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Effects of core self-evaluation on tobacco and alcohol use among left-behind children: mediating role of fear of missing out and moderating role of parental migration category and gender

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Abstract

Background Tobacco and alcohol use are quite prevalent among left-behind children, and core self-evaluation is an important contributing factor. Current research has rarely focused on the underlying mechanisms between these variables. This study aims to explore the relationships between core self-evaluation and tobacco and alcohol use among left-behind children, and the mediating effect of fear of missing out as well as the moderating effect of parental migration category and gender.

Methods For this study, data were collected from January 2024 to February 2025 at 25 rural primary and junior high schools in 5 cities in Jiangsu Province via a random cluster sampling method. A total of 1795 left-behind children were surveyed with the Core Self-Evaluation Scale, the Tobacco and Alcohol Use Questionnaire and the Multidimensional Fear of Missing Out Scale. SPSS 26.0 software was used for descriptive statistics and correlation analysis, and Mplus 8.4 software was used to analyse the mediation effect and moderated mediation effect.

Results Core self-evaluation was significantly associated with tobacco and alcohol use; the fear of missing out partly mediated the relationships between core self-evaluation and tobacco and alcohol use; the parental migration category served as a moderating factor in the mediation model, specifically, in households with dual-parent migration, the associations between fear of missing out and tobacco and alcohol use were more significant; no significant gender differences were observed in the relationships between fear of missing out and tobacco and alcohol use.

Conclusions This finding indicated that core self-evaluation contributed to tobacco and alcohol use among left-behind children through fear of missing out, and the parental migration category moderated the latter half of the mediating model.

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Keywords Left-behind children, Core self-evaluation, Tobacco and alcohol use, Fear of missing out, Parental migration category, Gender

Introduction

Left-behind children refer to minors who are compelled to reside with one parent or other relatives in their registered hometown due to the migration of both or one parent for employment opportunities [1]. Owing to the prolonged absence of parental behavior guidance and supervision, left-behind children exhibit higher rates of tobacco and alcohol use [2]. The tobacco and alcohol use not only harm the development of brain tissue in children [3], but also trigger negative emotions such as depression [4], anxiety [5], and loneliness [6]. Additionally, it increases the risk of aggression [7], drug abuse [8], and other illegal behaviors [9]. Therefore, it is essential to explore the mechanisms behind tobacco and alcohol use among left-behind children, aiming to provide more effective interventions for this group and promote their physical and mental health development.

Core self-evaluation and tobacco and alcohol use

Core self-evaluation refers to the fundamental assessment and estimation of one's own value and abilities [10]. It represents a relatively stable internal cognitive pattern, composed of four factors: self-esteem, generalized self-efficacy, emotional stability and locus of control, which have a profound impact on an individual's behaviors and attitudes [11]. Early research on core self-evaluation focused on the industrial field, revealing a close relationship between core self-evaluation and employees' job performance, job satisfaction, and job engagement [12]. In recent years, research has introduced core self-evaluation into the education field, exploring how it reduces students' problematic behaviors and improves their social adaptation and psychological well-being [13, 14]. This study focuses on a special group of left-behind children and aims to investigate the relationships between core self-evaluation and tobacco and alcohol use.

This study draws on the self-verification theory in the core self-evaluation to argue that individuals with lower core self-evaluation are more likely to accept negative feedback from others, perceiving themselves as deficient in competence and worth in the perspective of both parents and educators, emotionally labile, and incapable of exerting control over their own lives [15]. They may believe that they cannot meet the expectations placed on them in academic and life contexts, and may exhibit problem behaviors that are not sanctioned by parents and teachers to maintain their low level of core self-evaluation. Tobacco use is frequently construed as an emblem of "rebellion" and "juvenile delinquency," functioning as a corroboration of an individual's self-perception of being marginalized and unacknowledged. Meanwhile, alcohol use is widely interpreted as a form of escapism, reinforcing the adverse self-assessment of one's inability to govern their own existence. Previous studies have also indicated that core self-evaluation is an important factor contributing to tobacco [16] and alcohol use [17]. Additionally, the four components of core self-evaluation are closely related to tobacco and alcohol use. Individuals with lower self-esteem [18], lower generalized self-efficacy [19], greater emotional instability [20], and a tendency toward external control [21] are more likely to smoke and drink excessively. Therefore, this study aims to further examine the relationships between core self-evaluation and the tobacco and alcohol use in left-behind children.

The mediation of fear of missing out

Fear of missing out refers to a pervasive anxiety stemming from the fear of missing out on others' exciting experiences [22], with its root cause being the fear of position in one's mind being replaced by someone else [23]. The phenomenon of fear of missing out assumes particular significance in the context of left-behind children, primarily due to the profound sense of disconnection engendered by the absence of parental figures. These children, often grappling with the void left by migrating parents, may experience heightened susceptibility to fear of missing out as they seek to bridge the emotional and social chasms created by this separation. The pervasive use of social media among adolescents exacerbates this vulnerability, as it serves as a constant reminder of the social activities and familial interactions from which they are excluded. Consequently, fear of missing out not only amplifies their feelings of isolation but also perpetuates a cycle of anxiety and diminished self-worth, making it a critical area of study in understanding the psychosocial dynamics of left-behind children [24]. Moreover, this anxiety often extends beyond familial contexts and permeates other social domains, such as friendships [25]. Left-behind children, already struggling with feelings of abandonment and loneliness, may become hyper-vigilant about their social standing among peers. Fear of missing out can manifest in their friendships as an intense fear of being excluded from group activities, conversations, or shares experiences. This anxiety may drive them to engage in risk behaviors to gain acceptance or avoid further social ostracism. For instance, previous studies have demonstrated that adolescents with higher levels of fear of missing out are more likely to engage in problem gambling, speculative trading [26], social media

addiction [27], and moral violations [28]. Furthermore, from the perspective of self-determination theory, individuals exhibiting higher levels of fear of missing out are more likely to experience deficiencies in fulfilling their basic psychological needs, namely autonomy, competence, and relatedness [29]. Consequently, these individuals may engage in behaviors such as tobacco use within social contexts as a compensatory mechanism to attain a sense of autonomy and competence, foster social connections, and achieve a feeling of belonging, thereby addressing their unmet basic psychological needs. Additionally, individuals with elevated fear of missing out may exhibit heightened concerns about missing out on the enjoyment and excitement associated with peer drinking activities, which further predisposes them to such behaviors. Recent studies have corroborated that fear of missing out serves as a significant risk factor for both tobacco and alcohol use among adolescents [30–32].

Furthermore, according to the motivation model of substance use, inappropriate self-cognitive patterns can trigger corresponding negative emotional responses. The chemical properties of tobacco and alcohol, combined with their social labeling, may provide individuals with a means to reduce stress and alleviate negative emotional experiences [33]. As a special negative emotion, fear of missing out may mediate the relationships between core self-evaluation and both tobacco and alcohol use among left-behind children. Individuals with low core self-evaluation often perceive themselves as inferior to their peers in terms of self-worth and abilities, and they may struggle to maintain existing social relationships. This perception can lead to a heightened fear of losing these friendships if they fail to promptly track their peers' activities or respond to messages, thereby exacerbating fear of missing out [34]. To cope with these negative emotional experiences, such individuals may adopt strategies aimed at enhancing their social status within peer groups to secure their position [35]. Among adolescents, tobacco use is often perceived as a marker of maturity, and individuals who smoke may attain a leadership role among their peers. Consequently, tobacco use may become a preferred coping mechanism for left-behind children [36]. Moreover, individuals with low core self-evaluation may feel undervalued by their parents and may constantly seek parental validation to avoid feelings of abandonment. Missing communication from their parents may intensify their anxiety about parental disappointment, prompting them to use tobacco and alcohol as a way to alleviate these feelings [37]. Previous study has demonstrated a significant association between core self-evaluation and fear of missing out [38]. Meanwhile, core self-evaluation has been found to play a mediating role in the relationship between its components and problematic behaviors among adolescents [39–41]. Therefore, this study aims to investigate the mediating role of fear of missing out in the relationships between core self-evaluation and tobacco and alcohol use among left-behind children.

The moderation of parental migration category and gender

Parental migration can be classified into two distinct types: single-parent migration and dual-parent migration [25]. These categories may play a moderating role in the mechanisms underlying tobacco and alcohol use among left-behind children. According to social bonding theory, parents establish behavioral norms for their children, provide supervision, and facilitate the development of normative bonds, thereby reducing the likelihood of deviant behaviors [42]. When parents explicitly discourage smoking and drinking and offer real-time supervision, they help children internalize these norms as guiding principles, which can significantly reduce the propensity for tobacco and alcohol use [43]. In cases of single-parent migration, the remaining parent can actively regulate and monitor the child's behaviors related to smoking and drinking. In contrast, children experiencing dual-parent migration lack such direct supervision and are consequently more likely to engage in these behaviors. Furthermore, attachment theory posits that parents who consistently and sensitively respond to their children's emotional needs can effectively identify and address these needs in a timely manner [44]. This consistent care and responsiveness foster a sense of security and understanding in children, thereby reducing anxiety and diminishing the likelihood of problematic behaviors. Additionally, parents serve as role models for emotion regulation and expression, equipping children with strategies to manage negative emotions effectively, which in turn reduces emotion-driven behaviors [45]. In single-parent migration households, the resident parent can identify and respond to the child's emotional needs while modeling adaptive coping strategies. However, children in dual-parent migration households often lack such emotional support and guidance, which may exacerbate their fear of missing out and increase their susceptibility to tobacco and alcohol use. Consequently, children in dual-parent migration households are more likely to engage in tobacco and alcohol use and experience heightened levels of fear of missing out. In other words, the relationship between fear of missing out and tobacco and alcohol use may be more pronounced among left-behind children in dual-parent migration households.

Gender may serve as a moderating factor in the mechanisms underlying tobacco and alcohol use among left-behind children. According to gender role theory, societal expectations for boys and girls differ significantly, which may influence their behaviors and attitudes

toward substance use. Boys are often socialized to exhibit traits such as risk-taking, independence, and sociability, and the use of tobacco and alcohol is, to some extent, perceived as a symbolic expression of these traits. For instance, in social contexts, tobacco and alcohol use are frequently regarded as tools for socialization, enabling boys to integrate into peer groups, establish social networks, and demonstrate their interpersonal skills and extroverted personalities. In contrast, girls are typically expected to embody traits such as gentleness, modesty, and grace, and the use of tobacco and alcohol is generally viewed as incongruent with these traditional feminine ideals. Girls who engage in smoking or drinking may face more severe social stigma and be perceived as deviating from acceptable behavior [46]. Consequently, boys may exhibit a higher prevalence of tobacco and alcohol use compared to girls. Empirical studies have consistently demonstrated that the rates of tobacco and alcohol use are significantly higher among boys than among girls [47–49]. Moreover, the role of gender in fear of missing out remains a subject of debate in the current literature. While some studies report no significant gender differences in fear of missing out, others suggest that such differences do exist. For example, Rozgonjuk [50] and Li [51] found no gender-based disparities in fear of missing out, whereas Yin [52] and Brailovskaia [53] reported that boys scored significantly higher on fear of missing out measures than girls. Conversely, Zhang [54] observed that adolescent girls exhibited significantly higher fear of missing out scores than boys. These conflicting findings highlight the complexity of gender's role in fear of missing out and suggest that gender may act as a moderating variable in the relationships between fear of missing out and tobacco and alcohol use among left-behind children. Further research is needed to clarify these dynamics and explore the underlying mechanisms.

Based on the theoretical framework outlined above, fear of missing out may serve as a mediator in the relationships between core self-evaluation and tobacco and alcohol use among left-behind children. Additionally, the parental migration category (single-parent vs. dual-parent migration) and gender may interact with fear of missing out to influence these behaviors. Consequently, this study aims to investigate the moderating role of parental migration category and gender in the latter half of the mediation model involving fear of missing out.

The present study

Core self-evaluation may serve as a significant factor influencing tobacco and alcohol use among left-behind children. However, the mechanisms through which core self-evaluation contributes to such behaviors remain underexplored in prior research. Existing studies suggest that core self-evaluation is negatively associated with tobacco and alcohol use. To address the mediating role of fear of missing out in the relationships between core self-evaluation and tobacco and alcohol use among left-behind children, as well as the potential moderating role of parental migration category and gender. Specifically, this study hypothesized that fear of missing out would mediate the relationships between core self-evaluation and tobacco and alcohol use, and that parental migration category and gender would moderate the latter pathway of this mediation model.

Theoretical background

Core self-evaluation

Core self-evaluation represents an individual's most fundamental assessment of their own value and capabilities. It is a higher-order latent construct encompassing four key dimensions: self-esteem, generalized self-efficacy, emotional stability and locus of control [10]. Self-esteem refers to an individual's overall positive or negative appraisal of their self-worth [18]. Generalized self-efficacy reflects an individual's belief in their capacity to successfully complete tasks or achieve desired goals [19]. Emotional stability denotes the degree to which an individual's emotional state consistent and resilient in the face of stressors [20]. Lastly, locus of control pertains to an individual's perception of control over the outcomes of events in their life, ranging from internal (self-determined) and (externally influenced) [21]. Extensive research has demonstrated that core self-evaluation serves as a protective factor for mental health and social adaptation [11]. It has been shown to effectively mitigate the occurrence of problematic behaviors, including substance use and other risk-taking activities [12]. These findings underscore the importance of core self-evaluation as a critical psychological resource in promoting well-being and reducing maladaptive behaviors.

Self-Verification theory

The self-verification theory, as articulated by Talaifar and Swann, provides a robust framework for understanding the psychological utility of core self-evaluation. According to this theory, individuals actively seek feedback that aligns with their self-evaluations and engage in behaviors that reinforce these self-perceptions [55]. Individuals with high core self-evaluation tend to believe in their competence and self-worth. They seek positive feedback from others, experience heightened levels of positive emotions, and exhibit behaviors that align with social expectations to maintain and reinforce their positive self-view. Conversely, individuals with low core self-evaluation often perceive themselves as having little value or ability to meet others' expectations. They are more likely to accept negative feedback that confirms their self-view, experience increased negative emotions, and engage in

behaviors that deviate from social norms to sustain their negative self-evaluation [15]. Empirical research has demonstrated that core self-evaluation is significantly associated with psychological outcomes such as anxiety [34] and is closely linked to behaviors such as tobacco and alcohol use [35]. Building on these findings, the present study proposes a hypothesized model to further explore the mechanisms underlying these relationships.

Study hypothesis

This study investigates the relationships between core self-evaluation and tobacco and alcohol use among left-behind children, with a particular focus on the underlying mechanisms driving this associations. Core self-evaluation, fear of missing out, parental migration category, gender, tobacco and alcohol use were assessed using an online questionnaire administered to left-behind children. Based on the research objectives, the following hypotheses were proposed.

- 1.Hypothesis 1 (H1):
- H1a: Core self-evaluation is significantly associated with tobacco use among left-behind children.
- H1b: Core self-evaluation is significantly associated with alcohol use among left-behind children.
- 2.Hypothesis 2 (H2):
- H2a: Fear of missing out mediates the relationship between core self-evaluation and tobacco use among left-behind children.
- H2b: Fear of missing out mediates the relationship between core self-evaluation and alcohol use among left-behind children.
- 3.Hypothesis 3 (H3):
- H3a: Parental migration category moderates the relationship between fear of missing out and tobacco use.
- H3b: Parental migration category moderates the relationship between fear of missing out and alcohol use.
- 4.Hypothesis 4 (H4):
- H4a: Gender moderates the relationship between fear of missing out and tobacco use.
- H4b: Gender moderates the relationship between fear of missing out and alcohol use.

The findings of this study are expected to contribute to the understanding of the factors and mechanisms that may mitigate the risk of tobacco and alcohol use among left-behind children. Given that a substantial proportion of left-behind children engage in tobacco and alcohol use, identifying protective factors and their underlying mechanisms could provide valuable insights for the development of prevention and intervention strategies aimed at addressing mental health issues in this vulnerable population. To comprehensively examine the effects of core self-evaluation on tobacco and alcohol use among left-behind children, this study proposes a moderated mediation model, building on previous research (see Fig. 1). This model aims to elucidate the complex interplay between core self-evaluation, fear of missing out, parental migration category, and gender in influencing substance use behaviors among left-behind children.

Methods

Participants and procedures

The economic development of Jiangsu Province is characterized by significant regional imbalances, with the northern region (Subei) lagging behind the more prosperous southern (Sunan) and central (Suzhong) regions. This economic disparity has driven a large number of surplus laborers from Subei to migrate to Sunan and Suzhong in search of employment opportunities. As a

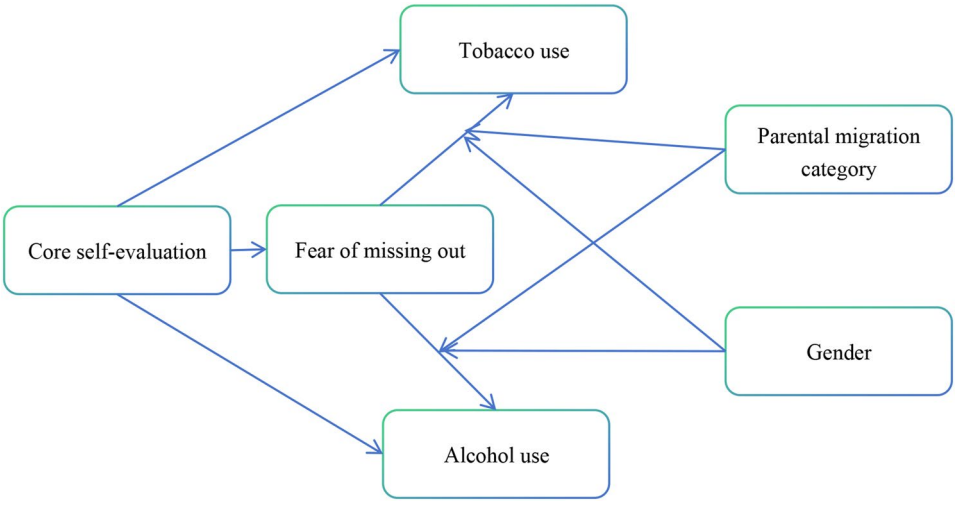

Fig. 1 Hypothesis testing model

result, many of these migrant workers leave their children behind in their hometowns in Subei, creating a substantial population of left-behind children. According to survey data, left-behind children account for approximately 9% of the total child population in Subei [56]. Given the socio-economic significance of this phenomenon, Subei was selected as the research region for this study.

From January 2024 to February 2025, this study utilized a random cluster sampling approach to gather data from students in grades 5 to 9 across 25 rural primary and junior high schools in five cities within the Subei region. The sampling strategy was meticulously designed to ensure both representativeness and methodological rigor. Initially, a comprehensive roster of rural primary and junior high schools in the five targeted cities was compiled. Employing a probability-based method, 25 schools were randomly selected as sampling clusters, ensuring an equal probability of inclusion for each school. Within these selected schools, all left-behind children in grades 5 to 9 were invited to participate in the study. Data collection was carried out through online questionnaires. Each school maintained a registry of left-behind children, and homeroom teachers facilitated the distribution of questionnaire links to the eligible students. Prior to their participation, informed consent was obtained from both the students and their parents to uphold ethical standards. This methodological framework ensured a representative and feasible data collection process while safeguarding the integrity and reliability of the study.

A total of 2000 questionnaires were collected from participants. Following the exclusion of invalid responses, 1795 valid questionnaires were retained for subsequent analysis. The sample consisted of 973 boys and 822 girls, with participants distributed across grade levels as follows: 325 fifth graders, 308 sixth graders, 339 seventh graders, 403 eighth graders, and 420 ninth graders. Among the respondents, 764 were only children, while 1031 had siblings. Additionally, 819 students reported single-parent migration, and 976 students reported dual-parent migration. The average age of the participants was 13.69 years (SD = 1.38). Ethical approval for this study was secured from the Institutional Review Board of the author's affiliated university, ensuring adherence to ethical standards in research involving human subjects.

Measures

Sociodemographic characteristics

A self-developed structured questionnaire was utilized to collect sociodemographic data, encompassing key variables such as gender (boys/girls), age, grade level, only-child status (yes/no), left-behind child status (yes/no), and parental migration category (single-parent migration/dual-parent migration).

Core self-evaluation scale

Core self-evaluation were measured using the core self-evaluation scale (CSES) [10]. The scale includes 8 items. An example item is "I feel like I wasn't sure about my academic success". Each item is rated on a 5-point Likert scale (1="completely disagree", 5="completely agree"). The average score of the 8 items is calculated, with higher scores indicating better core self-evaluation. The Cronbach' s alpha for this scale was 0.82.

Tobacco and alcohol use questionnaire

Tobacco and alcohol use were assessed using two distinct items: one measuring the frequency of tobacco use and the other measuring the frequency of alcohol use. The item evaluating tobacco use frequency was phrased as: "In the past 30 days, how many days did you smoke?" Responses were recorded on a 6-point Likert scale, ranging from "did not smoke" (scored as 1) to "20–30 days" (scored as 6). Similarly, the item assessing alcohol use frequency was formulated as: "In the past 30 days, how many days did you drink?" This item also employed a 6-point Likert scale, ranging from "did not drink" (scored as 1) to "20–30 days" (scored as 6). These measures were designed to capture the variability in substance use frequency among participants over a one-month period.

Multidimensional fear of missing out scale

Fear of missing out were measured using the multidimensional fear of missing out scale (MFS) [22]. The scale includes 13 items and 3 factors: social engagement (6 items), news information engagement (4items) and commercial information engagement (3 items). An example item is: "I get upset when my friends are having fun and I'm not able to participate" Each item is rated on a 5-point Likert scale (1="completely disagree", 5="completely agree"). The average score of the 13 items is calculated, with higher scores indicating greater fear of missing out. The Cronbach' s alpha for this scale was 0.85.

Statistical analysis

Data collection and analysis were conducted using SPSS 26.0 software. The key variables—core self-evaluation (independent variable), fear of missing out (mediating variable), tobacco and alcohol use (dependent variable), parental migration category and gender (moderating variables)—were first standardized and then analyzed using descriptive statistics and correlation analysis. To accommodate the diverse measurement scales in the dataset, four correlation methods were employed: continuous variables (core self-evaluation and fear of missing out), ordinal variables (tobacco and alcohol use), and dichotomous variables (parental migration category and gender). Specifically, Pearson correlations were used for associations between continuous variables, Spearman

Table 1 Descriptive statistics of each variable

Variable	Mean (SD)	Median (IQR)	Min	Max
Tobacco use	3.42 (0.89)	3 (1)	1	6
Alcohol use	3.34 (0.92)	3 (1)	1	6
Core self-evaluation	2.35 (0.51)	-	1	5
Fear of missing out	3.34 (0.58)	-	2	5

correlations for relationships involving ordinal measures, Point-Biserial correlations for combinations of dichotomous and continuous/ordinal variables, and Phi coefficients for associations between dichotomous variables. This comprehensive correlation strategy effectively addresses the unique statistical properties of each variable type, ensuring analytical consistency across all constructs.

The hypothesized model was analyzed using Mplus 8.4 software. The Weighted Least Squares Mean and Variance Adjusted (WLSMV) method, which is well-suited for handling ordinal and skewed data, was employed to investigate the mediating role of fear of missing out in the relationships between core self-evaluation and tobacco and alcohol use. Additionally, cross-group comparisons were conducted to evaluate the moderating effects of parental migration category and gender. To address within-cluster correlations, the "type = complex" command was implemented. Before proceeding with the main analyses, a single-factor confirmatory factor analysis was performed to assess the potential for common method bias, thereby ensuring the robustness and validity of the study's findings.

Results

Common method bias and test

Despite implementing several methodological safeguards—such as random sampling, ensuring respondent anonymity, and incorporating reverse-scored items—the potential for common method bias remains a concern in self-reported data. To address this issue, confirmatory factor analysis was employed to assess the extent of common method bias [57]. A single-factor model was constructed, in which all items were loaded onto a single common factor. The model fit indices ($\chi^2/df = 31.52$, RMSEA = 0.11, CFI = 0.30, TLI = 0.35) demonstrated poor fit, suggesting that the data did not align well with a single-factor structure. This poor fit indicates that common method bias is not a significant issue in this study, thereby supporting the validity of the findings. These results provide confidence that the observed relationships among the variables are not substantially influenced by common method variance.

Descriptive statistics of each variable

The descriptive statistics of each variable are shown in Table 1. Both tobacco and alcohol use data demonstrated positively skewed distributions with moderate asymmetry, as evidenced by mean values exceeding medians (tobacco use: mean 3.42 > median 3; alcohol use: mean 3.34 > median 3) and standard deviations approximating 1. The distribution patterns showed notable similarities: approximately three-quarters of respondents (75%) reported scores within the 1–4 point range for both substances, while high-range scores (5–6 points) accounted for relatively small proportions (tobacco use: 5.62%; alcohol use: 9.41%). This consistent pattern suggests that while most participants reported low-to-moderate substance use levels, the alcohol use data exhibited marginally higher variability in upper-range responses compared to tobacco use.

Correlation analyses

The results of the four correlation methods are summarized in Table 2. The independent variable (core self-evaluation) was strongly correlated with the mediation variable (fear of missing out) and dependent variable (tobacco and alcohol use), and the moderation variable (parental migration category and gender) was weakly correlated with the dependent variable and the mediation variable. This result was consistent with the theoretical expectations.

Mediation test of fear of missing out

The results of the mediation effect analysis are presented in Fig. 2; Table 3. Core self-evaluation demonstrated a significant negative predictive effect on fear of missing out (β=-0.21, $p < 0.001$), tobacco use (β=-0.10, $p < 0.01$), and alcohol use (β=-0.15, $p < 0.001$). In contrast, fear of missing out exhibited a significant positive predictive

Table 2 Correlation analyses

	1	2	3	4	5	6
1.Core self-evaluation	1					
2.Fear of missing out	-0.21*	1				
3.Tobacco use	-0.11**	0.11**	1			
4.Alcohol use	-0.17*	0.16*	0.52*	1		
5.Gender	-0.05*	-0.03*	0.04*	0.06*	1	
6.Parental migration category	0.01*	0.02*	0.04*	0.02*	-0.04*	1

Note. *$p<0.05$, **$p<0.01$, ***$p<0.001$

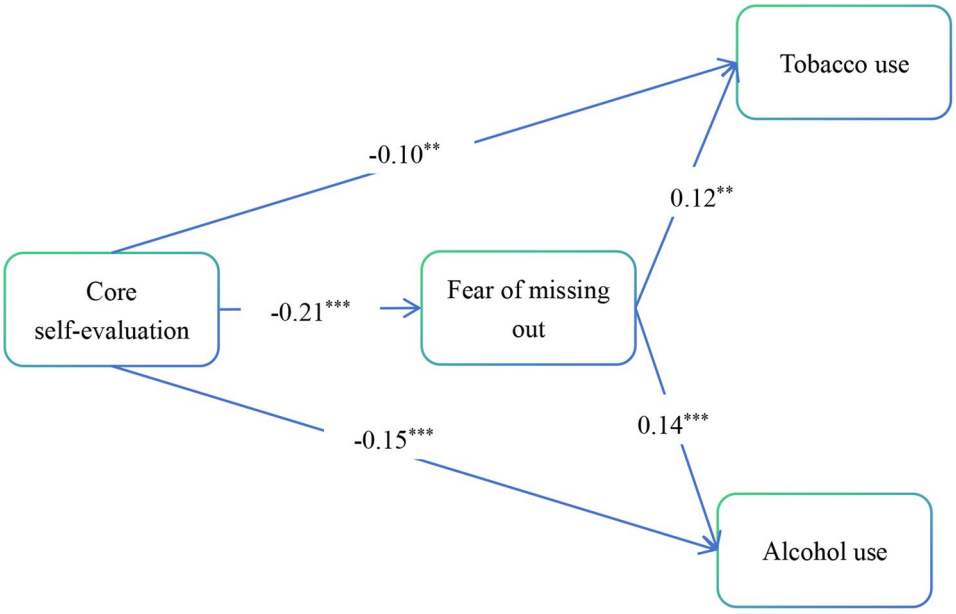

Fig. 2 Mediating model of fear of missing out in the relationships between core self-evaluation and tobacco and alcohol use (Standardized coefficients)

Table 3 Analysis of mediating effect of fear of missing out

Dependent variable	Effect type	95% CI	Effect value	Effect size
Tobacco use	Mediating effect	[-0.043, -0.008]	-0.03**	23.08%
	Direct effect	[-0.167, -0.034]	-0.10**	76.92%
	Total effect	[-0.193, -0.060]	-0.13***	100%
Alcohol use	Mediating effect	[-0.045, -0.013]	-0.03***	16.67%
	Direct effect	[-0.204, -0.099]	-0.15***	83.33%
	Total effect	[-0.234, -0.128]	-0.18***	100%

effect on both tobacco use ($\beta = 0.12$, $p < 0.01$) and alcohol use ($\beta = 0.14$, $p < 0.001$).

The Bootstrap test results revealed that the direct effect of core self-evaluation on tobacco use was −0.10, with a 95% confidence interval (CI) of [-0.167, -0.034], while the mediating effect of fear of missing out was −0.03, with a 95% CI of [-0.043, -0.008]. The mediating effect accounted for 23.08% of the total effect. Similarly, the direct effect of core self-evaluation on alcohol use was −0.15, with a 95% CI of [-0.204, -0.099], and the mediating effect of fear of missing out was −0.03, with a 95% CI of [-0.045, -0.013], accounting for 16.67% of the total effect. These findings indicate that fear of missing out partially mediated the relationships between core self-evaluation and both tobacco and alcohol use.

Moderation test of parental migration category

The results of the cross-group comparisons are presented in Fig. 3; Table 4. In the dual-parent migration group, fear of missing out significantly and positively predicted both tobacco use ($\beta = 0.19$, $p < 0.001$) and alcohol use ($\beta = 0.20$, $p < 0.001$), whereas in the single-parent migration group, the predictive effect of fear of missing out on both tobacco use ($\beta = 0.06$, $p > 0.05$) and alcohol use ($\beta = 0.09$, $p > 0.05$) were not statistically significant.

The Bootstrap test results indicated that predictive effect of fear of missing out on both tobacco and alcohol use were significantly different between the single-parent migration and dual-parent migration groups. These findings indicate that parental category moderated the relationships between fear of missing out and both tobacco and alcohol use.

Moderation test of gender

The results of the cross-group comparisons are illustrated in Fig. 4; Table 5. In both the girls' and boys' groups, fear of missing out demonstrated a significant positive predictive effect on tobacco and alcohol use.

The Bootstrap test results indicated that predictive effects of fear of missing out on both tobacco and alcohol use were not significantly different between the girls and boys. These findings suggest that gender did not moderate the relationships between fear of missing out and tobacco and alcohol use.

Discussion

This study explored the associations between core self-evaluation and tobacco and alcohol use among left-behind children, with a particular focus on the mediating role of fear of missing out and the moderating role of parental migration category and gender. By emphasizing these relationships, the research provides a nuanced understanding of how individual psychological traits and contextual factors interact to influence substance use behaviors in this population.

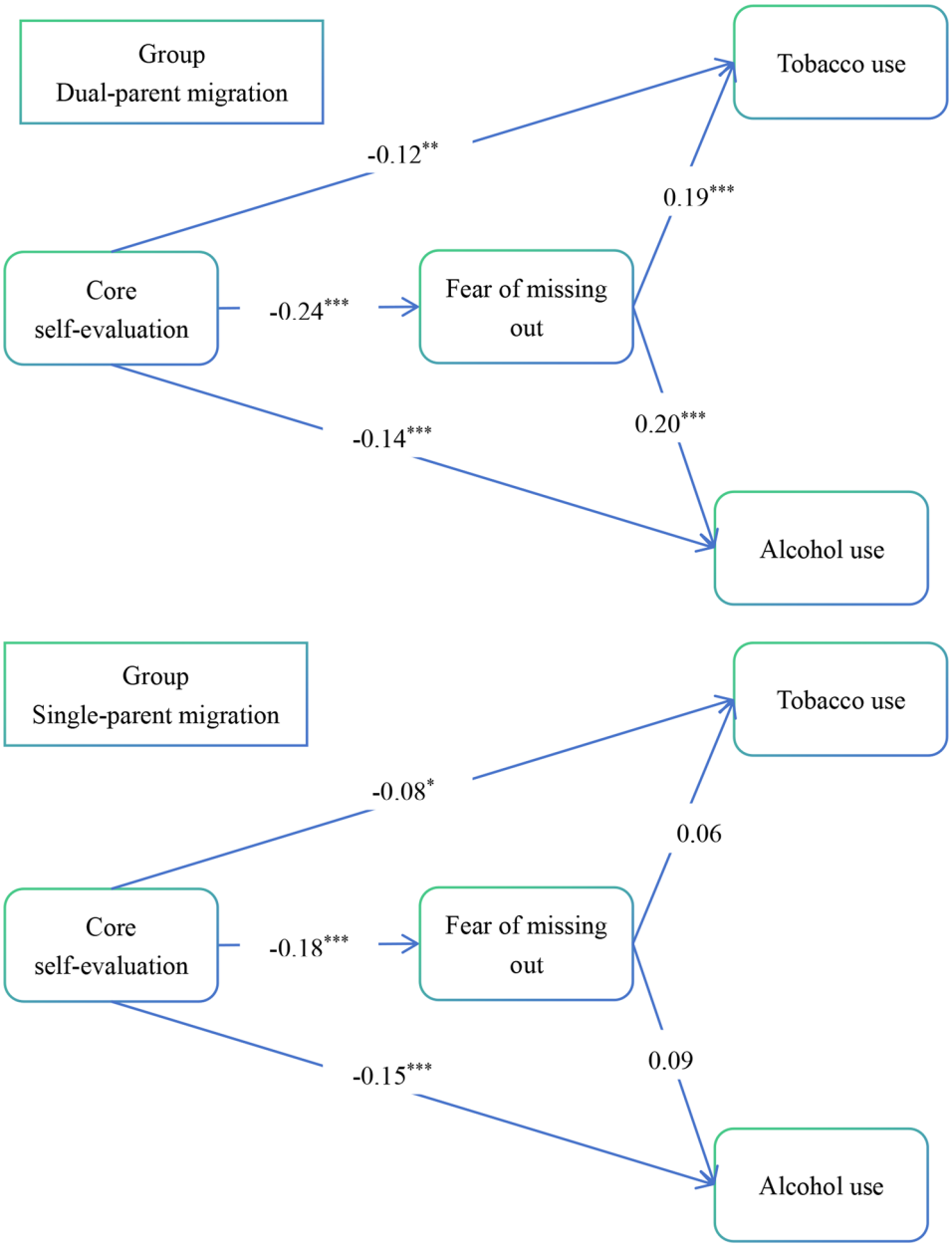

Fig. 3 Moderating model of parental migration in the relationships between fear of missing out and tobacco and alcohol use (Standardized coefficients)

Table 4 Cross-group comparisons coefficients of parental category

Dependent variable	95% CI	Estimate
Tobacco use	[-0.271, -0.030]	-0.15*
Alcohol use	[-0.253, -0.002]	-0.13*

This study suggests significant associations between core self-evaluation and tobacco and alcohol use among left-behind children. These findings align with Hypothesis 1 and corroborate previous research [16, 17]. The results also support self-verification theory [55], which posits that children with lower core self-evaluation are more inclined to accept negative evaluations from teachers and parents. They may feel unrecognized and unable to meet others' expectations, leading them to engage in tobacco use as a means to affirm and sustain their negative self-image [58]. Furthermore, the findings are consistent with the stress-coping process model [59], indicating that children with low core self-evaluation are more likely to perceive challenges in school and life as stressors, believing these issues to be insurmountable. In response, they may adopt maladaptive coping mechanisms, such as alcohol use, to escape from these difficulties. Thus, core self-evaluation appears to be associated with tobacco and alcohol use among left-behind children.

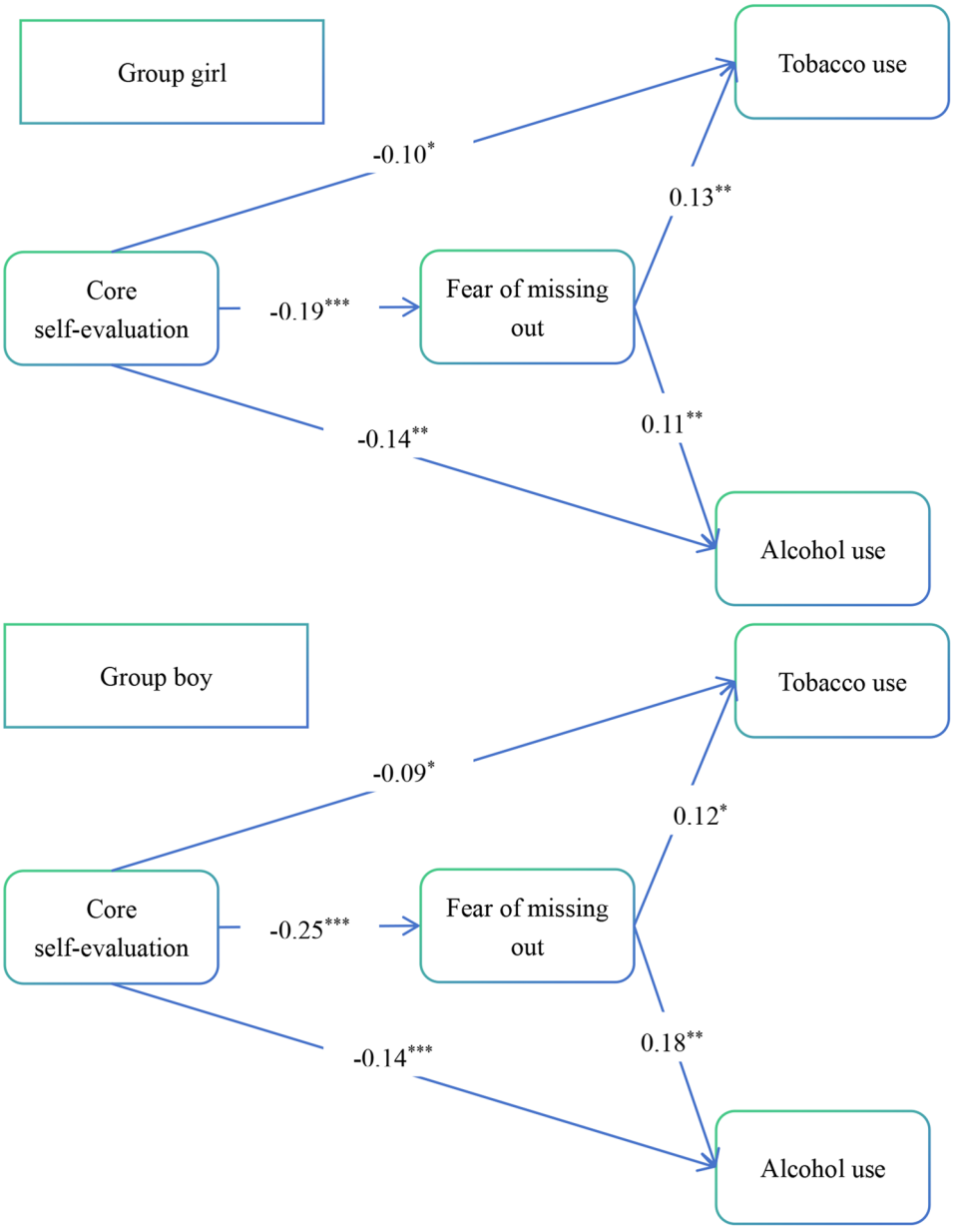

Fig. 4 Moderating model of gender in the relationships between fear of missing out and tobacco and alcohol use (Standardized coefficients)

Table 5 Cross-group comparisons coefficients of gender

Dependent variable	95% CI	Estimate
Tobacco use	[-0.153, 0.127]	-0.01
Alcohol use	[-0.066, 0.203]	0.07

This study suggests that core self-evaluation is associated with tobacco and alcohol use among left-behind children through the mediating role of fear of missing out. These findings support Hypothesis 2 and contribute to the expansion of the motivation model for tobacco and alcohol use [33]. Specifically, children with lower core self-evaluation may perceive themselves as less competent or valuable compared to their peers, leading to concerns about social marginalization. To mitigate these fears, such children may become overly vigilant about their peers' activities, striving to remain included in social circles. When they are unable to immediately respond to or engage with peer interactions, they may experience heightened fear of missing out [25]. In an attempt to cope with these emotions and restore social connections, these children may turn to behaviors such as tobacco use, which they mistakenly perceive as a way to enhance peer relationships and alleviate negative feelings [36, 37]. Additionally, children with low core self-evaluation may internalize feelings of inadequacy, believing they are incapable of meeting expectations in school or life.

They may also perceive themselves as unworthy of love or approval from their parents [10]. This cognitive pattern may lead them to closely monitor their parents' actions, fearing that any misstep could reinforce parental disappointment. When they miss out on parental interactions or dynamics, they may interpret this as abandonment or neglect, further exacerbating their fear of missing out. To cope with these intense emotions, they may resort to alcohol use as a maladaptive strategy to alleviate their distress [33]. In summary, the findings suggest that left-behind children with lower core self-evaluation are more likely to experience fear of missing out, which is in turn associated with higher levels of tobacco and alcohol use.

This study also found that parental migration category moderated the relationship of fear of missing out and tobacco and alcohol use. Specifically, the associations between fear of missing out and tobacco and alcohol use were significantly stronger among children with dual-parent migration compared to those with single-parent migration. These findings support Hypothesis 3 and align with social bonding theory [42]. For children with single-parent migration, the resident parent can establish clear behavioral norms and boundaries, provide real-time supervision and guidance, and help foster normative social bonds. When these children exhibit tendencies toward tobacco or alcohol use, the resident parent can intervene to dissuade or prevent such behaviors, thereby reducing the likelihood of substance use [60]. Even when children experience high levels of fear of missing out, the presence of a resident parent may deter them from engaging in tobacco and alcohol use due to concerns about parental discipline, ultimately lowering the frequency and extent of such behaviors. In contrast, children with dual-parent migration lack real-time parental supervision and guidance. As a result, they may engage in tobacco and alcohol use more freely when experiencing fear of missing out, as there are no immediate behavioral constraints or consequences. Furthermore, the findings are consistent with attachment theory [44], which suggests that single-parent migration mitigates the associations between fear of missing out and tobacco and alcohol use. For children with single-parent migration, the resident parent can better understand their emotional states and psychological needs, provide timely support, and offer appropriate coping strategies to alleviate negative emotions, thereby reducing the likelihood of tobacco and alcohol use [60]. Conversely, children with dual-parent migration not only lack the emotional support necessary to alleviate their fear of missing out, but the absence of both parents may also intensify their fear of missing out, leading to increased tobacco and alcohol use.

The results of this study indicate that gender did not play a moderating role in the relationships between fear of missing out and tobacco and alcohol use, leading to the rejection of Hypothesis 4. This lack of significant moderation may be influenced by regional cultural factors, as the sample was drawn exclusively from a single geographic area. Additionally, the cross-sectional design of the study may have limited the ability to capture potential gender-related dynamics that could emerge over time. Longitudinal studies might yield different results by providing a more nuanced understanding of how gender influences these relationships across different developmental stages or contexts. While the current findings do not support a significant moderation effect of gender, further exploration of the underlying reasons and implications of these results is warranted. Future research could investigate whether cultural, social, or contextual factors contribute to the observed patterns, as well as examine the potential role of gender in other populations or through alternative methodological approaches. Such efforts would enhance our understanding of the complex interplay between gender, fear of missing out, and tobacco and alcohol use behaviors among left-behind children.

Practical implications

This study revealed that the relationships between core self-evaluation and tobacco and alcohol use, as well as the mediating role of fear of missing out and the moderating role of parental migration category and gender through a survey of 1795 left-behind children. Introducing the related theory of core self-evaluation to the field of tobacco and alcohol use further expands the theory of left-behind children's tobacco and alcohol use. The findings of this study provide actionable recommendations for policymakers, schools, and caregivers to reduce tobacco and alcohol use among left-behind children. For policymakers, it is recommended to allocate funding to community-based organizations to develop and implement mental health programs aimed at enhancing the core self-evaluation of left-behind children. Additionally, interventions such as peer support groups and parent-child communication initiatives should be introduced at the community level to alleviate the fear of missing out experienced by these children. Furthermore, policymakers should promote distance education programs to equip parents of left-behind children with the necessary skills for effective remote communication and emotional support through online courses. For schools, it is essential to provide specialized training for teachers to enable them to identify and address low core self-evaluation among left-behind children at an early stage. Schools should also offer social skills training programs to help these children develop healthy interpersonal relationships, thereby reducing anxiety stemming from social isolation. Moreover, schools should maintain regular communication with the parents of left-behind children,

providing frequent updates on their academic progress and overall well-being to ensure that parents remain informed and involved in their children's lives, even from a distance. For caregivers, it is strongly advised that at least one parent remains present to care for the child whenever possible. Caregivers should prohibit children from engaging in behaviors such as smoking or drinking and should provide consistent supervision. Additionally, caregivers should offer emotional support through active companionship, attentive listening, and positive reinforcement to help the child build a stronger core self-evaluation and alleviate feelings of missing out. These measures collectively aim to create a supportive environment that fosters the psychological and social well-being of left-behind children, ultimately reducing their susceptibility to tobacco and alcohol use.

Limitations

This study has made significant strides in addressing numerous gaps in the existing literature; however, several limitations persist that warrant further investigation. While the research has elucidated the associations between core self-evaluation, fear of missing out, gender, and the use of tobacco and alcohol among left-behind children, it is crucial to acknowledge the cross-sectional design of the current study. Future research should employ longitudinal methodologies to rigorously examine and validate these relationships over time. The psychological mechanisms underlying tobacco and alcohol use among left-behind children are complex. In addition to core self-evaluation, fear of missing out, and parental migration categories, other factors such as peer relationships and economic conditions may play mediating or moderating roles. Moreover, the model utilized in this study did not account for several critical confounding variables, including students' mental health, the duration of being left behind, family socioeconomic status, and parental substance use. Future studies should incorporate and rigorously control for a broader array of confounding factors to enhance the robustness of the findings. Additionally, while this study has explored the differences between single-parent and dual-parent migration within the parental migration categories, it is plausible that the effects of father migration and mother migration on the mechanisms of tobacco and alcohol use among left-behind children may differ significantly. Future research should aim to uncover and elucidate these nuanced differences, as this would facilitate the development of more targeted and effective intervention strategies for addressing tobacco and alcohol use in this population. Finally, it is important to note that the sample in this study was limited to left-behind children in rural areas of Jiangsu Province. This restricted sampling scope significantly limits the generalizability of the findings and raises concerns regarding external validity. Future research should aim to expand the sample size and scope to include left-behind children from a wider range of regions and diverse socioeconomic backgrounds. By doing so, the representativeness and generalizability of the research findings can be substantially improved, thereby enhancing their applicability to broader contexts.

Conclusion

This study explored the relationships between core self-evaluation and tobacco and alcohol use among left-behind children. It constructed a structural model involving core self-evaluation, fear of missing out, parental migration category, gender, tobacco and alcohol use. The research indicates that core self-evaluation was significantly associated with tobacco and alcohol use among left-behind children. Additionally, fear of missing out mediated the relationships between core self-evaluation and tobacco and alcohol use among left-behind children. Furthermore, parental migration category moderates the indirect relationship of fear of missing out and tobacco and alcohol use, in other words, fear of missing out has a greater correlation with the tobacco and alcohol use of left-behind children with dual-parent migration.

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Author contributions

LZ conceived and designed this study, and completed the first draft; YZ revised the article and edited the writing; HW analyzed the data. All authors contribute sufficiently to this work. All authors read and approved the final manuscript.

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Data availability

The authors will provide the original data set that underlies the conclusions of this study without reservation.

Declarations

Ethics approval and consent to participate

This study was approved by the Ethics Committee of Suqian University. All participants signed informed consent forms before the survey and provided informed consent forms from their legal guardians. All methods were conducted in accordance with the Declaration of Helsinki.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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