

ORIGINAL

An integrated behavioral approach to understanding sociocognitive determinants and risk profiles of cannabis use in adolescents

Un enfoque conductual integrado para comprender los determinantes sociocognitivos y los perfiles de riesgo del consumo de cannabis en adolescentes

MARÍA-CARMEN TORREJÓN-GUIRADO*; SHAHAB JOLANI**; MARTA LIMA-SERRANO***; LIESBETH MERCKEN****; HEIN DE VRIES*****.

* Department of Nursing, University of Seville. School of Nursing, Physiotherapy and Podiatry, Institute of Biomedicine of Seville (IBiS), Seville (Spain), & Department of Health Promotion, Maastricht University. Care and Public Health Research Institute CAPHRI, Maastricht (The Netherlands).

** Department of Methodology and Statistics, Maastricht University. Care and Public Health Research Institute CAPHRI, Maastricht (The Netherlands).

*** Department of Nursing, University of Seville. School of Nursing, Physiotherapy and Podiatry, Institute of Biomedicine of Seville (IBiS), Seville (Spain).

**** Department of Health Psychology, Open University Heerlen, Heerlen (The Netherlands).

***** Department of Health Promotion, Maastricht University. Care and Public Health Research Institute CAPHRI, Maastricht (The Netherlands).

Abstract

Cannabis experimentation usually begins during adolescence, and it is associated with the development of mental disorders, and regular use in adulthood. This study aims to analyze the determinants and the trajectories of cannabis use in adolescence. A longitudinal study was conducted with 1,051 adolescents aged 14–18 years who completed a baseline and 6-month follow-up survey based on the I-Change Model. Two cross-sectional and one longitudinal regression analyses were performed to identify which determinants are associated with cannabis use. Then, the five cannabis use trajectories that were found were compared using ANOVA with Tukey's post hoc comparisons. The results showed that at 6 months of follow-up, 669 adolescents had remained non-users, while 187 non-users became users, of whom 121 were experimental and 66 regular users. Data analysis revealed the influence on cannabis use of having boyfriend/girlfriend, sensation seeking, not being convinced about the disadvantages of cannabis use, having peer influence favoring cannabis use and a positive intention to use cannabis in the future. At the beginning, non-users differed on perceptions about the sociocognitive factors from consistent users, but not of the new users. When comparing sociocognitive factors at follow-up, the scenario change, and they are the new users who showed more sociocognitive perceptions favoring cannabis than non-users. Considering the determinants of cannabis use from an integrated behavioral approach can be useful to develop prevention campaigns for this substance. This should provide healthy alternatives to the search for sensations, reinforce a negative attitude towards cannabis use, and influence peer influence and self-efficacy in risky situations/emotions that invite its consumption.

Keywords: cannabis, social determinants of health, adolescent behavior, health promotion

Resumen

La experimentación con el cannabis suele comenzar en la adolescencia, y se relaciona con el desarrollo de trastornos mentales y con un consumo habitual en la edad adulta. El objetivo de este estudio fue comprender los determinantes y las trayectorias de consumo de cannabis en adolescentes. Se realizó un estudio longitudinal con 1.051 adolescentes de 14 a 18 años que completaron una encuesta inicial y otra a los 6 meses, basada en el Modelo I-Change. Se realizaron dos análisis de regresión transversales y uno longitudinal para identificar qué determinantes están asociados al consumo de cannabis. Finalmente, las cinco trayectorias de consumo de cannabis que se identificaron se compararon mediante ANOVA con comparaciones post hoc de Tukey. Los resultados de este estudio muestran que, a los 6 meses de seguimiento, 669 adolescentes permanecieron como no consumidores, mientras que 187 adolescentes iniciaron el consumo de cannabis: 121 experimentalmente y 66 regularmente. El análisis de datos reveló la influencia en el consumo de cannabis de tener pareja, de querer buscar sensaciones nuevas, de no estar convencido de las desventajas del consumo de cannabis, de la influencia de los pares de iguales, y de tener una intención positiva de consumir cannabis en el futuro. Al inicio del estudio, los no consumidores difirieron de los consumidores consistentes en las percepciones sobre los factores sociocognitivos, pero no difirieron de los nuevos consumidores. Al comparar estos factores a los 6 meses, el escenario cambió, siendo los nuevos consumidores quienes mostraron mayores percepciones sociocognitivas a favor del cannabis. Considerar los determinantes del consumo de cannabis desde un enfoque conductual integrado puede ser útil para desarrollar campañas de prevención, donde se proporcionen alternativas saludables a la búsqueda de sensaciones, reforzar una actitud negativa hacia el cannabis, incidir en la influencia de los pares de iguales y en la autoeficacia del adolescente ante situaciones/emociones de riesgo que inviten al consumo.

Palabras clave: cannabis, determinantes sociales para la salud, conducta del adolescente, promoción de la salud

Cannabis use is a significant risk behavior among adolescents that doubles the risks of mental disorders, cognitive impairment, and early school-leaving (Boden et al., 2020; Estrada et al., 2011; European Monitoring Centre for Drugs and Drug Addiction, 2021; World Drug Report, 2021). Furthermore, cannabis is associated with the use of other illicit drugs or becoming a regular user in adulthood (Boden et al., 2020). Details about prevalence of the transitions of cannabis use are scarce examined. A longitudinal study found that a lowest prevalence of cannabis' experimentation among their participants aged 15-16 were 6% and the highest 10% (Raitasalo et al., 2021). Yet, the Spanish national survey ESTUDES 2021 revealed that 28.6% of Spanish adolescents had reported an experimental use (Spanish National Plan on Drugs, 2021).

Specifically, in Andalusia (Spain), 35.3% (n=1285) of adolescents reported using cannabis for the first time at 15 years (Agency for Social Services and Dependency of Andalusia, 2018). Data on adolescents' admissions to Andalusian public centers for drug treatment show that the main reason for these admissions is the use of cannabis (n=398, 86%) (Andalusian Government, 2020). As in other regions of Spain, the prevalence of cannabis consumption increases progressively with age (Spanish National Plan on Drugs, 2022). This situation also occurs in other European countries such as France and Italy (European Monitoring Centre for Drugs and Drug Addiction, 2021). Consequently, prevention programs should start at an early age to prevent the onset of cannabis use.

Knowing the determinants of cannabis use is relevant to address relevant factors in tailored prevention interventions (Guxens et al., 2007a; Suárez-Maldonado et al., 2022). International studies (Connor et al., 2021; Hayatbakhsh et al., 2009; Suárez-Maldonado et al., 2022; Torrejón-Guirado et al., 2023a), including Spanish studies (González-Cano-Caballero et al., 2023; Guxens et al., 2007b; Pérez et al., 2010; Rial et al., 2019; Torrejón-Guirado et al., 2023b), reveal that various determinants such as parental use, family functioning, individual and family finances, personality, self-esteem, beliefs about cannabis use, friends' norms, ability to refuse the offer to consume, and intention to use cannabis are involved in the onset of cannabis use in adolescence. However, the interpretation of the data is hindered by the fact that conclusions are mostly based on cross-sectional data and examination of only a few determinants (Alameda-Bailén et al., 2018; Alarcó-Rosales et al., 2019; Belzumegui-Eraso et al., 2020). Moreover, no longitudinal studies have been carried out in Andalusia concerning the determinants of cannabis use in adolescents, and those which were carried out in other regions of Spain are old (Guxens et al., 2007b; Pérez et al., 2010).

To develop tailored health education interventions for preventing cannabis use in adolescence, it may be relevant

to detect whether certain adolescents already have a risk profile that may be associated with later experimental or regular cannabis use (Epstein et al., 2015; Kelly & Vuolo, 2019). For instance, while curiosity and peer pressure may prompt experimental use of cannabis, experiencing positive outcomes such as relaxation may determine regular use (Hall, 2015). Other determinants such as the social environment can influence experimental users so that they become regular users (Järvinen & Ravn, 2011). However, research about determinants that are related to cannabis use trajectories is scarce (Epstein et al., 2015; Pérez et al., 2010), and most studies focus on a small set of determinants related to the development of a cannabis use disorder, not recreational or other non-medicinal use (Alarcó-Rosales et al., 2019; Connor et al., 2021; Pahl et al., 2011). The lack of an official standardised definition of recreational cannabis use also impedes the comparison of studies.

Finally, there is often a lack of theoretical grounding to understand the onset and progression of cannabis use in adolescence (Mayfield & Fogger, 2022). Several relevant social-cognitive models have been found to be useful for understanding cannabis use in adolescents (see, e.g., Jalilian et al., 2020). Yet, most target motivational processes do not pay attention to pre and post motivational processes, nor pay attention to preceding determinants such as predisposing determinants, which have recently been shown to be important (Suárez-Maldonado et al., 2022). This study uses the socioecological integrated change model (I-Change). The I-Change model has not been previously employed to investigate longitudinally cannabis use and its transitions over time. Yet, this model was applied in two recent cross-sectional studies about cannabis use among adolescents (González-Cano-Caballero et al., 2023; Torrejón-Guirado et al., 2023b), and it has been used to understand various health behaviors in adolescents (such as alcohol and tobacco use) in various countries (Martínez-Montilla et al., 2020; Smit et al., 2018; Swart, 2006). The I-Change model identifies three phases in the behavioral change process: awareness, motivation, and action. Awareness is determined by cognizance (awareness of one's own behavior), knowledge, risk perception, and cues to action, while motivation is determined by attitudes, social influence beliefs, and self-efficacy. Finally, action is determined by self-efficacy, action planning, and skills. These three phases can be influenced by both information determinants (e.g., mass media campaigns) and predisposing determinants. Predisposing determinants such as behavioral determinants (e.g., lifestyle), psychological determinants (e.g., self-esteem), biological determinants (e.g., sex), and social and cultural determinants (e.g., policies) have recently been shown to play an important role in cannabis use behavior (Torrejón-Guirado et al., 2023b). Using the I-Change model, factors such as personality, economic status, or

academic performance (predisposing factors), as well as the emotional and rational consequences of the behavior, social modelling and social pressure toward the adoption of a behaviour, could be studied. These variables are not examined by other relevant socio-cognitive models such as the Health Belief Model (Janz & Becker, 1984) or the Theory of Planned Behaviour (Ajzen, 1991).

Previous studies remark on the importance of developing evidence-based, context-aware, and research-orientated prevention, for which the analysis of the mechanism of behavioural adoption is crucial (Faggiano et al., 2014). Therefore, the hypothesis posits that the use of cannabis among adolescents will demonstrate a positive association with favorable attitudinal, social, and self-efficacy beliefs toward cannabis use. Yet, the variables that are associated with these factors may differ per age, gender and country. Hence, the first objective of our study aims at describing which determinants discriminate cannabis users from non-cannabis users in a sample of Andalusian adolescents aged 14–18 years after a six-month follow-up. Moreover, little research is available concerning the beliefs that may play a different role in the trajectories of cannabis use. Thus, the second objective is to analyze whether we can detect certain risk profiles from the different trajectories of cannabis use, attending to five groups who will be compared in order to identify similarities and differences in profiles: consistent nonusers, new experimental users, new regular users, consistent experimental users, and consistent regular users.

Method

Participants and procedures

A random sample was collected by the conglomerates of 21 high schools located in western Andalusia (Sevilla, Córdoba, Huelva y Cádiz) in November to December 2020 (baseline, T0: N = 2,028) and again at 6 months (follow-up, T1: N = 1,253). To calculate the sample size, the online GRANMO tool was used with an overall cumulative incidence of 5% (accepting an alpha risk of 0.05 and a beta risk of 0.2), estimating a dropout rate of 50%.

The inclusion criteria were that the students were aged 14–18 years and enrolled in 9th–12th grade or vocational training (VT). The exclusion criteria were duplicate or incomplete answers at baseline or follow-up, new students who had not participated at the baseline, and students whose identification between baseline and follow-up was not possible. Figure 1 is a participation flow chart showing that 1,896 (94.8%) students met all criteria at baseline. Those who participated in both measurements (N = 1,051, 55.4%) were included in the analysis.

The heads of the participating schools were contacted by telephone and email to request their approval and collaboration. An official letter was sent to them with information about the study, the informed consent form,

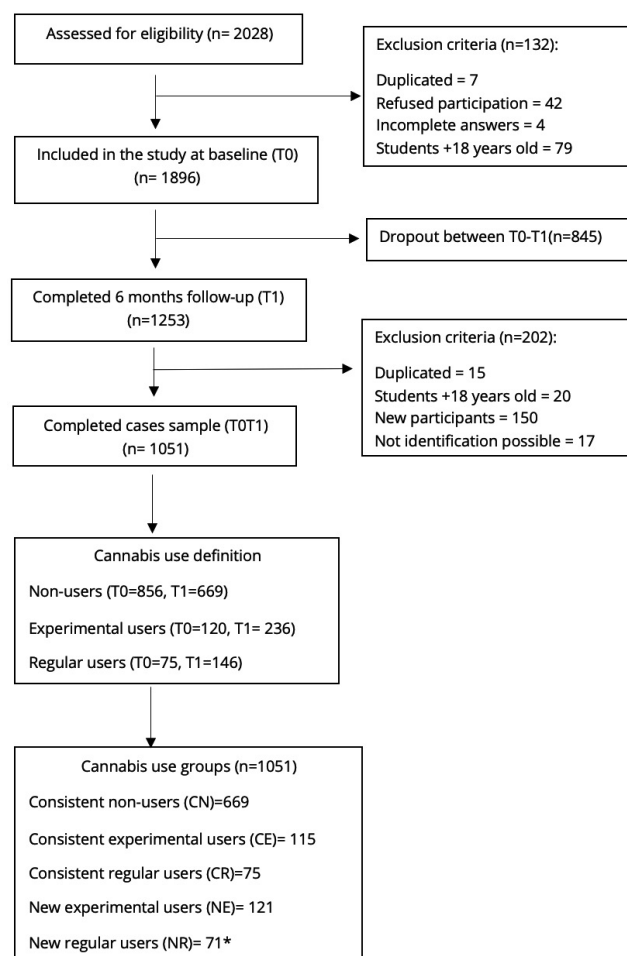
and the questionnaire. Once they approved, we contacted school counselors to arrange visits. Active written consent was requested from parents unless the schools indicated that they wanted to provide passive consent. Active consent was obtained from the participants. The online self-administered questionnaire was based on the I-Change Model (De Vries, 2017) and inspired by previous studies (Martinez-Montilla et al., 2020). It had undergone pilot testing (Torrejón-Guirado et al., 2023b) and took approximately 30 minutes to complete, during school hours, and supported by one research.

Questionnaire and measures

Predisposing determinants

The students were asked about their *sex* (female/male), *age* (in years), *nationality* (Spanish/other), *religion* (yes/no), *academic performance* (0%–39%, 50%–59%, 60%–69%, 70%–79%, 80%–100%), *educational level* (9th–12th grade or VT), *parents' educational level* (none, primary studies, secondary studies,

Figure 1
Flow diagram of recruitment process



Note. *5 experimental users at baseline became regular users after 6 months. They were included on new regular users group.

university studies, I do not have that relative), whether they had (1) or did not have (0) a *boyfriend/girlfriend*, and *weekly pocket money* (an amount). *Socioeconomic status* was measured using the Family Affluence Scale (FAS III) which goes from lowest purchasing power to the highest purchasing power, and whose Cronbach's $\alpha = 0.641$ (Hartely et al., 2016). *Family functioning* was assessed using the Family Apgar test where 0 = severely dysfunctional family, 1 = moderately dysfunctional family, and 2 = highly functional family (Smilkstein et al., 1982). Cronbach's $\alpha = 0.760$.

The psychological variables included were Rosenberg's *self-esteem* Scale with 10 questions which goes from 1 = "strongly disagree" to 4 = "strongly agree" (reverse coding for items 2, 6, 8, and 9), and whose Cronbach's $\alpha = 0.459$ (Vázquez Morejón et al., 2004), and *personality*, assessed using the Substance Use Risk Profile Scale with 23 questions which goes from 1 = "strongly disagree" to 4 = "strongly agree" (reverse coding: items 1, 4, 7, 13, 20, and 23) and with a four-dimensional component: hopelessness, impulsiveness, sensation seeking, and sensitivity anxiety (Fernández-Calderón et al., 2018). Cronbach's $\alpha = 0.737$.

Sociocognitive determinants

Attitude toward cannabis was assessed using nine perceived *advantages* (from 1 "strongly agree" to 5 "strongly disagree"; Cronbach's α : T0 = 0.87, T1 = 0.90) and nine *disadvantages* (from 1 "strongly disagree" to 5 "strongly agree"; Cronbach's α : T0 = 0.90, T1 = 0.92).

Social influence on cannabis use (i.e., social norm, modeling, and pressure) assessed the influences of 11 social agents (e.g., mother, female and male friends). *Social norms* were evaluated using the perceived opinion of social agents on whether the participant should consume cannabis or not (from 1 "It's definitely okay to use cannabis" to 5 "It's definitely not okay to use cannabis" or "I do not have that relative/friend"; Cronbach's α : T0 = 0.91, T1 = 0.78). *Social modeling* was assessed by the frequency of cannabis consumption by the social agents (from 1 "always" to 5 "never" or "I do not have that relative/friend"; Cronbach's α : T0 = 0.81, T1 = 0.72). *Social pressure* was assessed by the frequency with which the participant had encountered pressure to use cannabis by individuals in their social environment (same code as social modelling; Cronbach's α : T0 = 0.80, T1 = 0.72). For a correct interpretation of "I do not have that relative/friend", it was identified in the statistical software as a discrete missing value.

Self-efficacy was measured using 11 items (from 1 "strongly agree," which means low self-efficacy, to 5 "strongly disagree," which means high self-efficacy) to assess the perceived difficulty the adolescents had in avoiding cannabis use in different situations (Cronbach's α : T0 = 0.98, T1 = 0.96).

Coping plans were assessed by 11 items (from 1 "strongly disagree", which means that the student had not made a plan to not use cannabis in challenging situations, to 5 "strongly

agree", which means there was a plan for refusing cannabis; Cronbach's α : T0 = 0.99, T1 = 0.99).

Intention of cannabis use in the next year and in the future (from +3 "definitely not" to -3 "definitely yes"; Cronbach's α : T0 = 0.86, T1 = 0.92).

Cannabis use

Lifetime cannabis use was measured using the Spanish National Survey on Drug Use in Secondary Education (Spanish National Plan on Drugs, 2022). To avoid any inconsistency in the responses, two similar questions were asked. One was dichotomous (0 "I have never tried cannabis"; 1 "I have tried cannabis"), and the other was a frequency question based on how many days the participants had used cannabis in their lives (0, 1, 2, 3–9, 10–19, or 20 days or more). From these, a new variable with three categories was created: *nonusers* (no lifetime cannabis use experience), *experimental users* (cannabis use less than 10 days in their lifetime), and *regular users* (cannabis use more than 10 days in their lifetime) (Sznitman et al., 2015). Initially, consumption in the last 30 days was combined with lifetime consumption as proposed by the definition of Sznitman et al. (*non-users*=no lifetime use; *experimental user*= 1–2 days in the last month or more than this, but less than 10 days in their lifetime, and *regular use*=cannabis use 3 days in the last month or more than this, and at least 10 days in their lifetime).

Yet, we realized that Sznitman et al. definition had multiple interpretations and left some cases unaddressed. For example, regarding experimental use, we identified three different interpretations: (a) experimental use equates to 1-2 times in the last month or 3-9 times in the last month combined with 1-9 times in the lifetime; (b) 1-2 times in the last month or 3-20 times in the last month combined with 1-9 times in the lifetime; or (c) 1-2 times in the last month or 3-9 times in the lifetime. Additionally, we encountered three unaddressed cases: (a) individuals who have ever tried cannabis in their lifetime but did not use it in the last month, and (b) individuals who used cannabis for 1-2 days in the last month but more than 10 days in their lifetime.

Additionally, we saw that this combination of prevalences did not work in our study, since the second condition (lifetime) always overrules the first one (last month). For such reasons, it turned out that the lifetime use can only be used to define three kinds of groups (non-users, experimental and regular users).

To examine the trajectory of cannabis use after six months, the five groups shown in Figure 1 were developed: (1) students who still had never tried cannabis (consistent nonusers: N = 669), (2) students who had not tried cannabis at baseline but reported to have experimented with it after 6 months (new experimental users: N = 121), (3) students who continued the experimental use (consistent experimental users: N = 115), (4) non-users, and a very few experimental users who became regular users 6 months

later (new regular users: $N = 71$), and (5) students who continued to use regularly (consistent regular users: $N = 75$). The trajectory from users to quitters was also explored but nobody took this trajectory.

Statistical Analysis

Descriptive analysis was performed to analyze the characteristics of the participants at baseline and follow-up. One-way ANOVA and a Chi-square test were used to compare the characteristics of the participants with respect to their lifetime use of cannabis. We also investigated the reasons for dropout.

To analyze variables related to lifetime cannabis use, we performed three linear regression analyses: two cross-sectional and one longitudinal (Field, 2017). A separate model was built for each regression: first, we examine the variables predisposing to analyze lifetime cannabis use (Model 1). Then we added attitude, social influence, and self-efficacy to the model (Model 2), followed by coping plans and intention (Model 3). Only for the longitudinal assessment, lifetime cannabis use at baseline was added (Model 4) (ANCOVA method) (see, e.g., Tan & Jolani, 2022, Chapter 5). The last model was conducted to ascertain whether prior behaviour (i.e., previous cannabis use) continued to exert an influence after 6 months, independent of mediation by other factors. The level of significance was set at 0.05, and the effect size was calculated. Pearson coefficient was also measured (Schober et al., 2018).

Finally, we used one-way ANOVA with Tukey's post hoc HSD comparisons and Chi-square to assess the determinants associated with cannabis use according to five defined trajectories. Data imputation was not necessary. Data analyses were carried out using SPSS (version 27; IBM Corporation, Armonk, NY, USA, 2020).

Ethics statement

The study was approved by the Andalusian Research Ethics Committee (registration number: 0073-N-18). The confidentiality of the data was explained to the participants and their parents, and the procedures followed the Regulation (EU) 2016/679 of the European Parliament and the Data Protection Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data.

Results

Sample characteristics by lifetime cannabis use, and attrition analysis

Table 1 shows cannabis use and predisposing determinants (sociodemographic, family, and psychological characteristics) at baseline and at 6 months of follow-up. The baseline sample consisted of 1,896 Andalusian adolescents. Of that sample, 394 (20.8%) participants reported lifetime cannabis

use at baseline. The mean age was 15.48 years, mostly girls ($N = 1,001$, 52.8%), from 10th grade ($N = 581$, 30.6%), attending public schools ($N = 1,002$, 53%), and with excellent academic performance ($N = 800$, 42.2%). Most of participants reported not having a boyfriend/girlfriend ($N = 1,117$, 58.9%), being Spanish ($N = 1855$, 97.6%), not having religion ($N = 1117$, 58.9%), and an average of 13.25€ ($SD = 14.78$) for weekly pocket money. Regarding the educational level of parents, the mothers ($N = 443$, 33.1%) and fathers ($N = 550$, 29%) have a secondary school level. Most of the adolescents reported having a functional family according to the responses to the Apgar scale ($N = 1449$, 76.6%), the average of the family affluence scale was 7.5 ($SD = 2.70$). The average on the self-esteem scale was 28.89 ($SD = 3.64$), indicating a medium self-esteem, and on the substance use risk profile scale, the lowest punctuation was for anxiety sensitivity (mean = 9.63, $SD = 2.58$) while the highest punctuation was for hopelessness (mean = 20.83, $SD = 3.18$). Cannabis users were significantly older, males, without religion, with low academic performance, having boyfriend/girlfriend, from functional families but families with a lower affluence, they more often receive lower pocket money, and having higher impulsiveness and sensation seeking personalities than non-users.

The longitudinal study sample consisted of 1,051 adolescents who had a mean age of 15.29 ($SD = 1.289$), of whom 382 (36.3%) were cannabis users. The rest of the characteristics are similar to the baseline. Factors related to cannabis lifetime use were the same except for sex, grade, family functioning and family affluence (see table 1).

Attrition from baseline to six-month follow-up was 44.6% ($N = 845$). In appendix is shown the pair comparisons between retainers and dropped out participants. Furthermore, dropout regression analyses showed that adolescents who abandoned the study were in grades 10 and 12, attended public schools, and lived in a family with lower socioeconomic status.

Determinants of lifetime cannabis use among adolescents

Table 2 shows the determinants associated with adolescent's cannabis use in a cross-sectional view (i.e., at baseline and follow-up) and longitudinal view. The consistent pattern of associated factors with cannabis use across the three-time frameworks were having boyfriend/girlfriend, higher desire of sensation seeking, less perception of disadvantages of cannabis use, and a positive intention to use cannabis in the future (Model 3).

On one hand, variables related to cannabis use at two analysis (baseline and longitudinal analysis) were grade, academic performance, weekly pocket money and peer social norm. Yet, peer social modelling was associated with cannabis use at follow-up and longitudinal analysis, but not at baseline. On the other hand, peer social pressure

Table 1
Baseline and follow-up predisposing characteristics of participants

Variables	Baseline (T0)		Follow-up (T1)	
	N (%)	P value	N (%)	P value
Schools	N = 20		N = 20	
Classrooms	N = 96		N = 96	
Participants	N = 1896		N = 1051	
Lifetime cannabis (T0&T1: m ^a 0)				
- No	1502 (79.2%)		669 (63.7%)	
- Yes	394 (20.8%)		382 (36.3%)	
Age (14-18) (mean, SD ^d) (T0&T1: m 0)	15.48 (1.393)	.000	15.29 (1.289)	.003
Sex (T0&T1: m 0)				
- Male	895 (47.2%)	.005	491 (46.7%)	.815
- Female	1001 (52.8%)		560 (53.3%)	
Adolescents Grade (T0&T1: m 0)				
- 9 th Grade	474 (25%)	.000	322 (30.6%)	.281
- 10 th Grade	581 (30.6%)		368 (35%)	
- 11 th Grade	362 (19.1%)		176 (16.7%)	
- 12 th Grade	354 (18.7%)		130 (12.4%)	
- Vocational Training (VT)	125 (6.6%)		55 (5.2%)	
Type of school (T0: m 6; T1: m 0)				
- Public school	1002 (53%)	.105	519 (49.4%)	.762
- Private school	888 (47%)		532 (50.6%)	
Academic Performance (T0&T1: m 0)				
- Unsatisfactory (0-39%)	70 (3.7%)		39 (3.7%)	
- Satisfying (50-59%)	183 (9.7%)		106 (10.1%)	
- Good (60-69%)	482 (25.4%)	.000	263 (25%)	.009
- Excellent (70-79%)	800 (42.2%)		428 (40.7%)	
- Outstanding (80-100%)	361 (19%)		215 (20.5%)	
Boyfriend/girlfriend (T0&T1: m 0)				
- No	1401 (73.9%)	.000	792 (75.4%)	.000
- Yes	495 (26.1%)		259 (24.6%)	
Nationality (T0&T1: m 0)				
- Spanish	1855 (97.8%)	.777	1026 (97.6%)	.380
- Non-Spanish	41 (2.2%)		25 (2.4%)	
Religion (T0&T1: m 0)				
- No	1117 (58.9%)	.000	607 (57.8%)	.100
- Yes	779 (41.1%)		444 (42.2%)	
Adolescent weekly pocket money (mean, SD) (T0&T1: m 0)	13.25 (14.277)	.000	12.66 (14.199)	.005
Mother Educational Level (T0&T1: m 0)				
- None	233 (12.3%)	.576	233 (12.3%)	.145
- Basic or primary school	355 (18.7%)		355 (18.7%)	
- Secondary school	443 (23.4%)		443 (23.4%)	
- University studies	627 (33.1%)		627 (33.1%)	
- I do not have mother	238 (12.6%)		238 (12.6%)	
Father Educational Level (T0&T1: m 0)				
- None	275 (14.5%)	.253	275 (14.5%)	.202
- Basic or primary school	407 (21.5%)		407 (21.5%)	
- Secondary school	373 (19.7%)		373 (19.7%)	
- University studies	550 (29%)		550 (29%)	
- I do not have father	291 (15.3%)		291 (15.3%)	
Family functioning (T0: m 4; T1: m 3)				
- Severely dysfunctional family	116 (6.1%)		59 (5.6%)	
- Moderately dysfunctional family	327 (17.3%)	.027	188 (17.9%)	.888
- Functional family	1449 (76.6%)		801 (76.2%)	
Family affluence (mean, SD) (T0&T1: m 1)	7.25 (2.702)	.032	7.45 (2.709)	.451
Self-esteem (mean, SD) (T0: m 1; T1: m 2)	28.89 (3.641)	.500	29.01 (3.699)	.296
Substance Use Risk Profile Scale (mean, SD) (T0&T1: m 1)				
• Hopelessness	20.83 (3.182)	.137	20.90 (3.229)	.199
• Impulsiveness	11.90 (2.978)	.000	11.85 (3.059)	.003
• Sensation seeking	16.63 (3.756)	.000	16.54 (3.846)	.000
• Sensitivity to anxiety	9.63 (2.581)	.196	9.56 (2.641)	.629

Note. (m X) = number of missing values per variable at baseline or follow-up; P-value for ANOVA factor or χ^2 = Chi square; SD= standard deviation; T0 = baseline & T1 = follow-up.

to use cannabis and siblings social modelling of cannabis were associated with cannabis use at baseline, whereas not having religion, perceived many advantages of cannabis use, and parent social modelling favoring to cannabis were associated with cannabis use at follow-up. Finally, for the longitudinal regression analysis, when including the behavior of cannabis use at baseline (Model 4), only this predicted cannabis use at follow-up (correlation coefficient = .656; $B = 27.384$; $p = .000$; $R^2 = .427$).

Comparison of adolescent trajectories of cannabis use

In the longitudinal sample, 187 non-users at baseline became users at the 6-month follow-up (i.e., there was an increase of 17.7% of cannabis use between baseline and follow-up), of whom 121 became experimental users and 66 became regular users, while 669 participants remained non-users at baseline and follow-up.

Table 3 shows the differences in the scores of the *sociocognitive determinants* of cannabis use assessed at baseline and at follow-up for the five identified groups with respect to

the trajectories of cannabis use: CN, CE, CR, NE and NR. New users (experimental and regular) did not differ in their baseline profile from consistent non-users, but they differ from consistent users (experimental and regular). When we look to those sociocognitive factors six months later, the scenario changed: the greater differences are between new users and consistent non-users. Most of the factors were found significant either at baseline or at follow-up. Intention, peer social modelling and norms, and disadvantages of cannabis use were the more associated factors at both times.

At baseline, consistent users (especially regular users) reported having peers and sibling were who used most often cannabis and who have positive norm favoring cannabis use (especially peers), having the highest pressure for using cannabis were from peers in comparison with non-users, not be convinced of disadvantages of using cannabis, having a high intention to use cannabis. At six months, new users (especially regular new users) reported having social influences favoring cannabis (especially by peers), being less convinced of the disadvantages of cannabis use, and having higher intention to use cannabis in the future.

Table 2
Predictors of Lifetime Cannabis Use at Baseline (T0), Follow-Up (T1), and Transition (T0 versus T1)

	Model 1			Model 2			Model 3		
	T0 ^a	T1	T0-T1	T0	T1	T0-T1	T0	T1	T0-T1
Age	1.804	2.875			3.097			3.319	
Grade	2.843			3.205		3.205	2.891		2.891
Academic Performance	-4.798			-3.447		-3.447	-3.371		-3.371
Mother education	2.520								
Boyfriend/girlfriend	4.978	2.531	2.852	2.551	2.351	2.551	2.690	2.257	2.690
Religion	-4.726	-2.436	-2.037		-2.904			-2.677	
Weekly pocket money	4.468	2.576	2.576	3.081		3.081	3.305		3.305
Family affluence		-2.312		2.436		2.436			
Hopelessness	-2.155	-2.428	-2.428						
Sensation seeking	8.309	5.427	4.635	3.582	3.566	3.582	3.292	2.859	3.292
Disadvantages				-9.686	-6.018	-3.628	-8.174	-3.738	-3.352
Advantages					-2.723			-2.894	
Social norm (peer)				-3.907	-3.600	-3.600	-3.314		
Social modelling (peer)				-13.005	-8.318	-6.177		-7.590	-3.047
Social pressure (peer)				-2.468			-2.600		-5.927
Social modelling (siblings)				-5.652	-1.973	-1.973	-5.221		
Social modelling (parents)					3.116			3.213	
Self-efficacy				-4.116	-4.031				
Intention							-7.669	-6.055	-3.440
R2^b	.127	.052	.045	.394	.241	.157	.407	.257	.164

Note. In the first column on the left, the factors that were significant at least once are listed. The estimated coefficient for each factor is presented.

a: T0 = baseline; T1 = follow-up; T0-T1 = longitudinal (i.e., transition T0 to T1).

b: R2, indicator of explained variance.

In bold letters are those factors that exhibit a consistent relationship with cannabis use across different time frameworks.

Table 3

Association between sociocognitive variables and adolescent cannabis use transition at 6 months of follow-up: comparison between the trajectory of 5 groups

Socio-cognitive variables	Consistent non-users (CN)	New experimental users (NE)	New regular users (NR)	Consistent experimental users (CE)	Consistent regular users (CR)	ANOVA F	Turkey HSD
	mean (SD); n=669	mean (SD); n=121	mean (SD); n=71	mean (SD); n=115	mean (SD); n=75		
Baseline (T1)							
Disadvantages (m ^a 1)	4.06 (.823)	4.13 (.746)	3.99 (.914)	3.60 (.849)	2.70 (.871)	52.356**	CN>CE>CR.
Advantages (m 0)	2.51 (.959)	2.63 (.900)	2.60 (.936)	2.77 (.733)	3.04 (.630)	7.012**	CN>CE>CR.
Parent Social Norm (m 4)	4.91 (.332)	4.91 (.279)	4.86 (.344)	4.80 (.413)	4.70 (.579)	7.095**	CN>CE>CR.
Sibling Social Norm (m 0)	4.83 (.425)	4.88 (.368)	4.85 (3.77)	4.62 (.652)	4.34 (7.91)	21.535**	CN>CE>CR.
Peer Social Norm (m 4)	4.61 (.499)	4.65 (.466)	4.48 (.539)	4.19 (.616)	3.60 (.796)	70.496**	CN>CE>CR.
Parent Social Modelling (m 2)	4.95 (.260)	4.92 (.269)	4.86 (.555)	4.81 (.502)	4.89 (.393)	5.465**	CN>CE
Sibling Social Modelling (m 0)	4.95 (.252)	4.88 (.403)	4.90 (.518)	4.79 (.521)	4.68 (.678)	11.931**	CN>CE>CR.
Peer Social Modelling (m 1)	4.67 (.416)	4.67 (.454)	4.56 (.634)	4.15 (.622)	3.62 (.704)	98.028**	CN>CE>CR.
Parent Social Pressure (m 3)	4.98 (.251)	4.99 (.091)	5.00 (.000)	5.00 (.000)	4.96 (.349)	.524	NS
Sibling Social Pressure (m 2)	4.99 (.142)	5.00 (.000)	5.00 (.000)	5.00 (.000)	4.96 (.300)	1.335	NS
Peer Social Pressure (m 1)	4.93 (.253)	4.93 (.193)	4.92 (.227)	4.72 (.400)	4.74 (.383)	20.429**	CN>CE>CR.
Self-efficacy (m 1)	4.04 (1.507)	4.18 (1.373)	4.07 (1.502)	3.67 (1.321)	3.24 (1.137)	7.011**	CN>CR.
Coping plans (m 0)	2.70 (1.762)	2.57 (1.738)	2.73 (1.770)	2.65 (1.555)	2.08 (1.318)	2.341	CN>CR.
Intention (m 0)	1.28 (.855)	1.40 (.901)	1.11 (1.134)	.85 (1.468)	-.49 (2.032)	49.400**	CN>CE>CR.
Follow-up (T1)							
Disadvantages (m 0)	4.19 (.810)	3.74 (.874)	2.69 (.928)	3.95 (.938)	3.82 (1.050)	53.174**	CN>CE>CR>NE>NR
Advantages (m 0)	2.51 (.992)	2.65 (.900)	2.60 (.734)	2.77 (.734)	3.04 (.630)	7.012**	CN<NR.
Parent Social Norm (m 0)	4.89 (.380)	4.82 (.518)	4.50 (.879)	4.88 (.424)	4.87 (.461)	11.587**	CN>NR.
Sibling Social Norm (m 0)	4.76 (.608)	4.64 (.678)	4.01 (1.123)	4.69 (.576)	4.64 (.725)	18.233**	CN>NR.
Peer Social Norm (m 0)	4.54 (.649)	4.17 (.792)	3.39 (.914)	4.47 (.651)	4.38 (.785)	46.682**	CN>NE>NR
Parent Social Modelling (m 0)	4.94 (.340)	4.87 (.544)	4.63 (.976)	4.94 (.247)	4.89 (.454)	8.406**	CN>NR.
Sibling Social Modelling (m 0)	4.90 (.428)	4.73 (.744)	4.42 (1.013)	4.91 (.302)	4.78 (.695)	13.011**	CN>NE>NR.
Peer Social Modelling (m 0)	4.64 (.552)	4.15 (.756)	3.38 (.934)	4.55 (.566)	4.31 (.808)	73.620**	CN>CR>NE>NR.
Parent Social Pressure (m 0)	4.97 (.556)	4.92 (.452)	4.71 (.995)	5.00 (.000)	4.97 (.293)	7.323**	CN>NR.
Sibling Social Pressure (m 0)	4.96 (.389)	4.93 (.389)	4.69 (.969)	5.00 (.049)	4.97 (.252)	7.447**	CN>NR.
Peer Social Pressure (m 0)	4.91 (.400)	4.77 (.509)	4.60 (.867)	4.95 (.176)	4.87 (.368)	10.150**	CN>NE>NR.
Self-efficacy (m 0)	4.78 (.596)	4.50 (.764)	3.56 (1.141)	4.81 (.641)	4.68 (.797)	57.064**	CN>NE>NR.
Coping plans (m 0)	2.73 (1.808)	2.45 (1.621)	2.17 (1.371)	2.60 (1.745)	2.28 (1.665)	2.918	NS
Intention (m 0)	2.51 (.872)	1.68 (1.554)	-.49 (1.721)	2.39 (1.036)	2.13 (1.443)	126.079**	CN>CR>NE>NR.

Note. (m X), number of missing values per variable; ANOVA's $F^* = p < 0.05$; ** = $p < .001$; NS= no statistically significant.

Answer coding for disadvantages & coping plans: 1= Strongly disagree; 5= Strongly agree.; Answer coding for advantages & self-efficacy: 1= Strongly agree; 5= Strongly disagree; Answer coding for social norm: 1= I definitely can use cannabis; 5= I definitely cannot use cannabis; Answer coding for social modeling & pressure: 1= always; 5= never; Answer coding for intention: Surely no=+3, Surely yes=-3.

Discussion

This study is the first longitudinal research in Andalusia among adolescents aged 14–18 years that examines predisposing and sociocognitive determinants associated with recreational cannabis use, studying cannabis use risk profiles when comparing five groups according to cannabis use trajectory. Having boyfriend/girlfriend, sensation seeking personality, not being convinced about the disadvantages of cannabis use, having peer influence favoring cannabis use and a positive intention to use cannabis in the future were associated with cannabis use. Additionally, the new users showed more socio-cognitive perceptions favoring cannabis than non-users after 6 months follow-up.

Although we found a consistent pattern regarding the factors associated with cannabis use in the cross-sectional and longitudinal analysis, the introduction of the previous behavior in the model removed the significance of them, which could be related to the low incidence of cannabis use in a 6-month framework. Concerning the predisposing determinants, our results showed the significance at different times (baseline, follow-up, and longitudinal data) of having a boyfriend/girlfriend and a tendency to seek new sensations. Previous studies have already reported an increased likelihood of using cannabis if the boyfriend/girlfriend uses cannabis (Brook et al., 2011; Burdzovic Andreas et al., 2016). Therefore, it would be necessary to examine the frequency of cannabis consumption of the boyfriends / girlfriends of the participants to establish accurate associations. Furthermore, several studies have underlined that sensation seeking is a relevant predictor of cannabis use, as our results have done (Suárez-Maldonado et al., 2022). It will be relevant to provide adolescents with information on cannabis use risk situations and to brainstorm stimulant alternatives such as adventure sports activities or to encourage boredom tolerance.

Concerning sociocognitive determinants, low perception of disadvantages was consistently associated with cannabis use, working to emphasize with adolescents that detrimental effects may prevent the onset of cannabis use should be included in preventive interventions (Boden et al., 2020; Torrejón-Guirado et al., 2023b).

Although social influences have not shown a consistent association with cannabis use, many studies stated the importance of working on the norms and social modelling of peers, since adolescents tend to follow the subjective norms and behavior of their peer group (Guxens et al., 2007a; Pérez et al., 2010; Villanueva et al., 2021). This finding is also supported by sociocognitive theories explaining that adolescents tend to adopt social behavioral patterns as their own patterns (Jalilian et al., 2020). It will be important to encourage safe choices while providing healthy support for the autonomy of adolescents.

Our regression analyses only found an association between self-efficacy and cannabis use in the cross-sectional samples

but not in the longitudinal sample. This is contrary to other studies (Jalilian et al., 2020; Villanueva et al., 2021). This may have occurred because of its correlations with attitude, social influences and intention which may suppress the role of self-efficacy, in conjunction with the factors attitude and social influences). Additionally, most of the respondents are non-users who may not yet be able to fully grasp how easy or difficult it will be to stop using cannabis when they are not yet using it themselves. Our data may suggest that the adolescents may feel confident, whereas when it comes to the reality, in actual life they do not have the skills to refuse cannabis use. In other words, they think that they can refuse cannabis use, but when it comes to challenging situations, they appear not to have the skills nor the confidence. Yet, given the importance of self-efficacy exerted by previous studies, cannabis prevention programs should aim at forewarning adolescents of risky situations that may lead to cannabis use (e.g., boredom) and offer ideas about how to best cope with these situations, including developing action plans (Martinez-Montilla et al., 2020; Smit et al., 2018; Swart, 2006). Finally, by working on these proximal determinants, the intention to use cannabis could be reduced.

Regarding the second objective, which seeks to find the sociocognitive factors related to the different trajectories of cannabis use in the six-month follow-up, this study found a pattern that shows that the perceptions of new users about the sociocognitive factors related to cannabis use changed very quickly (at six-month follow-up). At the beginning of the study, there are many significant differences between consistent non-users and consistent users, but the perceptions of the non-users do not differ significantly from the new users. However, at six-month follow-up the scenario changes, still there are many significant factors, but now the differences in socio-cognitive factors are between nonusers and new users, being more marked with new regular users. In this pattern, it may be that participants were subject to rapid changes in cognitive structure due to adolescence, as previous research highlighted in regard to other risk behaviors (Vitoria et al., 2006). However, other studies reflected that this change is gradual (Boden et al., 2020; Epstein et al., 2015; Sznitman et al., 2015). Therefore, more research may be needed to clarify whether shorter follow-up periods are needed to observe the determinants associated with the cannabis use trajectories.

Finally, it would be specially recommended to introduce the approach to intention to use cannabis in the future, peer social modelling and norms, and disadvantages of cannabis use in the prevention of cannabis use due to they are the factors more associated in both times, as well as considering the rapid change in perceptions about cannabis use in adolescents in such kinds of programs. It is also recommended to incorporate additional items into the scales of the questionnaire to improve the predictability of cannabis consumption, as well as the development of validation studies with mixed methods.

Limitations and further research

First, the attrition rate was 44.6%. However, since the sample size was large enough, the attrition rate is expected to not have had much impact in the current study. A recommendation from this study to avoid the dropout for further studies is to administer the questionnaire at the beginning of the school year and academic quarter. Second, the 6-month follow-up was a short period to see which unique determinants were related to a clear change in behavior. Previous cannabis use behavior removed the significance of the remaining variables in the longitudinal analysis, and this may be because the incidence of cannabis use after 6 months was low. Therefore, we stick to the interpretation of longitudinal data without baseline cannabis use, as otherwise we may make a type II error. In contrast, six months could be a long period of time to detect clear risk profiles within the five groups because the use of cannabis by adolescents changed rapidly. It would be recommended to explore the determinants of cannabis use using shorter follow-up measures in long-term studies. Third, only a few experimental users ($N = 5$) at baseline became regular users, so we joined these five students with all non-users who became regular users to form the new group of regular users. Further studies should use a good sample size calculation to run the analysis separately for both groups. Fourth, it would be important to do validation studies. The included variables were not assessed by qualitative methods, neither by adolescents from different age and gender groups, so in order to include proper items that can explain cannabis use, we strongly recommend to do that.

Despite these limitations, this study also has strong points. First, longitudinal studies are a priority in epidemiological research that aims to relate risk behaviors to adverse health effects. Second, this longitudinal study points out the relevance of identifying increased risks among non-users to prevent the transition to experimental use, and these results can be used to formulate tailored, theoretically based interventions.

To this end, it is important to discuss with adolescents (1) the realistic perception of risk in seeking new sensations through cannabis consumption, (2) the knowledge of detrimental effects of cannabis use, (3) the adolescent's own criteria of empowerment to avoid being influenced by their peers, (4) self-efficacy in not using cannabis in specific social situations and moods, and (5) coping plans for when someone offers the adolescent a joint (e.g., through role-play techniques). Finally, prevention efforts for new users, either experimentally or regularly, should be developed since there is a greater probability that they will abandon its use, as other studies have shown (Boden et al., 2020; Chen & Kandel, 1998). In this sense, the intention approach is of vital importance, as previous research has shown (Guxens et al., 2007b; Martinez-Montilla et al., 2020).

Conclusions

Cannabis prevention for adolescents should be based on theory to understand the multifactorial nature of cannabis use. Some predisposing factors, such as having a boyfriend / girlfriend, a sensation seeking personality trait, and some sociocognitive factors, such as perceiving few disadvantages of cannabis use or having intention to use cannabis, were consistently associated with lifetime cannabis use in adolescents. Regarding the profiles for the different trajectories of cannabis use, they were found that there are significant different perceptions about the sociocognitive determinants of cannabis use, but this change quickly in a six-time follow-up term. At first, the perceptions of the consistent non-users differ mainly from the consistent users. Later, these differences are found between consistent non-users and new users. The finding of this study can be considering developing prevention strategies for the onset of cannabis use and the transition from experimental to regular use. Cannabis programs should take an integrative perspective, providing to adolescents skills to prevent desire to seek new sensations thought cannabis, reinforcing a negative attitude towards cannabis, and empowering adolescents to be able to cope with social influences favoring cannabis use with risky situations.

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Conflicts of interest

The authors declare that they have no conflict of interest.

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Appendix

Table 1

Differences between baseline characteristics between participants who did not abandon those who abandoned at 6 months of follow-up

Variable	Total	Retainers	Dropped out	χ^2/t -test	P value
Participants	N=1896	N=1051	N= 845		
Schools	N=20				
Classrooms	N=96				
Age (14-18) (mean, SD ^a) (m ^a 11)	15.48 (1.393)	15.29 (1.289)	15.73 (1.475)	6.976	.000
Sex (m 0)					
- Male	895 (47.2%)	491 (46.7%)	441 (52.32%)	.225	.644
- Female	1001 (52.8%)	560 (53.3%)	404 (47.8%)		
Adolescent Grade (m 0)					
- 9th Grade	474 (25%)	322 (30.6%)	151 (17.9%)	109.838	.000
- 10th Grade	581 (30.6%)	368 (35%)	213 (25.2%)		
- 11th Grade	362 (19.1%)	176(16.7%)	187 (22.1%)		
- 12th Grade	354 (18.7%)	130(12.4%)	224 (26.5%)		
- Vocational Training (VT)	125 (6.6%)	55 (5.2%)	70 (8.3%)		
Type of school (m 6)				12.554	.000
- Public school	1002 (53%)	519 (49.4%)	483 (57.6%)		
- Private school	888 (47%)	532(50.6%)	356 (42.4%)		
Academic Performance (m 0)				4.304	.366
- Fail (o to 4)	70 (3.7%)	39 (3.7%)	31 (3.7%)		
- Pass (5)	183 (9.7%)	106 (10.1%)	77 (9.1%)		
- Good (6)	482 (25.4%)	263 (25%)	219 (25.9%)		
- Notable (7 or 8)	800 (42.2%)	428 (40.7%)	372 (44%)		
- Excellent (9 or 10)	361 (19%)	215 (20.5%)	146 (17.3%)		
Boyfriend/girlfriend (m 0)					
- No	1401 (73.9%)	792 (75.4%)	609 (72.1%)	2.621	.105
- Yes	495 (26.1%)	259 (24.6%)	236 (27.9%)		
Nationality (m 0)					
- Spanish	1855 (97.8%)	1026 (97.6%)	829 (98.1%)	.521	.470
- Non-Spanish	41 (2.2%)	25 (2.4%)	16 (1.9%)		
Religion (m 0)					
- Religion	1117 (58.9%)	607 (57.8%)	510 (60.4%)	1.309	.253
- No religion	779 (41.1%)	444 (42.2%)	335 (39.6%)		
Family functioning (m 4)				1.555	.460
- Severely dysfunctional family	116 (6.1%)	59 (5.6%)	57 (6.8%)		
- Moderately dysfunctional family	327 (17.3%)	188 (17.9%)	139 (16.5%)		
- Highly functional family	1449 (76.6%)	801 (76.2%)	648 (76.8%)		
Weekly pocket money (mean, SD) (m 1)	13.25 (14.277)	12.66 (14.199)	13.99 (14.340)	2.025	.043
Mother Educational Level (m 0)					
- None	233 (12.3%)	123 (11,7%)	110 (13%)		
- Basic or primary school	355 (18.7%)	187 (17.8%)	168 (19.9%)	3.71	.446
- Secondary school	443 (23.4%)	242 (23%)	201 (23.3%)		
- University studies	627 (33.1%)	360 (34.3%)	267 (31.6%)		
- I do not have mother	238 (12.6%)	139 (13.2%)	99 (11.7%)		
Father Educational Level (m 0)					
- None	275 (14.5%)	144 (13.7%)	131 (15.5%)		
- Basic or primary school	407 (21.5%)	199 (18.9%)	208 (24.6%)	12.63	.013
- Secondary school	373 (19.7%)	221 (21%)	152 (18%)		
- University studies	550 (29%)	322 (30.6%)	228 (27%)		
- I do not have mother	291 (15.3%)	165 (15.7%)	126 (14.9%)		
Family affluence money (mean, SD) (m 1)	7.25 (2.702)	7.45 (2.709)	7.01 (2.677)	-3.465	.001
Self-esteem (mean, SD) (m 1)	28.89 (3.641)	29.01 (3.699)	28.74 (3.565)	-1.569	.117
Substance Use Risk Profile Scale (mean, SD) (m 0)					
- Hopelessness	20.83 (3.182)	20.90 (3.229)	20.74 (3.123)	-1.119	.261
- Impulsiveness	11.90 (2.978)	11.85 (3.059)	11.97 (2.875)	.894	.372
- Sensation seeking	16.63 (3.756)	16.54 (3.846)	16.73 (3.641)	1.082	.279
- Sensitivity to anxiety	9.63 (2.581)	(9.56 (2.641)	9.71 (2.503)	1.300	.194

Note. (m X): number of missing values per variable. SD= standard deviation.

