks suggested by Cohen (1988).

Table 2
Results of the simple mediational models.

Model path	<i>b</i> ^a	<i>SE</i> ^b	<i>t</i>	<i>p</i>	95 % CI (Lower) ^c	95% CI (Upper) ^c
Model 1. DERS total score (M)						
a path: Past-month cannabis use (X) → DERS total score (M)	2.126	1.264	1.682	0.092	-0.352	4.605
b path: DERS total score (M) → DASS-21 score (Y)	0.884	0.014	60.236	<0.001	0.855	0.913
c' path: Past-month cannabis use (X) → DASS-21 score (Y)	2.552	0.975	2.616	0.008	0.639	4.465
Indirect effect of past-month cannabis use (X) on DASS-21 score (Y)	1.880	1.157	-	-	-0.362	4.180
Model 2. Non-acceptance of emotional responses DERS subscore (M)						
a path: Past-month cannabis use (X) → Non-acceptance of emotional responses DERS subscore (M)	0.468	0.460	1.016	0.309	-0.435	1.371
b path: Non-acceptance of emotional responses DERS subscore (M) → DASS-21 score (Y)	2.049	0.047	43.346	<0.001	1.957	2.142
c' path: Past-month cannabis use (X) → DASS-21 score (Y)	3.473	1.144	3.034	0.002	1.229	5.718
Indirect effect of past-month cannabis use (X) on DASS-21 score (Y)	0.959	0.935	-	-	-0.859	2.799
Model 3. Lack of emotional control DERS subscore (M)						
a path: Past-month cannabis use (X) → Lack of emotional control DERS subscore (M)	1.270	0.470	2.698	0.007	0.347	2.193
b path: Lack of emotional control DERS subscore (M) → DASS-21 score (Y)	2.244	0.042	53.302	<0.001	2.162	2.327
c' path: Past-month cannabis use (X) → DASS-21 score (Y)	1.582	1.042	1.517	0.129	-0.462	3.627
Indirect effect of past-month cannabis use (X) on DASS-21 score (Y)	2.851	1.082	-	-	0.725	5.019
Model 4. Difficulties in engaging in goal-directed behavior DERS subscore (M)						
a path: Past-month cannabis use (X) → Difficulties in engaging in goal-directed behavior DERS subscore (M)	0.156	0.263	0.594	0.552	-0.360	0.673
b path: Difficulties in engaging in goal-directed behavior DERS subscore (M) → DASS-21 score (Y)	3.220	0.087	36.614	<0.001	3.047	3.392
c' path: Past-month cannabis use (X) → DASS-21 score (Y)	3.929	1.217	3.227	0.0013	1.542	6.315
Indirect effect of past-month cannabis use (X) on DASS-21 score (Y)	0.504	0.824	-	-	-1.106	2.134
Model 5. Lack of emotional clarity DERS subscore (M)						
a path: Past-month cannabis use (X) → Lack of emotional clarity DERS subscore (M)	0.384	0.205	1.873	0.061	-0.017	0.787
b path: Lack of emotional clarity DERS subscore (M) → DASS-21 score (Y)	3.766	0.117	32.08	<0.001	3.536	3.997
c' path: Past-month cannabis use (X) → DASS-21 score (Y)	2.984	1.267	2.355	0.018	0.499	5.468
Indirect effect of past-month cannabis use (X) on DASS-21 score (Y)	1.448	0.849	-	-	-0.208	3.133
Model 6. Lack of emotional awareness DERS subscore (M)						
a path: Past-month cannabis use (X) → Lack of emotional awareness DERS subscore (M)	-0.152	0.229	-0.667	0.504	-0.601	0.296
b path: Lack of emotional awareness DERS subscore (M) → DASS-21 score (Y)	1.886	0.118	15.987	<0.001	1.654	2.117
c' path: Past-month cannabis use (X) → DASS-21 score (Y)	4.721	1.419	3.325	0.0009	1.937	7.504
Indirect effect of past-month cannabis use (X) on DASS-21 score (Y)	-0.288	0.446	-	-	-1.145	0.599

Note. DERS = Difficulties in Emotion Regulation Scale; DASS-21 = Depression Anxiety Stress Scale-21.

^a = Unstandardized coefficients; ^b = Standard Error; ^c = Confidence Interval.

of perceived risk of using cannabis (Lowe et al., 2019; Pacek et al., 2020), which may also lead to strengthen the cannabis use and emotional distress association.

Our results showed that the detrimental effects of cannabis use on mental health were mediated by ED in women but not in men. The most probable reason is because cannabis use relates to ED in females only. Even though women vs. men are not more vulnerable to stressful life events, the former are more prone to respond with a negative problem orientation characterized by rumination and thought and anger suppression (Afifi, 2007; Hoin Kwon et al., 2013). ED involves a lack of emotion regulation abilities characterized by non-acceptance of emotional responses and emotion-driven impulsivity (i.e., lack of emotional control and difficulties in engaging in goal-directed behavior). This finding is consistent with a recent meta-analysis which shows that the effect of sex varies by the specific emotion regulation ability considered (Weiss et al., 2022). Also, laboratory studies have shown that women have greater emotional reactivity to negative stimuli than men, suggesting a female negativity bias when processing aversive emotional stimuli (Gardener et al., 2013). This female bias may hinder effective emotion regulation and facilitate emotionally-driven impulsive behaviors. Specifically, non-acceptance of emotional responses has been linked to several impulsive behaviors in university students, including drug use and self-harm, a form of experiential avoidance (Miller and Racine, 2022). It is likely that female young adults high in lack of emotional control react impulsively under both positive and negative stimuli and engage in short-term emotional relieving behaviors (i.e., cannabis use), rather than in goal-oriented behaviors (Smith and Cyders, 2016). This is in part supported by that fact that the non-acceptance of negative emotions relates to coping cannabis use motivations (Bonn-Miller et al., 2008). Substance use choice is driven by the expected value of the drug and can be augmented by stress/negative mood induction –

an effect that is amplified in those with drug use coping motives (Hogarth, 2020). The difficulties in goal-oriented behavior may also reflect the tendency of female cannabis users to bias decision-making in favor of immediate reinforcing effects (i.e., pain relief, emotional alleviation), rather than in delayed and more adaptive ones (i.e., academic performance, or rewarding effects from prosocial activities) (Murphy et al., 2012).

The present study is subject to several limitations, including the limited generalizability to young adults not attending college. First, data are cross-sectional, so we are unable to infer causality or directionality between the variables assessed. Second, it also makes sense to explore the mental health and cannabis use link, but longitudinal designs (e.g., linear mixed-effects models) are needed as they are deemed as more appropriate than cross-sectional studies. As future longitudinal research avenues, it would be worth to test the reverse association (i.e., emotional symptoms as predictors of cannabis use frequency and severity of problems, moderated by sex and other transdiagnostic variables). Analytically, identifying mediators of this link will shed light on relevant prevention/intervention targets. Hopelessness and distress intolerance could be considered, as they represent important risk factors for cannabis use in young samples (Farris et al., 2016; Moreno-Mansilla et al., 2021). Third, data collected on recent cannabis use was based on self-report and not confirmed by objective methods. Relatedly, we only reported on smoked cannabis use and future studies would be needed to consider other modes of use (e.g., edibles, vaporizers, sublinguals). In addition, other important variables, such as the presence of a cannabis-use partner, cannabis use motives, or a cannabis-using social network, were not assessed. Lastly, we based our analyses on past-month cannabis use and there is a need to examine if low emotional regulation ability is also a mediator for those using cannabis regularly and/or presenting cannabis use disorder risk. In our study, the percentages of

Table 3
Results of the moderated mediational models.

Model path	<i>b</i> ^a	<i>SE</i> ^b	<i>t</i>	<i>p</i>	95 % CI (Lower) ^c	95% CI (Upper) ^c
Model 1. DERS total score (M)						
a ₁ path: Past-month cannabis use (X) → DERS total score (M)	2.871	1.249	2.297	0.021	0.421	5.320
a ₂ path: Sex (W) → DERS total score (M)	-3.830	0.442	-8.651	<0.001	-4.698	-2.962
a ₃ path: Past-month cannabis use (X) × Sex (W) → DERS total score (M)	-3.321	1.249	-2.658	0.0079	-5.771	-0.871
b ₁ path: DERS total score (M) → DASS-21 score (Y)	0.8845	0.014	60.236	<0.001	0.855	0.913
c' path: Past-month cannabis use (X) → DASS-21 score (Y)	2.552	0.975	2.616	0.008	0.639	4.465
Conditional indirect effect (women)	5.476	1.647	-	-	2.303	8.765
Conditional indirect effect (men)	-0.398	1.429	-	-	-3.172	2.426
Index of moderated mediation	-5.874	2.176	-	-	-10.196	-1.653
Model 2. Non-acceptance of emotional responses DERS subscore (M)						
a ₁ path: Past-month cannabis use (X) → Non-acceptance of emotional responses DERS subscore (M)	0.726	0.457	1.589	0.112	-0.169	1.622
a ₂ path: Sex (W) → Non-acceptance of emotional responses DERS subscore (M)	-1.278	0.162	-7.891	<0.001	-1.595	-0.960
a ₃ path: Past-month cannabis use (X) × Sex (W) → Non-acceptance of emotional responses DERS subscore (M)	-0.950	0.457	-2.080	0.037	-1.847	-0.054
b ₁ path: Non-acceptance of emotional responses DERS subscore (M) → DASS-21 score (Y)	2.049	0.047	43.346	<0.001	1.957	2.142
c' path: Past-month cannabis use (X) → DASS-21 score (Y)	3.473	1.144	3.034	0.0024	1.229	5.718
Conditional indirect effect (women)	3.437	1.367	-	-	0.765	6.122
Conditional indirect effect (men)	-0.460	1.208	-	-	-2.789	1.948
Index of moderated mediation	-3.898	1.836	-	-	-7.596	-0.311
Model 3. Lack of emotional control DERS subscore (M)						
a ₁ path: Past-month cannabis use (X) → Lack of emotional control DERS subscore (M)	1.552	0.464	3.338	<0.001	0.640	2.463
a ₂ path: Sex (W) → Lack of emotional control DERS subscore (M)	-1.449	0.164	-8.797	<0.001	-1.772	-1.126
a ₃ path: Past-month cannabis use (X) × Sex (W) → Lack of emotional control DERS subscore (M)	-1.253	0.464	-2.696	0.0071	-2.165	-0.341
b ₁ path: Lack of emotional control DERS subscore (M) → DASS-21 score (Y)	2.244	0.042	53.302	<0.001	2.162	2.327
c' path: Past-month cannabis use (X) → DASS-21 score (Y)	1.582	1.042	1.517	0.129	-0.462	3.626
Conditional indirect effect (women)	6.297	1.563	-	-	3.259	9.365
Conditional indirect effect (men)	0.670	1.279	-	-	-1.796	3.225
Index of moderated mediation	-5.627	2.006	-	-	-9.558	-1.667
Model 4. Difficulties in engaging in goal-directed behavior DERS subscore (M)						
a ₁ path: Past-month cannabis use (X) → Difficulties in engaging in goal-directed behavior DERS subscore (M)	0.245	0.263	0.932	0.351	-0.270	0.761
a ₂ path: Sex (W) → Difficulties in engaging in goal-directed behavior DERS subscore (M)	-0.524	0.093	-5.628	<0.001	-0.707	-0.341
a ₃ path: Past-month cannabis use (X) × Sex (W) → Difficulties in engaging in goal-directed behavior DERS subscore (M)	-0.664	0.263	-2.527	0.011	-1.180	-0.149
b ₁ path: Difficulties in engaging in goal-directed behavior DERS subscore (M) → DASS-21 score (Y)	3.220	0.087	36.614	<0.001	3.047	3.392
c' path: Past-month cannabis use (X) → DASS-21 score (Y)	3.929	1.217	3.227	0.0013	1.542	6.315
Conditional indirect effect (women)	2.930	1.113	-	-	0.771	5.122
Conditional indirect effect (men)	-1.351	1.129	-	-	-3.539	0.834
Index of moderated mediation	-4.281	1.589	-	-	-7.458	-1.239
Model 5. Lack of emotional clarity DERS subscore (M)						
a ₁ path: Past-month cannabis use (X) → Lack of emotional clarity DERS subscore (M)	0.472	0.205	2.304	0.021	0.070	0.874
a ₂ path: Sex (W) → Lack of emotional clarity DERS subscore (M)	-0.428	0.072	-5.896	<0.001	-0.571	-0.286
a ₃ path: Past-month cannabis use (X) × Sex (W) → Lack of emotional clarity DERS subscore (M)	-0.296	0.205	-1.444	0.148	-0.698	0.106
b ₁ path: Lack of emotional clarity DERS subscore (M) → DASS-21 score (Y)	3.766	0.117	32.078	<0.001	3.536	3.997
c' path: Past-month cannabis use (X) → DASS-21 score (Y)	2.984	1.267	2.355	0.0186	0.499	5.468
Conditional indirect effect (women)	2.896	1.162	-	-	0.635	5.186
Conditional indirect effect (men)	0.664	1.192	-	-	-1.644	3.033
Index of moderated mediation	-2.232	1.677	-	-	-5.539	1.018
Model 6. Lack of emotional awareness DERS subscore (M)						
a ₁ path: Past-month cannabis use (X) → Lack of emotional awareness DERS subscore (M)	-0.125	0.230	-0.543	0.587	-0.577	0.327
a ₂ path: Sex (W) → Lack of emotional awareness DERS subscore (M)	-0.149	0.081	-1.829	0.067	-0.309	0.010
a ₃ path: Past-month cannabis use (X) × Sex (W) → Lack of emotional awareness DERS subscore (M)	-0.155	0.230	-0.675	0.499	-0.608	0.296
b ₁ path: Lack of emotional awareness DERS subscore (M) → DASS-21 score (Y)	1.886	0.118	15.987	<0.001	1.654	2.117
c' path: Past-month cannabis use (X) → DASS-21 score (Y)	4.721	1.419	3.325	0.0009	1.937	7.504
Conditional indirect effect (women)	0.057	0.608	-	-	-1.128	1.272
Conditional indirect effect (men)	-0.530	0.657	-	-	-1.847	0.738
Index of moderated mediation	-0.587	0.899	-	-	-2.409	1.111

Note. DERS = Difficulties in Emotion Regulation Scale; DASS-21 = Depression Anxiety Stress Scale-21.

^a = Unstandardized coefficients; ^b = Standard Error; ^c = Confidence Interval.

the total sample endorsing at-risk/cannabis use disorder (as of the CUDIT-R) were 15.1% (N = 48) and 19.8% (N = 63) respectively, which may have led to insufficient power to detect significant differences. A well-known effect of Δ-9-tetrahydrocannabinol (THC) pertains to its impact on the reduced dopamine synthesis (Bloomfield et al., 2016) and monoaminergic systems, leading to decreased serotonin activity (De Gregorio et al., 2020). In this vein, there are several studies suggesting a cannabis dose-dependent effect in that greater levels of emotional dysregulation, perceived stress, and severity of mental health symptoms are

associated to more frequent cannabis use and problems (Cavalli & Cvservenka, 2021; Manning et al., 2019), thus further supporting the relevance of looking at the link between cannabis use frequency and emotional symptoms.

Despite the above shortcomings, the present study adds to the literature in several ways. Our findings suggest that there may be sex specific pathways that influence the effect of cannabis use on mental health among young adults. From a clinical standpoint, sex should be considered as a fundamental variable when designing interventions for

cannabis use and mental health in young adults. Emotion regulation teaching based on The Gross model (Gross, 2015b, 2002) has proven to increase resistance against environmental unexpected pressures and drug use specifically in female adolescents (Shahbazirad and Azizi, 2018). This study also highlights the importance for policy makers of disseminating public health messages incorporating female sex as a potential risk factor for the co-occurrence of cannabis use and emotional problems. As a future prospect, we note the relevance of considering both sex and gender. There is nascent research on gender identity as a risk factor for cannabis use (Buttazzoni et al., 2021) and there is a need for more inquiry into examining the role and influence of different gender identities in cannabis-related problems.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. This study received funding from the Spanish Government Delegation for the National Plan on Drugs (ref. 2020I003).

Data availability

Data will be made available on request.

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