Quantifying cannabis problems among college students from English and Spanish speaking countries: Cross-cultural validation of the Cannabis Use Disorders Identification Test-Revised (CUDIT-R)

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ABSTRACT

Objective: The Cannabis Use Disorders Identification Test - Revised (CUDIT-R) is a broadly employed measure of cannabis-related problems. However, minimal research has tested the measurement invariance of the CUDIT-R among youths from different countries, hindering cross-national comparisons. Thus, the present study aimed to test the measurement invariance of the CUDIT-R between seven countries and gender groups, and provide different sources of reliability and validity evidence of the scale.
Methods: A sample of 4,712 college student lifetime cannabis users (mean age = 20.57, *SD* = 3.97; 70.4% females) from seven countries completed the CUDIT-R. Last 30-day cannabis users (n = 2402; mean age = 20.09, *SD* = 3.18; 67.7% females) additionally completed another measure of cannabis-related problems, and measures of cannabis frequency, quantity and motives.
Results: Multigroup analysis showed configural (equal number of factors and pattern of factor-indicator relationships), metric (equal factor loadings) and scalar (equal thresholds) invariance of the CUDIT-R across five countries and across gender in the sample of lifetime cannabis users. Cronbach's alphas and ordinal omegas ranked from .72 and .85. Large correlations were found between the CUDIT-R and another cannabis-related problem scale. Small to large associations were found between the CUDIT-R and other criterion variables (frequency and quantity of consumption and cannabis-related motives) providing convergent and discriminant validity evidence. Only a few differences in the magnitude of the correlations across countries were found.
Conclusions: The results suggest that the CUDIT-R is a suitable measure to assess cannabis-related problems among college student from the U.S., Canada, South Africa, Spain, and Argentina and across gender groups.

1. Introduction

Cannabis is one of the most commonly used drugs worldwide (United Nations Office on Drugs and Crime, 2020) and young adults report some of the highest past-year rates of cannabis use. For example, data from South America indicates that around 14% of young adults in Argentina and 18% in Uruguay reported past-year cannabis use (Inter-American Drug Abuse Control Commission [CICAD], 2019). In Europe, 19.1% of young adults in Spain and 13.4% in the United Kingdom (UK) consumed cannabis during the last year (European Monitoring Centre for Drugs

and Drug Addiction, 2021). Reports from North America show higher 12-month cannabis use prevalence indices. Studies from Canada show past 12-month cannabis use prevalence of 44% in young adults aged 16–19, 52% aged 20–24, and 24% aged 25 years or older (Government of Canada Canadian Cannabis Survey, 2020). While in the U.S., the prevalence was 27% in young adults aged 18–34 (CICAD, 2019).

Among young adults, college students are a specific high-risk subgroup. For example, annual prevalence of cannabis use is at historic high among U.S. college students (43% in both 2018 and 2019) and daily cannabis consumption increased among U.S. university students in 2019 to 5.9% (Schulenberg, Johnston, O'Malley, Bachman, Miech, & Patrick, 2020). Furthermore, college students who engage in a high-intensity or high-frequency pattern of use, are at greater risk of experiencing negative consequences (Bravo, Pearson, Pilatti, & Mezquita, 2019), including addiction (i.e., meet criteria for dependence in the Diagnostic and Statistical Manual of Mental Disorders, 4th edition; Volkow, Baler, Compton, & Weiss, 2014). Therefore, it is necessary to develop assessment measures to screen for problematic cannabis consumption among college students in order to increase identification and treatment of at risk students (Schultz, Bassett, Messina, & Correia, 2019).

In a relevant review, among all potential instruments that assess cannabis-related problems, the Cannabis Use Disorders Identification Test (CUDIT) was selected as one of the most appropriate instruments for use in general population surveys because is simple and easy to understand, is brief and available in a public domain, encompasses a broad spectrum of cannabis-related problems and has been validated in general population samples and in samples of adolescents and young adults (Annaheim & Legleye, 2017). The CUDIT was developed by Adamson and Sellman (2003) based on the Alcohol Use Disorders Identification Test (Saunders, Aasland, Babor, De la Fuente, & Grant, 1993) in a cannabis-using alcohol-dependent sample ($n = 53$). The questionnaire was later revised and improved (CUDIT-R; Adamson et al., 2010) using a higher sample size of clinical patients ($n = 144$). The most updated version of the CUDIT-R suggests a one-factor solution composed of 8 items, assessing: consumption (e.g., frequency of use), cannabis problems (e.g., injured as a result of your cannabis use), physical dependence (e.g., need to use cannabis in the morning to get yourself going after a heavy session), and psychological features (e.g., had a problem with your memory or concentration after using cannabis). Scores can range from 0 to 32, with a cut-off score of 13 indicative of a probable DSM-IV diagnosis of CUD (dependence) (Adamson et al., 2010). Compared with the CUDIT (original 10-items version), the CUDIT-R (revised and shortened to 8 items) has shown equivalent internal consistency ($\alpha = 0.91$), improved discriminant validity (area under the ROC curve of 0.96; criterion was cannabis use diagnosis using the SCID-III-R Patient Version; Spitzer, Williams, Gibbon, & First, 1988); and an improved test–retest reliability index ($r = 0.87$).

To our knowledge, only two recent studies have provided validity and reliability evidence of the CUDIT-R scores among college students. Schultz et al. (2019), in a sample of 229 undergraduates from the U.S. who reported past 30-day cannabis consumption, found good internal consistency of the questionnaire ($\alpha = 0.83$) and concurrent validity with cannabis related outcomes. They also found that a cut-off of six was adequate to differentiate between college students with and without problematic cannabis use. Risi, Sokolovsky, White, and Jackson (2020), in a sample of 1,390 undergraduates from the U.S., found a one-factor structure for the CUDIT-R and configural and metric invariance across gender.

Despite high rates of cannabis use globally, minimal research has examined the evidence of validity and reliability of the CUDIT-R among college students outside the U.S. Moreover, minimal research has tested the measurement invariance of the CUDIT-R across countries, hindering cross-national comparisons. This is especially relevant among nations with different cannabis consumption policies (e.g., regulatory policies of recreational/medical use), as differing use patterns may lead to differences in cannabis use problems experienced.

1.1. Purpose of the present study

The aims of the present research were to: 1) test the factor structure and provide reliability evidence of the CUDIT-R scores among college student marijuana users (i.e., endorsed lifetime marijuana use) from seven different countries, 2) test for measurement invariance of the scale between country samples and gender groups, 3) provide convergent validity evidence of the CUDIT-R by relating its scores with another measure of negative-related consequences (i.e., B-MACQ, Simons, Dvorak, Merrill, & Read, 2012), 4) provide criterion validity-related evidence of the CUDIT-R by relating its scores with frequency and quantity of cannabis use measures and cannabis motives, and 5) explore if these associations are similar in strength among countries.

2. Method

2.1. Participants and procedures

Participants were college students recruited to participate in an online survey from 7 countries (U.S., Argentina, Spain, Uruguay, England, and South Africa) between February 2019 and March 2020 (see Bravo et al., 2021 for a detailed description of the sample). In the present study, participants that reported consuming cannabis at least once in their lifetime and completed the CUDIT-R (N = 4712) were included in the psychometric analyses. Analyses examining correlations between the CUDIT-R and non-CUDIT-R measures were limited to 2402 students that reported cannabis consumption during the last 30 days (see Table 1 for demographics in the whole sample and across countries).

For the U.S., Canadian, England, and South African sites, students were recruited from psychology department pools and received research participation credits. In Argentina and Uruguay, students were recruited through online social networks, e-mail listings and flyers (only in Argentina), and those who completed the survey were entered into a raffle for prizes. In Spain an email was sent to all the students of the university inviting them to participate in the research. The participants received 5 euros for completing the survey. Study procedures were approved by the institutional review boards at the participating universities.

2.2. Measures

Only students who endorsed past 30-day use of marijuana (51% of total sample; see Table 1 for rates across countries) were administered non CUDIT-R measures. Invariance testing of all non-CUDIT-R measures demonstrated metric invariance across the countries, which is necessary when examining associations between study constructs across different groups (analyses available upon request).

2.2.1. Cannabis Use Disorders Identification Test-Revised (CUDIT-R)

Cannabis misuse was assessed using the CUDIT-R (Adamson et al., 2010). In Argentina, Spain, and Uruguay, we used a version translated into Spanish. The translation was performed by two Spanish-speaking psychologists proficient in English and Spanish and with expertise in test adaptation and addictive behaviors. Once the first drafts of the scale were performed in Castilian Spanish and Argentinian Spanish; the two versions were compared and only minor differences were kept across both Spanish versions (e.g., "conducir" in Castilian vs "manejar" in Argentinian, both terms that mean "drive") to facilitate the understanding of the scale in each cultural context (see Appendix). For both the Spanish and English versions, items 1 to 7 use a 5-point Likert scale that ranks from 0 to 4, while item 8 uses a 3-point Likert scale (scored 0, 2, and 4). In the present study, a total score was obtained by summing scores on each of the 8 items (range = 0–32).

2.2.2. Brief Marijuana Consequences Questionnaire (B-MACQ)

Past 30-day cannabis-related problems were assessed using the 21-

Table 1
General demographics, Cronbach's alphas and ordinal omegas (lifetime cannabis users / past month cannabis users).

	Total		U.S.		Canada		South Africa		Spain		Argentina		Uruguay		England	
	Lifetime	Past Month	Lifetime	Past Month	Lifetime	Past Month	Lifetime	Past Month	Lifetime	Past Month	Lifetime	Past Month	Lifetime	Past Month	Lifetime	Past Month
Sample size	4712	2402	2238	1292	751	377	472	215	392	113	580	299	104	46	175	60
Age (Mean, SD)	20.57 (3.97)	20.09 (3.18)	19.85 (3.47)	19.46 (2.63)	20.30 (4.40)	19.94 (3.51)	20.51 (2.39)	20.22 (1.84)	21.18 (3.11)	20.92 (3.80)	22.64 (4.66)	22.19 (3.89)	26.05 (5.92)	24.35 (4.24)	19.51 (4.11)	18.87 (1.36)
% past 30-day users	51.0	–	57.7	–	50.2	–	45.6	–	28.8	–	51.6	–	44.2	–	34.3	–
Gender																
% Males	28.9	31.6	31.5	32.8	31.3	34.7	19.3	21.4	32.4	38.9	25.7	29.1	14.4	17.4	22.8	30
% Females	70.4	67.7	68.0	66.6	67.2	63.1	79.2	77.7	67.3	61.1	74.0	70.6	85.6	82.6	76.6	70
% Other/Missing	0.7	0.8	0.5	0.6	1.5	2.1	1.5	0.9	0.3	0	0.3	0.3	0	0	0.6	0
Education* (% of sample)																
First Year (Freshman)	—	—	51.0	55.1	63.8	65	33.5	36.7	25.3	27.4	29.7	29.1	12.5	8.7	97.1	98.3
Second Year (Sophomore)	—	—	23.9	22.4	22.9	22.8	27.1	31.6	35.2	39.8	24.0	23.4	18.3	28.3	1.7	1.7
Third Year (Junior)	—	—	15.4	14.9	8.1	8	28.0	20.5	15.3	19.5	16.7	15.1	30.8	26.1	0.6	0
Four Year (Senior)	—	—	9.2	7.3	2.8	2.1	9.3	8.8	15.1	9.7	12.4	13.7	21.1	26.1	—	—
Fifth/Sixth/Seventh Year	—	—	——	—	1.6	1.3	1.7	1.9	3.0	1.8	9.1	10.7	—	—	—	—
Other or Missing	—	—	0.5	0.4	0.8	0.8	0.4	0.5	6.1	1.8	8.1	8	17.3	10.9	0.6	0
α [95%CI]	0.817 [0.809 0.825]	0.814 [0.803 0.825]	0.823 [0.811 0.834]	0.822 [0.807 0.837]	0.824 [0.804 0.843]	0.816 [0.786 0.843]	0.829 [0.804 0.852]	0.834 [0.797 0.866]	0.789 [0.756 0.819]	0.806 [0.746 0.856]	0.773 [0.744 0.800]	0.767 [0.724 0.805]	0.815 [0.757 0.865]	0.773 [0.659 0.860]	0.724 [0.658 0.782]	0.766 [0.665 0.846]
Ω [95%CI]	0.819 [0.810 0.828]	0.820 [0.809 0.831]	0.822 [0.807 0.833]	0.826 [0.810 0.840]	0.827 [0.801 0.848]	0.827 [0.796 0.851]	0.842 [0.817 0.863]	0.844 [0.815 0.868]	0.780 [0.731 0.819]	0.800 [0.738 0.842]	0.788 [0.755 0.817]	0.783 [0.738 0.817]	0.848 [0.784 0.888]	0.808 [0.703 0.872]	0.748 [0.622 0.813]	0.792 [0.666 0.858]

Note. *Education was assessed differently for each country. Lifetime = total sample of students that endorsed cannabis use at least once in their lifetime. Past Month = subsample of students that endorsed past month cannabis use.

item B-MACQ (Simons et al., 2012) and its Spanish version for students in Argentina, Spain, and Uruguay (Bravo et al., 2019). We summed all items to create a cannabis-related problems composite score reflective of the number of distinct problems experienced in the past 30 days. Cronbach's alpha in the present study was 0.88 for the whole sample, and ranged from 0.75 to 0.89 across countries.

2.2.3. Cannabis frequency and quantity

Past 30-day typical cannabis use frequency and quantity were assessed using the Marijuana Use Grid (MUG; Pearson & Marijuana Outcomes Study Team, 2021). The measure was translated into Spanish for students in Argentina, Spain, and Uruguay. Specifically, each day of the week was broken down into six 4-hour blocks of time (12a-4a, 4a-8a, etc.), and participants were asked to report at which times they used cannabis during a "typical week" in the past 30 days as well as the quantity of grams consumed during that time block. We calculated typical frequency of cannabis use by summing the total number of time blocks for which they reported using during the typical week (ranges: 0–42). We calculated typical quantity of cannabis use by summing the total number of grams consumed across time blocks (quantity estimates > 3SDs above the mean were Winsorized).

2.2.4. Marijuana Motives Measure Short Form (MMM-SF)

Past 30-day cannabis motives were measured using the English (Simons, Correia, Carey, & Borsari, 1998) and the Spanish version of the MMM-SF (Mezquita, Ruiz-Valero, Martínez-Gómez, Ibáñez, & Ortet, 2018). The MMM-SF has 15 items that are answered on a 5-point response scale from 1 (*almost never/never*) to 5 (*almost always/always*). The Cronbach's alpha in the whole sample were 0.89 for social, 0.83 for enhancement, 0.88 for coping, 0.86 for conformity and 0.91 for expansion. Across countries the Cronbach's alphas ranged from 0.74 to 0.92.

2.3. Statistical analyses

To examine the internal structure of the CUDIT-R across sites, we conducted confirmatory factor analyses (CFA) using a diagonally weighted least squares (WLSMV) estimator in *Mplus* 8.4 (Muthén & Muthén, 1998–2019) among lifetime cannabis users. To evaluate overall model fit, we used the Comparative Fit Index (CFI) > 0.90 (acceptable) > 0.95 (optimal), Tucker-Lewis Index (TLI) > 0.90 (acceptable) > 0.95 (optimal), Root Mean Square Error of Approximation (RMSEA) < 0.06 (Marsh, Hau, & Wen, 2004). To examine the internal consistency of the CUDIT-R, we estimated Cronbach's alphas and ordinal omegas with 95% CIs (Dunn, Baguley, & Brunsden, 2014).

To determine the configural, metric and scalar invariance of the CUDIT-R across countries and gender groups, we conducted multi-group confirmatory factor analyses (MG-CFA). We used model comparison criteria of $\Delta CFI / \Delta TFI \geq 0.01$ (Cheung & Rensvold, 2002) and $\Delta RMSEA \geq 0.015$ (Chen, 2007) to indicate significant decrement in fit when testing for measurement invariance. Evidence of convergent and criterion validity was examined by correlating the total CUDIT-R score with the B-MACQ and cannabis outcomes scores (frequency, quantity and motives), respectively.

To explore the differences in the magnitude of the correlations across countries, the absolute value of the differences in the magnitude of the correlations for pairs of countries were computed in the sample of last 30-day cannabis users. As the statistical tests of these differences can be oversensitive to small differences when including differences in sample sizes across countries, attention was paid to the magnitude of these differences. As done in previous studies (Bravo et al., 2019), we considered differences < 1 SD small, differences between 1 SD and 2 SD medium, those between 2 SD and 3 SD large, and any over 3 SD were considered substantial.

3. Results

3.1. Structure validity and invariance evidence

When the one-factor CFA was performed with the whole sample of lifetime cannabis users (Model 1) and in each country separately (Models 2 to 8) the fit indices were optimal (see Table 2). For the MG-CFA across countries, data of England and Uruguay could not be included due to no endorsement of several items, probably due to their low sample size ($n = 175$ and $n = 104$, respectively). The MG-CFA with the five countries (Model 11) showed optimal fit indices and minimal changes in the CFI, TLI, RMSEA when the constraints across loadings (Model 12) and thresholds (Model 13) were included suggesting metric and scalar invariance across sites.

Fit indices for males (Model 9) and females (Model 10), and for the MG-CFA across gender groups (Model 14) were also optimal, and the changes in CFI, TLI, RMSEA when the constraints were added also suggested metric (Model 15) and scalar (Model 16) invariance across groups. As scalar invariance was met, differences in the CUDIT-R total score across groups were explored. After controlling for age and gender effects in the ANCOVA, we found significant differences across countries in the CUDIT-R total score, $F(4) = 15.8$, $p < .001$, $\eta^2 = 0.01$ (U.S., $M = 5.72$, SD = 5.75; South Africa, $M = 5.61$, SD = 5.59; Canada, $M = 5.12$, SD = 5.42; Argentina, $M = 4.94$, SD = 4.79; and Spain $M = 3.45$, SD = 4.63). Post-hoc analysis showed that the differences were significant between Spain and the rest of the countries ($p < .001$), and between Argentina and U.S. ($p < .05$). Differences in the CUDIT-R total score between males ($M = 6.49$, SD = 6.10) and females ($M = 4.81$, SD = 5.16) were also significant ($p < .001$) after controlling the age effect, $F(1) = 86.1$, $p < .001$, $\eta^2 = 0.02$.

It is important to note, that measurement invariance test across countries and gender groups were also conducted among the subsample of students that consumed cannabis in the past 30-days and results were consistent with those of the larger analytic sample (see Supplementary Material).

3.2. Sources of reliability evidence

The Cronbach's alphas and ordinal omegas are presented in Table 1. Values ranged from 0.72 to 0.85 across countries and were 0.82 in the whole sample.

3.3. Sources of convergent and criterion validity evidence

The correlations between the CUDIT-R, the B-MACQ and the criterion variables are presented in Table 3. The correlations between the CUDIT-R with the B-MACQ were large; while correlations with quantity and frequency of cannabis use were small to moderate. Correlations with cannabis motives were from moderate to large across groups (Cohen, 1992). When partial correlations between the CUDIT-R and cannabis motives were performed (i.e., controlling for the effect of the other motives) the results showed that the CUDIT-R was mainly related to the internal cannabis motives (i.e., coping, expansion and enhancement).

When the absolute value of the correlations was compared between pairs of groups, the average difference in correlations was 0.077 (SD = 0.064) across 143 possible comparisons. Thus, differences < 0.141 were considered small, differences between 0.141 and 0.205 were considered medium, those between 0.206 and 0.269 were considered large, and any over 0.270 were considered substantial. The correlation differences between the CUDIT-R and the rest of the criterion variables are presented in Table 4. We found large differences in the correlation of the CUDIT-R with cannabis quantity between the Argentinian sample and the sample from South Africa and Spain (Arg < SA, SP). The correlations between conformity motives and the CUDIT-R were higher in Spain than in Canada, South Africa and Argentina. Specifically, large and substantial differences were found between the CUDIT-R and conformity

Table 2
Model fit and measurement invariance testing results of the CUDIT-R across countries and gender.

Lifetime cannabis users	Model		χ^2_{S-B} (df)	CFI	TLI	RMSEA	90%CI	SRMR	Ref	ΔCFI	ΔTLI	ΔRMSEA
1-factor model	1	Whole sample	547.780(20)**	0.985	0.978	0.075	0.069 0.080	0.030	–	–	–	–
	2	U.S.	337.198(20)**	0.982	0.975	0.084	0.076 0.092	0.034	–	–	–	–
	3	Canada	68.186(20)**	0.993	0.991	0.057	0.042 0.072	0.028	–	–	–	–
	4	South Africa	61.331(20)**	0.992	0.989	0.066	0.048 0.085	0.032	–	–	–	–
	5	Spain	24.604(20)	0.998	0.998	0.024	0.000 0.052	0.022	–	–	–	–
	6	Argentina	88.465(20)**	0.983	0.976	0.077	0.061 0.094	0.041	–	–	–	–
	7	Uruguay	39.977(20)*	0.985	0.979	0.098	0.052 0.142	0.053	–	–	–	–
	8	England	23.161(20)	0.997	0.996	0.030	0.000 0.074	0.067	–	–	–	–
	9	Males	203.152(20)**	0.986	0.980	0.082	0.072 0.092	0.032	–	–	–	–
	10	Females	368.185(20)**	0.982	0.975	0.072	0.066 0.079	0.031	–	–	–	–
Invariance testing across countries†	11	Configural	556.501(100)**	0.988	0.983	0.072	0.066 0.078	0.033	–	–	–	–
	12	Metric	763.048(128)**	0.983	0.982	0.075	0.070 0.080	0.038	M11	-0.005	-0.001	0.003
	13	Scalar	745.162(212)**	0.986	0.991	0.053	0.049 0.057	0.041	M12	0.003	0.009	-0.022
Invariance testing across gender	14	Configural	571.255(40)**	0.984	0.977	0.075	0.070 0.081	0.031	–	–	–	–
	15	Metric	604.705(47)**	0.983	0.980	0.071	0.066 0.076	0.032	M14	-0.001	0.003	-0.004
	16	Scalar	494.317(68)**	0.987	0.989	0.052	0.048 0.056	0.033	M15	0.004	0.009	-0.019

†Only includes students from U.S., Canada, South Africa, Spain and Argentina.
**$p < 0.001$; *$p < 0.01$

motives in South Africa and Argentina compared with Spain respectively. When the effect of the rest of motives was controlled for, large correlation differences in conformity motives between Spain and Canada were found, and substantial correlation differences in Spain compared with South Africa and Argentina were shown.

4. Discussion

The CUDIT-R (Adamson et al., 2010) is one of the most widely used measures to assess and detect problematic cannabis use (Annaheim & Legleye, 2017). However, limited research has tested the measurement invariance of the questionnaire across different countries. Thus, a main aim of the present research was to test the measurement invariance of the CUDIT-R among college students from seven countries. The results showed that the measure was invariant at different levels (i.e., configural, metric and scalar) among the U.S., Canada, Argentina, Spain, and South African samples suggesting that the CUDIT-R is a suitable measure to compare cannabis-related problems among students from these five countries. Due to their low item endorsement, it was not possible to the test the invariance of the questionnaire in Uruguay and England. Future studies with a higher sample size of students from these two countries are required.

In addition, measurement invariance of the questionnaire across males and females was explored. A previous study performed with a large sample of undergraduates from the U.S. found configural and metric invariance of the measure across gender groups (Risi et al., 2020). Our results extend previous findings, showing that the structure (i.e., configural invariance), the factor loadings (i.e., metric invariance) and the thresholds (i.e., scalar invariance) were similar across a sample of males and females from different nationalities and languages. Scalar invariance of the questionnaire across groups is relevant, as differences in the CUDIT-R scores across countries and gender groups can be

interpreted as differences in problematic cannabis use, rather than merely artifacts of other processes, such as the interpretation of items (Risi et al., 2020). To this end, when mean comparisons of the CUDIT-R total score were examined, as it is usually found, males showed higher problematic cannabis use than females (McCabe et al., 2006). We also found lower problematic cannabis use in the Spain and Argentina than in U.S., and also in Spain compared with the rest of the countries. These differences could be related to cannabis polices, as lower rates of CUDIT-R were found in countries in which the access to cannabis is more difficult (particularly Spain).

The present research also provided reliability evidence of the CUDIT-R scores, showing that both Cronbach's alphas and ordinal omegas were higher than the standard cut-off of 0.70, and similar to those found in previous studies that have explored the unidimensional structure of the questionnaire (Schultz et al., 2019). Convergent validity evidence was also provided in five countries, as the CUDIT-R showed large correlations in magnitude with the B-MACQ. The magnitude of these associations was similar to that found in previous studies with undergraduates from the U.S. (Risi et al., 2020), suggesting that the Spanish version provided similar convergent validity evidence with the B-MACQ as the English version.

Finally, criterion validity evidence of the CUDIT-R scores was provided using different measures of cannabis consumption and cannabis-related motives. As expected, CUDIT-R scores positively correlated to cannabis frequency and quantity across the five countries and gender groups (Bresin & Mekawi, 2019). Although the correlations with quantity were positive and significant across all countries, the magnitude of this correlation was lower in Argentina than in the remaining countries. This result is somewhat different to past research comprising Argentinean college students in which higher correlations between cannabis quantity and cannabis-related problems have been found (Pilatti & Bravo, 2021). Thus, more studies are needed to better clarify

Table 3
Correlations between the CUDIT-R and the criterion variables among past month cannabis users.

	Whole sample		Males		Females		U.S.		Canada (CN)		South Africa (SA)		Spain (SP)		Argentina (ARG)	
	N	r	N	r	N	r	N	r	N	r	N	r	N	r	N	r
B-MACQ	2402	0.771***	758	0.763***	1625	0.766***	1292	0.760***	377	0.776***	215	0.833***	113	0.723***	299	0.793***
Frequency	2112	0.554***	678	0.448***	1417	0.597***	1119	0.560***	333	0.536***	195	0.649***	96	0.457***	277	0.516***
Quantity	2112	0.409***	678	0.348***	1417	0.427***	1119	0.418***	333	0.389***	195	0.493***	96	0.472***	277	0.235***
Social	2400	0.264***	757	0.199***	1624	0.273***	1290	0.258***	377	0.201***	215	0.249***	113	0.345***	299	0.391***
Coping	2402	0.488***	758	0.450***	1625	0.520***	1292	0.480***	377	0.493***	215	0.477***	113	0.534***	299	0.499***
Enhancement	2402	0.350***	758	0.305***	1625	0.354***	1292	0.343***	377	0.327***	215	0.360***	113	0.467***	299	0.361***
Conformity	2399	0.139***	756	0.183***	1624	0.095***	1289	0.159***	377	0.145**	215	0.097	113	0.312***	299	0.034
Expansion	2401	0.425***	757	0.322***	1625	0.458***	1291	0.408***	377	0.398***	215	0.500***	113	0.480***	299	0.485***
Social^P	2398	-0.021	755	-0.048	1624	-0.020	1288	-0.048	377	-0.036	215	-0.022	113	0.067	299	0.127*
Coping^P	2398	.331***	755	0.332***	1624	0.348***	1288	0.324***	377	0.352***	215	0.273***	113	0.388***	299	0.344***
Enhancement^P	2398	0.146***	755	0.164***	1624	0.126***	1288	.160***	377	0.141***	215	0.138*	113	0.150	299	0.054
Conformity^P	2398	0.017	755	0.069	1624	-0.026	1288	0.046	377	0.026	215	-0.039	113	0.239*	299	-0.093
Expansion^P	2398	0.213***	755	0.135***	1624	0.236***	1288	0.195***	377	0.210***	215	0.284***	113	0.188	299	0.266***

Note. ^{P} indicates that the correlation was partial, controlling for the rest of cannabis motives. According to Cohen (1992), a correlation coefficient of 0.10 is thought to represent a weak or small association; a correlation coefficient of 0.30 is considered a moderate correlation; and a correlation coefficient of 0.50 or larger is thought to represent a strong or large correlation.
***$p < 0.001$; **$p < 0.01$; *$p < 0.05$.

the magnitude and differences of these associations.

Among motives, all five cannabis motives (apart from conformity motives in Argentina and South Africa) were associated with the CUDIT-R scores across groups, as found in recent *meta*-analysis (Bresin & Mekawi, 2019). In the same vein, when the rest of the motives were controlled for, the CUDIT-R was mainly related to coping motives across countries and gender groups. Lower but significant associations between the CUDIT-R scores and enhancement and expansion motives were also found. Our findings and previous research performed with college students (i.e., Patterson, Vu, Haardörfer, Windle, & Berg, 2020) suggest that internal cannabis motives are indicators of risk. The only exception was found in the sample of Spanish youths, in which the correlation between the CUDIT-R scores and conformity motives remained significant even when accounting for other motives. Consequently, substantial differences in the magnitude of the correlations between the CUDIT-R scores and conformity motives in Spain compared with South Africa and Argentina arose. The higher correlation between the conformity motives and cannabis-related problems in Spain could be due to differences in cannabis policies across sites. For example, in Spain buying, selling, and the use of cannabis in public places is illegal, however, there are "cannabis social clubs (CSC)" in which the "private" sale and consumptions is allowed from 18 or 21 years old depending on the club or the Spanish autonomous community (Decorte et al., 2017). Thus, in this particular context in which the cannabis use is allowed and shared with peers, it is possible that youths have lower self-efficacy to reject consumption (i.e., higher conformity motives) which in turn could be related to higher problems with cannabis. Nonetheless, further research is needed to better clarify the association between conformity motives and the CUDIT-R in Spanish youths.

The present study has a number of limitations. The relatively low number of participants from Uruguay and England impeded testing the invariance of the CUDIT-R's scores in these samples. Moreover, our convenience sampling procedures impedes generalizing our findings. Sample size and the gender distribution were different across countries which, alongside the online data collection, may have introduced unwanted bias. Another limitation is that we did not provide cut-off scores for detecting problematic use or cannabis-related disorders (i.e., sensitivity and specificity).

Despite these limitations, the present research offers encouraging evidence of the psychometric properties of the CUDIT-R scores in college student cannabis users from five countries and across gender groups. Overall, these results suggest that the CUDIT-R could be efficiently used to identify English or Spanish-speaking college students with problematic cannabis use, who would benefit from interventions aimed at reducing cannabis use and its negative consequences.

Role of Funding Sources

CRediT authorship contribution statement

Laura Mezquita: Conceptualization, Formal analysis, Funding acquisition, Writing – original draft, Writing – review & editing. **Adrian**

Table 4
Absolute value of the correlation differences across countries and gender groups between the CUDIT-R and the criterion variables among subsample of past month cannabis users.

	Males - Female	U.S. - CN	U.S. - SA	U.S. - SP	U.S. -ARG	CN - SA	CN-SP	CN-ARG	SA-SP	SA-ARG	SP-ARG
B-MACQ	0.003	0.016	0.073	0.037	0.033	0.057	0.053	0.017	0.110	0.040	0.070
Frequency	*0.149*	0.024	0.089	0.103	0.044	0.113	0.079	0.020	*0.192*	0.133	0.059
Quantity	0.079	0.029	0.075	0.054	*0.183*	0.104	0.083	*0.154*	0.021	**0.258**	**0.237**
Social	0.074	0.057	0.009	0.087	0.133	0.048	*0.144*	*0.190*	0.096	*0.142*	0.046
Coping	0.070	0.013	0.003	0.054	0.019	0.016	0.041	0.006	0.057	0.022	0.035
Enhancement	0.049	0.016	0.017	0.124	0.018	0.033	0.140	0.034	0.107	0.001	0.106
Conformity	0.088	0.014	0.062	*0.153*	0.125	0.048	*0.167*	0.111	**0.215**	0.063	**0.278**
Expansion	0.136	0.010	0.092	0.072	0.077	0.102	0.082	0.087	0.020	0.015	0.005
Social[p]	0.028	0.012	0.026	0.115	*0.175*	0.014	0.103	*0.163*	0.089	*0.149*	0.060
Coping[p]	0.016	0.028	0.051	0.064	0.020	0.079	0.036	0.008	0.115	0.071	0.044
Enhancement[p]	0.038	0.019	0.022	0.010	0.106	0.003	0.009	0.087	0.012	0.084	0.096
Conformity[p]	0.095	0.020	0.085	*0.193*	0.139	0.065	**0.213**	0.119	**0.278**	0.054	**0.332**
Expansion[p]	0.101	0.015	0.089	0.007	0.071	0.074	0.022	0.056	0.096	0.018	0.078

Note. [p] indicates that the correlation was partial, controlling for the rest of cannabis motives. Medium correlation differences are shown in italics, large differences are in bold, and substantial differences are in bold and underlined.

J. Bravo: Data curation, Project administration, Funding acquisition, Writing – original draft, Writing – review & editing. **Angelina Pilatti:** Funding acquisition, Writing – original draft, Writing – review & editing. **Generós Ortet:** Funding acquisition, Writing – original draft, Writing – review & editing. **Manuel I. Ibáñez:** Funding acquisition, Writing – review & editing.

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.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.addbeh.2021.107209.

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