

Clinical characteristics of adolescents with substance use disorders in outpatient care in Costa Rica

Características clínicas de adolescentes con trastornos por consumo de sustancias en atención ambulatoria en Costa Rica

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Abstract

Substance use in adolescents is associated with high psychiatric comorbidity and multiple psychosocial vulnerabilities. The aim of the study was to describe the sociodemographic and clinical characteristics, as well as patterns of substance use, in adolescents receiving outpatient treatment for substance use. An observational, descriptive, retrospective study was conducted based on the review of 333 clinical records. Clinical variables, patterns of use, and vulnerabilities were analyzed. High psychiatric morbidity was observed (anxiety 42.3%, depression 39.6%), along with risk behaviors (self-harm 32.7%, suicidal ideation 27%). Females showed a higher likelihood of depression, anxiety, and suicidal behavior, while males exhibited a more externalizing profile. Substance use was predominantly polysubstance, with cannabis, alcohol, and nicotine being the most prominent. Cannabis showed the highest progression to dependence (41%) and a higher prevalence in males. Family and neurodevelopmental vulnerabilities were significantly associated with substance use. It is concluded that adolescents in treatment present high clinical and psychosocial complexity. Substance use is primarily related to cumulative vulnerabilities, supporting the need for comprehensive, sex-specific interventions focused on family and developmental factors.

Keywords

Adolescents; substance use; comorbidity; vulnerability; mental health.

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Resumen

El consumo de sustancias en adolescentes se asocia con elevada comorbilidad psiquiátrica y múltiples vulnerabilidades psicosociales. El objetivo del estudio fue describir las características sociodemográficas, clínicas y patrones de consumo en adolescentes en tratamiento ambulatorio por consumo de sustancias. Se realizó un estudio observacional, descriptivo y retrospectivo basado en la revisión de 333 expedientes clínicos. Se analizaron variables clínicas, patrones de consumo y vulnerabilidades. Se evidenció una alta morbilidad psiquiátrica (ansiedad 42,3%, depresión 39,6%) y conductas de riesgo (autolesiones 32,7%, ideación suicida 27%). Las mujeres presentaron mayor probabilidad de depresión, ansiedad y conducta suicida, mientras que los hombres mostraron un perfil más externalizante. El consumo fue predominantemente policonsumo, destacando cannabis, alcohol y nicotina. El cannabis presentó la mayor progresión a dependencia (41%) y mayor prevalencia en hombres. La vulnerabilidad familiar y del neurodesarrollo se asociaron significativamente con el consumo. Se concluye que los adolescentes en tratamiento presentan alta complejidad clínica y psicosocial. El consumo se relaciona principalmente con vulnerabilidades acumulativas, lo que respalda la necesidad de intervenciones integrales, diferenciadas por sexo y centradas en factores familiares y del neurodesarrollo.

Palabras clave

Adolescentes; consumo de sustancias; comorbilidad; vulnerabilidad; salud mental.

INTRODUCTION

Adolescence represents a critical stage of development characterized by significant biological, psychological, and social changes that may increase vulnerability to risk behaviors. In Costa Rica, adolescents aged 10–19 years accounted for approximately 15% of the total population in 2022, according to the National Institute of Statistics and Census (INEC, 2022). Within this context, psychoactive substance use is recognized as an important risk factor associated with suicidal behavior, self-harm, and a wide range of mental disorders (Gracini et al., 2024). Globally, the World Health Organization (WHO, 2025) estimates that one in seven adolescents experiences a mental disorder, representing approximately 15% of the global burden of disease in this age group.

Among adolescents with substance use disorders, a high prevalence of psychiatric comorbidity has been documented, particularly involving anxiety disorders, depressive disorders, and neurodevelopmental disorders. In this regard, meta-analytic evidence indicates that approximately one in four adolescents receiving treatment for substance use has attention-deficit/hyperactivity disorder (ADHD) (Rohner et al., 2023). Furthermore, this population exhibits a greater burden of both internalizing and externalizing symptoms compared with adolescents who do not use substances (Chan et al., 2008; Hawkins et al., 1992).

Additionally, exposure to adverse childhood experiences, such as sexual abuse, constitutes an important risk factor. Globally, its estimated prevalence before the age of 18



is 18.9% among females and 14.8% among males (Cagney et al., 2025), further highlighting the clinical and psychosocial complexity associated with substance use during this developmental stage.

Drug use may act as both a proximal risk factor, by increasing psychological distress, impulsivity, aggression, and dysphoria, and a distal risk factor, by increasing chronic stress and contributing to the development of comorbid psychopathology (Dodge et al., 2014). Consistent with this perspective, a 25-year longitudinal study involving a cohort of 463,396 adolescents found that 23,345 had used cannabis during the previous year, which was associated with an increased risk of psychotic disorders (OR = 2.19), bipolar disorder (OR = 2.01), depressive disorders (OR = 1.34), and anxiety disorders (OR = 1.24) (Kelly et al., 2026).

Early identification of substance use and appropriate referral to specialized treatment services are essential to ensure timely access to care and improve health outcomes. In 2024, the Instituto sobre Alcoholismo y Farmacodependencia (IAFA) provided outpatient treatment to 1,549 adolescents through Casa JAGUAR, a specialized center offering comprehensive care for individuals under 18 years of age of both sexes with substance use, substance use disorders, or related risk conditions. Of all adolescents receiving care, 70% were male and 30% were female (Casa JAGUAR Medical Records, 2025).

Within this context, the present study describes the sociodemographic and clinical characteristics of adolescents receiving outpatient treatment for substance use at IAFA.

METHODS

In accordance with current Costa Rican legislation governing biomedical research (Law No. 9234, Biomedical Research Regulatory Act), retrospective studies based on the review of clinical records, without direct participant involvement and using anonymized data, do not require approval by a scientific ethics committee. Nevertheless, the present study was reviewed and authorized by the corresponding institutional authorities of the Instituto sobre Alcoholismo y Farmacodependencia (IAFA) and was conducted in strict accordance with international ethical principles for research involving human participants, including the Declaration of Helsinki, ensuring confidentiality, anonymity, and the appropriate protection of all information.

To protect participant confidentiality, each case was assigned a unique alphanumeric code that was irreversibly dissociated from any personally identifiable information. No names, identification numbers, or other information that could allow direct or indirect identification were recorded. Access to the clinical records was restricted exclusively to the study authors.

A retrospective, descriptive, observational study was conducted based on the review of clinical records of adolescents receiving outpatient treatment at Casa JAGUAR. Cases were evaluated by specialized health-care professionals, and diagnoses were established according to the criteria of the International Classification of Diseases, Tenth Revision (ICD-10) as part of routine clinical practice.



The reference population consisted of all adolescents who received treatment through the program during 2024 ($n = 1,549$; 459 females and 1,090 males). Based on this population, a sample size of 333 participants was estimated using a 95% confidence level and a 5% margin of error. Eligible participants included adolescents who had attended at least three clinical visits during the therapeutic process and met the predefined inclusion criteria.

The sample was selected using proportional stratified sampling according to sex and age group in order to preserve the distribution observed in the reference population. Within each stratum, participants were selected by simple random sampling using a macro developed in Microsoft Excel, ensuring an equal probability of selection for all eligible individuals.

Data analysis was performed using IBM SPSS Statistics version 27, following standardized statistical procedures. First, descriptive analyses of the sociodemographic and clinical variables were conducted using absolute and relative frequencies for categorical variables. Age was categorized into three groups (11–14 years, 15–16 years, and 17 years), corresponding to early, middle, and late adolescence. Likewise, vulnerability variables were grouped into analytical categories that included family-, developmental-, and clinical-related risk factors.

Subsequently, bivariate analyses were performed using 2×2 contingency tables to examine the association between sex and substance use, as well as between age groups and the variables of interest. Crude odds ratios (ORs) and their corresponding 95% confidence intervals (95% CIs) were calcu-

lated as measures of association. Statistical significance was determined using Pearson's chi-square (χ^2) test or Fisher's exact test, as appropriate, according to the assumptions regarding expected cell frequencies.

Finally, binary logistic regression models were constructed to evaluate the association between substance use (during the previous year and the previous month) and the independent variables sex and age group. Adjusted odds ratios (aORs) with their corresponding 95% confidence intervals were estimated. Age group was entered as an ordinal variable to evaluate a potential gradient effect. Model goodness-of-fit was assessed using the Hosmer–Lemeshow test. A two-sided p value < 0.05 was considered statistically significant.

Generative artificial intelligence tools were used to support the writing and editing of the manuscript; they were not used for data analysis. The authors are solely responsible for the final content of the manuscript and all scientific decisions.

RESULTS

The study population consisted predominantly of males (71%), with a mean age of 15.12 years ($SD = 1.38$). Slightly more than half of the participants (52.6%) were 15 years of age or younger. The vast majority were enrolled in the educational system (91.6%), whereas 8.4% were not attending school at the time of assessment.

Regarding educational attainment, most adolescents were enrolled in the first stage of secondary education (75.7%), followed by upper secondary education (14.7%) and primary education (10.2%). Overall, 6.6%



were under institutional protection, and 1.5% were in juvenile detention. Regarding referral sources, 40% were referred by the Ministry of Public Education (MEP), while 30.6% were referred by family members.

With respect to family history, approximately four out of every ten adolescents had parents with substance use disorders. Histories of domestic violence (30.6%), sexual abuse (15.6%), neglect (10.8%), involvement in criminal or delinquent activities (5.4%), and school bullying (16.0%) were also reported. In the educational domain, 24% presented learning disorders. In addition, nearly half of the sample (49%) had previously received mental health care.

Personal history revealed a high prevalence of externalizing psychopathology, with conduct disorders identified in approximately half of the adolescents and impulsivity in 36%. Anxiety and depressive disorders were observed in 42.3% and 39.6% of participants, respectively. Regarding risk behaviors, 32.7% reported a history of self-harm and 27% had a history of suicidal ideation.

Sex-stratified analyses revealed differences in the clinical profile. Females showed higher prevalences of depression, anxiety, and self-harming behaviors, whereas males more frequently presented impulsivity and attention-deficit/hyperactivity disorder (ADHD). ADHD was identified in 15.3% of the adolescents, with a significantly higher prevalence among males than females (18.6% vs. 7.2%). Accordingly, females were less likely to present ADHD (OR = 0.33; 95% CI: 0.14–0.78; $p = 0.009$) (Table 1).

Regarding the clinical symptoms identified during the initial assessment in the program,

the most frequent were anxiety (65.5%), irritability or low frustration tolerance (50.5%), sleep disorders (50.5%), mood changes (48.3%), and depression (46.8%). Self-harming behaviors and suicidal ideation were observed in 21.3% and 17.2% of participants, respectively. Among externalizing symptoms, impulsivity was identified in 34.4%, aggressive behavior in 36.3%, and antisocial behavior in 25.5%.

Sex-stratified analyses also revealed differences in the symptom profile at admission. Females presented higher prevalences of depression (65.6% vs. 39.0%), anxiety (82.3% vs. 58.5%), mood changes (61.5% vs. 42.8%), suicidal ideation (30.5% vs. 11.9%), and self-harming behaviors (40.6% vs. 13.3%).

These findings were consistent with the association analyses. Females showed higher odds of depression (OR = 2.99; 95% CI: 1.82–4.91; $p < 0.001$), anxiety (OR = 3.30; 95% CI: 1.84–5.92; $p < 0.001$), mood changes (OR = 2.13; 95% CI: 1.31–3.46; $p = 0.002$), suicidal ideation (OR = 3.21; 95% CI: 1.78–5.78; $p < 0.001$), and self-harm (OR = 4.53; 95% CI: 2.60–7.89; $p < 0.001$).

Among males, externalizing symptoms were more frequent, including antisocial behavior (24.2% vs. 17.7%) and aggressive behavior (37.7% vs. 32.3%), as well as irritability and low frustration tolerance. However, these differences did not reach statistical significance. Likewise, no significant differences were observed for sleep disorders or any of the other clinical manifestations evaluated.

Substance use data showed high lifetime prevalences of cannabis, alcohol, nicotine vaping, and tobacco use (Table 2).



Table 1. Prevalence of family and personal risk factors for substance use among adolescents, by sex (n = 333)

Variable	Total n (%)	Males (n=236) n (%)	Females (n=97) n (%)	OR (IC 95%)	p
Family history					
Parental substance use	128 (38,4)	92 (39,0)	36 (37,1)	—	—
Sibling substance use	31 (9,3)	23 (9,7)	8 (8,3)	—	—
Parental mental illness	39 (11,7)	21 (8,9)	18 (18,8)	—	—
Neglect and abandonment	36 (10,8)	19 (8,1)	17 (17,7)	—	—
Personal history					
Conduct disorder	164 (49,2)	122 (51,7)	42 (43,3)	0,71 (0,44–1,14)	0,160
Impulsivity	120 (36,0)	86 (36,4)	34 (35,4)	0,94 (0,57–1,54)	0,810
Depression	132 (39,6)	76 (32,2)	56 (57,7)	2,87 (1,76–4,67)	<0,001
Anxiety	141 (42,3)	90 (38,1)	51 (52,6)	1,79 (1,11–2,89)	0,015
Self-harm	109 (32,7)	51 (21,6)	58 (59,8)	5,39 (3,23–8,99)	<0,001
Suicide attempt	90 (27,0)	50 (21,2)	40 (41,2)	2,61 (1,56–4,35)	<0,001
Learning disorders	80 (24,0)	65 (27,5)	15 (15,6)	0,48 (0,25–0,89)	0,019
Attention-deficit/hyperactivity disorder (ADHD)	51 (15,3)	44 (18,6)	7 (7,2)	0,33 (0,14–0,78)	0,009
Previous mental health care	163 (48,9)	109 (46,2)	54 (56,3)	1,46 (0,91–2,35)	0,116
Domestic violence	102 (30,6)	64 (27,1)	38 (39,2)	1,73 (1,05–2,85)	0,030
School bullying	53 (15,9)	38 (16,1)	14 (14,6)	—	—
Conflict with the law	24 (7,2)	21 (8,9)	3 (3,1)	—	—
Sexual abuse	52 (15,6)	15 (6,4)	37 (37,5)	9,08 (4,67–17,65)	<0,001

Source: Clinical records from the Casa JAGUAR Program. OR: odds ratio; 95% CI: 95% confidence interval. Odds ratios were calculated using females as the reference group. Pearson's χ^2 test or Fisher's exact test was used, as appropriate. A p value < 0.05 was considered statistically significant. Odds ratios were not calculated for variables with no meaningful differences or with low frequencies.



Table 2. Prevalence of psychoactive substance use among adolescents according to time window and sex (n = 333)

Substance	Lifetime Total n (%)	Previous year Total n (%)	Previous month Total n (%)
Tobacco	n (%)	170 (51,1)	86 (25,8)
Nicotine vaping	213 (64,0)	184 (55,3)	121 (36,3)
Alcohol	294 (88,3)	268 (80,5)	138 (41,4)
Cannabis	295 (88,6)	284 (85,3)	224 (67,3)
Cocaine	81 (24,3)	66 (19,8)	32 (9,6)
Crack cocaine	15 (4,5)	10 (3,0)	3 (0,9)
Ketamine	41 (12,3)	33 (9,9)	12 (3,6)
Amphetamines	41 (12,3)	34 (10,2)	6 (1,8)
Benzodiazepines	55 (16,5)	41 (12,3)	16 (4,8)
Hallucinogens	23 (6,9)	15 (4,5)	6 (1,8)

Note. The percentages were calculated using the total number of participants within each sex as the denominator.

Cannabis showed the highest prevalences across all time windows, followed by alcohol and vaping. The latter exhibited higher prevalences than conventional tobacco smoking across all measurements (Table 2).

Sex differences were observed in recent cannabis use, with a higher prevalence among males (75.4% vs. 47.4%). In the association analyses, male sex was associated with greater odds of cannabis use across all time windows, including lifetime prevalence (OR = 3.38; 95% CI: 1.79–6.38), use during the previous year (OR = 3.35; 95% CI: 1.86–6.02), and use during the previous month (OR = 3.38; 95% CI: 1.99–5.73).

Alcohol showed a high lifetime prevalence but a lower prevalence of use during the previous month, with no significant differences according to sex. Regarding other

substances, cocaine, ketamine, and amphetamine use were also identified, although active use prevalences were low (Table 2).

Cannabis showed the highest proportion of dependence, particularly during middle adolescence. Alcohol was characterized by a high prevalence of harmful use and a low proportion of dependence. Likewise, nicotine use, particularly through vaping, was associated with high prevalences of active use, harmful use, and dependence (Table 3).

No statistically significant sex differences were observed for most substances. However, a higher proportion of dependence was found among males for cannabis and vaping, whereas females showed higher proportions of dependence for benzodiazepines and tobacco.



Table 3. Prevalence of substance use and substance use disorder diagnoses according to substance type and ICD-10 diagnostic criterion

Substance	Occasional use Total (%)	Harmful use Total (%)	Dependence Total (%)
Tobacco	39,6	44,2	16,2
Nicotine vaping	19,0	61,0	20,0
Alcohol	33,2	65,4	1,4
Cannabis	16,0	43,0	41,0
Cocaïne	44,4	47,0	8,6
Crack cocaine	46,7	40,0	13,3
Ketamine	42,5	50,0	7,5
Amphetamines	59,5	33,3	7,1
Benzodiazepines	58,0	33,0	8,8
Hallucinogens	74,0	26,0	0,0

Note. Percentages were calculated using the total number of users of each substance as the denominator. Differences in totals are due to rounding.

Regarding substance use characteristics, differences were observed in the proportions of harmful use and dependence according to substance type (Table 3). Cannabis showed the highest proportion of dependence (41%).

Alcohol showed a high prevalence of harmful use (65.4%) and a low proportion of dependence (1.4%). Nicotine use, particularly through vaping, showed a prevalence of harmful use of 61% and a dependence prevalence of 20% (Table 3).

Among psychostimulants, cocaine showed prevalences of harmful use and dependence of 47% and 8.6%, respectively, whereas amphetamines exhibited a higher proportion of occasional use (59.5%). Regarding benzodiazepines, harmful use was observed in 33% of users, while 8.8% met criteria for dependence, with a higher proportion among

females (Table 3). Sex-stratified analyses revealed differences in the severity of substance use for some substances, particularly a higher proportion of dependence among males for cannabis and vaping, and a greater relative vulnerability among females for benzodiazepines.

Age-group analyses showed differences in substance use according to sex for selected substances and time windows (Table 4).

Binary logistic regression analyses showed that age was significantly associated with an increased likelihood of substance use. During the previous year, this effect was particularly evident for alcohol (OR = 3.00; 95% CI: 1.88–4.77; $p < 0.001$), cannabis (OR = 3.73; 95% CI: 2.11–6.58; $p < 0.001$), and tobacco (OR = 1.52; 95% CI: 1.11–2.09; $p = 0.010$).

Table 4. Factors associated with substance use during the previous year and previous month: binary logistic regression analysis

Substance	Time window	Variable	OR (IC95%)	p	Direction
Tobacco	Previous year	Sex	0,87 (0,54–1,41)	0,580	—
		Age	1,52 (1,11–2,09)	0,010	↑
	Previous month	Sex	1,05 (0,60–1,83)	0,876	—
		Age	2,08 (1,44–3,00)	<0,001	↑
Nicotine vaping	Previous year	Sex	0,90 (0,55–1,47)	0,666	—
		Age	0,47 (0,34–0,66)	<0,001	↓
	Previous month	Sex	0,73 (0,44–1,21)	0,222	—
		Age	0,79 (0,57–1,09)	0,150	—
Alcohol	Previous year	Sex	1,09 (0,59–2,01)	0,794	—
		Age	3,00 (1,88–4,77)	<0,001	↑
	Previous month	Sex	0,87 (0,53–1,44)	0,582	—
		Age	2,06 (1,48–2,87)	<0,001	↑
Cannabis	Previous year	Sex	0,33 (0,17–0,63)	0,001	↓
		Age	3,73 (2,11–6,58)	<0,001	↑
	Previous month	Sex	0,31 (0,19–0,52)	<0,001	↓
		Age	2,24 (1,54–3,25)	<0,001	↑

Note. OR: odds ratio; 95% CI: 95% confidence interval. Models were adjusted for sex and age group.

Similarly, for substance use during the previous month, age was associated with a greater likelihood of tobacco use (OR = 2.08; 95% CI: 1.44–3.00; $p < 0.001$), alcohol use (OR = 2.06; 95% CI: 1.48–2.87; $p < 0.001$), and cannabis use (OR = 2.24; 95% CI: 1.54–3.25; $p < 0.001$).

In contrast, vaping showed an inverse association with age for use during the previous year (OR = 0.47; 95% CI: 0.34–0.66; $p < 0.001$), suggesting a higher prevalence among younger age groups.

Sex was not significantly associated with the use of most substances. However, a signifi-

cant association was observed for cannabis use during both the previous year (OR = 0.33; 95% CI: 0.17–0.63; $p = 0.001$) and the previous month (OR = 0.31; 95% CI: 0.19–0.52; $p < 0.001$). Considering the coding of the sex variable in the model (male = 1; female = 2), ORs < 1 indicate a lower likelihood of cannabis use among females relative to males.

The odds ratios presented in the descriptive analyses correspond to crude estimates, whereas the results shown in Table 4 were obtained from adjusted logistic regression models.



Regarding vulnerability domains, 59.2% of the adolescents presented at least one family vulnerability factor, 67.6% presented neurodevelopmental vulnerability, and 77.8% presented clinical vulnerability. Overall, 75% exhibited high vulnerability, defined as the simultaneous presence of two or more vulnerability domains. Co-occurrence analyses showed that 39% of the adolescents simultaneously presented family, neurodevelopmental, and clinical vulnerabilities.

Binary logistic regression models were used to evaluate the association between vulnerability domains and substance use during the previous month. For cannabis, both family vulnerability (OR = 2.61; $p = 0.001$) and neurodevelopmental vulnerability (OR = 1.97; $p = 0.013$) were significantly associated with substance use, whereas clinical vulnerability showed an inverse association (OR = 0.49; $p = 0.032$). For alcohol, family vulnerability (OR = 2.03; $p = 0.012$) and neurodevelopmental vulnerability (OR = 1.90; $p = 0.007$) were significantly associated with substance use, whereas no significant association was observed for clinical vulnerability. Overall, family and neurodevelopmental vulnerabilities emerged as the factors most consistently

associated with tobacco, alcohol, and cannabis use.

More complex substance use, defined as the use of at least one higher-risk substance (ketamine, cocaine, crack cocaine, or hallucinogens), was significantly associated with family vulnerability (OR = 2.50; 95% CI: 1.48–4.33; $p = 0.001$) and developmental vulnerability (OR = 2.82; 95% CI: 1.55–5.13; $p < 0.001$). Clinical vulnerability was not significantly associated with more complex substance use (Table 5).

DISCUSSION

The findings of the present study demonstrate that adolescents receiving treatment for substance use disorders constitute a population with substantial clinical and psychosocial complexity, characterized by the convergence of individual, family, and structural vulnerabilities. This complexity is reflected in the high frequency of psychiatric symptoms identified during the clinical assessment, including internalizing symptoms such as anxiety and depression, as well as externalizing manifestations such as impulsivity and conduct disorders, together with

Table 5. Association between vulnerability domains and substance use patterns ($n = 333$)

Vulnerability domain	Basic substance use n (%)	Complex substance use n (%)	OR (IC95%)	P
Family vulnerability	130 (53,5)	67 (74,4)	2,53 (1,48–4,33)	0,001
Developmental vulnerability	151 (62,1)	74 (82,2)	2,82 (1,55–5,13)	0,001
Clinical vulnerability	183 (75,3)	76 (84,4)	1,78 (0,94–3,38)	0,075

Note. Pearson's χ^2 test. OR: odds ratio; 95% CI: 95% confidence interval. Complex substance use was defined as the use of at least one higher-risk substance during the previous year.



a high prevalence of risk behaviors, including self-harm and suicidal ideation. This pattern is consistent with contemporary models of substance use disorder development, which emphasize the interaction between neurobiological, psychopathological, and contextual factors (Tarter, 1994; Hawkins et al., 1992).

The study sample was predominantly male (71%), consistent with the international literature (Bhatia et al., 2024; Sakai et al., 2012). Regarding access to treatment, the educational system represented the main referral source (40%), followed by family members and social protection services, highlighting the pivotal role of school-based detection, in line with previous findings in school-aged adolescent populations (Lucchese et al., 2014), as well as the importance of inter-institutional coordination for early identification and referral. Nevertheless, the presence of adolescents outside the educational system, although representing a minority, reflects a subgroup experiencing greater vulnerability, in whom school disengagement is associated with trajectories of psychosocial risk and problematic substance use.

Relevant qualitative differences emerged according to sex. While males exhibited a predominantly externalizing profile characterized by impulsivity, attention-deficit/hyperactivity disorder (ADHD), conduct disorders, and greater involvement in antisocial behaviors, females presented a predominantly internalizing profile, with higher rates of depression, anxiety, self-harm, suicidal ideation, and histories of interpersonal trauma. These profiles are consistent with the differences observed in symptom presentation during the initial clinical assessment, where females exhibited higher prevalences of internalizing symptoms and self-harming

behaviors, whereas externalizing symptoms predominated among males. The higher prevalence of ADHD among males is consistent with previous studies reporting both a greater prevalence of the disorder in males and its association with impulsive behavior and increased risk of substance use during adolescence. These findings suggest distinct etiological trajectories, consistent with previous studies (Marinelli et al., 2023; Guild et al., 2017), in which substance use among females appears to be more strongly mediated by affective dysregulation and adverse life experiences, whereas among males it is more closely associated with behavioral disinhibition (Moffitt, 2011).

In this regard, the adolescents' personal histories revealed a high burden of psychiatric comorbidity, which may act as both a proximal risk factor, by increasing psychological distress, impulsivity, aggression, and dysphoria, and a distal risk factor, by increasing stress and promoting the development of comorbid psychopathology (Dodge et al., 2014). This pattern was evident across both the externalizing and internalizing spectra, supporting the hypothesis that substance use may function as a strategy for emotional regulation, particularly in the context of anxiety, depression, and psychological distress (Chan et al., 2008). Likewise, the high prevalence of self-harm, suicidal ideation, and suicide attempts confirms the close relationship between substance use and suicidal risk, identifying this population as a high-priority clinical group.

The family context of the adolescents included in this study was characterized by a substantial burden of risk, including parental substance use, mental illness, and family violence, consistent with previous evidence



regarding the intergenerational transmission of addiction risk (Buu et al., 2009; Marmorstein et al., 2009). Furthermore, the co-occurrence of vulnerabilities observed in this cohort—including family, neurodevelopmental, and clinical domains among a considerable proportion of adolescents—reinforces the concept of cumulative risk and the interaction between individual and contextual factors. These vulnerabilities, together with exposure to adverse experiences such as sexual abuse, school bullying, and involvement in criminal or delinquent activities, create developmental environments characterized by limited emotional support and inadequate supervision. Such conditions have been consistently associated with earlier initiation and progression of substance use and are in agreement with the findings reported by Wang et al. (2009).

Regarding substance use patterns, polysubstance use was characterized primarily by alcohol, cannabis, and nicotine. Cannabis exhibited the highest prevalence across all time windows, followed by alcohol and vaping, the latter exceeding conventional tobacco smoking in every measurement. However, cannabis is noteworthy not only because of its high prevalence but also because it showed the greatest progression to dependence, with elevated transition rates within this clinical cohort. These findings challenge the widespread perception that cannabis poses a relatively low risk and suggest a considerable potential for the development of dependence (Hall & Degenhardt, 2014), particularly in the context of early initiation and emotional vulnerability.

In contrast, despite its high prevalence, alcohol was characterized by a high frequency of harmful use but a relatively low proportion

of dependence, suggesting that its role is more closely related to initiation and socialization than to progression toward severe patterns of substance use. These findings reinforce the importance of implementing preventive strategies aimed at delaying or preventing the initiation of alcohol use during the early stages of development, given that early alcohol initiation has been consistently associated with an increased likelihood of developing problematic patterns of substance use and with subsequent progression to the use of other psychoactive substances.

Nicotine and vaping, in turn, appear to function as substances that sustain the addictive cycle, with vaping emerging as a phenomenon that is progressively replacing conventional cigarette smoking, as has been widely documented among adolescent populations (Centers for Disease Control and Prevention, 2023).

The multivariable analysis showed that age was the primary factor associated with substance use, with a consistent gradient indicating that the likelihood of substance use increased significantly with advancing age. This effect was particularly pronounced for alcohol and cannabis, both for use during the previous year and current use (previous month), suggesting a progression toward more frequent and intensive patterns of use among older adolescents. This pattern is consistent with developmental models describing the transition from experimental substance use to regular use and dependence during late adolescence.

In contrast, vaping showed an inverse association with age for substance use during the previous year, indicating a higher prevalence among younger adolescents. This find-



ing suggests that vaping may function as an initiating substance within substance use trajectories, consistent with the literature identifying it as a potential gateway to the subsequent use of other substances, particularly in contexts characterized by social normalization and a low perception of risk.

Regarding sex, no significant associations were observed with most substances in the adjusted models. However, cannabis use showed a consistent association, with a lower likelihood of use in one of the sex groups, suggesting substance-specific differences that may be related to patterns of socialization, availability, or cultural factors. Together with the clinical differences previously described, these findings reinforce the need for a sex- and gender-responsive approach to understanding adolescent substance use.

A central finding of this study is that more complex patterns of substance use were significantly associated with family and developmental vulnerabilities. These findings reinforce the importance of structural and neurodevelopmental factors in shaping substance use trajectories, in contrast to the relatively smaller contribution of clinical vulnerability in the adjusted models. Family vulnerability is linked to family dysfunction, inadequate parental supervision, and exposure to substance use within the household, whereas developmental vulnerability reflects difficulties in behavioral regulation, school adjustment, and social integration. In this context, more complex substance use appears to represent a marker of cumulative psychosocial risk trajectories rather than an exclusively clinical phenomenon.

Overall, the findings reinforce the need for comprehensive interventions that simultaneously address substance use, mental health, trauma, and the broader social determinants of health. Such interventions should include structured family-based approaches aimed at interrupting intergenerational cycles of risk, sex- and gender-responsive strategies that emphasize trauma and suicide risk among females and behavioral regulation among males, as well as early prevention and detection strategies implemented within educational and healthcare settings.

Finally, the findings support understanding adolescent substance use not as an isolated behavior but rather as the expression of cumulative vulnerability trajectories, in which developmental, family, and clinical factors converge within broader social, educational, and structural determinants, including social inequality, social exclusion, and fragile support networks.

CONCLUSIONS

Adolescents receiving outpatient treatment for substance use disorders present a highly complex clinical profile characterized by polysubstance use, a high burden of psychiatric comorbidity, and substantial psychosocial vulnerability. Cannabis emerged as the substance with the greatest potential for progression to dependence in this cohort, whereas suicide risk and exposure to interpersonal trauma represent critical dimensions for clinical assessment and intervention.

Nicotine vaping was more frequent among younger adolescents, positioning it as a potential initiating substance within substance



use trajectories. In addition, it emerged as one of the most prevalent substances, exceeding conventional tobacco smoking across all time windows and predominating in current use (previous month).

Sex was not significantly associated with the use of most substances in the adjusted models. However, specific differences were identified for cannabis use, suggesting the existence of substance-specific patterns that should be considered in clinical practice together with the psychopathological differences observed between males and females.

Regarding vulnerability factors, the findings support an explanatory model of substance use centered on contextual and developmental determinants. Family vulnerability emerged as a key factor, being consistently associated with a greater likelihood of substance use and highlighting the influence of family dynamics, parental supervision, and exposure to substance use within the home. These findings suggest that family vulnerability may represent the expression of broader structural conditions that increase the risk of substance use during adolescence, underscoring the need for preventive strategies and comprehensive interventions addressing both family-related factors and the associated social determinants.

Complementarily, developmental vulnerability, expressed through impulsivity, behavioral dysregulation, and difficulties in school adjustment, emerged as a central factor associated with more active and persistent patterns of substance use. These findings are consistent with the international literature recognizing executive functions and self-regulation processes as essential

components of behavioral adaptation and decision-making, whose immaturity or impairment during adolescence increases vulnerability to substance use.

Taken together, these findings suggest that adolescent substance use should be understood as the expression of cumulative psychosocial risk trajectories rather than as an exclusively clinical phenomenon. From a public health perspective, this implies the need to prioritize interventions targeting the family environment and developmental difficulties, moving toward a broader biopsychosocial model of care.

Given the early initiation of substance use, strengthening comprehensive public policies aimed at delaying the age of initiation through reducing adolescents' exposure, access, and exposure to the advertising of psychoactive substances should be considered a priority. These strategies should be complemented by strengthening life skills, promoting the early identification and intervention of adolescents with vulnerability factors, and enhancing multisectoral coordination among the health, education, and social protection sectors to reduce vulnerability trajectories in this population.

Limitations

The findings of the present study should be interpreted considering several methodological limitations. First, the retrospective design based on clinical records depends on documentation completed by different healthcare professionals, which may have introduced variability in the quality and completeness of the available information. In addition, the absence of structured diagnostic interviews limits the precision of the



formal characterization of certain psychiatric disorders.

Furthermore, because this study was conducted in a clinical cohort of adolescents receiving treatment, the findings cannot be generalized to the broader adolescent population and should instead be interpreted within the context of this specific clinical population. Likewise, the results should be considered in light of the possible underrepresentation of adolescents experiencing the highest levels of vulnerability, particularly those outside the educational system or with limited access to and engagement with healthcare services, including adolescents living in socially and geographically vulnerable settings, such as rural or remote areas, or in environments with limited support networks.

Nevertheless, the study has important strengths. Clinical information was recorded by trained healthcare professionals using standardized diagnostic criteria based on the International Classification of Diseases, Tenth Revision (ICD-10), providing consistency and validity to the data analyzed. Furthermore, the sample size, proportional stratified sampling strategy, and sex-stratified analyses strengthen the robustness of the findings and support adequate internal validity.

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