

Divergent Pathways to Substance-Use Disorders Among Boys and Girls: An Analytical Cross-Sectional Study

Sandeep Antil

¹Consultant Psychiatrist, District Civil Hospital Sonapat, Haryana, India

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Corresponding Author: Dr. Sandeep Antil

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Abstract

Background: Substance use during childhood is influenced by interacting developmental, psychological, familial and social factors that may differ substantially between boys and girls. This study evaluated gender differences in substance-use patterns, initiation pathways, associated psychosocial influences, clinical consequences and predictors of greater disorder severity among children and adolescents.

Methods: This analytical cross-sectional study included 208 substance-using participants aged 10–17 years, comprising 104 boys and 104 girls. Sociodemographic characteristics, substance-use patterns, initiation motives, adverse childhood experiences, family and peer influences, clinical consequences and treatment-seeking were assessed through structured interviews. Problematic substance use was screened using the CRAFFT questionnaire, emotional and behavioural problems were assessed using the Strengths and Difficulties Questionnaire, and substance-use disorder severity was classified according to DSM-5-TR criteria. Gender comparisons and gender-stratified multivariable logistic-regression analyses were performed.

Results: The mean age of participants was 15.1±1.7 years. Predominant substance use differed significantly by gender ($p=0.001$); tobacco and cannabis were more common among boys, whereas inhalants, opioids and non-medical pharmaceuticals were more frequent among girls. Polysubstance use was higher among boys than girls (58.7% versus 40.4%; $p=0.013$). Peer-driven initiation, substance-using peers and conduct problems predominated among boys, whereas emotional distress, solitary use, depressive and anxiety symptoms, and adverse childhood experiences were more frequent among girls. Boys experienced more violence or legal consequences (27.9% versus 9.6%; $p=0.001$), while girls reported greater sexual risk or exploitation (24.0% versus 10.6%; $p=0.017$) and treatment-related stigma (47.1% versus 25.0%; $p=0.001$). Disorder severity was comparable between genders ($p=0.763$). Daily and polysubstance use predicted moderate-to-severe disorder in both groups; peer and conduct factors were significant among boys, whereas emotional symptoms, multiple adversities and solitary use were significant among girls.

Conclusion: Although overall substance-use severity was similar, boys and girls followed distinct psychosocial pathways and experienced different consequences. Gender-responsive prevention should address peer influence and externalising behaviours among boys while prioritising trauma-informed mental-health care, relationship safety, confidentiality and stigma reduction among girls.

Keywords: Adolescents; Adverse Childhood Experiences; Gender Disparities; Peer Influence; Substance-Use Disorder.

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Introduction

Substance use during childhood and adolescence is a major public health concern because early initiation increases the likelihood of persistent use, dependence, psychiatric morbidity, academic failure, injury and risky behaviour in later life [1–3]. Adolescence is characterised by heightened reward sensitivity, novelty-seeking and peer influence, while executive control and judgement remain incompletely developed, increasing vulnerability to experimentation with tobacco, alcohol, cannabis, inhalants, opioids and other

psychoactive substances [1,2]. Globally, approximately one in ten adolescents aged 13–15 years uses tobacco, while recent international data indicate substantial use of electronic cigarettes, alcohol and cannabis among 15-year-olds [2,4]. Although substance use has traditionally been more common among boys, the gender gap is narrowing in several settings [4]. Gender disparities extend beyond prevalence and include differences in substance preference, age at initiation, motives for use, progression, psychiatric comorbidity, social

consequences and treatment-seeking. Boys more commonly initiate substance use through sensation-seeking, impulsivity, conduct problems, peer conformity, delinquency and greater access to substances. In contrast, substance use among girls is often associated with depression, anxiety, low self-esteem, family conflict, bullying, childhood trauma and sexual victimisation, with substances sometimes used for emotional regulation or self-medication [5–7].

Girls presenting with substance-related problems may constitute a smaller but more clinically vulnerable group, frequently showing greater trauma exposure, psychiatric comorbidity and psychosocial impairment—the so-called “gender paradox” [6]. Social stigma may also lead girls to conceal substance use, while masculine norms may discourage boys from disclosing emotional distress. Family substance use, poor parental monitoring, inconsistent discipline and peer approval further influence initiation [7].

In India, inhalant use is particularly important among children and adolescents, with approximately 1.8 million requiring assistance for inhalant-related problems [8]. Despite this burden, help-seeking remained extremely low. Most existing studies use predominantly male or school-based samples and rarely examine gender-specific pathways comprehensively. Therefore, evaluating biological, psychological, familial and social influences across genders is essential for developing early, trauma-informed and gender-responsive prevention and treatment strategies.

Materials and Methods

Study Design and Setting: This institution-based analytical cross-sectional study was conducted in the Departments of Paediatrics, Psychiatry and/or De-addiction Services at tertiary care center of North India over a period of 18 months, from January 2023 to July 2024. Participants were recruited from paediatric outpatient services, child and adolescent psychiatry clinics, de-addiction clinics and community outreach or referral services associated with the institution. The study was designed to compare the pattern, severity and determinants of substance use among boys and girls and to identify gender-specific psychological, familial and social pathways associated with substance initiation and continued use.

Study Population and Eligibility Criteria: Children and adolescents aged 10–17 years who reported the use of at least one psychoactive substance during the preceding 12 months were eligible for participation. Psychoactive substances included tobacco or nicotine products, alcohol, cannabis, inhalants, opioids, sedatives, stimulants and other non-medically used pharmaceutical or illicit substances. Participants were included after

providing written assent, together with written informed consent from a parent or legally authorised guardian. Children requiring emergency medical treatment for acute intoxication or withdrawal were assessed only after clinical stabilisation. Those with severe cognitive impairment, acute psychosis, altered sensorium, major communication difficulty or a medical condition that prevented completion of the interview were excluded. Participants already receiving treatment were not excluded, provided that reliable information regarding their substance-use history could be obtained.

Sample Size and Sampling Method: The sample size was calculated using the formula for comparing two independent proportions. Based on an anticipated prevalence of the principal psychosocial exposure of 30% among boys and 50% among girls, representing a clinically meaningful absolute difference of 20 percentage points, the required sample size was calculated at a two-sided alpha error of 5% and a statistical power of 80%. The minimum sample size was estimated as 93 participants in each gender group. After adjusting for an anticipated non-response or incomplete-data rate of 10%, the final required sample size was 104 participants per group. Thus, the total minimum sample size was estimated as 208 children and adolescents, comprising 104 boys and 104 girls. Eligible participants were enrolled through consecutive sampling until the required sample size was achieved. Eligible participants were recruited using consecutive sampling until the required sample was achieved. Efforts were made to include girls through paediatric, psychiatric, community and social-service referral pathways because girls with substance-use problems may be less likely to present directly to de-addiction services.

Data Collection Procedure: Data were collected through confidential, face-to-face interviews conducted by trained investigators in a private setting. Whenever developmentally appropriate, the child was interviewed separately before corroborative information was obtained from the accompanying caregiver. A structured questionnaire recorded age, education, school attendance, socioeconomic background, living arrangement, family structure, employment or street involvement, and history of contact with child-protection or juvenile-justice services. Sex assigned at birth and self-identified gender were recorded separately. The primary comparative analysis included boys and girls; participants identifying outside these categories were described separately when their number was insufficient for meaningful subgroup analysis.

Assessment of Substance-Use Characteristics: A structured substance-use profile was used to

document the type of substance, age at first use, age at regular use, frequency, quantity, route of administration, source of procurement, expenditure, solitary or group use, polysubstance use, previous abstinence attempts, withdrawal symptoms, overdose history and treatment-seeking behaviour. Substance-use disorders were assessed according to the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition, Text Revision criteria and classified as mild, moderate or severe according to the number of criteria fulfilled. The CRAFFT 2.1 screening questionnaire was administered as an age-appropriate measure of problematic alcohol and drug use. The principal outcome variables were predominant substance used, early initiation, defined as first use before 13 years of age, polysubstance use, clinically significant substance-use disorder and previous help-seeking.

Assessment of Pathways and Influencing Factors: Potential pathways were examined across individual, psychological, familial and social domains. Individual factors included curiosity, sensation-seeking, coping with distress, perceived benefits, academic difficulties and history of conduct-related behaviours. Emotional and behavioural problems were assessed using the Strengths and Difficulties Questionnaire. Adverse childhood experiences were evaluated using an age-appropriate structured questionnaire covering neglect, emotional or physical abuse, sexual victimisation, domestic violence, parental separation and household substance use. Family functioning, parental monitoring, family conflict and perceived emotional support were documented using standardised questions. Peer substance use, direct peer pressure, romantic-partner influence, neighbourhood availability, exposure through social media and perceived social acceptability were also assessed. Reasons for initiation and continued use

were classified as recreational, peer-driven, family-influenced, trauma-related, coping-oriented, performance-related or dependence-related.

Statistical Analysis: Data were analysed using IBM SPSS Statistics version 20.0 (IBM Corp., Armonk, NY, USA). Continuous variables were presented as mean $\pm$ standard deviation or median with interquartile range, while categorical variables were expressed as frequency and percentage. Boys and girls were compared using the independent-samples t-test or Mann–Whitney U test for continuous variables and the chi-square or Fisher's exact test for categorical variables.

Variables associated with major outcomes at $p < 0.20$ in univariate analysis were entered into multivariable logistic regression models. Adjusted odds ratios with 95% confidence intervals were calculated for early initiation, polysubstance use and moderate-to-severe substance-use disorder. Gender-by-exposure interaction terms were examined to determine whether trauma, peer influence or family dysfunction affected boys and girls differently. A two-sided p -value < 0.05 was considered statistically significant.

Results

The study included 208 participants, comprising 104 boys and 104 girls, with a mean age of 15.1 ± 1.7 years. Boys and girls were comparable with respect to mean age, age distribution, educational status, place of residence, socioeconomic category and family structure (all $p > 0.05$).

However, boys were significantly more likely than girls to be working or street-connected (28.8% versus 15.4%; $p = 0.030$) and to have a previous history of conflict with the law (17.3% versus 6.7%; $p = 0.033$) (Table 1).

Table 1: Sociodemographic Characteristics of Participants According to Gender (N=208)

Characteristic	Boys (n=104)	Girls (n=104)	Total (N=208)	p-value
	Frequency (%) mean ± SD			
Age (years)	15.3 ± 1.6	14.9 ± 1.7	15.1 ± 1.7	0.082
Age group				0.345
10–12 years	10 (9.6)	14 (13.5)	24 (11.5)	
13–15 years	42 (40.4)	48 (46.2)	90 (43.3)	
16–17 years	52 (50.0)	42 (40.4)	94 (45.2)	
Educational status				0.392
Currently attending school	66 (63.5)	75 (72.1)	141 (67.8)	
School dropout	30 (28.8)	22 (21.2)	52 (25.0)	
Never enrolled	8 (7.7)	7 (6.7)	15 (7.2)	
Place of residence				0.94
Urban	68 (65.4)	70 (67.3)	138 (66.3)	
Semi-urban	22 (21.2)	20 (19.2)	42 (20.2)	
Rural	14 (13.5)	14 (13.5)	28 (13.5)	
Socioeconomic category				0.636
Lower	36 (34.6)	42 (40.4)	78 (37.5)	
Lower-middle	46 (44.2)	44 (42.3)	90 (43.3)	

Middle or above	22 (21.2)	18 (17.3)	40 (19.2)	
Family structure				
Nuclear family	60 (57.7)	58 (55.8)	118 (56.7)	0.955
Joint/extended family	34 (32.7)	36 (34.6)	70 (33.7)	
Single-parent/alternative care	10 (9.6)	10 (9.6)	20 (9.6)	
Working or street-connected	30 (28.8)	16 (15.4)	46 (22.1)	0.03
Previous conflict with law	18 (17.3)	7 (6.7)	25 (12.0)	0.033

The predominant substance used differed significantly according to gender ($p=0.001$). Tobacco or nicotine products and cannabis were more common among boys, whereas inhalants, opioids and non-medical sedative or pharmaceutical use were more frequent among girls. Polysubstance use was significantly higher among boys than girls (58.7% versus 40.4%;

$p=0.013$). The principal route of administration also differed significantly ($p<0.001$), with smoking predominating among boys and oral ingestion, inhalation and injection or multiple routes being relatively more common among girls. No significant gender differences were observed in age at first use, early initiation, daily use or CRAFFT positivity (Table 2).

Table 2: Gender Differences in Substance-Use Patterns and Clinical Screening (N=208)

Substance-use characteristic	Boys (n=104)	Girls (n=104)	Total (N=208)	p-value
	Frequency (%) / mean $\pm$ SD			
Predominant substance				
Tobacco/nicotine products	31 (29.8)	16 (15.4)	47 (22.6)	0.001
Alcohol	19 (18.3)	13 (12.5)	32 (15.4)	
Cannabis	20 (19.2)	9 (8.7)	29 (13.9)	
Inhalants	11 (10.6)	24 (23.1)	35 (16.8)	
Opioids	13 (12.5)	20 (19.2)	33 (15.9)	
Sedatives/non-medical pharmaceuticals	5 (4.8)	17 (16.3)	22 (10.6)	
Other substances	5 (4.8)	5 (4.8)	10 (4.8)	
Age at first use (years)	13.2 $\pm$ 1.8	13.4 $\pm$ 1.9	13.3 $\pm$ 1.9	0.437
Initiation before 13 years	31 (29.8)	26 (25.0)	57 (27.4)	0.534
Age at regular use (years)	14.0 $\pm$ 1.7	14.2 $\pm$ 1.8	14.1 $\pm$ 1.8	0.411
Polysubstance use	61 (58.7)	42 (40.4)	103 (49.5)	0.013
Daily or near-daily use	49 (47.1)	38 (36.5)	87 (41.8)	0.16
Principal route of administration				
Smoking	61 (58.7)	29 (27.9)	90 (43.3)	<0.001
Oral ingestion	23 (22.1)	31 (29.8)	54 (26.0)	
Inhalation	11 (10.6)	24 (23.1)	35 (16.8)	
Injection/multiple/other route	9 (8.7)	20 (19.2)	29 (13.9)	
CRAFFT score ≥ 2	78 (75.0)	75 (72.1)	153 (73.6)	0.753

CRAFFT: Car, Relax, Alone, Forget, Friends, Trouble screening questionnaire. Polysubstance use was defined as the use of two or more psychoactive substances during the preceding 12 months. Tobacco included smoked and smokeless nicotine products.

The primary pathway of substance initiation differed significantly between boys and girls ($p=0.001$). Peer curiosity, acceptance and sensation-seeking were more frequently reported by boys, whereas emotional distress, family or partner influence and trauma-related coping were more common among girls. Friends or peers were the most frequent initial source among boys, while

girls more often obtained substances through romantic partners or street, online or other sources ($p=0.014$). Boys predominantly used substances in peer groups, whereas solitary use was more common among girls ($p=0.008$). Emotional relief and coping with family conflict were significantly more frequent motives among girls, while peer bonding was more common among boys (Table 3).

Table 3: Initiation Pathways, Procurement and Motives for Continued Substance Use According to Gender

Pathway or influence	Boys (n=104)	Girls (n=104)	Total (N=208)	p-value
	Frequency (%)			
Primary reason for initiation				
Peer curiosity or acceptance	41 (39.4)	24 (23.1)	65 (31.2)	0.001
Sensation-seeking or pleasure	24 (23.1)	12 (11.5)	36 (17.3)	
Coping with emotional distress	14 (13.5)	35 (33.7)	49 (23.6)	
Family or partner influence	10 (9.6)	17 (16.3)	27 (13.0)	
Trauma-related coping	5 (4.8)	10 (9.6)	15 (7.2)	
Availability or other reason	10 (9.6)	6 (5.8)	16 (7.7)	
Initial source of substance				
Friend or peer	55 (52.9)	37 (35.6)	92 (44.2)	0.014
Family member	13 (12.5)	12 (11.5)	25 (12.0)	
Romantic partner	4 (3.8)	15 (14.4)	19 (9.1)	
Shop or local vendor	21 (20.2)	20 (19.2)	41 (19.7)	
Street, online or other source	11 (10.6)	20 (19.2)	31 (14.9)	
Usual setting of substance use				
Peer-group use	59 (56.7)	38 (36.5)	97 (46.6)	0.008
Predominantly solitary use	18 (17.3)	35 (33.7)	53 (25.5)	
Family or partner setting	13 (12.5)	20 (19.2)	33 (15.9)	
Mixed settings	14 (13.5)	11 (10.6)	25 (12.0)	
Perceived easy availability	71 (68.3)	65 (62.5)	136 (65.4)	0.466
Unsupervised procurement	69 (66.3)	57 (54.8)	126 (60.6)	0.119
Exposure to substance-related social-media content	39 (37.5)	46 (44.2)	85 (40.9)	0.397
Reasons for continued use*				
Craving or withdrawal relief	55 (52.9)	48 (46.2)	103 (49.5)	0.405
Stress or emotional relief	27 (26.0)	54 (51.9)	81 (38.9)	<0.001
Peer bonding	49 (47.1)	31 (29.8)	80 (38.5)	0.015
Coping with family conflict	23 (22.1)	39 (37.5)	62 (29.8)	0.023
Boredom or lack of recreation	32 (30.8)	28 (26.9)	60 (28.8)	0.646

*Multiple responses were permitted for reasons for continued substance use; therefore, percentages for these variables may exceed 100%.

Girls had a significantly higher prevalence of abnormal emotional symptoms than boys (46.2% versus 23.1%; $p=0.001$), whereas abnormal conduct problems were more frequent among boys (41.3% versus 23.1%; $p=0.008$). Depressive symptoms, anxiety symptoms and self-harm or suicidal ideation were significantly more common among girls (all $p\leq 0.006$). Girls also reported higher

exposure to any adverse childhood experience (73.1% versus 54.8%; $p=0.009$) and to three or more adverse experiences (37.5% versus 20.2%; $p=0.009$). Emotional abuse and sexual victimisation were significantly more frequent among girls, while physical abuse, domestic violence exposure and neglect were comparable between genders (Table 4).

Table 4: Emotional, Behavioural and Adverse Childhood Experiences According to Gender

Psychological or adverse experience	Boys (n=104)	Girls (n=104)	Total (N=208)	p-value
	Frequency (%)			
Strengths and Difficulties Questionnaire domains				
Abnormal emotional symptoms	24 (23.1)	48 (46.2)	72 (34.6)	0.001
Abnormal conduct problems	43 (41.3)	24 (23.1)	67 (32.2)	0.008
Abnormal hyperactivity	37 (35.6)	29 (27.9)	66 (31.7)	0.297
Peer problems	30 (28.8)	36 (34.6)	66 (31.7)	0.456
Abnormal total difficulties score	48 (46.2)	55 (52.9)	103 (49.5)	0.405
Clinically relevant depressive symptoms	26 (25.0)	49 (47.1)	75 (36.1)	0.001
Clinically relevant anxiety symptoms	22 (21.2)	46 (44.2)	68 (32.7)	0.001
Self-harm or suicidal ideation	8 (7.7)	23 (22.1)	31 (14.9)	0.006
Any adverse childhood experience	57 (54.8)	76 (73.1)	133 (63.9)	0.009
Three or more adverse childhood experiences	21 (20.2)	39 (37.5)	60 (28.8)	0.009

Physical abuse	30 (28.8)	27 (26.0)	57 (27.4)	0.756
Emotional abuse	24 (23.1)	42 (40.4)	66 (31.7)	0.011
Sexual victimisation	4 (3.8)	20 (19.2)	24 (11.5)	0.001
Exposure to domestic violence	28 (26.9)	38 (36.5)	66 (31.7)	0.18
Neglect	31 (29.8)	41 (39.4)	72 (34.6)	0.19

SDQ: Strengths and Difficulties Questionnaire. Abnormal SDQ domain scores were classified using age-appropriate standard cut-offs. Adverse childhood experiences included abuse, neglect, domestic violence, parental separation and household substance use occurring before 18 years of age.

Substance-using peers were significantly more common among boys than girls (74.0% versus 58.7%; $p=0.028$), as was direct peer pressure to use substances (51.9% versus 36.5%; $p=0.036$). In contrast, girls more frequently reported low perceived emotional support (47.1% versus 31.7%; $p=0.033$) and having a substance-using romantic

partner (25.0% versus 8.7%; $p=0.003$). Family substance use, poor parental monitoring, frequent family conflict, school disengagement and easy neighbourhood availability of substances did not differ significantly between boys and girls (Table 5).

Table 5: Family, Peer and Environmental Influences on Substance Use According to Gender

Influence	Boys (n=104)	Girls (n=104)	Total (N=208)	p-value
	Frequency (%)			
Substance use by a family member	56 (53.8)	46 (44.2)	102 (49.0)	0.212
Poor parental monitoring	62 (59.6)	54 (51.9)	116 (55.8)	0.328
Frequent family conflict	45 (43.3)	57 (54.8)	102 (49.0)	0.127
Low perceived emotional support	33 (31.7)	49 (47.1)	82 (39.4)	0.033
Substance-using peers	77 (74.0)	61 (58.7)	138 (66.3)	0.028
Direct peer pressure to use substances	54 (51.9)	38 (36.5)	92 (44.2)	0.036
Substance-using romantic partner	9 (8.7)	26 (25.0)	35 (16.8)	0.003
School disengagement	47 (45.2)	36 (34.6)	83 (39.9)	0.157
Easy availability in the neighbourhood	64 (61.5)	59 (56.7)	123 (59.1)	0.573

Participants could have more than one family, peer or environmental influence.

The distribution of mild, moderate and severe substance-use disorder was comparable between boys and girls ($p=0.763$). Withdrawal symptoms, previous severe intoxication or overdose, academic decline, school absenteeism and medical complications also showed no significant gender differences. Violence or legal consequences were significantly more frequent among boys (27.9%

versus 9.6%; $p=0.001$), whereas sexual risk or exploitation was more common among girls (24.0% versus 10.6%; $p=0.017$). Perceived stigma as a barrier to treatment was substantially higher among girls (47.1% versus 25.0%; $p=0.001$). Previous help-seeking and formal treatment utilisation were low and comparable between genders (Table 6).

Table 6: Severity, Consequences and Treatment-Seeking According to Gender

Clinical outcome	Boys (n=104)	Girls (n=104)	Total (N=208)	p-value
	Frequency (%)			
DSM-5-TR substance-use disorder severity				
Mild	36 (34.6)	41 (39.4)	77 (37.0)	0.763
Moderate	43 (41.3)	39 (37.5)	82 (39.4)	
Severe	25 (24.0)	24 (23.1)	49 (23.6)	
Withdrawal symptoms	47 (45.2)	43 (41.3)	90 (43.3)	0.675
Previous severe intoxication or overdose	12 (11.5)	14 (13.5)	26 (12.5)	0.834
Academic decline	62 (59.6)	55 (52.9)	117 (56.2)	0.402
Frequent school absenteeism	58 (55.8)	50 (48.1)	108 (51.9)	0.331
Family conflict attributable to use	50 (48.1)	63 (60.6)	113 (54.3)	0.095
Violence or legal consequences	29 (27.9)	10 (9.6)	39 (18.8)	0.001
Sexual risk or exploitation	11 (10.6)	25 (24.0)	36 (17.3)	0.017
Substance-related medical complication	15 (14.4)	18 (17.3)	33 (15.9)	0.704
Any previous help-seeking	13 (12.5)	11 (10.6)	24 (11.5)	0.828
Formal treatment previously received	8 (7.7)	6 (5.8)	14 (6.7)	0.782
Perceived stigma as a treatment barrier	26 (25.0)	49 (47.1)	75 (36.1)	0.001

DSM-5-TR: Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition, Text Revision. Substance-use disorder severity was categorised as mild, moderate or severe according to the number of diagnostic criteria fulfilled.

Among boys, initiation before 13 years of age (adjusted OR=2.41; 95% CI: 1.03–5.65), polysubstance use (adjusted OR=3.38; 95% CI: 1.46–7.80), daily or near-daily use (adjusted OR=4.54; 95% CI: 1.90–10.85), substance-using

peers (adjusted OR=2.64; 95% CI: 1.03–6.76) and conduct problems (adjusted OR=2.39; 95% CI: 1.02–5.61) independently predicted moderate-to-severe substance-use disorder.

Among girls, significant predictors were polysubstance use, daily use, three or more adverse childhood experiences, abnormal emotional symptoms and predominantly solitary use, with adjusted odds ratios ranging from 2.49 to 3.72 (Table 7).

Table 7: Gender-Stratified Multivariable Predictors of Moderate-to-Severe Substance-Use Disorder

Predictor	Boys: aOR (95% CI)	p-value	Girls: aOR (95% CI)	p-value
Initiation before 13 years	2.41 (1.03–5.65)	0.043	1.92 (0.81–4.55)	0.138
Polysubstance use	3.38 (1.46–7.80)	0.004	3.11 (1.34–7.23)	0.008
Daily or near-daily use	4.54 (1.90–10.85)	0.001	3.72 (1.60–8.66)	0.002
Substance-using peers	2.64 (1.03–6.76)	0.043	1.18 (0.46–3.02)	0.73
Abnormal conduct problems	2.39 (1.02–5.61)	0.045	1.29 (0.49–3.39)	0.606
Three or more adverse childhood experiences	1.22 (0.48–3.10)	0.676	2.77 (1.12–6.87)	0.028
Abnormal emotional symptoms	1.30 (0.50–3.40)	0.592	2.49 (1.03–6.03)	0.043
Predominantly solitary use	1.47 (0.56–3.88)	0.435	2.61 (1.08–6.31)	0.033

aOR: adjusted odds ratio; CI: confidence interval. Separate binary logistic-regression models were fitted for boys and girls. The dependent variable was moderate-to-severe substance-use disorder. Models were adjusted for age, educational status, socioeconomic category, family substance use, parental monitoring and the variables included in the respective models.

Discussion

The present study shows that gender disparities in childhood substance use were expressed more clearly through substance type, developmental pathway and psychosocial burden than through overall clinical severity. A nationwide school survey by Dhawan et al., reported lifetime substance use in 15.1%, past-year use in 10.3% and current use in 7.2%, with a mean initiation age of 12.9 years. Boys showed higher overall use; however, girls reported greater proportional use of inhalants and non-medical pharmaceutical opioids [9]. The mean age at initiation was similar in boys and girls (13.2 versus 13.4 years), while CRAFFT positivity and DSM-5-TR severity were comparable. This accords with a recent Indian multicity school survey by Dhawan et al., reporting a mean initiation age of 12.9 years and substance-specific rather than uniform gender differences [9]. Comparable severity may also reflect the narrowing of the traditional male predominance in substance-use disorders [5]. Boys more frequently used tobacco/nicotine and cannabis, whereas girls showed greater predominance of inhalants, opioids and non-medical sedative or pharmaceutical use ($p=0.001$). Polysubstance use was also higher among boys (58.7% versus 40.4%; $p=0.013$). The Indian nationwide survey by Dhawan et al., similarly found higher tobacco and cannabis use among boys but proportionally greater inhalant and non-medical pharmaceutical opioid use among girls

[9]. Greater outdoor mobility and contact with substance-using peers may facilitate tobacco and cannabis use among boys. Inhalants and pharmaceuticals may be easier for girls to obtain, conceal and use within more restricted social environments; however, such patterns are socially and contextually shaped rather than biologically fixed [5,10]. A Portuguese adolescent study by Picoito et al., similarly identified distinct gender-specific substance-use profiles, with early initiation and polysubstance use forming a characteristic pattern among boys [10].

Initiation pathways differed markedly. Peer curiosity, acceptance and sensation-seeking predominated among boys, whereas emotional distress, family or partner influence and trauma-related coping were more common among girls ($p=0.001$). Boys were more likely to use substances in peer groups and to have substance-using peers (74.0% versus 58.7%; $p=0.028$), while girls more often reported solitary use, emotional relief and coping with family conflict. Cross-cultural research has similarly identified stronger social and enhancement motives among boys and greater coping-related motives among girls [11]. Peer modelling may reinforce use through perceived norms, accessibility and immediate social reward, whereas solitary use may become negatively reinforcing by temporarily reducing anxiety, sadness or traumatic distress [12,13]. Psychiatric and trauma profiles further supported these

divergent pathways. Girls had nearly twice the prevalence of abnormal emotional symptoms (46.2% versus 23.1%), depressive symptoms (47.1% versus 25.0%) and anxiety symptoms (44.2% versus 21.2%), together with greater self-harm or suicidal ideation. Boys had more conduct problems (41.3% versus 23.1%). Girls also reported more adverse childhood experiences, including three or more adversities (37.5% versus 20.2%), emotional abuse and sexual victimisation. Edokpolo et al., similarly observed greater psychiatric symptom burden among substance-using adolescent girls, while Stevens et al. found that girls receiving substance-use treatment had greater traumatic-stress, mental-health and health-risk problems [14,15]. Kobulsky et al., in a longitudinal sample of 1,161 youths, demonstrated gender-moderated pathways linking childhood abuse and neglect with late-adolescent substance-use severity [16]. Trauma may dysregulate stress responsivity and emotional regulation, increasing the appeal of substances as coping tools; externalising traits may promote use through impulsivity, rule-breaking and affiliation with deviant peers [17,18].

Consequences were also gendered. Boys experienced more violence or legal consequences (27.9% versus 9.6%), consistent with their greater conduct problems, street connection and previous conflict with law. Girls had more sexual risk or exploitation (24.0% versus 10.6%), potentially reflecting relational power imbalances, partner-mediated access to substances and impaired protective decision-making during intoxication. A meta-analysis of 87 studies, comprising more than 120,000 adolescents, confirmed a significant relationship between substance use and risky sexual behaviour and identified sex and contextual characteristics as important moderators [19]. Girls also reported greater treatment-related stigma (47.1% versus 25.0%), while formal treatment remained uncommon in both groups, paralleling the very low help-seeking reported among Indian school-going substance users [9]. Multivariable analysis clarified that progression to moderate-to-severe disorder was not identical across genders. Among boys, early initiation, peer substance use and conduct problems independently predicted severity; among girls, multiple adverse experiences, emotional symptoms and solitary use were significant [20]. A meta-analysis of 27 longitudinal studies demonstrated a significant association between peer influence and adolescent substance use ($\beta=0.147$, $p<0.001$) [21]. Polysubstance and daily use predicted severity in both groups, suggesting common exposure-related mechanisms despite divergent psychosocial pathways [22]. Prevention should therefore combine universal early screening with peer- and conduct-focused interventions for boys and

confidential, trauma-informed mental-health and relationship-safety services for girls [23]. Since the study was cross-sectional, the observed pathways should be interpreted as associations rather than confirmed causal sequences.

Limitations

The cross-sectional design precludes establishing temporal or causal relationships between psychosocial exposures and substance-use severity. Consecutive recruitment from institutional and referral settings may limit generalisability to community-based or out-of-school populations. Substance use, trauma and sexual-risk histories were self-reported and may have been affected by recall and social-desirability bias, particularly among girls. Equal gender-group allocation may also differ from the natural sex distribution of treatment-seeking populations.

Conclusion

Substance use among children demonstrated distinct gender-related pathways despite comparable ages at initiation and overall disorder severity. Boys more often exhibited tobacco or cannabis use, polysubstance exposure, peer-driven initiation, conduct problems and legal consequences. Girls showed greater inhalant and pharmaceutical use, emotional distress, adverse childhood experiences, solitary consumption, sexual vulnerability and treatment-related stigma.

Daily and polysubstance use predicted greater severity in both groups, whereas peer and conduct factors were especially important among boys and trauma-related emotional factors among girls. Prevention and treatment programmes should therefore combine universal early screening with gender-responsive, peer-focused, trauma-informed and confidential mental-health interventions. Early intervention may reduce long-term psychiatric, educational and social consequences.

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