

Original Research

Factors Associated With Anxiety Due to Secondhand Alcohol-Related Harm Among Adolescents: A Secondary Analysis of the Youth Health Behavior Survey

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Abstract

Background: This study aimed to identify factors associated with anxiety due to secondhand alcohol-related harm among adolescents.**Methods:** This secondary study used data from the Youth Health Behavior Survey, comprising 52,150 adolescents who responded to a question on experience of secondhand alcohol-related harm. Study variables were categorized into general, physical, and psychological characteristics and analyzed using complex sample cross-tabulation analysis and complex sample regression in SPSS version 27.0.**Results:** In participants without exposure to secondhand alcohol-related harm, factors associated with anxiety included sex, household income level, drug use experience, breakfast consumption frequency, stress level, sleep satisfaction, alcohol consumption, smoking status, subjective health status, sadness or despair, suicidal ideation, suicide planning, suicide attempts, and loneliness; the model explained 42.0% of the variance ($F = 468.30, p < 0.001$). In participants exposed to secondhand alcohol-related harm, factors associated with anxiety included sexual experience, academic grade level, household income level, drug use experience, breakfast consumption frequency, body mass index (BMI), stress level, sleep satisfaction, subjective health status, sadness or despair, suicidal ideation, suicide planning, suicide attempts, and loneliness; the model explained 44.7% of the variance ($F = 491.79, p < 0.001$). **Conclusions:** The possibility of exposure to secondhand alcohol-related harm should be considered when developing interventions to alleviate anxiety among adolescents.**Keywords:** adolescents; anxiety; general characteristics; physical characteristics; psychological characteristics; secondhand alcohol-related harm

1. Introduction

Adolescence is a formative stage characterized by major developmental changes and the emergence of essential psychosocial and adaptive skills (Crews et al., 2016). Mental disorders that emerge during adolescence result from a complex interplay between genetic predispositions and environmental associations (Davidson et al., 2015). Although genetic factors confer vulnerability, environmental disruptions during sensitive periods may contribute significantly to psychopathology. Adolescents are particularly sensitive to environmental associations owing to their ongoing neurodevelopment and limited autonomy, making adverse exposure more likely to negatively affect their mental health (Do et al., 2020). Such developmental characteristics heighten adolescents' vulnerability to external stressors, particularly when those stressors occur in unpredictable or adverse environments.

A significant environmental risk factor in this regard is secondhand alcohol-related harm (SHAH), which arises from alcohol-induced impairments in judgment and emotional regulation and has been associated with aggressive behavior as well as with emotional, physical, and social forms of harm (Hoaken and Stewart, 2003; Laslett et al., 2019; Sontate et al., 2021). SHAH encompasses emotional,

physical, and social consequences resulting from others' drinking. Prior studies have shown that SHAH contributes to broader social difficulties and places persistent psychological burdens on those who experience it (Room et al., 2010). Adolescents may have fewer mechanisms to buffer alcohol-related disruptions in their environment because their autonomy and regulatory capacities are still developing, increasing their reliance on adults for emotional stability (Steinberg, 2014). Considering the social and emotional dependency characteristics of adolescents, exposure to SHAH can critically undermine mental well-being and exacerbate the risks of anxiety, depression, and social dysfunction.

Exposure to others' drinking may be associated with anxiety through psychosocial pathways. Stressful or unpredictable drinking-related situations can heighten daily stress, disrupt sleep, and undermine a sense of security, all of which are strongly associated with adolescent anxiety (Chai and Bian, 2024; Zheng and Peng, 2025). Repeated exposure to adverse or unstable environments has been linked to increased hopelessness, emotional withdrawal, and suicidal thoughts in adolescents, indicating that environmental stressors can accumulate and heighten psychological vulnerability (Landberg et al., 2019; Toro et al.,



2025). Recent increases in indicators of psychological distress among adolescents highlight the need to identify environmental factors that contribute to anxiety (Maurer et al., 2025).

Previous studies have shown that adolescents exposed to alcohol-related parental harm report more intense anxiety symptoms (Ramirez-Meneses et al., 2025). Such exposure may compromise adolescents' emotional security and increase vulnerability to anxiety. However, this issue is not limited to parental SHAH to which adolescents are exposed. Studies on university students have shown that SHAH involves sleep disruptions, harassment, and insults that significantly increase anxiety (Thompson et al., 2017). Therefore, SHAH from both family members and a broader range of unspecified individuals poses a threat to adolescent mental health and exacerbates anxiety. Recent studies indicate that psychosocial factors—stress, sleep problems, social isolation, depressive symptoms, and suicidal thoughts—contribute differently to the association between SHAH and anxiety in adolescents (Trangenstein et al., 2025). Sociodemographic factors, such as socioeconomic status, sex, and academic performance, also warrant consideration as determinants of vulnerability to anxiety. Of particular concern is the limited number of large-scale, nationally representative analyses focusing on adolescents. The present study addressed this gap by comparing the factors influencing anxiety among adolescents with and without SHAH exposure.

Current research that comprehensively assesses the impact of SHAH on adolescent anxiety remains scarce, and studies integrating diverse biological, psychological, and social determinants are particularly limited. Differentiating the factors influencing anxiety in both groups from those observed only in SHAH-related environments may provide clearer insight into how harmful drinking contexts relate to anxiety among adolescents. Prior research has identified a range of demographic, behavioral, and psychosocial elements that have been associated with anxiety among adolescents. These elements include socioeconomic conditions, dietary and physical activity patterns, substance use, and difficulties related to stress, sleep problems, and difficulties with emotional regulation (Lee et al., 2023; Maurer et al., 2025; Nash, 2025; Wang et al., 2025; Zheng and Peng, 2025). Exposure to harmful drinking environments has also been recognized as an important environmental exposure for adolescents, who often have limited autonomy to modify their surroundings and depend on adults for emotional stability. Based on this evidence, the present study included variables from these domains and incorporated SHAH to examine factors influencing adolescent anxiety across different exposure contexts. The findings provide a basis for identifying adolescents who are vulnerable to anxiety in SHAH-related contexts and contribute to the development of future preventive and supportive strategies.

2. Materials and Methods

2.1 Conceptual Framework

The conceptual framework of this study is shown in Fig. 1.

2.2 Participants

A total of 54,653 people participated in the 20th Korean Youth Health Behavior Survey conducted in 2024. Of these, 52,150 took part in this study; 22,241 had experience with SHAH, and 29,909 had not. SHAH experience was determined based on responses to the following item: "During the past 12 months, have you experienced any of the following due to another person's drinking?" Respondents who reported none of the four situations listed below were assigned to the non-exposure group, whereas those who reported experiencing at least one situation were categorized as exposed.

- I have been harassed or bothered by people drinking alcohol in public places or on the street.
- I have felt afraid when encountering people drinking on the street.
- I have had difficulty sleeping at night because of people drinking alcohol.
- I have felt unsafe in public places because of the presence of people drinking alcohol.

2.3 Variables

The study variables were categorized into general, physical, and psychological characteristics. General characteristics included sex, school classification (middle school or high school), academic grade level (upper, middle, lower), household economic level (upper, middle, lower), residential type (living with family or others), sexual intercourse experience (yes or no), drug experience (yes or no), experience of therapy for violence (yes or no), frequency of breakfast consumption per week (0, 1–2, 3–5, ≥ 6), and frequency of fast food consumption (0, 1–2 times/week, 3–6 times/week, ≥ 1 /day).

Physical and psychological characteristics included days of physical activity per week (0, 1–2, ≥ 3), Body Mass Index (BMI; <18.5 kg/m², 18.5–24.9 kg/m², ≥ 25 kg/m²), perceived stress levels (feel a lot, feel a little, feel almost nothing), sleep satisfaction (enough, moderate, not enough), alcohol consumption (yes or no), smoking status (yes or no), subjective health (healthy, moderate, unhealthy), sadness or despair (yes or no), suicidal ideation (yes or no), suicide planning (yes or no), suicide attempts (yes or no), loneliness (feel less, feel more), and anxiety. The number of days of physical activity per week was categorized based on responses to the question, "In the past seven days, on how many days did you engage in physical activity that increased your heart rate or caused you to be out of breath for a total of at least 60 minutes per day, regardless of the type of activity?" Anxiety was assessed using the 7-item Generalized Anxiety Disorder Scale (GAD-

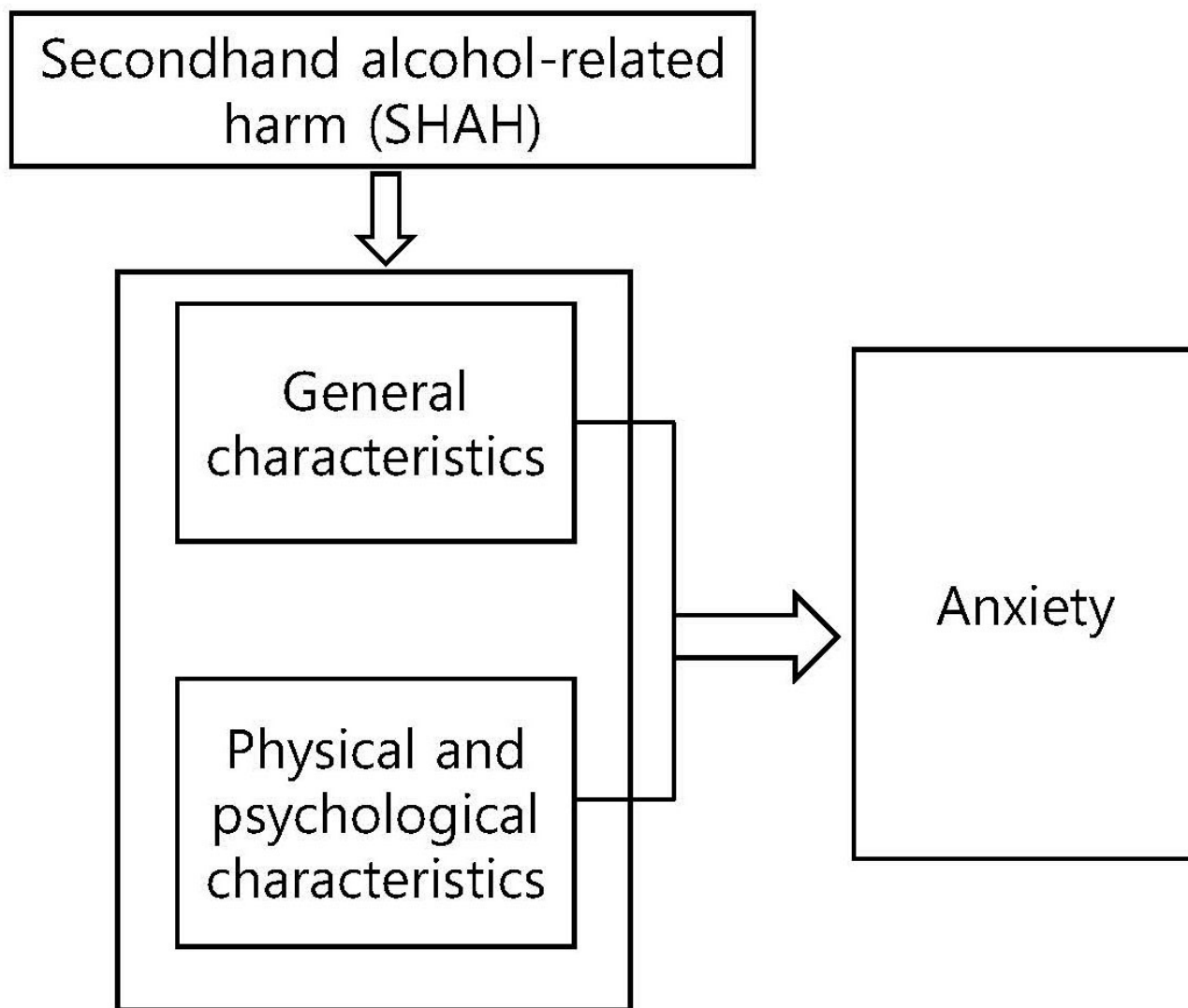


Fig. 1. Conceptual framework.

7) developed by Spitzer et al. (2006). The GAD-7 employs a four-point Likert scale with total scores ranging from 0 to 21.

A higher score indicates greater anxiety, and the range of scores is 0–21. 0–4 indicates normal levels, 5–9 mild anxiety, 10–14 moderate anxiety, and 15–21 severe anxiety.

2.4 Procedure

We conducted a secondary analysis of raw data from the 20th (2024) Korea Youth Health Behavior Survey. The Korea Youth Health Behavior Survey is a nationally approved annual statistical project initiated in 2005, designed to assess the health behaviors of Korean adolescents (National Approval Statistics (Approval No. 117058)). The survey targeted students from the first year of middle school to the third year of high school, and employed an anonymous self-administered online questionnaire. The Korea Youth Health Behavior Survey is administered collabora-

tively by the Korea Disease Control and Prevention Agency (KDCA) and the Ministry of Education. Nationwide sampling was conducted among middle- and high-school student populations using a multistage stratified sampling design. The sampling process consisted of three phases: stratification of the target population, allocation of the sample, and selection of the sampled units. For the 20th iteration in 2024, the survey was administered to 800 schools, comprising 400 middle schools and 400 high schools across the country.

2.5 Data Analysis

Data analyses were performed using SPSS version 27.0 (IBM Corp., Armonk, NY, USA). Following KDCA recommendations, a complex sampling plan file was created, incorporating strata, clusters, and weights, after which complex sample analyses were performed. The significance level was set at $p < 0.05$. Descriptive statistics,

including means and weighted percentages, were used to summarize the general characteristics and physical and psychological attributes of adolescents. Differences in general characteristics according to the presence or absence of SHAH were examined using complex sample chi-square tests and *t*-tests. Factors influencing anxiety based on exposure to SHAH were analyzed using complex-sample linear regression models.

3. Results

3.1 Differences in General Characteristics by Secondhand Alcohol-Related Harm Exposure

Significant differences in general characteristics were observed based on exposure to SHAH, specifically in terms of sex, academic achievement, economic status, substance use experience, history of violence treatment, and frequency of breakfast consumption (Table 1). Participants who experienced SHAH were more likely to be female, have a higher academic grade level, and report a lower household economic level. This group also included a greater proportion of individuals with experience of substance use or a history of violence treatment. Additionally, a higher frequency of both non-breakfast consumption and breakfast intake six or more times per week was observed among those exposed to SHAH.

3.2 Differences in Physical and Psychological Characteristics by SHAH Exposure

Significant differences were observed between the exposed and unexposed groups to SHAH across all physical and psychological characteristics (Table 2). Adolescents exposed to SHAH exhibited fewer days of physical activity, a lower BMI, higher stress levels, and decreased sleep satisfaction. The non-exposed group reported higher rates of current alcohol use and smoking and perceived themselves as healthier. Suicidal ideation, planning, and attempts were more prevalent among those with SHAH exposure, and this group also demonstrated greater feelings of sadness or hopelessness, loneliness, and higher anxiety.

3.3 Factors Associated With Anxiety According to SHAH Exposure

Among adolescents not exposed to SHAH, factors significantly associated with anxiety included sex, household economic level, drug experience, frequency of breakfast consumption, physical activity, stress level, sleep satisfaction, alcohol consumption, smoking status, subjective health, sadness or hopelessness, suicidal ideation, suicide planning, suicide attempts, and loneliness. These factors explained 42.0% of the variance in anxiety levels ($F = 468.30, p < 0.001$) (Table 3).

Adolescents with an upper household economic level had anxiety scores 0.586 times lower than those with a lower household economic level.

Compared to adolescents without drug experience, those with drug use had 1.001 times higher anxiety. Compared to adolescents who ate breakfast more than six times a week, those who did not have breakfast had anxiety scores 0.115 times lower. Compared to adolescents who exercised more than three days a week, those who exercised once or twice had anxiety scores 0.128 times higher. Compared to adolescents who rarely felt stressed, those who felt a lot of stress had 2.853 times higher anxiety, and those who felt a little stress had 0.957 times higher anxiety. Compared to adolescents who did not have sufficient sleep, those who had sufficient sleep had 0.635 times lower anxiety, and those with moderate sleep had 0.498 times lower anxiety. Compared with adolescents who did not drink alcohol, those who drank alcohol had 0.148 times higher anxiety, and those who smoked had 0.190 times lower anxiety compared to those who did not. Compared to adolescents who felt unhealthy, adolescents who felt healthy had 1.330 times lower anxiety, and adolescents who felt average had 0.726 times lower anxiety. Compared to adolescents who did not feel sadness or despair, adolescents who did feel sadness or despair had anxiety scores 1.759 times higher, and compared to adolescents who did not have suicidal ideation, adolescents who did have suicidal ideation had anxiety 1.408 times higher. Compared to adolescents who did not have suicidal plans, adolescents who did have suicidal plans had anxiety 1.242 times higher, and compared to adolescents who did not attempt suicide, adolescents who did attempt suicide had anxiety 0.843 times higher. Compared to adolescents who felt a lot of loneliness, adolescents who felt little loneliness had anxiety scores 2.870 times lower.

Among adolescents exposed to SHAH, factors significantly associated with anxiety included sex, grade level, household economic level, drug experience, frequency of breakfast consumption, BMI, stress level, sleep satisfaction, subjective health, sadness or hopelessness, suicidal ideation, suicide planning, suicide attempts, and loneliness. These factors explained 44.7% of the variance in anxiety levels ($F = 491.79, p < 0.001$).

Anxiety was 0.226 times lower in males than in females, and adolescents had anxiety scores 0.543 times lower than adolescents with lower academic grades, and adolescents with middle grades had anxiety scores 0.585 times lower than adolescents with lower academic grades. Adolescents with a history of drug use had 1.101 points higher anxiety scores than adolescents without a history of drug use. Compared to adolescents who ate breakfast 6 or more times a week, those who did not eat breakfast had anxiety scores 0.157 lower, and those who ate breakfast 1–2 times had anxiety scores 0.191 times lower. Adolescents with a BMI of less than 18.5 kg/m² had 0.192 points lower anxiety than adolescents with a BMI of 25 kg/m² or higher. Compared to adolescents who felt unhealthy, adolescents who felt healthy had 1.622 points lower anxiety, and ado-

Table 1. Differences in general characteristics depending on exposure to secondhand alcohol-related harm (n = 52,150).

Characteristics	Categories	No experience of being harmed by others' drinking	Experience of being harmed by others' drinking	χ^2 (p)
		N (weighted %)/M $\pm$ (SE)	N (weighted %)/M $\pm$ (SE)	
Sex	Male	18,730 (62.900)	7943 (35.700)	3804.690 (<0.001)
	Female	11,179 (37.100)	14,298 (64.300)	
School classification	Middle school	15,776 (49.900)	11,766 (50.200)	0.520 (0.735)
	High school	14,133 (50.100)	10,475 (49.800)	
Academic grade level	Upper	3629 (12.100)	3039 (13.600)	110.290 (<0.001)
	Middle	23,097 (77.300)	17,398 (78.300)	
	Lower	3181 (10.600)	1803 (8.100)	
Household economic level	Upper	3651 (12.400)	2366 (10.900)	31.640 (<0.001)
	Middle	25,714 (85.900)	19,404 (87.100)	
	Lower	541 (1.800)	469 (2.000)	
Residential type	Living with family	28,417 (95.900)	21,210 (96.100)	1.410 (0.368)
	Others	1488 (4.100)	1028 (3.900)	
Experience of sexual intercourse	Yes	1845 (6.400)	1306 (6.000)	3.700 (0.108)
	No	28,064 (93.600)	20,935 (94.000)	
Drug experience	Yes	316 (1.100)	364 (1.700)	37.65 (<0.001)
	No	29,593 (98.900)	21,877 (98.300)	
Experience of therapy for violence	Yes	619 (2.000)	633 (2.700)	26.430 (<0.001)
	No	29,290 (98.000)	21,608 (97.300)	
Frequency of breakfast consumption (day/week)	0	5415 (24.500)	7756 (26.100)	48.360 (<0.001)
	1–2	4016 (18.000)	4859 (16.200)	
	3–5	5723 (25.300)	7362 (24.200)	
	≥ 6	7087 (32.200)	9932 (33.500)	
Frequency of fast food consumption	0	4633 (15.200)	3379 (14.900)	8.020 (0.090)
	1–2/week	16,821 (56.000)	12,622 (56.400)	
	3–6/week	7733 (26.400)	5776 (26.600)	
	$\geq 1/\text{day}$	722 (2.500)	464 (2.100)	

SE, standard error.

lescents who reported average health had 0.955 times lower anxiety. Compared to adolescents who did not have sadness or despair, adolescents who did have anxiety scores 1.667 points higher, and compared to adolescents who did not have suicidal ideation, adolescents who did have anxiety 1.475 points higher. Compared to adolescents who did not have suicidal plans, adolescents who did have suicidal plans had anxiety 0.947 points higher, and compared to adolescents who did not attempt suicide, adolescents who did have anxiety 0.753 points higher. Compared to adolescents who felt a lot of loneliness, adolescents who felt little loneliness had anxiety 2.904 points lower.

4. Discussion

This study examined adolescents with and without SHAH exposure and identified several demographic, behavioral, and emotional differences between the two groups. Based on these differences, the discussion examines risk factors that were common across both groups and patterns specific to adolescents exposed to SHAH.

The discussion first examines the factors that appeared in both groups.

Several demographic, behavioral, and emotional characteristics were associated with anxiety regardless of SHAH exposure. Female adolescents reported higher anxiety levels, consistent with established evidence on sex-based vulnerability to anxiety (Bao and Han, 2025; Sanchis-Sanchis et al., 2020). Prior research has also shown that women are more likely to experience harm caused by others' drinking, which provides additional context for the heightened vulnerability observed among adolescents exposed to adverse environments (Room et al., 2010).

Economic status was associated with anxiety, and adolescents from economically disadvantaged households showed heightened emotional vulnerability. Socioeconomic disadvantage is known to contribute to disparities in adolescent mental health (Maurer et al., 2025). Prior evidence also indicates that economically vulnerable individuals are more susceptible to harm caused by others' drinking, which provides relevant context for understanding the broader vulnerabilities observed in this study (Karriker-Jaffe et al., 2017).

Substance use was associated with anxiety in both groups, aligning with evidence that adolescent substance in-

Table 2. Differences in physical and psychological characteristics according to exposure to secondhand alcohol-related harm (n = 52,150).

Characteristics	Categories	No experience of being harmed by others' drinking	Experience of being harmed by others' drinking	$\chi^2/t (p)$
		N (weighted %)/M $\pm$ SE	N (weighted %)/M $\pm$ SE	
Physical activity (days/week)	0	8567 (29.100)	7086 (32.700)	256.510 (<0.001)
	1–2	8548 (28.700)	7125 (32.100)	
	≥ 3	12,794 (42.100)	8030 (35.200)	
Body mass index (kg/m ²)	<18.5	5810 (20.200)	4869 (23.100)	149.210 (<0.001)
	18.5–24.9	17,489 (61.200)	13,140 (62.000)	
	≥ 25	5374 (18.600)	3259 (14.900)	
Stress level	Feel a lot	10,818 (36.200)	11,147 (50.400)	1333.120 (<0.001)
	Feel a little	13,249 (44.600)	8665 (38.900)	
	Feel almost nothing	5842 (19.200)	2429 (10.700)	
Sleep satisfaction	Enough	7822 (25.500)	3934 (17.200)	965.980 (<0.001)
	Moderate	9610 (32.100)	6101 (27.200)	
	Not enough	12,477 (42.500)	12,206 (55.600)	
Alcohol consumption	Yes	9497 (32.100)	6394 (28.900)	63.870 (<0.001)
	No	20,412 (67.900)	15,847 (71.100)	
Smoking status	Yes	2526 (8.500)	1457 (6.600)	65.940 (<0.001)
	No	27,383 (91.500)	20,784 (93.400)	
Subjective health	Healthy	20,976 (70.000)	13,643 (61.400)	473.980 (<0.001)
	Average	6677 (22.500)	6020 (26.900)	
	Unhealthy	2256 (7.500)	2578 (11.600)	
Sadness or despair	Yes	6785 (22.600)	7564 (33.800)	794.610 (<0.001)
	No	23,124 (77.400)	14,677 (66.200)	
Suicidal ideation	Yes	2804 (9.400)	3733 (16.700)	620.140 (<0.001)
	No	27,105 (90.600)	18,508 (83.300)	
Suicide planning	Yes	1062 (3.500)	1409 (6.200)	201.900 (<0.001)
	No	28,847 (96.500)	20,832 (93.800)	
Suicide attempts	Yes	618 (2.000)	802 (3.500)	105.770 (<0.001)
	No	29,291 (98.000)	21,439 (96.500)	
Loneliness	Feel less	25,735 (85.800)	16,762 (75.300)	917.660 (<0.001)
	Feel more	4174 (14.200)	5479 (24.700)	
	No anxiety	10.48 (0.030)	12.75 (0.040)	
Anxiety	Mild anxiety	16,507 (56.200)	7045 (33.800)	2710.610 (<0.001)
	Moderate anxiety	9279 (32.500)	8847 (43.400)	
	Severe anxiety	3233 (11.300)	4680 (22.800)	

involvement is often associated with mental health challenges (Nash, 2025). However, evidence showing that substance use contributes to anxiety remains limited. Longitudinal research may help clarify the conditions under which substance use and anxiety co-occur. In this study, stress levels showed an association with anxiety, consistent with prior findings linking academic stress to elevated anxiety in adolescents (Zheng and Peng, 2025). Sleep satisfaction is another relevant factor, given that inadequate sleep can hinder emotional regulation and is related to a higher risk of anxiety (Chai and Bian, 2024). This study found that adolescents who rarely consumed breakfast reported lower anxiety than those who ate breakfast more frequently. This result does not indicate that skipping breakfast reduces anxiety. Prior studies have repeatedly shown that regular break-

fast consumption is associated with lower anxiety (Nau-moska et al., 2025; Wang et al., 2025). A possible interpretation is that adolescents who do not consume breakfast may differ from regular breakfast eaters in broader patterns of daily living. Breakfast habits form part of daily routines that include sleep schedules, preparation before school, academic demands, and family organization. These routines can shape the way adolescents perceive and report their emotional states. Some adolescents skip breakfast for academic or personal reasons, and unmeasured factors related to these circumstances may have been associated with the finding. Daily experiences during adolescence may also vary according to cultural background or other subgroup characteristics. These contextual differences may have contributed to the observed patterns. Further research using

Table 3. Factors associated with anxiety according to exposure to secondhand alcohol-related harm (n = 52,150).

Characteristics		No experience of being harmed by others' drinking			Experience of being harmed by others' drinking		
		B	SE	t (p)	B	SE	t (p)
Sex (ref.: female)	Male	-0.292	0.048	-6.130 (<0.001)	-0.226	0.065	-3.480 (0.001)
Academic grade level	Upper	0.077	0.098	0.780 (0.434)	-0.543	0.133	-4.090 (<0.001)
(ref.: lower)	Middle	0.040	0.078	0.510 (0.609)	-0.585	0.115	-5.090 (<0.001)
Household economic level	Upper	-0.586	0.201	-2.900 (0.004)	-0.887	0.271	-3.270 (0.001)
(ref.: lower)	Middle	-0.355	0.194	-1.830 (0.067)	-0.888	0.260	-3.410 (0.001)
Drug experience (ref.: no)	Yes	1.001	0.305	3.280 (0.001)	1.101	0.318	3.460 (0.001)
Experience of therapy for violence (ref.: no)	Yes	-0.381	0.202	-1.880 (0.060)	-0.361	0.252	-1.430 (0.153)
Frequency of breakfast consumption (ref.: ≥6)	0	-0.115	0.056	-2.050 (0.040)	-0.157	0.075	-2.080 (0.037)
	1–2	-0.056	0.065	-0.860 (0.390)	-0.191	0.084	-2.270 (0.023)
	3–5	-0.090	0.054	-1.670 (0.095)	0.043	0.071	0.600 (0.547)
Physical activity (ref.: ≥3)	0	0.047	0.052	0.900 (0.368)	0.133	0.075	1.770 (0.076)
	1–2	0.128	0.050	2.560 (0.010)	-0.087	0.068	-1.280 (0.199)
Body mass index (ref.: ≥25)	<18.5	-0.034	0.068	-0.490 (0.620)	0.192	0.094	2.050 (0.041)
	18.5–24.9	0.073	0.057	1.270 (0.202)	0.077	0.078	0.980 (0.324)
Stress level (ref.: feel al- most nothing)	Feel a lot	2.853	0.059	48.610 (<0.001)	3.689	0.078	47.390 (<0.001)
	Feel a little	0.957	0.036	26.800 (<0.001)	1.412	0.064	21.990 (<0.001)
Sleep satisfaction (ref.: not enough)	Enough	-0.635	0.052	-12.300 (<0.001)	-0.669	0.074	-9.050 (<0.001)
	Moderate	-0.498	0.048	-10.390 (<0.001)	-0.411	0.060	-6.790 (<0.001)
Alcohol consumption (ref.: no)	Yes	0.148	0.050	2.960 (0.003)	-0.114	0.065	-1.750 (0.080)
Smoking status (ref.: no)	Yes	-0.190	0.088	-2.160 (0.031)	-0.080	0.128	-0.620 (0.531)
Subjective health (ref.: unhealthy)	Healthy	-1.330	0.107	-12.480 (<0.001)	-1.622	0.115	-14.110 (<0.001)
	Average	-0.726	0.113	-6.420 (<0.001)	-0.955	0.122	-7.800 (<0.001)
Sadness or despair (ref.: no)	Yes	1.759	0.069	25.510 (<0.001)	1.667	0.076	21.950 (<0.001)
Suicidal ideation (ref.: no)	Yes	1.408	0.125	11.260 (<0.001)	1.475	0.118	12.490 (<0.001)
Suicide planning (ref.: no)	Yes	1.242	0.194	6.400 (<0.001)	0.947	0.165	5.720 (<0.001)
Suicide attempts (ref.: no)	Yes	0.843	0.252	3.340 (0.001)	0.753	0.224	3.360 (0.001)
Loneliness (ref.: feel more)	Feel less	-2.870	0.092	-31.350 (<0.001)	-2.904	0.090	-32.280 (<0.001)
F (p)/R ²		468.30 (<0.001)/0.420			491.79 (<0.001)/0.447		

longitudinal designs is needed to examine how breakfast habits relate to emotional development over time.

Emotional vulnerability indicators, including feelings of sadness or hopelessness, suicidal ideation, suicide planning, and suicide attempts, were identified as common factors influencing adolescent anxiety, regardless of SHAH exposure. This finding aligns with recent evidence showing that depression and anxiety frequently co-occur during adolescence and are closely associated with an elevated risk of suicide (Toro et al., 2025). Higher anxiety levels have also been linked to later suicidal ideation and attempts, reinforcing the association between anxiety and suicidality (Fang et al., 2024). These findings suggest that suicide-related risk factors play a key role in adolescents' emotional vulnerability, highlighting the importance of early identification.

Several factors were associated with anxiety only among adolescents who had been exposed to SHAH. Academic achievement emerged as a significant factor in this

group, suggesting that unstable or stressful environments may amplify anxiety related to academic pressure or evaluative situations. The association between academic performance and anxiety among adolescents who experienced SHAH can be interpreted in light of the effects of environmental stress on cognitive and emotional functioning. These factors may lead to reduced academic concentration and heightened perception of threat during evaluative situations. Although direct evidence is limited, previous findings offer relevant comparisons. Academic achievement was associated with anxiety only in the SHAH-exposed group, suggesting that exposure-related stress may intensify the emotional demands of academic situations. Comparable patterns have been reported in studies of second-hand smoke exposure, where adolescents show lower academic performance and greater emotional difficulties (Choi et al., 2020; Wan et al., 2024). BMI scores also showed a significant association with anxiety only among adoles-

cents exposed to SHAH. BMI is closely tied to body image and self-evaluation in adolescence. Prior research has shown that a higher BMI score is linked to lower self-esteem (Meland et al., 2021) and increased vulnerability to anxiety (Garipey et al., 2010). In emotionally unstable environments, BMI-related self-evaluations may become more reactive. Although direct empirical evidence of the relationship between SHAH and BMI remains limited, the present findings may be interpreted in terms of psychosocial pathways. Future research may help clarify how BMI-related self-evaluation contributes to anxiety in the context of SHAH.

Among adolescents without exposure to SHAH, physical activity, alcohol use, and smoking were associated with anxiety. Low physical activity frequency (one to two days per week) was associated with higher anxiety, a pattern consistent with prior evidence (Lee et al., 2023). This suggests that health behaviors may play a more direct role in emotional regulation when adolescents are not exposed to harmful environmental conditions.

Alcohol consumption and smoking were also factors associated with anxiety only in the non-exposed group. A similar pattern has been observed in secondhand smoke exposure research, where these behaviors show stronger associations with anxiety among adolescents not exposed to harmful environmental conditions. Such findings suggest that in more stable environments, individual health behaviors may be more directly associated with emotional regulation. These findings indicate that harmful environmental conditions may be associated with interference in emotional and behavioral regulation, limiting the extent to which health behaviors are reflected in anxiety levels (Lim et al., 2024).

These findings underscore the importance of a comprehensive analytical approach, which is a strength of this study. This study conducted an integrated analysis of behavioral, emotional, and environmental factors associated with adolescent anxiety in relation to SHAH exposure. By examining adolescents exposed and not exposed to SHAH within the same analytic framework, it distinguishes risk factors that are observed across both groups from those that appear only under SHAH-related conditions. This structure enables a clearer understanding of both general vulnerabilities and exposure-specific patterns. The use of nationally representative data enhances the generalizability of the findings, and the inclusion of multiple domains offers a more comprehensive perspective than studies focusing on single predictors.

Limitations

This study has several limitations. The analysis was based on cross-sectional data, which does not allow the determination of temporal order and limits causal interpretation. The study also relied on nationally collected secondary survey data, and the variables available for analysis

were limited by the structure of the dataset. The regression model did not include interaction terms between SHAH and the individual predictors, and the absence of these terms may have reduced the ability to identify subtle differences in associations according to SHAH status. Future longitudinal studies can address these limitations by incorporating temporal information and contextual characteristics. A longitudinal approach permits the examination of developmental changes and clarifies the manner in which SHAH exposure relates to behavioral and emotional responses among adolescents.

5. Conclusions

This study contributes to existing research by identifying the factors associated with adolescent anxiety irrespective of SHAH exposure and those that emerged only among SHAH-exposed adolescents. These findings suggest that certain risk factors may show associations that are independent of environmental exposure, whereas others may vary according to the presence of SHAH-related experiences. Intervention strategies for adolescents exposed to SHAH may benefit from incorporating the exposure-specific factors identified in this analysis. The factors observed across exposure groups underscore the foundational elements that should inform a broader framework for adolescent anxiety interventions.

Availability of Data and Materials

This study used publicly available, anonymous data. We used raw data from the Korea Disease Control and Prevention Agency's Korea Youth Health Behavior Survey website. Data are available upon request at <https://www.kdca.go.kr/yhs/> (accessed date on 28 August 2025).

Author Contributions

MK and SAK designed the research study. MK and SAK performed the research. MK analyzed the data. MK and SAK drafted the manuscript. Both authors contributed to the critical revision of the manuscript for important intellectual content. Both authors read and approved the final manuscript. Both authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

Not applicable.

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Conflicts of Interest

The authors declare no conflicts of interest.

References

- Bao C, Han L. Gender difference in anxiety and related factors among adolescents. *Frontiers in Public Health*. 2025; 12: 1410086. <https://doi.org/10.3389/fpubh.2024.1410086>
- Chai R, Bian WJ. Adolescent sleep and its disruption in depression and anxiety. *Frontiers in Neuroscience*. 2024; 18: 1479420. <https://doi.org/10.3389/fnins.2024.1479420>
- Choi K, Chen-Sankey JC, Merianos AL, McGruder C, Yerger V. Secondhand Smoke Exposure and Subsequent Academic Performance Among U.S. Youth. *American Journal of Preventive Medicine*. 2020; 58: 776–782. <https://doi.org/10.1016/j.amepre.2019.12.020>
- Crews FT, Vetreno RP, Broadwater MA, Robinson DL. Adolescent Alcohol Exposure Persistently Impacts Adult Neurobiology and Behavior. *Pharmacological Reviews*. 2016; 68: 1074–1109. <https://doi.org/10.1124/pr.115.012138>
- Davidson LL, Grigorenko EL, Boivin MJ, Rapa E, Stein A. A focus on adolescence to reduce neurological, mental health and substance-use disability. *Nature*. 2015; 527: S161–S166. <https://doi.org/10.1038/nature16030>
- Do KT, Prinstein MJ, Telzer EH. Neurobiological susceptibility to peer influence in adolescence. In Kadosh KC. (ed.) *The Oxford handbook of developmental cognitive neuroscience* (pp. 863–883). Oxford University Press: Oxford. 2020. <https://doi.org/10.1093/oxfordhb/9780198827474.013.27>
- Fang L, Tong Y, Li M, Wang C, Li Y, Yuan M, et al. Anxiety in adolescents and subsequent risk of suicidal behavior: A systematic review and meta-analysis. *Journal of Affective Disorders*. 2024; 358: 97–104. <https://doi.org/10.1016/j.jad.2024.05.005>
- Garipey G, Nitka D, Schmitz N. The association between obesity and anxiety disorders in the population: a systematic review and meta-analysis. *International Journal of Obesity*. 2010; 34: 407–419. <https://doi.org/10.1038/ijo.2009.252>
- Hoaken PNS, Stewart SH. Drugs of abuse and the elicitation of human aggressive behavior. *Addictive Behaviors*. 2003; 28: 1533–1554. <https://doi.org/10.1016/j.addbeh.2003.08.033>
- Karriker-Jaffe KJ, Greenfield TK, Kaplan LM. Distress and alcohol-related harms from intimates, friends, and strangers. *Journal of Substance Use*. 2017; 22: 434–441. <https://doi.org/10.1080/14659891.2016.1232761>
- Landberg J, Danielsson AK, Hemmingsson T. Fathers' alcohol use and suicidal behaviour in offspring during youth and young adulthood. *Acta Psychiatrica Scandinavica*. 2019; 140: 563–573. <https://doi.org/10.1111/acps.13098>
- Laslett AM, Room R, Waleewong O, Stanesby O, Callinan S, World Health Organization. Harm to others from drinking: Patterns in nine societies. World Health Organization: Geneva. 2019.
- Lee HJ, Choi JP, Oh K, Min JY, Min KB. Impact of Physical Activity on the Association Between Unhealthy Adolescent Behaviors and Anxiety Among Korean Adolescents: A Cross-sectional Study. *Journal of Preventive Medicine and Public Health = Yebang Uihakhoe Chi*. 2023; 56: 552–562. <https://doi.org/10.3961/jpmph.23.313>
- Lim JH, Kim DB, Ko J, Joo MJ, Park EC. Association between secondhand smoke exposure and anxiety among adolescents: A nationwide cross-sectional study. *Tobacco Induced Diseases*. 2024; 22: 145. <https://doi.org/10.18332/tid/191750>
- Maurer J, Meyrose AK, Kaman A, Mauz E, Ravens-Sieberger U, Reiss F. Socioeconomic Status, Protective Factors, and Mental Health Problems in Transition from Adolescence to Emerging Adulthood: Results of the Longitudinal BELLA Study. *Child Psychiatry and Human Development*. 2025; 56: 649–660. <https://doi.org/10.1007/s10578-023-01582-1>
- Meland E, Breidablik HJ, Thuen F, Samdal GB. How body concerns, body mass, self-rated health and self-esteem are mutually impacted in early adolescence: a longitudinal cohort study. *BMC Public Health*. 2021; 21: 496. <https://doi.org/10.1186/s12889-021-10553-x>
- Nash A. The Landscape of Substance Use in Youth-2024. *Journal of Pediatric Health Care : Official Publication of National Association of Pediatric Nurse Associates & Practitioners*. 2025; 39: 990–1001. <https://doi.org/10.1016/j.pedhc.2025.06.003>
- Naumoska T, Zafirovski K, Hanna F. The Association Between Skipping Breakfast and Anxiety and Depression in Adolescents-A Scoping Review. *Children (Basel, Switzerland)*. 2025; 12: 953. <https://doi.org/10.3390/children12070953>
- Ramirez-Meneses D, Carbonel A, Vilela-Estrada AL, Bernabe-Ortiz A, Uribe-Restrepo JM, Olivar N, et al. Do Coping Strategies Modify the Association Between Experiencing Parental Alcohol Misuse and Symptoms of Depression, Anxiety and Alcohol Consumption? A Case-Control Study Among Young People From Deprived Urban Areas in Latin America. *Revista Colombiana De Psiquiatria*. 2025; 54: 15–24. <https://doi.org/10.1016/j.rcp.2025.05.002>
- Room R, Ferris J, Laslett AM, Livingston M, Mugavin J, Wilkinson C. The drinker's effect on the social environment: a conceptual framework for studying alcohol's harm to others. *International Journal of Environmental Research and Public Health*. 2010; 7: 1855–1871. <https://doi.org/10.3390/ijerph7041855>
- Sanchis-Sanchis A, Grau MD, Moliner AR, Morales-Murillo CP. Effects of Age and Gender in Emotion Regulation of Children and Adolescents. *Frontiers in Psychology*. 2020; 11: 946. <https://doi.org/10.3389/fpsyg.2020.00946>
- Sontate KV, Rahim Kamaluddin M, Naina Mohamed I, Mohamed RMP, Shaikh MF, Kamal H, et al. Alcohol, Aggression, and Violence: From Public Health to Neuroscience. *Frontiers in Psychology*. 2021; 12: 699726. <https://doi.org/10.3389/fpsyg.2021.699726>
- Spitzer RL, Kroenke K, Williams JBW, Löwe B. A brief measure for assessing generalized anxiety disorder: the GAD-7. *Archives of Internal Medicine*. 2006; 166: 1092–1097. <https://doi.org/10.1001/archinte.166.10.1092>

- Steinberg LD. Age of opportunity: Lessons from the new science of adolescence. Houghton Mifflin Harcourt: Boston. 2014.
- Thompson K, Davis-MacNevin P, Teehan M, Stewart S, Caring Campus Research Team. The Association Between Secondhand Harms From Alcohol and Mental Health Outcomes Among Postsecondary Students. *Journal of Studies on Alcohol and Drugs*. 2017; 78: 70–78. <https://doi.org/10.15288/jsad.2017.78.70>
- Toro GVR, Arias P, de la Torre-Luque A, Singer JB, Lagunas N. Depression, Anxiety, and Suicide Among Adolescents: Sex Differences and Future Perspectives. *Journal of Clinical Medicine*. 2025; 14: 3446. <https://doi.org/10.3390/jcm14103446>
- Trangenstein PJ, Yeh JC, Sparks A, Arria AM, Greenfield TK, Jernigan DH. Alcohol's Collateral Damage: Harms From Others' Drinking Are Linked to Academic and Mental Health Challenges Among U.S. College Students. *Journal of Studies on Alcohol and Drugs*. 2025; 86: 769–777. <https://doi.org/10.15288/jsad.24-00170>
- Wan B, Peng-Li D, Chen J, Xu P, Sun D, Chen Q, et al. The effect of secondhand smoke exposure on self-satisfaction and perceived freedom of life choice. *Journal of American College Health*. 2024; 72: 439–445. <https://doi.org/10.1080/07448481.2022.2039157>
- Wang H, Guan Y, Du H, Dai P, Zhong J, Yu M, et al. Association of Breakfast Consumption Frequency with Depression and Anxiety Symptoms Among School Students: A Cross-Sectional Study in Eastern China. *Nutrients*. 2025; 17: 1271. <https://doi.org/10.3390/nu17071271>
- Zheng G, Peng H. The Effects of Social Media Addiction, Academic Stress, and Sleep Quality on Anxiety Symptoms: A Cross-Sectional Study of Chinese Vocational Students. *Psychology Research and Behavior Management*. 2025; 18: 1571–1584. <https://doi.org/10.2147/PRBM.S522652>