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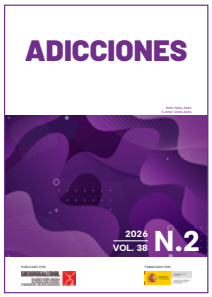

ORIGINAL

Personality factors associated with alcohol, tobacco and marijuana use in adolescents: A longitudinal study

Factores de personalidad asociados al uso de alcohol, tabaco y marihuana en adolescentes: Un estudio longitudinal

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Abstract

Longitudinal studies examining how personality variables predict substance use in adolescents in Latin America are scarce. This study examined variations in alcohol, tobacco, and cannabis use over three years among Argentinian adolescents, and assessed how impulsivity and risk-taking (at Time 1) prospectively discriminate between adolescents with and without binge drinking, tobacco and cannabis use at Time 3. A longitudinal design was employed. A total of 1080 adolescents (*M*=12.27 years, *SD*=0.952; 54% girls) from Córdoba (Argentina) completed, once per year for three years, a risk-taking task (BART) and a survey assessing substance use and trait impulsivity. Drug use increased over time, reaching lifetime prevalence rates of 85% (alcohol), 18% (tobacco), and 8% (cannabis) at the final assessment. Tobacco use was significantly higher ($p \leq .05$) among girls and cannabis use was higher ($p \leq .01$) among boys. Higher levels of negative urgency (PR = 1.023), lack of premeditation (PR = 1.025), lack of perseverance (PR = 1.045), sensation seeking (PR = 1.036), and risk-taking (PR = 1.008) at baseline were associated with a higher prevalence of BD two years later. Higher levels of lack of perseverance (PR = 1.033) and sensation seeking (PR = 1.029) were associated with a higher subsequent prevalence of tobacco use. Lack of premeditation (PR = 1.057), lack of perseverance (PR = 1.042), sensation seeking (PR = 1.033), and risk-taking (PR = 1.019) were associated with a higher subsequent prevalence of marijuana use. Adolescents with higher levels of impulsivity and risk-taking constitute a relevant subpopulation for the design of preventive interventions aimed at delaying the onset and progression towards problematic substance use.

Keywords: alcohol, tobacco, marijuana, adolescents, impulsivity, risk-taking

Resumen

Son escasos los estudios longitudinales que, en Latinoamérica, describen como las variables de personalidad predicen el consumo de sustancias en adolescentes. Este estudio examinó variaciones en el consumo de alcohol, tabaco y marihuana, a lo largo de tres años, en adolescentes, y analizó como la impulsividad y toma de riesgos (en el Tiempo 1 [T1]) discriminan prospectivamente entre adolescentes con y sin consumo episódico excesivo de alcohol (BD, binge drinking), tabaco y marihuana en el Tiempo 3. Se utilizó un diseño longitudinal. Mil ochenta adolescentes (*M*=12,27 años, *DE*=0,95; 54% chicas) de Córdoba (Argentina) completaron, una vez por año durante tres años, una prueba de toma de riesgos (BART) y una encuesta sobre consumo de sustancias e impulsividad rasgo. El consumo de sustancias aumentó con el tiempo, alcanzando prevalencias de consumo alguna vez en la vida de 85% (alcohol), 18% (tabaco) y 8% (marihuana) en la última medición. El consumo de tabaco fue significativamente mayor en chicas ($p \leq 0,05$) y el de marihuana más alto en chicos ($p \leq 0,01$). Mayores niveles de urgencia negativa (RP = 1,023), falta de premeditación (RP = 1,025), falta de perseverancia (RP = 1,045), búsqueda de sensaciones (RP = 1,036) y toma de riesgos (RP = 1,008) en T1 se asociaron con una mayor prevalencia de BD dos años después. Mayores niveles de falta de perseverancia (RP = 1,033) y búsqueda de sensaciones (RP = 1,029) se asociaron con una mayor prevalencia posterior de consumo de tabaco. Falta de premeditación (RP = 1,057), falta de perseverancia (RP = 1,042), búsqueda de sensaciones (RP = 1,033) y toma de riesgos (RP = 1,019) se asociaron con una mayor prevalencia posterior de consumo de marihuana. Las personas adolescentes con mayores niveles de impulsividad y toma de riesgos constituyen una subpoblación relevante para el diseño de intervenciones preventivas orientadas a retrasar el inicio y progresión hacia comportamientos de uso problemático.

Palabras clave: alcohol, tabaco, marihuana, adolescentes, impulsividad, toma de riesgos

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Alcohol, tobacco, and marijuana use typically begins between the ages of 12 and 17 years. In Spain, by age 14,55% of adolescents had consumed alcohol, 13.8% tobacco, and 9.8% marijuana in the previous year (OEDA, 2024), with similar figures reported in South America and Argentina (SEDRONAR, 2019). During adolescence, compared with adulthood, alcohol use tends to be less frequent but involves larger quantities per drinking occasion (National Institute on Alcohol Abuse and Alcoholism [NIAAA], 2017). One underlying reason for this phenomenon is that adolescents are more likely to display a high-risk drinking pattern known as binge drinking (BD). From an epidemiological perspective (Ministerio de Salud de la Nación Argentina, 2025; OEDA, 2024), BD is defined as the consumption of ≥5 standard alcohol units (SAUs). However, international agencies recommend operationalising BD according to sex and age, establishing cut-off points of ≥3 SAUs (42 grams of alcohol) for girls and between ≥3 and 5 SAUs (42 to 70 grams of alcohol) for boys, depending on age (NIAAA, 2017).

Of particular relevance, studies with adolescents have reported that between 26% and 47% (Addolorato et al., 2018; OEDA, 2024; Pilatti et al., 2023; SEDRONAR, 2023; Teixidó-Compañó et al., 2019) engaged in BD during the previous month. BD, as well as tobacco and marijuana use, has been associated with numerous negative outcomes, including increased aggressiveness, fighting, and driving under the influence of substances (Donoghue et al., 2017; OPS, 2021), as well as cognitive deficits (Lees et al., 2020; Meruelo et al., 2017; Smith et al., 2015; Spear, 2018) and a greater likelihood of developing substance use disorders (Walker & Loprinzi, 2014; Waller et al., 2019).

Over the last decade, the gap in alcohol use between boys and girls has narrowed (White, 2020). Illustrating this, a study conducted with adolescents (M age = 15.26 years, SD = 1.26) found very similar prevalence rates of alcohol use among boys and girls during the previous year (75.5% and 76.8%, respectively), as well as BD in the previous month (43.5% and 49.1%, respectively) (Pilatti et al., 2023). Regarding tobacco use, girls even show higher monthly prevalence rates than boys (≈20% vs. ≈15%; Ministerio de Salud de la Nación Argentina, 2020; OEDA, 2024). However, boys tend to initiate smoking earlier, usually in peer contexts, whereas girls more often initiate use in family settings (Okoli et al., 2013). In relation to marijuana, use is more prevalent among boys (18.8% vs. 13.2%), who also display riskier consumption patterns than girls (SEDRONAR, 2017).

Impulsivity and risk-taking tend to increase during adolescence, partly because brain areas associated with the reward system mature earlier than those involved in cognitive control (Shulman et al., 2016). In addition, socialisation processes, peer interaction, and cultural norms, including gender roles, shape the expression of these behaviours (Allen, 2024; Wang et al., 2025). For example, boys are often socialised to take risks and display aggression, whereas girls are more frequently socialised to adopt coping or avoidance responses in risky situations (Hemsing & Greaves, 2020; Man, 2024). Impulsivity and risk-taking, understood as components of the broader disinhibition construct (Reynolds et al., 2013), are associated with a greater likelihood of psychoactive substance use (Caneto et al., 2020; Hanson et al., 2014; LaSpada et al., 2020; Martínez-Loredo et al., 2018).

Impulsivity is the tendency to act rapidly and without planning in response to internal or external stimuli, without adequately considering possible negative consequences (International Society for Research on Impulsivity, 2021). It is a multidimensional construct that includes facets related to sensation seeking, the tendency to act under intense emotions, and difficulties in behavioural planning. Evidence suggests that each facet predicts different indicators (e.g., frequency, quantity, problems) of substance use (Bos et al., 2019; Pilatti et al., 2017; VanderVeen et al., 2016). Likewise, Rømer Thomsen et al. (2018) showed that specific dimensions of impulsivity were differentially associated with problematic alcohol, marijuana, and other substance use.

Risk-taking, which is closely linked to impulsivity, may be understood as the propensity to choose courses of action in which the probability of outcomes is uncertain (Duell et al., 2018) and which may compromise one's own wellbeing or that of others (Hawley, 2011). Some international studies have shown that risk-taking is associated with the use of alcohol (Fernie et al., 2013; MacPherson et al., 2010) and marijuana (Felton et al., 2015; Hanson et al., 2014) in adolescents. In Argentina, a study with adolescents aged 15 to 18 years (Pilatti et al., 2017) found that trait impulsivity was associated with alcohol quantity and BD frequency reported three months later. However, in that study, risk-taking was not significantly associated with any alcohol use indicator. Another study found that peer presence may increase risk-taking, particularly among boys (De Boer et al., 2017).

Most of the studies described above employed cross-sectional designs. In addition, most longitudinal studies have been conducted in the United States (Felton et al., 2015; MacPherson et al., 2010) or Europe (Fernie et al., 2013; Martínez-Loredo et al., 2018), limiting the generalisability of findings to other cultural contexts. In Argentina, for example, moderate alcohol use has a certain degree of social legitimacy, and early drinking experiences often occur within family contexts (Pilatti et al., 2013). It is therefore necessary to examine potential risk factors for early substance use that may be useful for the development of culturally sensitive interventions (Henrich et al., 2010).

The aims of this study, conducted with adolescents, were to: (1) describe indicators of alcohol, tobacco, and

marijuana use across three measurement waves; (2) analyse changes in substance use as a function of time and sex; and (3) examine the prospective association between personality variables (impulsivity and risk-taking) and the prevalence of tobacco use, marijuana use, and BD two years later. To the best of our knowledge, there is limited regional literature on longitudinal monitoring of the use of these substances and the predictive capacity of personality traits. The present study contributes to the early identification of adolescents who may be more vulnerable to initiating or escalating the use of these substances.

Method

Design

A longitudinal panel design was employed (Hernández Sampieri et al., 2014). The design featured three administrations of all instruments to the same participants, separated by approximately 12 months.

Participants

Based on the official list of schools in the city of Córdoba (Argentina), all institutions located within a 10 km² radius of the downtown area were invited (n = 46). Final selection was based on convenience (e.g., having a computer lab) and opportunity (i.e., willingness to participate). Ten privately managed schools took part (13 did not have a computer room and 23 declined participation).

Students attending the final year of primary school (Year 6) and the first two years of secondary school were invited. An informed consent form was sent to parents/legal guardians, and 71% provided permission. In addition, students who agreed to participate provided voluntary assent, with only 1.2% declining participation.

At baseline, the sample comprised 1,080 students aged between 10 and 15 years (M = 12.27, SD = 0.952), with a higher proportion of girls (54%) than boys. In the second year, 973 students aged between 11 and 16 years participated (54.6% girls; M = 13.30, SD = 0.957), and in the third wave, 873 students aged between 12 and 17 years took part (54.4% girls; M = 14.34, SD = 0.974). Supplementary Material presents the age distribution of participants at each of the three waves. The Supplementary Material is available in OSF at https://doi.org/10.17605/OSF.IO/7YHSC

Procedure

This study was part of the MATE project (Marijuana, Alcohol and Tobacco in Schools Study), which examined substance use among adolescents in Córdoba (Argentina). Data collection was conducted in groups of approximately 15 students in each school's computer room. Each year, participants completed the BART and an online survey (LimeSurvey platform). Data were collected over a four-month period (August to November) across three consecutive years (2017–2019). To encourage participation, prizes were raffled each year among students who completed the survey (e.g., thermal mugs, boxes of alfajores [caramel cookies], mates [containers used for a traditional Argentinian beverage]). Study procedures were approved by the Ethics Committee of the Institute for Psychological Research (CEIIPsi), Faculty of Psychology, National University of Córdoba.

Measures

Alcohol Use

Alcohol use was assessed using a questionnaire (Pilatti et al., 2021) that examined the prevalence (0 = no; 1 = yes) of lifetime and last-year alcohol use (≥1 glass). Three additional questions assessed the beverage most frequently consumed: (1) type (e.g., beer, wine), (2) frequency of use during the previous year (ranging from 0 = I have never drunk alcohol/I did not drink during the last 12 months to 12 = four times per week or more), and (3) number of glasses consumed on a single occasion. Based on the alcoholic content of the reported beverage (previously determined using market information), the grams of pure alcohol consumed were calculated. Prevalence and frequency of binge drinking (BD) were measured. BD was defined as the consumption, on a single occasion, of 3 standard alcohol units (SAUs; i.e., 42 grams of alcohol) among girls aged 9 to 17 years. For boys, thresholds varied according to age: 3 SAUs (42 grams of alcohol) for boys aged 9 to 13 years, 4 SAUs (56 grams of alcohol) for those aged 14 and 15 years, and 5 SAUs (70 grams of alcohol) for those aged 16 and 17 years (NIAAA, 2017). Responses regarding alcohol use frequency and BD frequency were converted into quantitative variables (e.g., a response of 1–2 times in the previous year was recoded as 1.5 times). For regression analyses (see Data Analysis section), participants were classified as drinkers with or without BD according to their reported BD prevalence during the previous year at Time 3.

Tobacco Use

Participants were asked about the prevalence (0 = no; 1 = yes) of lifetime and last-year smoking (≥1 whole cigarette). Frequency of tobacco use during the previous year was assessed (from 0 = I have never smoked/I did not smoke during the previous 12 months to 12 = four times per week or more), as well as the number of cigarettes smoked per day. This ordinal variable was transformed into a quantitative variable through response recoding (e.g., 1–2 times in the previous year was recoded as 1.5). For regression analyses, participants were classified as users or non-users according to their reported tobacco use prevalence during the previous year at Time 3.

Marijuana Use

Participants were asked about the prevalence (0 = no; 1 = yes) of lifetime and last-year marijuana use (e.g., "During the previous 12 months, have you used marijuana at least once?"). Frequency of marijuana use during the previous year was also assessed (from 0 = I have never used marijuana/I did not use marijuana during the previous 12 months to 12 = four times per week or more). This ordinal variable was transformed into a quantitative variable through response recoding (e.g., 1–2 times in the previous year was recoded as 1.5). For regression analyses, participants were classified as users or non-users according to their reported marijuana use prevalence during the previous year at Time 3.

UPPS-P Impulsivity Scale for Children and Adolescents.

The Spanish version (UPPS-P NA; Caneto et al., 2020) of the UPPS-P-Child scale (Gunn & Smith, 2010) was used. This instrument consists of 40 items designed to assess five dimensions of impulsivity: Positive Urgency, Negative Urgency, Lack of Perseverance, Lack of Premeditation, and Sensation Seeking. Participants rated the extent, on a 4-point scale (from 1 = not at all like me to 4 = very much like me), to which each item described their behaviour. Responses were summed within each dimension, with higher scores indicating higher levels of impulsivity. The original version (α = .65 to α = .89; Gunn & Smith, 2010), the Spanish adaptation (α = .73 to α = .89; Caneto et al., 2020), and the present study (α = .69 to α = .90) all showed acceptable reliability values for the population under study.

Balloon Analogue Risk Task (BART).

The Balloon Analogue Risk Task (BART; Lejuez et al., 2003) was used to assess risk-taking propensity. The task is computer-based and consists of 30 trials in which participants inflate a balloon by clicking the mouse. Five points are earned for each pump; however, each balloon has a variable and unknown explosion point. Each trial ends when the participant decides to bank the accumulated points or when the balloon explodes, resulting in the loss of points earned during that trial. The principal dependent measure was the adjusted average number of pumps (i.e., the mean number of pumps on balloons that did not explode), with higher scores indicating greater risk-taking propensity. The task was administered using The Psychology Experiment Building Language Test Battery software (Mueller & Piper, 2014).

Data Analysis

Descriptive analyses of alcohol, tobacco, and marijuana use were conducted for each of the three waves, separately for the total sample and by sex. Specifically, lifetime and last-year prevalence (nominal variables) of use of the three substances were calculated, as well as means and standard deviations describing frequency and quantity (quantitative variables) of use for each substance (quantity of marijuana use was not assessed). To determine changes in lifetime and annual prevalence of alcohol, tobacco, and marijuana use across the three waves, differences in proportions for these nominal variables were examined. To analyse sex differences and changes over time in quantity (alcohol and tobacco) and frequency (alcohol, tobacco, and marijuana) of use, repeated-measures ANOVAs were conducted. Sex (boys, girls) was included as a between-subjects factor, and time (Time 1 [T1], Time 2 [T2], and Time 3 [T3]) as a within-subjects repeated-measures factor. ANOVAs showing significant main effects or significant interactions were followed by Tukey post hoc tests to identify the locus of these effects. Effect size was reported using partial eta squared (η^2p).

To examine the association between trait impulsivity dimensions and risk-taking measured at T1 (independent quantitative variables) and the prevalence of BD/tobacco/marijuana use during the previous year at T3 (dichotomous nominal dependent variable [yes/no]), Poisson regression models with a log link function and robust variance estimation were used. This approach allows estimation of prevalence ratios (PRs) rather than odds ratios, which is more appropriate in studies where event prevalence is not low, as odds ratios tend to diverge from the real effect in terms of prevalence and usually overestimate the magnitude of association (Espelt et al., 2017; Espelt et al., 2019). Specifically, trait impulsivity dimensions and risk-taking measured at T1 were entered as independent variables, and consumption status (use vs. no use) at T3 was entered as the dependent variable. The analysis identified which variables were significantly associated with prevalence of use, and PRs together with their 95% confidence intervals (CIs) were estimated. Overall model fit was evaluated using the likelihood ratio chi-square test, where a significant value indicates that the model with predictors provides better fit than the null model. The deviance ratio and Pearson chi-square statistic relative to their degrees of freedom were also examined as indicators of overdispersion. Values close to 1 were considered indicative of adequate fit, whereas values above 1 suggested overdispersion (Hardin & Hilbe, 2018).

Regressions with BD (yes/no) as the dependent variable were conducted using the full sample. For tobacco and marijuana regressions, given the low prevalence of use at T3 (16% and 8% of the total sample, respectively), random subsamples of non-users were generated to balance the number of cases between comparison groups (users vs. non-users). The tobacco regression subsample comprised 296 participants (47.2% had used tobacco during the previous year), whereas the marijuana regression subsample comprised 111 participants (49.3% had used

marijuana during the previous year). It should be noted that participants who had already reported substance use behaviours at T1 were not excluded, as the aim was to analyse the discriminative capacity of personality variables regardless of initial level of use. Likewise, T1 and T3 were compared in order to evaluate the predictive value of personality traits for substance use over a broader longitudinal period. Repeated-measures ANOVAs were conducted using STATISTICA version 10, and all remaining analyses were performed using SPSS version 23.

Results

Descriptive Results and Group Differences

Lifetime and Last-Year Prevalence of Alcohol, Tobacco, and Marijuana Use Across Assessment Waves

Table 1 presents indicators of lifetime and last-year prevalence of alcohol, BD, tobacco, and marijuana use, as well as annual frequency of use, across the three assessment waves. The table also reports the quantity of alcohol consumed per occasion (expressed in grams) and the number of tobacco cigarettes smoked per day. Alcohol was the most commonly used substance at the beginning of the study (T1), alcohol was the most commonly used substance (66%), followed by markedly lower rates of tobacco (8.3%) and marijuana use (1.5%).

At T1, more than two thirds of adolescents reported having consumed alcohol at least in their lifetime. This percentage increased significantly to 73% at T2 ($p \leq .01$) and to 85% at T3 ($p \leq .001$). Last-year alcohol use prevalence was 42% at T1 and also showed a significant increase over time: 56% at T2 ($p \leq .001$) and 69% at T3 ($p \leq .001$). Among those reporting alcohol use during the previous year, lifetime prevalence of BD was 19% at T1, increasing to 31% at T2 ($p \leq .01$) and to 40% at T3 ($p \leq .05$). Similarly, the percentage of participants reporting BD during the previous year increased significantly, rising from 16% at T1 to 29% at T2 ($p \leq .01$) and to 38% at T3 ($p \leq .05$).

Eight percent of the sample reported lifetime tobacco use at T1, increasing to 14% at T2 and 18% at T3. Although a higher percentage of participants reported tobacco use over time in descriptive terms, these changes

Table 1
Descriptive statistics for alcohol, tobacco, and marijuana use across the three waves for the total sample and by sex

	Time 1 (*n*= 1080; *M age*= 12.27; SD= 0.95)			Time 2 (*n*= 973; *M age*= 13,29; SD= 0,95)			Time 3 (*n*= 873; *M age*= 14,33; SD= 0,96)		
	% total (*n*) *M* (*SD*)*	Boys	Girls	% total (*n*) *M* (*SD*)*	Boys	Girls	% total (*n*) *M* (*SD*)*	Boys	Girls
Alcohol									
Lifetime	66.4 (717)	67.9	65.1	73.1 (711)	71.9	74.2	84.9 (741)	83.2	86.3
Last year	41.5 (448)	41.9	41.1	55.8 (542)	54.3	57.1	69.0 (602)	65.3	72
Gr occasion[a]	31.8 (41.4)	30.0 (42.3)	33.3 (40.6)	42.0 (49.3)	41.9 (51.6)	41.9 (47.5)	53.6 (51.9)	54.5 (56.8)	53.0 (47.7)
Freq 12M[a]	16.1 (30.8)	17.9 (35.1)	14.6 (26.5)	18.6 (30.3)	18.8 (32.3)	18.5 (28.6)	19.2 (30.8)	22.1 (35.3)	17.0 (26.7)
BD									
Lifetime	18.6 (201)	18.3	18.8	30.9 (300)	27.8	33.3	40.0 (349)	34.9	44.2
Last year	15.9 (172)	15.1	16.6	28.6 (278)	25.6	31.1	37.9 (331)	31.9	42.9
Freq 12M[a]	8.1 (23.9)	9.5 (28.5)	6.8 (19.2)	11.6 (26.0)	11.5 (27.7)	11.8 (25.0)	13.1 (29.1)	13.7 (31.2)	12.6 (26.9)
Tobacco									
Lifetime	8.3 (89)	7.9	8.6	13.8 (134)	12	15.3	18.3 (160)	13.1	22.7
Last year	5.9 (64)	5.8	6	12.7 (123)	10.4	14.5	16.3 (142)	11.8	20
Cig. Per day[a]	3.6 (6.1)	4.8 (8.7)	2.7 (2.4)	4.9 (6.7)	4.4 (6.7)	5.3 (6.7)	3.9 (5.4)	3.9 (6.3)	3.9 (4.9)
Freq 12M[a]	40.7 (59.7)	50.2	32.7 (48.6)	39.6 (59.6)	31.2 (54.8)	44.6 (62.1)	43.8 (59.2)	39.1 (53.7)	46.1 (61.8)
Marijuana									
Lifetime	1.5 (16)	2.2	0.9	3.2 (31)	4.1	2.4	8.1 (71)	8.5	7.8
Last year	1.0 (11)	1.4	0.7	2.9 (28)	3.4	2.4	7.6 (66)	7.6	7.6
Freq 12M[a]	16.9 (29.5)	22.6 (36.5)	7 (5.8)	38.8 (66.9)	60.9 (83.2)	13.3 (26.6)	20.2 (40.4)	30.2 (54.5)	11.8 (20.3)

Note. *Depending on the level of measurement, values are expressed as absolute frequency (n), relative frequency (%) or mean (standard deviation). Lifetime = lifetime prevalence of use; Last year = prevalence of use during the previous year; Grams per occasion = grams of alcohol consumed per drinking occasion; Freq 12M = frequency during the previous 12 months; BD = binge drinking; Cig. per day = number of cigarettes smoked per day. [a]Calculated among participants who reported use of the substance.

were not statistically significant. The same pattern was observed for past-year tobacco use prevalence. Marijuana use prevalence was markedly lower than that observed for alcohol and tobacco. Specifically, lifetime prevalence was 1.5% at the first assessment, 3.2% at the second, and 8.1% at T3. Past-year marijuana use prevalence did not show a significant increase across assessment waves. Descriptive analyses for each variable by age group, at each of the three time points, are presented in section Supplementary Material of this manuscript.

Quantity and Frequency of Alcohol, Tobacco, and Marijuana Use by Sex and Across Time

The ANOVA for quantity of alcohol consumed per occasion revealed a significant main effect of Time, ($F_{2, 1708}$ = 151.7, $p \leq .001$, $\eta^2p = .15$). Post hoc analyses indicated that all three time points differed significantly from one another, showing increased consumption over time.

A significant main effect of Time was found for frequency of alcohol use during the previous year, ($F_{(2, 1712)}$ = 6.03, $p \leq .01$, $\eta^2p = .01$). However, post hoc analyses indicated no statistically significant difference between measurement waves.

For BD frequency during the previous year, a significant main effect of Time was observed, ($F_{(2, 1712)} = 9.81, p \leq .001$, $\eta^2p = .01$). According to post hoc analyses, BD frequency increased significantly across each of the three waves.

Regarding tobacco use, the ANOVA for number of cigarettes smoked per day showed a significant main effect of Time, ($F_{(2, 1698)}$ = 12.74, $p \leq .001$, $\eta^2p = .01$), with the value recorded at T1 being significantly lower than at T2 and T3.

The ANOVA for tobacco use frequency during the previous year showed significant main effects of Sex, ($F_{(1, 854)}$ = 5.01, $p \leq .05$, $\eta^2p = .01$), and Time, ($F_{(2, 1708)}$ = 20.47, $p \leq .001$, $\eta^2p = .02$). Tobacco use frequency was significantly higher among girls than boys and increased across measurement waves.

The ANOVA for marijuana use frequency revealed significant main effects of Sex ($F_{(1, 855)}$ = 7.16, $p \leq .01$, η^2p = .01), and Time, ($F_{(2, 1710)}$ = 12.69, $p \leq .001$, $\eta^2p = .01$). Marijuana use frequency was significantly higher among boys than girls. In addition, there was a significant increase from T1 to T3, whereas marijuana use frequency at T2 was statistically similar to both T1 and T3.

Poisson Regression with Log Link Function and Robust Variance

Adolescents With and Without Past-Year Binge Drinking

The Poisson regression model showed adequate fit to the data (χ^2 = 47.98, $p < .001$). The deviance/degrees of freedom ratio (0.684) and the Pearson chi-square/degrees of freedom statistic (0.608) indicated adequate model fit, with no evidence of overdispersion. Among the variables included, higher scores at T1 on Negative Urgency (PR = 1.023), Lack of Premeditation (PR = 1.025), Lack of Perseverance (PR = 1.045), Sensation Seeking (PR = 1.036), and risk-taking (PR = 1.008) were significantly associated with higher prevalence of BD at T3 (see Table 2).

Adolescents With and Without Past-Year Tobacco Use

The Poisson regression model showed adequate fit to the data (χ^2 = 15.10, $p < .05$). The deviance/degrees of freedom ratio (0.675) and the Pearson chi-square/degrees of freedom statistic (0.538) indicated satisfactory model fit, with no evidence of overdispersion. Among the included variables, higher T1 scores on Lack of Perseverance (PR = 1.033) and Sensation Seeking (PR = 1.029) were

Table 2

Prevalence ratios comparing adolescents with and without substance use for the variables binge drinking, tobacco use, and marijuana use

	RP	CI 95%	
		Lower	Upper
Binge Drinking			
Trait impulsivity			
NEG URG	**1.023**	**1.003**	**1.043**
LACK PREM	**1.025**	**1.001**	**1.048**
LACK PERS	**1.045**	**1.023**	**1.069**
SENS SEEK	**1.036**	**1.017**	**1.055**
POS URG	1.003	0.984	1.022
Risk-taking	**1.008**	**1.001**	**1.014**
Tobacco			
Trait impulsivity			
NEG URG	1.019	0.993	1.047
LACK PREM	1.019	0.988	1.052
LACK PERS	**1.033**	**1.003**	**1.064**
SENS SEEK	**1.029**	**1.003**	**1.057**
POS URG	1.012	0.986	1.039
Risk-taking	1.002	0.993	1.011
Marijuana			
Trait impulsivity			
NEG URG	1.010	0.972	1.049
LACK PREM	**1.057**	**1.011**	**1.105**
LACK PERS	**1.042**	**1.007**	**1.079**
SENS SEEK	**1.033**	**1.001**	**1.066**
POS URG	1.000	0.967	1.035
Risk-taking	**1.019**	**1.009**	**1.030**

Note. PR = prevalence ratio; CI = confidence interval; NEG URG = Negative Urgency; LACK PREM = Lack of Premeditation; LACK PERS = Lack of Perseverance; SENS SEEK = Sensation Seeking; POS URG = Positive Urgency. Statistically significant results at $p \leq .05$ are shown in **bold**.

significantly associated with higher prevalence of tobacco use at T3 (see Table 2).

Adolescents With and Without Past-Year Marijuana Use

The Poisson regression model showed adequate fit to the data ($\chi^2 = 17.45$, $p < .01$). The deviance/degrees of freedom ratio (0.599) and the Pearson chi-square/degrees of freedom statistic (0.513) indicated satisfactory model fit, with no evidence of overdispersion. Of all variables included, higher T1 scores on Lack of Premeditation (PR = 1.057), Lack of Perseverance (PR = 1.042), Sensation Seeking (PR = 1.033), and risk-taking (PR = 1.019) were significantly associated with higher prevalence of marijuana use at T3 (see Table 2). In other words, higher baseline levels of these impulsivity dimensions and risk-taking were associated with a greater likelihood of marijuana use at the end of follow-up.

Discussion

One of the aims of this longitudinal study was to describe and examine changes in alcohol, tobacco, and marijuana use among adolescents (aged 10 to 15 years at baseline) across three annual assessment waves. Of particular relevance, we found that two thirds (66%) of the sample (M age = 12 years) had already had contact with alcohol at the beginning of the study, increasing to 85% at the third assessment. These percentages are even higher than those reported in national (SEDRONAR, 2017) and international surveys (OEDA, 2024), in which between 46% and 58% of adolescents aged 12 to 14 years and between 79% and 81% of those aged 15 to 16 years had consumed alcohol at least once in their lifetime. Notably, average alcohol consumption (among those who drank) increased from 31.8 grams per occasion (equivalent to two glasses of beer) at baseline to 53.6 grams (equivalent to four glasses of beer, corresponding to BD) at T3. Likewise, average drinking frequency increased by three days per year, rising from 16 to 19 drinking days annually.

The percentage of adolescents reporting lifetime tobacco and marijuana use increased from 8.3% and 1.5%, respectively, at baseline to 18.3% and 8.1% at T3. These values are markedly lower than those reported by the Argentine Observatory on Drugs (SEDRONAR, 2019), where 20.6% and 5.7% of adolescents aged up to 14 years reported tobacco and marijuana use, respectively, whereas those aged 15 to 16 years showed prevalence rates of 41.2% and 18.7%. A noteworthy finding of our study concerns the frequency of use of these substances. Tobacco use increased from three times per month at the first assessment to almost once per week at T3, whereas marijuana use increased from once per month to twice per month at the final assessment.

The increase in substance use observed across waves likely reflects developmental changes associated with age. In this regard, the transition from preadolescence to middle adolescence constitutes a critical period for the initiation and escalation of substance use (Spear, 2018). Several studies have shown that both prevalence and frequency of use increase with age (Aiken et al., 2018; Johnston et al., 2021; Pilatti et al., 2023). It is worth highlighting that one of the main contributions of this study is the longitudinal documentation of these changes in a cohort of Argentine adolescents. Specifically, the study contributes to understanding factors that may promote escalation of use during this developmental stage.

When analysing substance use according to sex, the findings are consistent with national (Ministerio de Salud de la Nación Argentina, 2020; Pilatti et al., 2023; SEDRONAR, 2017) and international studies (Johnston et al., 2021; OEDA, 2024; OPS, 2021; White, 2020). Specifically, alcohol use behaviours were similar among boys and girls over time, whereas tobacco use was higher among girls and marijuana use was higher among boys across waves. Some studies have reported that, compared with boys who smoke, girls who smoke experience stronger psychological effects during abstinence (Faulkner et al., 2018), are more likely to relapse under stress (Xu et al., 2008), and show greater difficulty maintaining long-term abstinence (Smith et al., 2016).

Another aim was to examine the prospective association between personality variables (impulsivity and risk-taking) and prevalence of substance use two years later. Regarding alcohol, all dimensions of trait impulsivity except Positive Urgency, as well as risk-taking, were associated with greater prevalence of BD. These findings partially coincide with longitudinal studies from other countries. For example, studies in samples of US adolescents have shown that impulsivity in general (Farley & Kim-Spoon, 2015), urgency traits (Riley et al., 2016), Lack of Premeditation, and Sensation Seeking (Ellingson et al., 2019) were associated with greater subsequent alcohol use frequency. In Spain, Fernández-Artamendi et al. (2018) found that higher levels of impulsivity and Sensation Seeking predicted greater frequency of intoxication episodes and alcohol-related problems in adolescents (M age = 13.02 years, SD = 5.07). In Argentina, Pilatti et al. (2017) found that only Positive and Negative Urgency were associated with later alcohol use (typical use and BD), although that study included only two waves separated by three months. In general, studies examining alcohol use and risk-taking (using the BART) have not reported significant associations or effects of alcohol use on subsequent risk-taking (see review by Canning et al., 2022). In this sense, a novel finding of the present study concerns the role of risk-taking in involvement in problematic drinking patterns such as BD.

Regarding tobacco use, adolescents who showed a greater tendency to seek novel sensations (Sensation Seeking) and greater difficulty persisting with long and boring tasks (Lack of Perseverance) displayed higher prevalence of tobacco use two years later. Consistent with our findings, several international studies have shown that higher levels of impulsivity in adolescents distinguish between those with and without tobacco use (Fields et al., 2009; Reynolds et al., 2007; Weckler et al., 2017), as well as predicting later tobacco use (Farley & Kim-Spoon, 2015; Malmberg et al., 2013). Moreover, a meta-analysis (Bos et al., 2019) found that all UPPS-P dimensions were positively associated with tobacco use in adolescents, although Sensation Seeking was the most strongly associated dimension (r = .20), consistent with the present findings. Another study (Zhao et al., 2019) found that Sensation Seeking positively predicted tobacco as well as alcohol use in adolescents aged 11 to 16 years.

In turn, a greater tendency to act without considering consequences (Lack of Premeditation), greater tendency to seek novel sensations (Sensation Seeking), greater difficulty persisting with long and boring tasks (Lack of Perseverance), and higher risk-taking were associated with greater prevalence of marijuana use two years later. These findings are consistent with a meta-analysis in adolescent populations showing associations between trait impulsivity dimensions and marijuana use, as well as related problems (VanderVeen et al., 2016). Likewise, previous studies have found that risk-taking distinguishes between individuals with and without marijuana use, being higher among users (Hanson et al., 2014), and predicts increases in use over time (Felton et al., 2015). It has also been reported that greater risk-taking is associated with lower likelihood of discontinuing use during youth (LaSpada et al., 2020). According to LaSpada et al., difficulties in processing risks associated with behaviour may contribute to greater subsequent use, as the ability to consider long-term consequences may be diminished. This is in line with our findings, as greater difficulty considering consequences (Lack of Premeditation) was also associated with higher prevalence of marijuana use.

This study has several limitations. Although all schools located within the predefined geographical radius were invited to participate, schools were not selected through a random procedure but through self-selection, and public schools were not included. These factors limit sample representativeness. Although the study included a large sample and adequate sex representation, findings should be interpreted with caution, as the observed prevalence rates and associations may reflect a specific socioeconomic profile, limiting generalisability, particularly to adolescents attending schools with fewer resources. In addition, trait impulsivity and substance use were assessed through self-report measures, which depend on participants' ability to accurately evaluate their own personality traits and may lead to imprecise estimates of use because of recall bias. Another limitation is that the number of participants reporting substance use (especially tobacco and marijuana) prevented multivariate analyses stratified by sex. Future studies should aim to obtain even larger samples allowing differential analyses by sex. Furthermore, other variables that may have influenced substance use behaviours were not considered. For example, social norms (Pilatti et al., 2021) or expectancies regarding substance use (Smit et al., 2018) may have acted as mediating variables in the relationship between personality factors and substance use (Paternó Manavella et al., 2022; Pearson & Hustad, 2014). Future studies should integrate these variables. Finally, the definition of a standard alcohol unit shows some geographical variability. For example, in Spain it is equivalent to 10 grams of alcohol (Valencia Martín et al., 2014), whereas in Argentina it usually corresponds to approximately 14 grams (Ministerio de Salud de la Nación Argentina, 2025). These differences represent a limitation when comparing prevalence rates across countries.

Despite these limitations, the present study provides evidence regarding the prevalence of alcohol, tobacco, and marijuana use, and their variation across three years, in a large sample of adolescents with a low attrition rate (≤20%). The findings suggest a specific personality profile associated with prevalence of each substance assessed. This is particularly important because impulsivity, as well as the propensity to engage in risky behaviours, shows its greatest increase during this developmental stage (Bava & Tapert, 2010; Collado et al., 2014). Adolescents with self-control difficulties may be more vulnerable to becoming involved in substance use behaviours and may therefore represent a relevant subpopulation for the design of early interventions aimed at delaying progression towards problematic patterns of use.

In this regard, our findings suggest as potential intervention pathways those strategies aimed at strengthening self-control and promoting engagement in exciting yet healthy activities (Hampson et al., 2013). Interventions specifically designed to prevent marijuana and/or alcohol use could focus on the development of self-control skills, emotional regulation (Modecki et al., 2017), and mindfulness (Lokita et al., 2021). However, it is important to consider that current prevention models advocate multicomponent approaches integrating individual variables, interpersonal relationships, and educational environments (Liu et al., 2023; Tinner et al., 2022). In this sense, incorporating assessment of specific impulsivity dimensions and risk-taking in school and primary care contexts may be highly relevant in order to identify vulnerable profiles early and implement preventive interventions. Likewise, the findings of the present study should be interpreted both as a contribution and as a starting point for future research integrating additional

contextual variables, thereby facilitating the development of comprehensive prevention programmes.

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Conflict of Interest

The authors declare that they have no conflicts of interest.

Supplementary Material

Supplementary Material of this manuscript is openly available in OSF at https://doi.org/10.17605/OSF.IO/7YHSC

Author Contributions

Gabriela Rivarola Montejano, Angelina Pilatti, and Ricardo Pautassi conceived the study and contributed to its design. Rivarola Montejano collected the data, and Pilatti and Pautassi supervised data collection. Rivarola Montejano, Pilatti, and Pautassi conducted the statistical analyses. Rivarola Montejano drafted the first version of the manuscript. Pilatti and Pautassi critically reviewed, edited, and approved the final version of the manuscript.

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