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A discriminant analysis model of psychosocial predictors of problematic Internet use and cannabis use disorder in university students

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ABSTRACT

Researchers have found similarities and differences between behavioral and drug addictions. The present study was designed to explore which of a series of psychosocial predictors of addictive behaviors could differentiate problematic Internet use (PIU) and Cannabis Use Disorder (CUD) in a sample of University students. A total of 144 participants (76 males, mean age = 23.03 years ± 2.83) were separated into three groups: those presenting with PIU (18 females, Mean age = 22.27 years), those presenting with CUD (22 female, Mean age = 22.73 years), and a control group (28 female, Mean age = 24.04 years). Participants completed the Internet Abusive Use Questionnaire (IAUQ), the Severity of Dependence Scale (SDS), the Multidimensional Scale of Perceived Social Support (MSPSS), the Barratt Impulsiveness Scale-11 (BIS-11), the Multidimensional Distress Tolerance Scale (MDTS), the Emotion Regulation Questionnaire (ERQ), the Metacognitions Questionnaire-30 (MCQ-30), and the Repetitive Thinking Questionnaire-10 (RTQ-10). The classification analysis results showed that 68.8% of the control group, 70.8% of the PIU group, and 81.3% of the CUD group were correctly classified in their respective groups. In addition, the results of the discriminant function analysis showed that there was a significant difference between members of the PIU and CUD groups in the degree of family support (0.45), significant other (0.33), tolerance of physical discomfort (0.30), reappraisal (0.42), and cognitive confidence (0.35). The findings provide evidence that specific psychosocial predictors can discriminate PIU from CUD.

1. Introduction

The phenomenon of non-chemical addictions, or 'behavioral addictions', was first introduced over thirty years ago (Marks, 1990) and the subsequent criteria to define and diagnose these different types of addictive behaviors have been highly controversial ever since (Kardefelt-Winther et al., 2017). Shaffer and Stimmel (2014) defined three core characteristics of an addictive behavior. The first is the presence of psycho-physiological responses when exposed to the environmental stimulus for that behavior. The second is the engagement in repetitive behavior despite its harmful consequences. The third is wanting to stop the behavior but being unable to do so. Common features of behavioral addictions suggest that these share similar features to drug addictions, but there are also noticeable differences. A key similarity is the emergence of a short-term reward that continues to intensify despite the negative consequences of engaging in the addictive behavior (Thege, Woodin, Hodgins, & Williams, 2015). Key dissimilarities include the dependence on a substance (Alavi et al., 2012) and the severity of symptoms (Thege et al., 2015) not attenuating as fast in drug addictions.

Several studies have also examined the differences in personality or psychopathology between behavioral addictions and drug addictions (Ko et al., 2006; Maremmani et al., 2018; Zilberman, Yadid, Efrati, Neumark, & Rassovsky, 2018). Ko and colleagues (2006), for example, showed that novelty seeking, harm avoidance, and reward dependence predicted addictive behaviors generally. Maremmani and colleagues (2018) found higher general psychopathology in people with heroin use disorder than people with gambling disorder. Zilberman and colleagues (2018) reviewed the importance of personality in discriminating the type of addictive behavior. The personality profile of individuals with alcohol use disorder showed lower extraversion and openness to experience, and the personality profile of individuals with gambling disorder showed higher impulsivity and neuroticism (Zilberman et al., 2018).

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The similarities and differences between behavioral and drug addictions remain a contentious matter. In the current study, and using a discriminant analysis model, we aimed to determine whether certain psychosocial factors could differentiate problematic Internet use (PIU) and Cannabis Use Disorder (CUD) in University students. We chose PIU and CUD as 'representatives' of behavioral and drug addictions, respectively. The prevalence of PIU is between 9% and 11% (Moreno, Eickhoff, Zhao, Young, & Cox, 2019) and it can cause significant problems in the lives of University students (Costa, Patrão, & Machado, 2019; Meda et al., 2017; Pearson, Hustad, Neighbors, Conner, & Bravo, 2018; Troup, Andrzejewski, Braunwalder, & Torrence, 2016). The prevalence of CUD is 4.4% among those aged 18–29 years, according to the Diagnostic and Statistical Manual of Mental Disorders, 5th Edition (DSM-5; American Psychiatric Association, 2013), making it the most prevalent illicit/non-medical drug disorder in University students. In a study conducted in Iran on 4261 university students, the prevalence of PIU was estimated at 27.3% (Poorolajal et al., 2019). Furthermore, many studies have shown the relationship between insomnia (Shadzi, Salehi, & Vardanjani, 2020), impulse control disorders (Mazhari, 2012), poor general health (Poorolajal et al., 2019), anxiety (Hashemi et al., 2020), and PIU among the Iranian population. In a *meta*-analysis, the prevalence of CUD among Iranian college students was 2%–3% (Nazarzadeh et al., 2015). Also, a negative correlation has been observed between Iranian college students' level of quality of life, sleep quality (Kushkestani, Parvani, Ebrahimpour Nosrani, & Bathaeezadeh, 2020), and CUD, and a positive correlation with depression, anxiety (Noori et al., 2015), and CUD. What follows is a brief review of research data on both PIU and CUD and several key psychosocial factors (social support, impulsiveness, distress tolerance, emotion regulation, metacognitions, and repetitive negative thinking) which have been found to predict these addictive behaviors.

1.1. PIU and CUD

Internet users have grown by 1,266% to 5 billion people over the last 20 years Internet World Stats (2020). However, with all its undeniable uses and benefits, the Internet can have many destructive psychological and social effects for its users (Elhai, Dvorak, Levine, & Hall, 2017). such as PIU (Davis, Flett, & Besser, 2002; Spada, 2014), Internet dependency (Tewildt, 2011), pathological Internet use (Morahan-Martin & Schumacher, 2000), and compulsive computer use (Black, Belsare, & Schlosser, 1999) effectively describe the same phenomenon (Mihajlov & Vejmelka, 2017): excessive and possibly compulsive use of the Internet along with adverse consequences. Yau, Crowley, Mayes, and Potenza (2012) reviewed the clinical and biological characteristics of PIU and suggested that that it could be considered a behavioral addiction.

Cannabis is the most abused illicit drug (Centre, 2020) and about one out of every ten people who have used cannabis are likely to develop CUD (Copeland & Swift, 2009). Long-term marijuana use can cause memory impairment (Hall & Lynskey, 2016) and can significantly negatively impact on physical health (Feeney & Kampman, 2016). Furthermore, regular cannabis use is associated with structural and functional changes in the brain (Nader & Sanchez, 2018). A systematic review by Volkow et al. (2016) reported that cannabis use can affect people's behavior, causes learning and memory impairments, decreases motivation, and increases the risk for psychosis. In general, it can be said that frequent cannabis consumption can harm mental and physical health in various ways (Karila et al., 2014). Moreover, CUD has associations with anxiety and mood disorders, antisocial personality disorder, and conduct disorder (Agosti, Nunes, & Levin, 2002; Schoeler et al., 2018).

1.2. The role of social support in PIU and CUD

Social support refers to the resources provided to people by others (Cohen & Syme, 1985) and protects individuals from stress and negative emotions (Wood, Maltby, Gillett, Linley, & Joseph, 2008). Studies showed that when social resources are relatively scarce, some people choose the internet or cannabis use as a medium through which to meet their needs and gain social support, especially when they are required to reestablish social networks because of environmental changes (Carter et al., 2016; Yao & Zhong, 2014; Zhang et al., 2018). Perceived lack of social support has been found to be indirectly associated with PIU (Prievara, Piko, & Luszczynska, 2019) and, additionally, PIU has been found to be less common in those who perceive more social support (Gunuc & Dogan, 2013). Lack of social support has been found to increase the likelihood of CUD (2013b; van der Pol et al., 2013a). Cougle, McDermott, Hakes, and Joyner (2020), for example, highlight that cannabis dependence is associated with higher rates of personality disorders and lower social support. Patients who used cannabis more often also showed an absence of social support (Dorard, Bungener, Corcos, & Berthoz, 2013).

1.3. The role of impulsiveness in PIU and CUD

Evenden (1999) defined impulsiveness as the behavior that is performed with little or insufficient tact which often leads to adverse consequences. Impulsiveness is a predictor of PIU (Mottram & Fleming, 2009) and individuals with PIU, exhibited more trait impulsivity than control group (Choi et al., 2014). People with higher impulsiveness have higher levels of severity of Internet addiction symptoms (Evren, Dalbudak, Evren, & Ozen, 2019). A recent systematic review demonstrated a positive association between impulsiveness and Internet Gaming Disorder, which is one of the facets of PIU (Şalvarlı & Griffiths, 2019). Impulsiveness is also an important risk factor for CUD (Brewer & Potenza, 2008; Day, Metrik, Spillane, & Kahler, 2013; DeVito et al., 2020; VanderVeen, Hershberger, & Cyders, 2016; Verdejo-García, Lawrence, & Clark, 2008). Higher impulsiveness, with greater access to marijuana, for example, is related to CUD (Haas, Zamboanga, Bersamin, & Hyke, 2018).

1.4. The role of distress tolerance in PIU and CUD

Distress tolerance refers to a person's ability to tolerate negative emotions and unpleasant situations (Zvolensky, Vujanovic, Bernstein, & Leyro, 2010). Distress tolerance plays an important role in PIU. Akbari (2017b) showed that distress tolerance is a significant mediator of the relationship between emotional dysregulation and PIU. Distress tolerance is also associated with different aspects of cannabis use, such as withdrawal severity and coping-oriented use (Manning et al., 2018). There is evidence to suggest that cannabis use can cause more problems in people with low distress tolerance (Bujarski, Norberg, & Copeland, 2012). Buckner, Walukevich Dienst, and Zvolensky (2019) showed that low distress tolerance is associated with an increase in cannabis cravings.

1.5. The role of emotion regulation in PIU and CUD

Emotion regulation allows for the ability to moderate emotional experiences and to create appropriate responses to stressful and negative events (Gross & Muñoz, 1995). The development of emotion regulation skills has been found to be key in preventing Internet addiction (Karaer & Akdemir, 2019). Difficulties in emotion regulation have also been observed to be associated with PIU (Estévez, Jáuregui, Sánchez-Marcos, López-González, & Griffiths, 2017; Evren, Evren, Dalbudak, Topçu, & Kutlu, 2018; Spada & Marino, 2017). Difficulties in emotion regulation have also been connected to cannabis use (Allen, 2019). In several studies, emotion regulation plays a mediating role between marijuana use and other psychological phenomena. For example, it appears to mediate the relationship between post-traumatic stress and coping approaches related to marijuana use (Bonn-Miller, Vujanovic, Boden, & Gross, 2011).

1.6. The role of metacognitions in PIU and CUD

Metacognitions refer to higher order thinking that involves active control over one's cognitive processes and establishes the pattern of responses to one's thoughts (Wells & Matthews, 1996). Generally, metacognitions play a key role in choosing adaptive or maladaptive coping strategies when faced with unpleasant emotions (Spada, Nikčević, Moneta, & Wells, 2008). A recent systematic review has showed the central role that metacognitions play in the development and maintenance of both PIU (and other behavioral addictions), as well as drug addictions (e.g., alcohol use and nicotine use; Spada, Caselli, Nikčević, & Wells, 2015; Hamonniere & Varescon, 2018) including cannabis use (Brosnan, Kolubinski, & Spada, 2020).

1.7. The role of repetitive negative thinking in PIU and CUD

Repetitive negative thinking (RNT) refers to the style of thinking about one's problems or negative experiences that is repetitive, intrusive, and difficult from which to shift attention (Ehring et al., 2011). Research has shown that RNT levels are elevated across behavioral and drug addictions (Bravo, Sotelo, Pilatti, Mezquita, & Read, 2019; Li & Wang, 2013). Rumination, a perseverative style of thinking that focuses on the problem without any attempt to problem-solve, is also one of the instances of RNT that is associated with both PIU (Bağatarhan & Siyez, 2020) and CUD (Memedovic et al., 2019).

1.8. Aims of the current study

A discriminant analysis model based on the above psychosocial factors was devised to differentiate between PIU and CUD predictors in a sample of university students. By separating the factors that predict PIU and CUD, not only will it be easier to identify vulnerable people in PIU and CUD presentations, but also more specialized prevention programs could be developed. We predicted that there would be a difference on all measures between the PIU and CUD groups on the one hand and the control group on other, with higher scores in the PIU and CUD groups.

2. Methods

2.1. Participants

The study was conducted on a convenience sample of 144 students, aged 18–29, from three Universities in Tehran, Iran (Amirkabir, Kharazmi, and Tehran). There were 18 women and 30 men (M = 22.27 years, SD = 2.83) in the PIU group, 22 women and 26 men (M = 22.73 years, SD = 2.54) in the CUD group, and 28 women and 20 men (M = 24.04 years, SD = 2.40) in the control group. In terms of education in the PIU group, 29 were undergraduate students and 19 were graduate students, in the CUD group 34 were undergraduate students and 14 were graduate students, and in the control group, 26 were undergraduate students and 22 were graduate students.

2.2. Measures

A face-to-face clinical interview i.e., the Structured Clinical Interview for DSM-5 (SCID-5, First, 2014) was conducted with students who formed the PIU, CUD and control groups. All questionnaires administered in the study were the Persian forms of the original scales.

2.2.1. The structured clinical interview for DSM-5 (SCID-5; First, 2014)

The SCID-5, a structured clinical interview, was used to diagnose CUD. The validity and reliability of the original version have been proven in several studies and the calculated kappa value showed excellent agreement for substance use disorders (Osório et al., 2019; Shankman et al., 2018). Furthermore, the validity and reliability study of Persian version of the SCID-5 was established in an Iranian sample and good internal consistency (0.95–0.99), test–retest reliability (0.60–0.79), and Kappa reliability (0.57–0.72) have been reported (Mohammadkhani, Forouzan, Hooshyari, & Abasi, 2020).

2.2.2. Severity of dependence Scale (SDS; Gossop et al., 1995)

The SDS is a 5–item self-report measure that assesses the severity of substance dependence that has been used in this study to measure to measure the severity level of CUD. Responses are based on the following 4-point Likert-style scoring: 0 (never/almost never) to 3 (always/nearly always) for items 1–4 and 0 (not difficult) to 3 (impossible) for item 5. Higher scores indicate higher levels of cannabis dependence. There was acceptable reliability of the SDS total score in cannabis users (Cronbach's alpha = 0.70) and at the optimal differentiating cut-off (cutoff point = 3) sensitivity (61.3%) was acceptable (2013b; van der Pol et al., 2013a). Additionally, the validity and reliability study of Persian version of the SDS was established in an Iranian sample and acceptable internal consistency (Cronbach's alpha = 0.64) was demonstrated (Habibi & Alahdadi, 2018).

2.2.3. Internet abusive use Questionnaire (IAUQ; Calvo-Francés, 2016)

The IAUQ is a 12-item self-report measure that evaluates level of abusive use of internet. Responses are based on the following 5-point Likert-style scoring: 0 (totally disagree) to 4 (totally agree). Higher scores indicate higher levels of abusive internet use. The IAUQ shows good structural validity and discriminative capacity (Calvo-Francés, 2016). The cut-off point for the IAUQ was 24 (Calvo-Francés, 2016). The validity and reliability study of IAUQ was established in an Iranian sample and strong internal consistency (Cronbach's alpha = 0.91) and adequate convergent reliability (r = 0.82) and test–retest reliability were demonstrated (Mottaghi & Safaie, 2017).

2.2.4. The Multidimensional Scale of perceived social support (MSPSS; Zimet, Dahlem, Zimet, & Farley, 1988)

The MSPSS is a 12–item self-report measure that assesses preceived social support. The MSPSS has three factors that include family, friends, and significant others. Responses are based on the following 7-point Likert-style scoring: 1 (very strongly disagree) to 7 (very strongly agree). Higher scores indicate higher levels of perceived social support. The MSPSS possesses good psychometric properties in various studies (e.g., Pedersen, Spinder, Erdman, & Denollet, 2009; Stewart, Umar, Tomenson, & Creed, 2014). Also, Salami and colleagues (2009) reported Cronbach's alpha of over 0.80 in the Persian version in all three subscales (friends, family, and significant other).

2.2.5. The Barratt impulsiveness Scale-11 (BIS-11; Patton, Stanford, & Barratt, 1995)

The BIS-11 is a 30–item self-report measure that assesses impulsiveness. It comprises three factors: attentional impulsiveness, motor impulsiveness, and non-planning impulsiveness. Responses are based on the following 4-point Likert-style scoring: 1 (never) to 4 (always). Higher scores indicate higher levels of impulsiveness. The BIS-11 has good psychometric properties to measure impulsiveness among patients and other populations (Patton et al., 1995). The validity and reliability study of Persian version of the BIS-11 was established in an Iranian sample. Cronbach's alpha and test–retest were 0.81 and 0.77, respectively (Javid, Mohammadi, & Rahimi, 2012). Also, in another study Cronbach's alpha for the Persian version was 0.84 (Ekhtiari, Rezvanfard, & Mokri, 2008).

2.2.6. The Multidimensional Distress tolerance Scale (MDTS; Thomas, 2018)

The MDTS is a 20-item self-report measure that assesses one's perceived ability to tolerate physical discomfort, frustration, ambiguity, and emotional pain. Responses are based on the following 5-point Likert-style scoring: 1 (not at all) to 5 (extremely). Higher scores indicate lower levels of distress tolerance. Thomas (2018) study provided

evidence of adequate psychometric properties for the MDTS as indicated by the level of internal consistency (The Cronbach's alpha for total score, tolerance of physical discomfort, frustration, ambiguity, and emotional pain was.0.94, 0.92, 0.91, 0.89, and 0.89, respectively). Because the MDTS has not been validated in Iran, for the present study, the English version of the MDTS was translated into Persian by the Iranian authors and a bilingual psychologist. Following this, the equivalence of the two versions was checked and confirmed. The first version for rating the understandability and fluency of each item was completed by 86 participants from the general population of Tehran (F = 28.53%; mean age = 21.03 ± 1.44 years) in a pilot study. This process did not result in any changes in items, and the final version of the Persian MDTS was confirmed. In this pilot study the Cronbach's alpha for total score, tolerance of physical discomfort, frustration, ambiguity, and emotional pain was 0.73, 0.81, 0.78, 0.78, and 0.86, respectively.

2.2.7. *Emotion regulation Questionnaire (Gross & John, 2003)*

The ERQ is a 10-item self-report measure that assesses emotion regulation. The ERQ has two opposing factors that include cognitive reappraisal, which involves changing the way one thinks about a potentially emotion-eliciting event, and suppression, which involves changing the way one responds behaviorally to an emotion-eliciting event. Responses are based on the following 7-point Likert-style scoring: 1 (strongly disagree) to 7 (strongly agree). Higher scores indicate higher levels of emotion regulation strategies use. The original version of the ERQ had a Cronbach's alpha of 0.79 for reappraisal and 0.73 for suppression. Test–retest reliability across three months was 0.69 for both scales (Gross & John, 2003). In the current study emotion regulation was measured using the Persian version of the ERQ. Hasani (2017) reported good reliability for the Persian version in total score (Cronbach's alpha = 0.91), reappraisal (Cronbach's alpha = 0.87), and suppression (Cronbach's alpha = 0.85).

2.2.8. *The metacognitions Questionnaire 30 (Wells & Cartwright-Hatton, 2004)*

The MCQ-30 is a 30-item measure that assesses metacognitions. The MCQ-30 has five factors: positive beliefs about worry; (ii) negative beliefs about thoughts concerning uncontrollability and danger; (iii) cognitive confidence; (iv) beliefs about the need to control thoughts; and (v) cognitive self-consciousness. Responses are based on the following 4-point Likert-style scoring: 1 (do not agree) to 4 (agree very much). Higher scores indicate higher levels of maladaptive metacognitions. The MCQ-30 has demonstrated good internal consistency and convergent validity and has acceptable test–retest reliability (Spada, Mohiyeddini, & Wells, 2008; Wells & Cartwright-Hatton, 2004). The Persian MCQ-30 was used in the present study. This measure has been shown to have acceptable internal consistency (Cronbach's alpha = 0.73), test–retest reliability (ICC = 0.73) and acceptable validity (Shirinzadeh, Goudarzi, RAHIMI, & Naziri, 2009). Also, Cronbach's alpha coefficients of all subscales range between 0.59 and 0.87 (Shirinzadeh et al., 2009).

2.2.9. ***Repetitive thinking Questionnaire-10 (RTQ-10; McEvoy, Thibodeau, & Asmundson, 2014)***

The RTQ-10 is a 10-item self-report measure that assesses RNT. Responses are based on the following 5-point Likert-style scoring: 1 (not true at all) to 5 (very true). Higher scores indicate higher levels of RNT. The RTQ-10 exhibits excellent internal consistency (Cronbach's alpha = 0.94) and is significantly correlated with worry, depression, and anxiety (McEvoy et al., 2014). The validity and reliability study of Persian version of the RTQ-10 was established in an Iranian sample (Akbari, 2017b) and Cronbach's alpha is reported to be 0.91 (Akbari, 2017b). It also showed good convergent and divergent validity with measurements of anxiety, depression, rumination, worry, and affect in Iranian samples (Akbari, 2017b).

2.3. *Procedure*

The total sample of 144 participants were selected via convenience sampling from three universities in Tehran, Iran. The inclusion criterion for the PIU group was scoring higher than the cutoff point on the IAUQ; the exclusion criterion was receiving a CUD diagnosis based on the SCID-5. This was done to prevent the inclusion of participants who had both PIU and CUD. The inclusion criterion for the CUD group was receiving a CUD diagnosis based on the SCID-5; the exclusion criterion was a score greater than the cutoff point on the IAUQ. This was done to prevent the inclusion of participants who have both CUD and PIU. The inclusion criteria for the control group were a score lower than the cutoff point on the IAUQ and the SDS. The exclusion criterion was receiving a CUD diagnosis based on the SCID-5.

Participants were recruited using advertisements on social network groups at from three universities in Tehran, Iran. There were three stages to the recruitment of participants. To begin with students who used cannabis daily were invited to fill the IAUQ and the SDS and provide their contact information. Three hundred eighty-three students completed this phase of the recruitment process. Following a review of the responses obtained, 203 students who had recorded the highest score on the SDS (score of 3 or more) and not scored more than the cutoff point (cutoff = 24) in the IAUQ were invited for a face-to-face interview. There were 83 students who agreed to attend the face-to-face interview i.e., the SCID-5 interview, which was conducted by two authors of the present study; out of these, 48 students who met the CUD criteria formed the CUD group.

In the second phase of the recruitment process, students who used the internet excessively (more than 3 h per day; Berchtold, Akre, Barrense-Dias, Zimmermann, & Surís, 2018). Were invited to complete the IAUQ and the SDS and provide their contact information. Out of the 443 students who completed the questionnaires, 294 who had the lowest score on the SDS and a score higher than the cutoff point on the IAUQ, were invited to attend the SCID-5 interview. Out of 294 students who were contacted, 102 students agreed to attend the face-to-face interview. Two of the authors of the present study interviewed the participants based on the SCID-5. Finally, to match this group with the CUD group in terms of number, 48 people who were not diagnosed with CUD and scored more than the cutoff point on the IAUQ formed the PIU group. The PIU group was evaluated with the IAUQ. We used a simple random sampling based on an exact number of cases using SPSS 22.

In the third phase of the recruitment process, students were invited to complete the SDS and provide their contact information. Seven hundred and thirty people completed this task and 105 of these who had the lowest score on the SDS, and did not have a score more than the cutoff point on the IAUQ, attended the face-to-face interview. Two of the authors of the present study interviewed the participants based on the SCID-5. Finally, to match this group with the CUD group in terms of number, 48 people who were not diagnosed with CUD and scored less than the cutoff point on the IAUQ formed the control group. We used a simple random sampling based on an exact number of cases using SPSS 22.

All groups were asked to complete a battery of measures assessing social support, impulsivity, distress tolerance, emotion regulation, metacognitions, and RNT. All participants were informed of the study aims and gave written informed consent before completing the study pack. All procedures performed in studies involving human participants were in accordance with the 1989 Helsinki Declaration and its later amendments or comparable ethical standards.

2.4. *Statistical analyses*

A discriminant function analysis was employed to evaluate predictors of PIU, CUD and control group membership. In this analysis, after examining the differences between the three groups, we sought to find the canonical functions to determine the relationship between predictor

variables and criterion variable. Then we identified the best predictor variables across the three groups. Finally, we examined how many members of each group identified with these predictor variables and obtained the accuracy of classifying members.

3. Results

There were no significant differences in gender ($\chi^2 = 4.235$, $p = 0.120$), age ($F = 6.001$, $p = 0.130$) and education ($\chi^2 = 2.883$, $p = 0.237$) between the PIU and CUD groups and the control group. Before performing the analyses related to the statistical tests, the assumptions of normality, homogeneity of variances and multiple sequence alignment between the study variables were checked. Kolmogorov-Smirnov tests for all variables (except for the cognitive impulsiveness and unplanned variables in CUD group) were not significant, so the assumption of normality for the final analysis was accepted, since skewness and kurtosis for these two variables was very low. Furthermore, the M-box test (as an index of multivariate normality) was not significant ($F = 1.128$, $p = 0.099$).

To evaluate the alignment the tolerance index and the variance inflation factor (VIF) were calculated. Since none of the values related to the tolerance value was less than 0.01 and none of the values related to the VIF exceeded the cutoff of 10, these assumptions were confirmed (Tabachnick & Fidell, 2013). Lastly, Levene's test was used to evaluate homogeneity of variance and this was found not to be significant in most instances, indicating that the variances were approximately equal (see Table 1 for Levene's statistics in all variables). However, Levene's test was significant in two of the study variables (reappraisal and suppression), but according to the volume of all three groups, Tabachnick and Fidell (2013) suggest that the overall results are not impacted if the larger variance can be divided into the smaller variance where the result is less than 10. This was the case with the current data, which indicated that the assumption of homogeneity of variance was met.

Table 2 presents mean and standard division for all subscales of variables among the PIU group, CUD group, and control group that be compared with ANOVA.

Three canonical functions were produced in three separate discriminant function analyses to determine the relationship between predictor variables and the group criterion variable (see Table 3). The first discriminant function (F1) was between the PIU group and the control group, the second discriminant function (F2) was between the CUD group and the control group, and the third discriminant function (F3) was between the PIU group and the CUD group. The first discriminant function (F_1) had a significant relationship ($r = 0.66$, $\chi^2 = 48.96$, $p < 0.001$) with the dependent variables of group membership (PIU and control). The second discriminant function (F_2) had a significant relationship with the dependent variable of group membership ($r = 0.74$, $\chi^2 = 66.72$, $p < 0.001$). The third discriminant function (F_3) also had a significant relationship with the dependent variable of group membership ($r = 0.74$, $\chi^2 = 66.82$, $p < 0.001$).

Once the relationship between the canonical function, the independent variables consisting of social support, impulsiveness, distress tolerance, emotion regulation, metacognitions, and repetitive negative thinking, and the dependent variable were determined, we progressed to examine the contribution of the independent variables in the formation of the canonical function.

Table 4 shows that the first function has a significant relationship with the following variables: non-planning (0.45), motor (0.64), and attentional (0.66), which belong to impulsiveness; frustration (0.40), ambiguity (0.43) and emotional pain (0.51), which belong to distress tolerance; cognitive confidence (0.43), positive beliefs about worry (0.39), negative beliefs about thoughts (0.62), need to control thoughts (0.38) which belong to metacognitions; and RNT (0.66). the second function demonstrated a significant relationship with the following variables: significant other (0.37), family support (0.59), which belongs to social support; motor impulsiveness (0.30), and non-planning impulsiveness (0.41), which belong to impulsiveness; suppression (0.30), which belongs to emotion regulation; need to control thoughts (0.31), which belongs to metacognitions; and RNT (0.66). the third function demonstrated a significant relationship with the following variables: significant other (0.34), family support (0.43), which belong to social support; motor impulsiveness (0.32), which belongs to impulsiveness; physical discomfort (0.34), and emotional pain (0.35) which belong to distress tolerance; reappraisal (0.37), which belongs to emotion regulation; cognitive confidence (0.37), which belongs to metacognitions.

As shown above, the first function distinguishes individuals in the PIU group from those in the control group, whilst the second function distinguishes individuals in the CUD from those in the control group. The third function distinguishes individuals in the PIU from those in the CUD group.

Finally, the results of classification analysis showed that based on the predictor variables in general, 73.6% of the study participants were correctly placed in their respective groups. Since the degree of separation is more than 50%, it can be said that the discriminant functions worked well (Meyers, Gamst, & Guarino, 2016). Based on the classification analysis, it was also found that 68.8% of the control group, 70.8% of the PIU group, and 81.3% of the CUD group were correctly classified in their respective group.

Table 1
Levene's test for equality of variances in all variables for groups.

Variable	Subscales	*F*	*P*
Social support	Friends	3.852	0.225
	Significant other	0.294	0.746
	Family	0.924	0.401
Impulsiveness	Non-planning	1.632	0.201
	Motor	0.165	0.848
	Attentional	1.358	0.263
Distress tolerance	Physical discomfort	2.527	0.086
	Frustration	2.083	0.131
	Ambiguity	0.014	0.987
	Emotional pain	0.616	0.542
Emotion regulation	Reappraisal	4.074	0.029
	Suppression	3.251	0.044
Metacognitions	Cognitive confidence	0.615	0.543
	Positive beliefs about worry	2.430	0.098
	Cognitive self-consciousness	0.174	0.302
	Negative beliefs about thoughts	0.188	0.401
	Need to control thoughts	2.892	0.474
Repetitive negative thinking		0.042	0.959

4. Discussion

In the present study, participants in the PIU group had higher scores, compared to the control group, on motor, attentional and non-planning impulsiveness (Lee, Hoppenbrouwers, & Franken, 2019; Mottram & Fleming, 2009), tolerance of frustration, emotional pain, and ambiguity (Akbari, 2017a; Ko, Yen, Yen, Chen, & Wang, 2008), negative beliefs about thoughts, positive beliefs about worry, need to control thoughts, and cognitive confidence (Akbari, Bahadori, Bouruki Milan, Caselli, & Spada, 2021; Hamonniere & Varescon, 2018), and RNT (Bağatarhan & Siyez, 2020; Dempsey, O'Brien, Tiamiyu, & Elhai, 2019). Also participants in the CUD group had lower scores, compared to the control group, on family, and significant other support (Ates, Unubol, Bestepe, & Bilici, 2019; Leos-Toro, Shiplo, & Hammond, 2018), and had higher scores compared to the control group on motor, and non-planning impulsiveness (Lee et al., 2019), tolerance of frustration, emotional pain, and ambiguity (Hasan, Babson, Banducci, & Bonn-Miller, 2015; Ko et al., 2008), and suppression (Blanchard, Stevens, Cann, & Littlefield, 2019; Buckner, Walukevich, Zvolensky, & Gallagher, 2017), and need to control thoughts (Hamonniere & Varescon, 2018; Wasmuth et al., 2015), and RNT (Hamonniere et al., 2020; Hill, 2020). These findings are fully aligned with previous research.

Table 2
Mean and standard deviations of variables across groups.

Variable	Subscales	Control Group (N = 48)		(PIU) (N = 48)		(CUD) (N = 48)		F	P
		M	SD	M	SD	M	SD		
Social support	Friends	20.27	6.29	22.40	4.64	20.77	4.29	2.23	0.111
	Significant other	20.94	6.91	20.13	6.10	15.92	5.37	9.18	0.001
	Family	21.79	5.41	20.23	5.95	15.15	4.93	19.53	0.001
Impulsiveness	Non-planning	19.46	4.07	22.06	3.49	22.50	2.67	10.86	0.001
	Motor	25.63	4.40	31.33	5.72	28.15	3.28	18.75	0.001
	Attentional	8.96	1.81	11.21	2.07	10.13	1.85	16.57	0.001
Distress tolerance	Physical discomfort	12.96	5.34	15.79	5.55	12.38	3.64	6.63	0.002
	Frustration	11.67	4.39	14.38	3.25	13.52	2.67	7.45	0.001
	Ambiguity	13.75	4.61	17.17	4.51	14.60	3.74	8.195	0.001
	Emotional pain	14.67	6.71	20.04	5.26	16.10	5.14	11.24	0.001
Emotion regulation	Reappraisal	25.27	7.24	27.00	4.39	21.94	4.33	10.54	0.001
	Suppression	13.83	6.35	15.15	7.11	17.10	3.19	1.86	0.023
Metacognitions	Cognitive confidence	9.88	3.82	13.50	5.66	9.92	2.97	11.24	0.001
	Positive beliefs about worry	9.27	3.63	11.79	3.72	11.08	1.90	7.94	0.001
	Cognitive self-consciousness	15.33	3.31	15.92	3.03	16.60	2.79	2.08	0.128
	Negative beliefs about thoughts	11.11	4.39	15.42	3.58	13.29	3.97	13.98	0.001
	Need to control thoughts	13.17	4.02	15.73	3.72	15.63	3.30	7.40	0.001
Repetitive negative thinking		23.77	7.33	32.15	7.18	29.60	5.63	19.37	0.001

Notes: PIU = Problematic Internet Use; CUD = Cannabis Use Disorder.

Table 3
Eigenvalues, percentage of variance explained and canonical coefficients.

Comparison	Function	Eigenvalue	Percentage of variance explained	Canonical correlation	χ^2	*p*
PIU vs Control	Function $_1$	0.779	100	0.662	48.962	0.001
CUD vs Control	Function $_2$	1.192	100	0.737	66.725	0.001
PIU vs CUD	Function $_3$	1.195	100	0.738	66.822	0.001

Table 4
Canonical function structure matrix consisting of independent variables.

Variable	Subscales	Function 1	Function 2	Function 3
Social support	Friends	0.220	0.043	0.168
Social support	Significant other	−0.071	−0.375*	0.338*
Social support	Family	−0.157	−0.594*	0.430*
Impulsiveness	Non-planning	0.393*	0.409*	−0.065
Impulsiveness	Motor	0.640*	0.300*	0.216
Impulsiveness	Attentional	0.662*	0.295	0.255
Distress tolerance	Physical discomfort	0.298	−0.059	0.337*
Distress tolerance	Frustration	0.401*	0.236	0.133
Distress tolerance	Ambiguity	0.429*	0.094	0.286
Distress tolerance	Emotional pain	0.510*	0.111	0.250*
Emotion regulation	Reappraisal	0.165	−0.259	0.537*
Emotion regulation	Suppression	0.111	0.301*	−0.164
Metacognitions	Cognitive confidence	0.430*	0.006	0.367*
Metacognitions	Positive beliefs about worry	0.393*	0.289	0.111
Metacognitions	Cognitive self-consciousness	0.105	0.192	−0.109
Metacognitions	Negative beliefs about thoughts	0.616*	0.242	0.260
Metacognitions	Need to control thoughts	0.379*	0.309*	0.014
Repetitive thinking	Repetitive thinking	0.661*	0.413*	0.182

Notes: Function 1: PIU vs Control, Function 2: CUD vs Control, Function 3: PIU vs CUD.

4.1. Family and significant others support as a distinguishing factor between PIU and CUD

Individuals in the CUD group reported receiving less social support from family and significant others than those in the PIU group. One reason for this may be that individuals in the PIU group perceive greater support from online social networks and that this online support itself predicts PIU (Hardie & Tee, 2007; Tudorel & Vintilă, 2018). The reason for preferring online social support to offline could be a lack of face-to-face social skills (Caplan, 2005) with offline social support having been shown to have a negative relationship with the PIU (Lin et al., 2018). Furthermore, some personality traits might explain this difference. For example, cannabis users are less agreeable and conscientious than the general population (Terracciano, Löckenhoff, Crum, Bienvenu, & Costa, 2008). Additionally, personality disorders, such Borderline Personality Disorder (Vest & Tragesser, 2019) and Schizotypal Personality Disorder (Spriggens & Hides, 2015) are more likely to be present in CUD. It could be that these characteristics give- rise to more problems in social communication. In line with this finding, several studies have shown that family conflicts increase the likelihood of substance use disorder (Agha, Zia, & Irfan, 2008; Schafer, 2011).

4.2. Distress tolerance as a distinguishing factor between PIU and CUD

Individuals in the PIU group reported lower levels of tolerance of physical discomfort (Schmidt, Richey, & Fitzpatrick, 2006) than those in the CUD group. Given that individuals who use cannabis commonly experience physical symptoms such as tachycardia and hypotension (Caplan, 2013; Patel & Marwaha, 2019) it could be that, over time and with use, their ability to tolerate physical discomfort grows. This type of discomfort is limited in individuals who use internet problematically, with users typically reporting postural pain or blurred vision (Panova & Carbonell, 2018). Therefore, greater discomfort tolerance may be a byproduct of the addictive behavior. On the other hand, it could also be that individuals who have low physical discomfort tolerance are more

likely to engage in internet, rather than cannabis use, as internet is a readily available mean of escape, avoidance, and mood regulation (Skues, Williams, Oldmeadow, & Wise, 2016). In individuals who use cannabis, it has been suggested (Buckner, Keough, & Schmidt, 2007) that the greatest risk of cannabis problems is in those individuals with high capacity to tolerate physical discomfort. Thus, low physical discomfort tolerance could be a protective factor in problematic cannabis use (Buckner et al., 2007). Our findings are aligned with this suggestion by Buckner et al. (2007). Further research is needed to disentangle fully these relationships. A systematic literature review showed, for example, associations between distress tolerance factors and psychopathological symptoms and disorders, which included behavioral and drug addictions (Leyro, Zvolensky, & Bernstein, 2010).

4.3. Reappraisal as a distinguishing factor between PIU and CUD

Individuals in the CUD group reported lower levels of reappraisal than those in the PIU group. Previous research has suggested that a deficit in reappraisal is associated with craving tobacco (Garland et al., 2018; Szasz, Szentagotai, & Hofmann, 2012). One explanation for the current findings could be that the CUD group experience more cravings than the PIU group, since nicotine craving is more strongly linked to 'internal' symptoms such as withdrawal (Vollstädt-Klein et al., 2011). As previously mentioned, physical symptoms are more common in drug addiction. Generally, due to more craving in the CUD group, reappraisal strategies may become more difficult. Another reason could be that drug use can interrupt cognitive and executive function (Cyrus et al., 2021; Dolcos, Iordan, & Dolcos, 2011; Núñez et al., 2016). Therefore, due to these cognitive changes, the use of reappraisal strategies occurs less in the CUD group.

4.4. Cognitive confidence as a distinguishing factor between PIU and CUD

Individuals in the PIU reported lower levels of cognitive confidence than those in the CUD group. Low cognitive confidence leads to greater difficulty in problem-solving, which brings to dysfunctional coping (Spada et al., 2008). Also, lower cognitive confidence may be associated with a more consistent way of responding to a range of situations, leading to persistence of responses (Hezel & McNally, 2016; Nedeljkovic & Kyrios, 2007). This may explain excessive use of the Internet as a means of gaining greater confidence in decision-making (Spada et al., 2008). This said, research has also shown that cognitive confidence is a predictor of cannabis use (Brosnan et al., 2020) so further research to tease out the degree of importance of this construct across PIU and CUD is warranted.

4.5. Limitations and directions future research

Several limitations of this study should be noted. First, a cross-sectional design cannot be used to infer causality. Second, data were collected from self-report measures, which may have some disadvantages regarding social desirability. Third, recruiting only university students as participants has limitations with respect to generalizability. Fourth, other mental disorders such as anxiety and depression were not assessed when using SCID-5 during the interviews. Fifth, PIU has a wide scope and can include a variety of areas such as Internet Gaming Disorder and problematic social networking sites use. Future studies could examine the differences between the two addictive behaviors at various levels of severity across the general population. Additionally, to aid further generalization, future studies should be conducted on other behavioral addictions, such as gambling or compulsive shopping, and other drug addictions, such as stimulants or opioids lastly, future studies should also examine other psychological variables to differentiate behavioral from drug addictions. This could include, but is not limited to, delay-discounting or experiential avoidance.

4.6. Conclusions and clinical implications

Despite these limitations, the present study introduces a valuable model based on a variety of psycho-social variables that can distinguish PIU from CUD. It has been shown that social support, tolerance of physical discomfort, reappraisal and cognitive confidence play a significant role in discriminating between these two addictive behaviors. These findings can be of interest to psychological and mental healthcare practitioners working with behavioral (i.e., PIU) and drug addiction (i.e., CUD) clinical groups, during the process of assessment as well as treatment for example, in designing behavioral addictions interventions, emphasis could be placed on increasing cognitive confidence, whereas in designing drug addictions interventions, more attention could be paid to improving family relationships.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could influence the work reported in this paper.

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Data availability statement

The authors confirm that the data supporting the findings of this study are available.

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