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IJABR

International Journal of Advanced Biotechnology and Research
ISSN 0976-2612, Online ISSN 2278–599X,
17 (4), 2026, 49-59

Research Article

A cross-sectional case-control evaluation of Behavioural Activation and Inhibition (BIS/BAS) among offspring (13-25 years) of alcohol-dependent fathers

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Article Info

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Received: 19/09/2026
Accepted: 20/10/2026
Published: 29/10/2026

DOI: 10.5281/zenodo.23762732

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Abstract

Children of alcohol-dependent parents are considered a vulnerable population with increased risk for emotional, behavioural, and substance-related problems. Behavioural Inhibition System (BIS) and Behavioural Activation System (BAS) are important neuropsychological domains associated with reward sensitivity, impulsivity, and behavioural regulation while AUDIT score indicates risk of alcohol use. Only limited Indian studies have covered BIS/BAS and Alcohol Use Disorders Identification Test (AUDIT) profiles among offspring of alcohol-dependent fathers. To compare BIS/ BAS and AUDIT scores between offspring of alcohol-dependent fathers and offspring of non-alcohol-dependent fathers and to assess age-wise and gender-wise variations in these behavioural domains**.** This hospital-based cross-sectional case-control study was conducted among 68 participants aged 13-25 years. Thirty-three participants belonged to the high-risk group (offspring of alcohol-dependent fathers) and thirty-five participants belonged to the low-risk group. Behavioural inhibition and activation were assessed using the BIS/BAS scale developed by Carver and White. Alcohol use severity was assessed using the AUDIT score. Since data was not normally distributed, Mann-Whitney U test and Spearman correlation were used for analysis. No statistically significant differences were observed between high-risk and low-risk groups with respect to BIS, BAS drive, BAS fun seeking, BAS reward responsiveness, and AUDIT scores ($p>0.05$). Adolescents aged 13-18 years demonstrated significantly higher BAS fun seeking scores compared to young adults aged 19-25 years. Females showed significantly higher BAS reward responsiveness scores than males ($p=0.010$). The present study did not demonstrate significant differences in BIS/BAS profiles between offspring of alcohol-dependent fathers and controls. However, developmental and gender-related variations were observed in behavioural activation domains. Further studies with larger sample sizes are needed to better understand behavioural vulnerability markers among high-risk offspring populations.

Keywords: Alcohol dependence, BIS/ BAS, behavioural inhibition, behavioural activation, offspring, adolescents, reward sensitivity

Introduction

Alcohol dependence is a chronic relapsing disorder that impacts the person and the functioning of the family unit. Parents with alcohol dependence, especially fathers, have children that are at risk of emotional, behavioural, and psychiatric issues such as early alcohol use, anxiety, depression, and conduct disorders, are considered a vulnerable group, and have been identified as having a higher risk for emotional, behavioural, and psychiatric problems [1]. The World Health Organization (WHO) recognizes alcohol consumption as a key driver of the world's disease burden and its wider social and intergenerational impacts [2].

This vulnerability is due to a combination of factors, such as genetic vulnerability and poor family environments, including family stress, disrupted parenting and adverse home environment [2,3]. Adolescence and young adulthood (ages 13-25) is a developmental period with substantial neurobiological and psychosocial changes, with important changes in reward processing, impulsiveness, and emotional control systems. Studies using MRI have found that kids with alcohol use disorder in the family have abnormal activation in the brain regions associated with inhibitory control even prior to the onset of substance use, suggesting that there are early neurobiological differences in this group of children.

Two important theoretical constructs to understand individual differences in responses to punishment and reward are the Behavioural Inhibition System (BIS) and the Behavioural Activation System (BAS). The BIS is related to sensitivity to negative outcomes, avoidance behaviour, while the BAS is related to reward sensitivity, approach behaviour and impulsivity [8]. These systems have been linked to personality features like risk-taking and novelty seeking behaviours that have been related to substance use and substance related behaviours [9]. An increased sensitivity for BIS and BAS has been reported in clinical samples, including in India, in people with substance use disorders (SUDS), especially increased fun-seeking and drive components [10].

Though these results have been obtained, few studies exist that specifically focus on BIS/ BAS profiles in the children of alcohol dependent fathers, especially in the Indian context. There has been little research directly comparing HRY and LY in the 13-25 age group, and limited research that examines age-related and gender-related differences in these behavioural systems in this population. This awareness can assist in detection of early signs of vulnerability and support strategies to prevent problems.

The purpose of the current study is thus to compare the behavioural inhibition and activation (BIS/ BAS) profiles of alcohol dependent father (high-risk group) offspring and non-alcohol dependent father (low-risk group) offspring. It also aims to explore gender and age differences (adolescents and young adults). This study could aid in the identification of children who are at risk and may help to guide the development of prevention and intervention strategies.

Materials and Methods

This study was a hospital-based, cross-sectional case-control study conducted in the Departments of Psychiatry and General Medicine of a tertiary care hospital of Central Tamil Nadu for a period of six months. It included individuals aged 13-25 years, who were divided into high-risk group (cases) who were offspring of fathers diagnosed with alcohol dependence syndrome (based on ICD-10/ ICD-11 criteria, confirmed through clinical records or psychiatrist evaluation) and low-risk group (controls) who were offspring of fathers without alcohol dependence or any major psychiatric or substance use disorder in first-degree relatives. The participants were recruited with an attempt to maintain comparable distributions of age and gender.

According to an expected moderate-to-large effect size (Cohen's d = 0.7) [11], with significance level of 0.05 and 80% power, the study sample was required to contain a minimum of 32 participants per group. Allowing for approximately 10% non-response or attrition, a target sample of 70 participants (35 per group) was planned. Finally, 68 participants were included in the analysis, comprising 33 high-risk

and 35 low-risk participants. As two recruited high risk participants in this study was died, follow up cannot be possible, finally 33 high risk participants only possible. Participants were recruited from general outpatient department, staff families, and attached colleges; controls who are unrelated to cases were included. Participants between 13 and 25 years of age who were able to understand the questionnaire and provide consent/assent were included. Participants with current or past alcohol dependence or another substance dependence disorder were excluded; nicotine use was permitted.

Data was collected using socio-demographic proforma, BIS/ BAS Scale (Carver and White) [7], to assess behavioural inhibition and activation, AUDIT to assess alcohol use patterns in participants. The BIS/ BAS scale is a 24-item, well-validated self-report measure which assesses four domains: BIS (sensitivity to punishment and potential negative outcomes), BAS-drive (persistence in goal pursuit), BAS-fun seeking (attraction to novel rewards and impulsive approach), and BAS-reward responsiveness (positive affect in response to reward). The scale has been validated across adolescent and young adult populations [7]. The AUDIT, a WHO-validated 10-item instrument, was used to screen and quantify current alcohol use severity in the offspring.

Data was entered in Microsoft Excel spread sheet and analysed with SPSS software 29.0 version using descriptive and inferential statistics. Primary outcomes included BIS total scores and BAS subscale scores (drive, fun seeking, reward responsiveness). Secondary measures included AUDIT scores, age group differences, and gender-based variations. As data was not normally distributed according to Shapiro Wilk test, descriptive statistics like median, interquartile range and frequencies were used to express participant characteristics and BIS/ BAS scores. Intergroup variation in BIS and BAS domain scores (high risk versus low risk) was examined using Mann- Whitney U test. Subgroup analyses were performed as adolescents (13-18 years) versus young adults (19-25 years) and male versus female offspring, within and across risk groups. Spearman correlation was used to examine associations between BIS/BAS domains and AUDIT scores. A p-value <0.05 was considered statistically significant.

The study was initiated after obtaining the approval of the Institutional Ethics Committee. Written informed consent was obtained from participants aged 18 years and above. For participants aged 13–17 years, written assent was obtained from the participant and written informed consent was obtained from a parent or legally authorised representative. All interviews were conducted in a private, confidential setting. No monetary benefits were offered to the study subjects and they were allowed to withdraw from the study at any time. The study involved minimal risk, and participants experiencing distress were offered counselling and appropriate referral.

Results

The present study included a total of 68 participants with 33 cases and 35 controls. Age-wise distribution was equal in both adolescents (13-18 years) and young adults (19-25 years) i.e. 50%. Majority of the adolescents belonged to low-risk group while there was equal distribution in both groups among young adults. Male population (67.6%) was predominant compared to females (32.4%). Males predominated in the high risk group (78.8%), whereas the low risk group had a relatively higher proportion of females (42.9%) and the detailed description was depicted in table 1.

Table 1: Socio-demographic profile of study participants

Variables		n (%)	
		Low risk (n=35)	High risk (n=33)
Age (in years)	13-18 (n=34)	18 (52.9)	16 (47.1)
	19-25 (n=34)	17 (50.0)	17 (50.0)
Gender	Male (n=46)	20 (43.5)	26 (56.5)
	Female (n=22)	15 (68.2)	7 (31.8)

The median age was 17 (14 - 24) years in the low-risk group and 19 (15 - 23) years in the high-risk group. Median BIS, BAS Fun Seeking and AUDIT scores were similar between the groups, while the high-risk group had a slightly higher median BAS drive score [15 (13 - 17) versus 14 (12 - 17)] and a slightly lower median BAS reward responsiveness score [15 (13.5 - 18.5) vs. 16 (14 - 18)] (Table 2).

Table 2: Descriptive characteristics of participants

Variables	Median (Q1 - Q3)	
	Low risk (n=35)	High risk (n=33)
Age in years	17 (14 - 24)	19 (15 - 23)
BIS	21 (19 - 24)	21 (18 - 23)
BAS Drive	14 (12 - 17)	15 (13 - 17)
BAS Fun	12 (11 - 14)	12 (11 - 15)
BAS Reward	16 (14 - 18)	15 (13.5 - 18.5)
AUDIT	5 (2 - 7)	5 (2 - 8.5)

When BIS/BAS and AUDIT scores were compared between the two groups, no statistically significant difference was observed and their detailed observation was recorded in table 3.

Table 3: Comparison of BIS/ BAS and AUDIT scores between high and low-risk groups

Variable	Group	N	Mean Rank	U	Z value	p value
BIS	High-risk	33	32.44	509.5	-0.841	0.401
	Low-risk	35	36.44			
BAS Drive	High-risk	33	36.35	516.5	-0.754	0.451
	Low-risk	35	32.76			
BAS Fun Seeking	High-risk	33	36.45	513.0	-0.804	0.422
	Low-risk	35	32.66			
BAS Reward Responsiveness	High-risk	33	33.98	560.5	-0.210	0.834
	Low-risk	35	34.99			
AUDIT	High-risk	33	35.85	533.0	-0.549	0.583
	Low-risk	35	33.23			

Among adolescents aged 13 - 18 years, no significant difference was observed between low-risk and high-risk participants in BIS, BAS Drive, BAS Fun Seeking, BAS Reward Responsiveness or AUDIT scores ($p>0.05$). Among young adults aged 19-25 years, BIS scores differed significantly between the low-risk and high-risk groups ($U=86.5$, $Z=-2.015$, $p=0.044$) with a higher mean rank noted in the low-risk group. No significant differences were observed for BAS Drive, BAS Fun Seeking, BAS Reward Responsiveness or AUDIT scores in this age group (Table 4)

Table 4: Comparison of BIS/ BAS domains and AUDIT scores between high risk and low risk groups stratified by age

Variable	Age Group (years)	Low Risk group (Mean Rank)	High Risk group (Mean Rank)	U	Z	p value
BIS	13-18	16.53	18.59	126.5	-0.610	0.542
	19-25	20.91	14.09	86.5	-2.015	0.04
BAS Drive	13-18	18.67	16.19	123.0	-0.732	0.464
	19-25	14.38	20.62	91.5	-1.844	0.065
BAS Fun Seeking	13-18	17.61	17.38	142.0	-0.070	0.944
	19-25	15.32	19.68	107.5	-1.302	0.193
BAS Reward Responsiveness	13-18	19.39	15.38	110.0	-1.183	0.237
	19-25	15.97	19.03	118.5	-0.903	0.367
AUDIT	13-18	16.28	18.88	122.0	-0.765	0.444
	19-25	17.41	17.59	143.0	-0.052	0.959

Females exhibited higher BAS reward responsiveness scores that was statistically significant compared to males, while other BIS/BAS domains and AUDIT scores did not differ significantly by gender (Table 5).

Table 5: Gender-wise comparison of BIS/BAS and AUDIT scores (Males – 46 & Females – 22)

Variable	Gender	Mean Rank	U	Z value	p value
BIS	Male	36.79	400.5	-1.393	0.164
	Female	29.70			
BAS Drive	Male	34.03	484.5	-0.284	0.776
	Female	35.48			
BAS Fun Seeking	Male	33.97	481.5	-0.326	0.744
	Female	35.61			
BAS Reward Responsiveness	Male	30.26	311.0	-2.575	0.010
	Female	43.36			
AUDIT	Male	34.11	488.0	-0.237	0.813
	Female	35.32			

Participants were categorized into low-risk and hazardous use based on AUDIT scores. Out of the 68 study participants, 57 subjects had low-risk of alcohol use while 11 subjects had hazardous alcohol use. No statistically significant differences in BIS/BAS scores were observed between these two categories (Table 6).

Table 6: Comparison of BIS/ BAS domains with AUDIT category

Variable	AUDIT Category by alcohol use	N	Mean Rank	U	Z	p value
BIS	Non- hazardous	57	35.26	270.0	-0.730	0.465
	Hazardous	11	30.55			
BAS Drive	Non- hazardous	57	34.71	301.5	-0.201	0.840
	Hazardous	11	33.41			
BAS Fun Seeking	Non- hazardous	57	33.53	258.0	-0.939	0.348
	Hazardous	11	39.55			
BAS Reward Responsiveness	Non- hazardous	57	33.55	259.5	-0.906	0.365
	Hazardous	11	39.41			

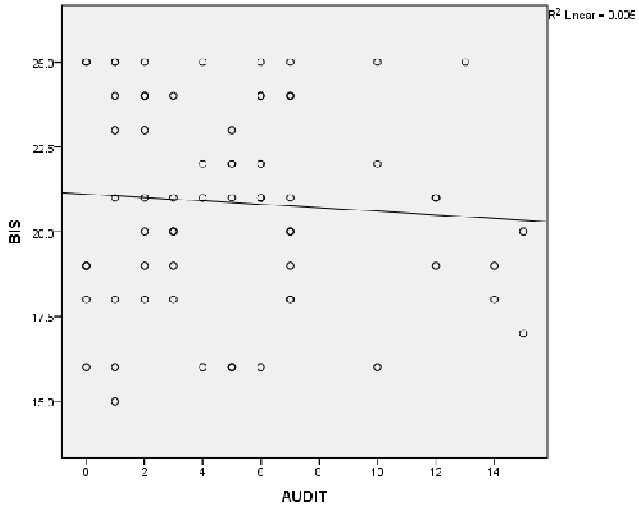
Spearman's correlation analysis showed no statistically significant correlation between AUDIT scores and BIS ($\rho = -0.036$, $p = 0.769$), BAS Drive ($\rho = -0.050$, $p = 0.684$), BAS Fun Seeking ($\rho = -0.016$, $p = 0.894$), or BAS Reward Responsiveness scores ($\rho = -0.021$, $p = 0.864$). Thus, AUDIT scores were not significantly associated with any of the BIS/BAS domains among the study participants (Table 7).

Table 7: Correlation between various BIS/BAS domains and AUDIT scores

Variables	Correlation Coefficient (ρ)	p-value
BIS vs AUDIT	-0.036	0.769
BAS Drive vs AUDIT	-0.050	0.684
BAS Fun Seeking vs AUDIT	-0.016	0.894
BAS Reward Responsiveness vs AUDIT	-0.021	0.864

The fitted linear trend line demonstrates a negligible negative association between AUDIT and BIS scores ($R^2 = 0.005$) (Figure 1).

Fig 1: Scatterplot showing the relationship between AUDIT and BIS scores.



Discussion

The present study explored whether offspring of alcohol-dependent fathers differed from controls in behavioural inhibition, behavioural activation, and alcohol-use patterns. At first glance, the absence of significant differences in BIS, BAS Drive, BAS Fun Seeking, BAS Reward Responsiveness, and AUDIT scores between the two groups may appear unexpected. However, when the characteristics of the sample and the methods used are considered, these findings become easier to understand.

The participants in the study were 68 (33 high-risk, 35 low-risk) equally distributed between adolescents (aged 13 - 18 years, n = 34) and young adults aged 19 - 25 years (n = 34). In the adolescent group, marginally more were in the low-risk group (52.9% compared to 47.1%) and young adults were evenly split (50% in each). There were more males than females overall (67.6% males, 32.4% females) and the gender disparity was greater in the high-risk group (78.8% males, 21.2% females) than in the low-risk group (57.1% males, 42.9% females). This is consistent with the predominance of alcohol dependence among men in India and globally and was also seen in other Indian case-control studies [2,13,14]. In comparison to the male group, the smaller number of females in the high-risk group (n = 7) reduces the power of the gender-specific subgroup comparisons and future studies should strive to achieve a more balanced gender sample.

Median BIS (21 versus 21), BAS Fun Seeking (12 versus 12), and AUDIT scores (5 versus 5) were identical. High-risk group was slightly more likely to have a median BAS Drive of 15 versus 14 for the low-risk group and slightly less likely to have a median BAS Reward Responsiveness score of 15 versus 16 for the low-risk group. Although the median BAS Drive and BAS Reward Responsiveness scores differed by one point, the distributions overlapped considerably, and these differences were not statistically significant. The median AUDIT score was 5 in both groups, although 11 participants were classified as having hazardous alcohol use according to the predefined study categorisation. This is similar to the data from India, which indicates that the mean age of alcohol initiation in adolescents is between 14.4 and 18.3 years [20], meaning that many participants, especially amongst the younger age group, had not yet initiated regular drinking.

There was no statistically significant difference between the high risk and low risk groups on any of the BIS/ BAS subscales or on the AUDIT score (all $p > 0.05$). This finding may sound paradoxical in light of the known disadvantage of children of alcohol dependent parents, but certain features of this sample can explain it. Alcohol-dependent fathers are known to raise children who are at risk for behavioural,

emotional and cognitive issues. These findings have been confirmed by a number of Indian studies. A study conducted in Karnataka revealed that almost half the children of alcohol dependent parents had problems maintaining their attention and a significant number had already begun to use tobacco or alcohol [10].

Sugaparaneetharan et al reported that children aged 7 - 14 years whose fathers were alcohol dependent were three times more likely to meet the ADHD criteria [13]. In the previous studies they were mainly younger children measured with objective assessment measures and in the present study they were older children from a population measured with self-report questionnaires with more emphasis on externalising problems [12]. Also, patients with current psychiatric disorders or substance abuse were not included. This might have led to the selection of a relatively healthier more emotionally stable group thereby decreasing the chance for finding personality differences.

The role of resilience in this population has also been highlighted in Indian research. Sugaparaneetharan et al reported that psychologically healthy young adult children of alcoholics in Karnataka showed stronger family support, better community connections, and greater involvement in cultural and religious activities [13]. Another South Indian study by the same authors found that among 1,555 college students identified as children of alcoholics, only 35% had emotional psychopathology [16]. Therefore, the lack of BIS/BAS differences in the present study may partly reflect genuine resilience in this sample rather than the complete absence of vulnerability.

Ganesh et al reported greater sensitivity for BIS and BAS in substance use disorder patients, especially in the fun-seeking and drive factors, as opposed to the current study where individuals mostly had no substance use disorder as well as focused on asymptomatic offspring with familial risk [10]. The difference between findings in clinical populations and the present high-risk offspring sample may indicate that BIS/BAS characteristics vary according to clinical status, alcohol-use severity, or developmental stage. Longitudinal studies are needed to clarify the temporal relationship. This is also confirmed by international research. One recent study showed that higher BIS scores were associated with greater alcohol use severity on the AUDIT, with anxiety and depression significantly mediating this relationship [17].

A large Swiss study further reported that fun-seeking was positively associated with risky drinking, whereas reward responsiveness showed an inverse relationship with alcohol use disorder [18]. Considering this complexity, the absence of intergroup differences in asymptomatic high-risk offspring is justified. Furthermore, Kendler et al study showed that the hazard ratio for alcohol use disorder among the children of parents with alcohol dependence was 2.36, but this risk typically occurs over many years rather than during the teen years in a cross-sectional design [19].

The median AUDIT score was 5.0 and there was no significant difference between the high-risk and low-risk groups (p=0.583). Likewise, there were no statistically significant differences between non- hazardous and hazardous drinkers on any of the BIS or BAS sub scales. Of the 68 participants, 57 were not classified as hazardous users and 11 were classified as hazardous users. The results are similar to the status quo of alcohol use among adolescents in India. It is important to remember that in Nadkarni et al, the prevalence of alcohol use among Indians aged 13-18 ranged from 10.6 to 32.9% with the mean age of initiation between 14.4 years and 18.3 years, meaning that many of the participants in this age group may not be in a significant alcohol use pattern [20]. Having alcohol-related outcomes associated with BIS/ BAS traits is likely to be more likely once drinking behaviours are more established and stable, and this may not always be the case in much of this sample.

The finding that adolescents aged 13 - 18 years had significantly higher BAS Fun Seeking scores than young adults aged 19 - 25 years in the present study is expected and clinically relevant. Steinberg's social neuroscience and

dual systems models explain that reward-seeking systems mature earlier than self-regulatory control systems, resulting in increased novelty-seeking during adolescence that gradually declines with age [6,21]. This increased reward sensitivity is considered developmentally adaptive, as it encourages adolescents to explore new experiences and develop independence [22]. A 14-year longitudinal study found that fun-seeking behaviour was associated with later attention problems, aggression, and alcohol and cannabis use [21].

Adolescents with alcohol-dependent parents are already exposed to poor coping mechanisms and disturbed family environments [22]. Therefore, the increased fun-seeking seen during the 13 - 18 year period may represent a particularly vulnerable stage where environmental and neurobiological risk factors overlap. It is noteworthy that in a randomised controlled trial (RCT) conducted by Omkarappa et al., 12 - 16 years, the internalising problems of their study population improved significantly if they received psychosocial intervention [25]. These findings demonstrate the need for early preventive interventions during adolescence.

Females in the current study showed significantly higher BAS Reward Responsiveness scores than males ($p=0.010$). Women have also been reported to put in greater effort for smaller but more frequent rewards, which may partly reflect differences in gender role socialisation from an early age [26]. The higher reward responsiveness observed among females in this study also matches findings from another study on offspring of alcohol-dependent parents, where girls are more likely to show internalising symptoms and boys are more likely to show externalising behaviours [24,27]. In contrast, a study done by Dhingra et al reported that men had higher sensitivity to reward and females having higher sensitivity to punishment [28]. These findings suggest that similar family risk environments may influence boys and girls through different motivational pathways, which future studies should examine more closely.

The weak but significant negative correlation between BIS and BAS Reward Responsiveness observed in this study is consistent with the theoretical proposition that the two systems work partly in opposition to each other such that heightened sensitivity to punishment may reduce an individual's responsiveness to rewarding stimuli [8,9]. However, the absence of significant correlations between BIS/BAS scores and AUDIT in the present study contrasts with Crozier et al [17] finding that BIS was significantly linked to alcohol use severity in an adult clinical sample, while Studer et al demonstrated that the BAS fun-seeking subscale predicted risky drinking in a large community sample [16].

This is not surprising because most participants in the study reported either minimal or no alcohol use. With very little variation in alcohol consumption, it becomes statistically difficult to identify meaningful relationships between alcohol use and personality-related neuropsychological traits. This is consistent with evidence that BIS/ BAS measures are more reliably linked to alcohol outcomes in populations with established or hazardous drinking patterns.

Few Indian studies have examined BIS/BAS profiles in offspring of alcohol-dependent fathers, and the present study adds data from an Indian clinical setting The marked difference in BAS Fun Seeking scores, seen across the adolescent age groups, emphasizes the need for early intervention targeting emotional regulation, impulse control and adaptive coping strategies, from a preventive psychiatry perspective. Mental health programmes in schools, family interventions, and psychoeducation about substance use can be effective in preventing a trajectory to harmful alcohol use among vulnerable youth populations.

Current limitations include cross-sectional design, small single-centre sample, and recall bias. Unequal gender distribution; relatively small high-risk subgroup; self-report nature of BIS/BAS and AUDIT; possible selection bias from hospital/staff-family/college recruitment;

inability to establish temporal or causal relationships; possible residual confounding from socioeconomic status, family environment, parental psychopathology, and other substance use are the limitations.

Conclusion

In the present study, no significant differences were observed between the BIS/ BAS profiles of the alcohol-dependent fathers' offspring and controls. Adolescents, however, had significantly higher BAS Fun Seeking scores than young adults, and females had higher BAS Reward Responsiveness scores than males. Based on these results, the findings suggest that developmental stage and gender may be associated with differences in behavioural activation patterns in this sample. Further research is needed with larger samples to better understand behavioural risk markers in high risk offspring populations.

Declarations

Ethics approval

Ethical approval was obtained from the Institutional Ethics Committee of Trichy SRM Medical College Hospital and Research Centre (Ref: 1403/TSRMMCH&RC/ME-1/2025; IEC No. 424 dated 19.12.2025). The study protocol was conducted in accordance with applicable ethical guidelines and regulations.

Informed consent

Written informed consent was obtained from participants aged 18 years and above. For participants aged 13–17 years, written assent was obtained from the participant and written informed consent was obtained from a parent or legally authorised representative..

Funding

The authors received no specific funding or financial support for the conduct of this study, preparation of the manuscript, or publication of the article.

Conflict of interest

The authors declare that they have no conflict of interest.

Data availability

The data generated and/or analyzed during the present study are available from the corresponding author on reasonable request, subject to applicable ethical and institutional restrictions.

Acknowledgements

The authors acknowledge the support of the Department of Psychiatry, Trichy SRM Medical College Hospital and Research Centre, Tiruchirappalli, India, during the conduct of this study.

Use of artificial intelligence

The authors declare that no generative artificial intelligence (AI) tools were used in the conception, conduct, analysis, interpretation, or writing of this manuscript.

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