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ORIGINAL RESEARCH

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Does accumulative childhood trauma affect adult depression? Exploring the mediating effects of substance misuse experience and gender differences

Kyu-Hyoung Jeong[1], Yiseul Kim[1,*], Seoyoon Lee[2], Yifang Hou[1]

[1]Department of Social Welfare, Jeonbuk National University, 54896 Jeonju-si, Republic of Korea
[2]Department of Health Policy and Management, School of Public Health, Texas A&M University, College Station, TX 77840, USA

***Correspondence**
srisri0501@jbnu.ac.kr
(Yiseul Kim)

Abstract

Background: There is a growing global concern of depression, especially notable in South Korea, where childhood trauma significantly elevates the risk of depression and substance misuse in adulthood. This study aims to explore the mediating role of substance misuse within this relationship, emphasizing gender differences. The insights gained from this research aim to inform the development of effective intervention strategies and public health policies. **Methods**: This study utilizes data from the 2021 Life Events and Trauma Experience Survey conducted in South Korea to explore gender differences in the mediating effects substance misuse on the relationship between childhood trauma and adult depression. The sample comprises 1331 adults who experienced childhood trauma, and depression is assessed using the Patient Health Questionnaire-9 (PHQ-9). Childhood trauma is categorized into 23 life events. **Results**: The findings indicated that both childhood trauma and substance misuse were significantly associated with increased levels of adult depression, with substance misuse intensifying this effect. Gender differences were observed, as females reported higher levels of both depression and experiences of childhood trauma. However, gender did not influence the mediating effect of substance misuse on depression. Furthermore, factors such as having a spouse, chronic illness, and economic status influenced levels of depression and substance misuse. **Conclusions**: The findings suggest the need for preventive efforts for childhood trauma and substance misuse interventions, emphasizing a comprehensive approach rather than a gender-specific one in mental health programs.

Keywords

Childhood trauma; Adult depression; Substance misuse; Gender differences

1. Introduction

Depression is defined by persistent feelings of sadness and a pervasive sense of helplessness in daily life [1]. It has increasingly emerged as a significant social issue in modern society, with its severity escalating due to various social and environmental factors [2]. Furthermore, depression is a representative signal of mental health problems, leading to increased global attention on its management and intervention. According to the World Health Organization (WHO), approximately 5% of the global adult population (around 400 million individuals) suffers from depression, marking it as a critical public health concern worldwide [3]. The National Survey on Knowledge and Attitudes toward Mental Health indicates that the percentage of individuals reporting prolonged feelings of depression for several days has surged to 40.2%, a notable increase of 10.2% compared to 2022 [4]. This rise in depression not only diminishes the overall quality of life for those affected but also results in substantial social costs, presenting a significant burden on society. The National Health Insurance Service estimates that the socioeconomic cost of depression in South Korea is approximately 10 trillion KRW (around 7 billion USD) annually [5]. As such, depression is recognized as a significant risk factor for suicide, thereby constituting one of the most urgent and critical mental health issues requiring intervention. As such, it is imperative to investigate depression and identify the multifaceted factors that contribute to its prevalence in order to mitigate the associated risks effectively [6].

According to previous studies, experiencing negative events such as parental conflict, economic hardship or illness during childhood has been associated with various mental health issues in adulthood, including depression and substance misuse [7]. In this context, it is important to pay attention to childhood trauma and substance misuse experiences as potential predictors of adult depression [8–11]. Adverse Childhood Experiences (ACE) refer to traumatic events that occur before the age of 18 [12, 13]. These encompass a range of experiences, including not only abuse and violence but also dysfunction within parental and adult family relationships. The definition

of trauma has expanded to include both direct and indirect experiences, such as accidents, disasters, infectious diseases and those experienced through different media. Trauma is characterized by adverse life events that result in physical or mental injuries or threats of death, often leading to feelings of fear, helplessness, anxiety, and dread [14]. Particularly, negative life events experienced during childhood can be classified as trauma [15].

When children experience such trauma, it can significantly impede their biological, social, emotional and cognitive development [16]. According to a 2024 survey conducted in South Korea [17], 67% of adults reported having experienced a traumatic event before the age of 18. The study found gender differences in trauma experiences depending on the number of incidents. While the rate of having no trauma experience was higher among women than men, the rate of experiencing 1 to 3 traumatic events was higher among men, and the rate of experiencing 4 or more traumatic events was higher among women. This indicates that women tend to have a higher frequency of childhood trauma experiences [17].

As such, experiencing trauma during childhood is not uncommon [18], and numerous studies have highlighted such adverse childhood experiences as a major factor contributing to depression in adulthood [11, 19–21]. This issue needs to be examined from a life-course perspective, as human development continues throughout life and each stage is interconnected rather than isolated [22]. Childhood trauma is emphasized as one of the most significant sources of stress [13]. Children may be particularly vulnerable due to the developmental stage of life they are in, as they may often lack the capacity to resolve problems that cause stress or to eliminate negative influences on their own [23]. As a result, they may be more likely to experience prolonged exposure to the negative impacts of trauma and stressful environments [17]. Children who have experienced trauma may show decreased abilities in stress management, emotional regulation and resilience compared to those who have not [24–26]. This is especially critical during the transition from childhood to adulthood, when new developmental tasks and changes in life circumstances can become major stressors [27]. Childhood trauma can impair a person's capacity to cope with and regulate stress, potentially intensifying the impact of daily stressors. Over time, this accumulated stress may not only persist from childhood through adolescence and adulthood, but can also gradually build up or worsen [23].

This can be explained through the Stress Process Model [28], which provides insight into the relationship between stress and health. In other words, adverse childhood experiences can trigger an initial stress response that weakens an individual's ability to cope with stress. As secondary stress accumulates, it can further amplify the stress, ultimately leading to depression. This suggests that childhood trauma experiences can be one of the predictors of adult depression.

There are also studies that directly examine the impact of childhood trauma on adult depression [29–31]. Previous research has shown that individuals who had experienced trauma in childhood are more likely to experience depression in adulthood compared to those who did not, and the more trauma experiences one has, especially overlapping or repeated ones, the higher the level of depression tends to be [32–34]. Depression also shows clear gender differences. According to a mental health survey conducted in South Korea, the prevalence rate of depressive disorders was twice as high in females compared to males [35]. In particular, females who experienced childhood trauma were found to be at a higher risk of adult depression [36, 37].

Early intervention in substance misuse is crucial, as life crises, such as trauma, can worsen the use of substances like alcohol, tobacco, food and drugs [38]. In this way, trauma experienced during childhood can contribute not only to adult depression but also to increased use of alcohol, tobacco, food and substances, and *etc*. [38]. Substance misuse often occurs among individuals seeking to escape from pain and emotional wounds [39]. In particular, drugs that provide temporary relief from the psychological distress caused by trauma can lead to stronger dependence, as the ongoing emotional pain intensifies the craving for these substances [39]. The self-medication hypothesis posits that individuals with substance misuse and abuse disorders often turn to substances to cope with painful emotions [39].

This may explain how individuals may repeatedly and selectively use substances as a means of self-healing from trauma. According to the self-medication hypothesis, people often turn to substances to cope with their painful emotions [40]. International studies have shown that over 60% of patients participating in drug treatment programs had experienced trauma during childhood [41, 42]. Furthermore, childhood trauma is linked to issues related to substance use, including the use of illegal drugs and the misuse of prescribed medications, as well as the timing of initial substance use [43]. A study in the United States found that one in seven individuals (14.4%) aged 18 to 25 reported misusing prescribed medications [44–46]. Multiple studies also indicate that adolescents may begin misusing substances like stimulants as early as elementary or middle school, with the highest rates of misuse starting in late adolescence [47, 48]. These findings provide evidence that childhood trauma increases the likelihood of experiencing substance misuse during adolescence. Studies have reported that early life trauma can damage various aspects of brain development, may induce accumulated stress throughout life, and may promote negative health behaviors [20].

According to research in the United States, issues spanning from prescription drug misuse and polysubstance use are particularly prominent among adolescents and young adults [46, 49, 50]. This highlights the need to examine the timing and progression of substance use: during adolescence, the misuse of prescribed medications is notable, and among adolescents who have experienced substance misuse even once, two-thirds stop misusing substances, while one-third continue to misuse substances into adulthood [49, 51]. This continuation has been shown to increase the risk of depression in adulthood in the form of dependence [52]. Furthermore, in the relationship between substance misuse and adult depression, there are slight gender differences; in females, repeated non-medical use of substances during late adolescence has been reported to predict adult depression [52].

This phenomenon can be explained by normalization theory [53]. While the use of illegal substances is often considered

pathological and stigmatized, the misuse of prescribed medications is currently viewed with more general and accepting attitudes [53]. As a result, an accepting attitude toward drugs can lead to a transition from repeated use or dependence on prescribed medications to the use of illegal substances [54], ultimately creating a vicious cycle that leads to substance use disorders. Therefore, even before measuring the frequency or severity of substance misuse, the mere experience of substance misuse itself may imply an accepting attitude toward drugs and the potential for repeated use not intended for treatment. Thus, exploring experiences of substance misuse embraces significant importance.

As previously mentioned, experiencing substance misuse does not necessarily lead to a substance use disorder [49, 51]. The motivation behind substance use is also important, as it influences patterns of use and outcomes [55]. Motivations can be classified into positive motivations, such as seeking pleasure, and negative motivations, such as relieving stress caused by discomfort or interpersonal conflict [55]. Both positive and negative motivations are associated with increased frequency of substance misuse, but only negative motivation is directly related to the later development of substance use disorders [55]. Therefore, psychological distress and discomfort caused by childhood trauma can play as negative motivations for drug use, reinforcing the idea that childhood trauma can lead to substance misuse experiences and ultimately serve as a predictor of substance use disorders [55].

In addition, most illegal substances with high addictive potential can lead to severe substance use disorders in about 13% of cases after just a single misuse [56]. When the motivation for drug use is to alleviate discomfort or similar negative feelings, it results in even more severe substance use disorders and consequences [55]. Thus, the self-healing use of drugs to relieve psychological distress and discomfort caused by childhood trauma—driven by an accepting attitude toward drugs and negative motivation—is likely to intensify over time and lead to worsening mental health issues.

Such substance misuse can act as a risk factor for mental health issues and can influence depression. Early exposure to substances can physiologically damage brain function, thereby potentially increasing the risk of mental illness [57]. Substance misuse is particularly prominent during adolescence, and problems with substance misuse during this period have been identified as a predictive factor for the development of depression [52]. According to studies examining the effects of drug use on mental health, substance misuse may temporarily provide a sense of stability or mood relief, but its side effects can lead to anxiety and depressive symptoms [58], ultimately resulting in mental health deterioration and negative outcomes such as depression. Research on gender differences in the impact of substance use on depression has shown that in male, substance use disorders are more common and tend to precede depression, whereas in female, depression tends to precede the onset of substance use disorders [59].

Overall, childhood trauma experiences may diminish children's ability to cope with and regulate stress, making them more vulnerable to additional stressors during developmental stages. This vulnerability increases the likelihood of using substance misuse as a method of self-healing to alleviate resulting psychological distress. Such a process can eventually lead to adult depression. Prior studies have also reported that childhood experiences of sexual abuse among females can be one of the major predictors of substance use disorders and be associated with higher levels of depression, somatic symptoms, and impulsivity in adulthood [60].

Although the seriousness of substance misuse have been discussed as a global public health issue [42], Korean health policy mainly focuses on illegal substance use; the importance of exploring substance misuse experiences, which could predict potential illegal substance use, is relatively overlooked in Korea. Despite the fact that investigating these pathways could initiate early detection of mental health issues such as depression and allow early intervention for those with childhood trauma experiences, the preventive efforts still remain insufficient [61].

One of the studies conducted in Korea have mainly focused on the relationship between trauma experiences and depression, and alcohol use issues among trauma-experienced groups [62], and some studies fragmentedly examined the actual conditions of substance misuse and its effects on suicide among adolescents and the aging population [63, 64]. However, no comprehensive research has explored the impact of substance misuse on the relationship between childhood trauma experiences and adult depression.

Therefore, this study aims to clarify whether substance misuse mediates the relationship between childhood trauma experiences and adult depression, and to explore the seriousness of misuse of illegal substances and prescribed medications that may arise as a result. It also seeks to examine how gender differences among key variables—childhood trauma, adult depression, and substance misuse—interact within these relationships. This research will contribute not only to understanding substance misuse as one of the complex influences of accumulated childhood trauma on adult depression but also to clarifying the role of substance misuse in this relationship, thereby providing important foundational data for developing effective intervention strategies. The purpose of this study is to extend the relationship between childhood trauma and depression found in previous research among Korean adults, exploring more detailed associations. Based on these findings, the study aims to propose practical and policy recommendations for social welfare interventions in Korea.

2. Materials and methods

2.1 Research model

This study aims to examine the gender differences in the mediating effect of substance misuse on the relationship between accumulated childhood trauma and adult depression. The research model for this study is illustrated in Fig. 1.

2.2 Data

This study utilized data from the Life Events and Trauma Experience Survey conducted in 2021 by the Korea Institute for Health and Social Affairs. The Life Events and Trauma Experience Survey aims to collect basic data on life events and trauma experiences encountered by adults aged 18 and older

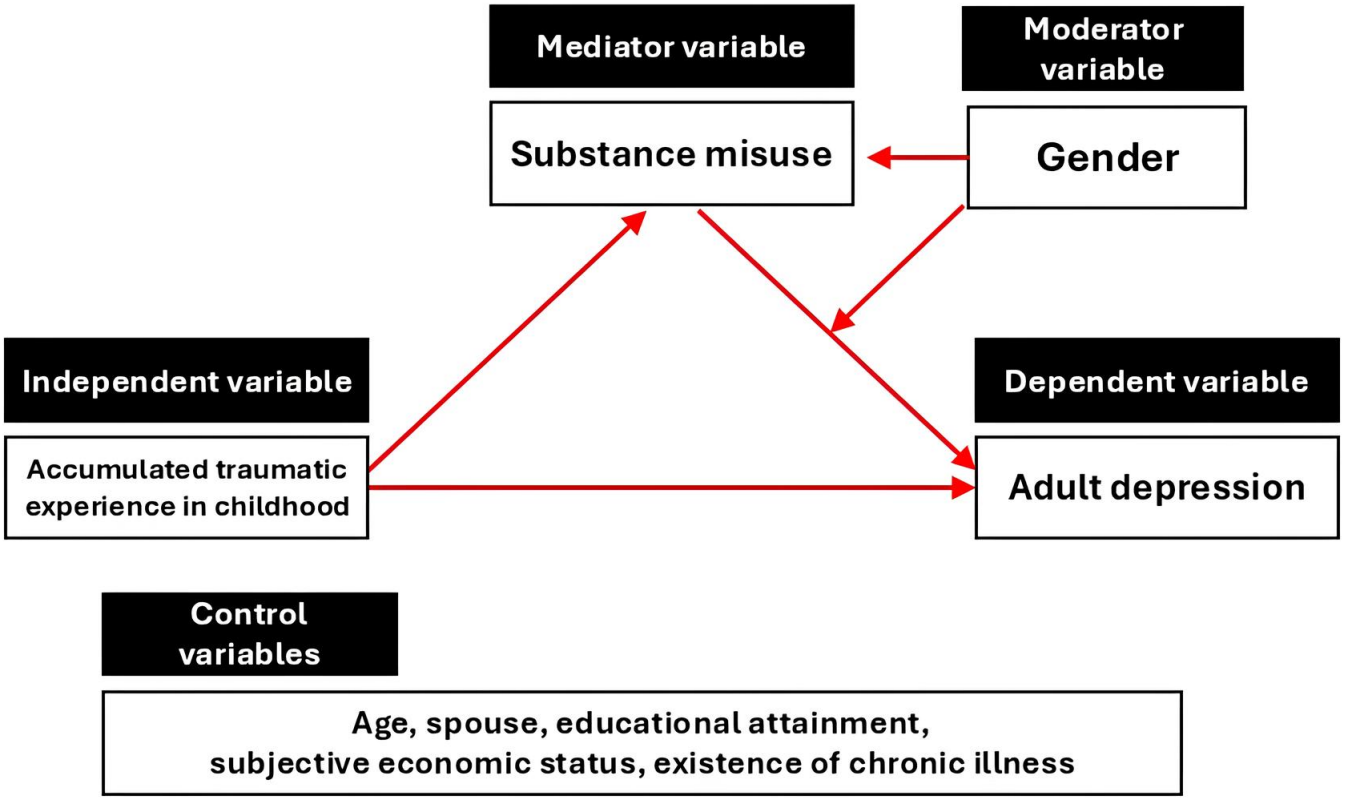

FIGURE 1. Research model.

to provide foundational information for policies and projects promoting mental health. The study sample comprised 2000 young adults aged 20 to 59 (confidence level of 95% and a margin of error of ±2.19%). The target sample was selected based on the population structure of the region, gender and age groups using resident registration data. The survey was conducted through random digit dialing (RDD). Participants who agreed to partake in the study were surveyed online. The survey was conducted over a period of 22 days, from 09 July to 30 July 2021. It received approval from the Institutional Review Board of the Korea Institute for Health and Social Affairs (Approval No. 2021-36) [17]. For this study, 1331 individuals, who had experienced childhood trauma before the age of 18 and for whom key variables could be accurately assessed, were included in the analysis.

2.3 Variables

2.3.1 Dependent variables: depression

The dependent variable in this study is depression. To assess it, we utilized the Korean version of the Patient Health Questionnaire-9 (PHQ-9), which was adapted by Ahn *et al.* [65] (2013) for use as a depression screening tool in clinical settings. The original PHQ-9 was developed by Spitzer, Kroenke and Williams (1999) [66] for evaluating depression in primary healthcare settings. The PHQ-9 consists of 9 items, with a 4-point scale (Not at all = 0, Several days = 1, More than half the days = 2, Nearly every day = 3). In this study, the sum of the 9 items was used as a measurement, where a higher score indicates a higher likelihood and severity of depression. A score of 0–4 is considered normal, 5–9 indicates mild depression, 10–19 indicates moderate depression, and 20 or more indicates severe depression. A higher score reflects a higher level of depression. The reliability of the test in this study was Cronbach's $\alpha = 0.880$.

2.3.2 Independent variable: accumulated traumatic experience in childhood

The independent variable in this study is the accumulated childhood trauma experience (before the age of 18), referring to any of 23 types of life events categorized as traumatic that occurred before the age of 18. These traumatic events include the 16 specified in the Life Events Checklist for DSM-5 (LEC-5), five commonly occurring adverse childhood experiences (ACEs), being diagnosed with COVID-19, and other severe stress events or experiences. The 16 events from the LEC-5 are natural disasters, fire or explosion, traffic accidents, serious accidents at work, home or during leisure activities, exposure to toxic substances, physical violence, attacks with a weapon, sexual violence, other unwanted or uncomfortable sexual experiences, exposure to combat or war zones, imprisonment, life-threatening illness or injury, profound human suffering, sudden death, sudden accidental death, and serious injury, harm or death of others caused by oneself. Among these ACEs, those considered in this study are: bullying and ostracism at school, work or within the family, divorce or separation of oneself or family members, living with someone who has issues with excessive drinking or alcohol/substance disorder, living with someone who has depression, mental illness or has attempted suicide, and economic ruin. Out of the 23 traumatic life events categorized as trauma events, those experienced before the age of 18 are regarded as childhood trauma. If an

individual experienced least one traumatic event before the age of 18, they were classified as part of the childhood[1] trauma experience group. The total number of different traumatic events was summed up and analyzed as a continuous variable.

2.3.3 Mediator variable: substance misuse

The mediator variable in this study is substance misuse, which was assessed using questions related to health status from the life Events and Trauma Experience Survey. These questions specifically examined experiences of substance misuse, with each serving as a single item focusing on the use of pharmaceuticals, inhalants and narcotics. The WHO defines substance misuse as "the use of substances in a non-medical manner or in ways inconsistent with approved usage, regardless of the consequences resulting from such use" [67]. In this study, substance misuse was assessed using two single-item questions regarding the use of pharmaceuticals, inhalants, and narcotics; (1) "Have you ever used any of the above substances in quantities or frequencies greater than the recommended amount?", and (2) "Have you ever used any of the above substances to alter your mood or behavior, such as to feel better or to relax, for purposes other than treatment?". The responses to each question were coded as "Yes = 1" and "No = 2". For analysis, the responses to the two substance misuse questions were combined and categorized on a 3-point scale: "No experience = 0", "Experienced either using beyond the recommended amount or using for non-treatment purposes once = 1", "Experienced both using beyond the recommended amount and using for non-treatment purposes = 2". These categories were then treated as a continuous variable for the analysis.

2.3.4 moderator variables: gender

The moderator variable used in this study was gender, binary variable; 0 for male and 1 for female.

2.3.5 Control variables: age, spouse, educational attainment, subjective economic status, existence of chronic illness

The control variables used in this study included dummy variables for the presence of a spouse (where spouse = 1 indicates presence and 0 indicates absence), educational (with 1 representing a college graduate or higher and 0 indicating a high school graduate or lower), and the presence of chronic illness (where 1 indicates the presence of a chronic illness and 0 indicates its absence). Additionally, age and subjective economic status were treated as continuous variables. A chronic illness was defined as such if the individual had been diagnosed with the condition and was currently receiving treatment; if not, the individual was classified as not having a chronic illness.

2.4 Statistical analysis

In this study, data analysis was conducted using SPSS 22.0 (IBM Corp., Armonk, NY, USA) and the SPSS PROCESS macro program (Andrew F. Hayes, Columbus, OH, USA). First, frequency analysis was performed to examine the demographic characteristics of the study participants. Next, independent *t*-tests were conducted to identify any differences in key continous variables based on gender. To assess the mediating effect of substance misuse on the relationship between accumulated childhood trauma and adult depression, regression analysis and bootstrapping were employed using PROCESS Macro Model 4. The statistical significance of the mediating effect was then verified. Additionally, to explore gender differences in the relationship between substance misuse and adult depression, a moderating effect was tested using PROCESS Macro Model 1. To investigate whether the impact of accumulated childhood trauma and substance misuse on adult depression differs by gender, we examined the moderating effect of substance misuse using PROCESS Macro Model 14. A bootstrapping method with 5000 resampled samples was used to confirm the presence of moderated mediation effect.

3. Results

3.1 Demographic characteristics

The demographic characteristics of the study participants were as follows in Table 1: Among the participants, 689 (51.8%) were male, and 642 (48.2%) were female. The age distribution indicated that the largest group was composed of participants in their 40s (n = 346, 26.0%), followed by those in their 20s (n = 337, 25.3%), 30s (n = 328, 24.6%), and 50s (n = 320, 24.0%). Those who graduated from college or higher accounted for the largest proportion at 1044 (78.5%), while those who graduated from high school or lower accounted for 287 (21.5%).

Regarding marital status, 678 participants (50.9%) were married, while 653 (49.1%) were unmarried. A significant number of study participants reported chronic illnesses, with 749 (56.3%) indicating that they had at least one chronic condition, while 582 (43.7%) reported not having any such condition. This finding underscores the high prevalence of chronic illnesses among the cohort. Regarding subjective economic status, the most substantial group consisted of 536 participants (40.3%) who self-identified within the "middle" economic category. This group was followed by 387 participants (29.1%) who classified themselves as "upper middle", 240 (18.0%) as "lower middle", 131 (9.8%) as "upper" and 37 (2.8%) as "lower" economic status. Notably, a greater number of participants identified with the "middle to upper" economic status classification compared to those who aligned with the "middle to lower" classification.

3.2 Differences in major variables by gender

To explore the differences in key variables based on gender, an independent samples *t*-test was conducted, with the results presented in Table 2. The analysis revealed statistically significant gender differences in adult depression ($t = -2.083$, $p < 0.05$) and accumulated childhood trauma experience ($t = -2.517$, $p < 0.05$). Specifically, females were found to have significantly higher levels of depression and accumulation of childhood trauma compared to males. In contrast, age, substance misuse experience, education level and subjective economic status did not show significant differences based on gender.

[1] In this study, childhood is defined as "any person under the age of 18" according to Article 2 of Korea's Child Welfare Act, reflecting legal standards for the protection of children's rights and welfare.

TABLE 1. Demographic characteristics of study participants by gender (N = 1331).

Variable	Categories	Male (n = 689)		Female (n = 642)	
		N	%	N	%
Gender		689	51.8	642	48.2
Age (yr)					
	20's	168	24.4	169	26.3
	30's	166	24.1	162	25.2
	40's	182	26.4	164	25.5
	50's	173	25.1	147	22.9
Presence of spouse					
	No	345	50.1	308	48.0
	Yes	344	49.9	334	52.0
Educational Attainment					
	High school education or less	151	21.9	136	21.2
	Graduate degree or higher	538	78.1	506	78.8
Subjective economic status					
	Upper	83	12.0	48	7.5
	Upper middle	199	28.9	188	29.3
	Middle	258	37.4	278	43.3
	Lower middle	124	18.0	116	18.1
	Lower	25	3.6	12	1.9
Chronic illness					
	No	295	42.8	287	44.7
	Yes	394	57.2	355	55.3

TABLE 2. Differences in the characteristics of main variables by gender (N = 1331).

Variables	Male (n = 689)		Female (n = 642)		*t*(sig.)
	M	SD	M	SD	
Adult depression	6.037	5.414	6.657	5.434	−2.083*
Accumulated childhood trauma	2.599	2.014	2.888	2.167	−2.517*
Substance misuse	0.958	0.349	0.118	0.381	−1.126
Educational attainment	0.219	0.414	0.212	0.409	0.324
Subjective economic status	2.720	1.010	2.780	0.893	−1.014
Age (yr)	39.470	11.166	38.66	11.018	1.318

*$p < 0.05$. *M: mean; SD: Standard Deviation; sig: Significance.*

3.3 The mediating effect of substance misuse on the relationship between cumulative childhood trauma and adult depression

To examine the effect of accumulated childhood trauma experience on adult depression and the mediating effect of substance misuse, we employed the SPSS PROCESS macro (Model 4) as proposed by Hayes. The first model assessed the relationship between the independent variable, accumulated childhood trauma experience, and the mediator, substance misuse. The results are presented in Table 3. The findings revealed that the explanatory power for substance misuse as a mediator was found to be 6.4% ($R^2 = 0.064$), and the overall research model was confirmed to be a good fit ($F = 14.973$, $p < 0.001$). Furthermore, the analysis revealed that control variables, including marital status ($\beta = -0.066$, $p < 0.05$), education level ($\beta = -0.152$, $p < 0.001$), and the presence of chronic illness ($\beta = 0.099$, $p < 0.001$), significantly influenced substance misuse. That is, compared to individuals who are married, those who are unmarried, have a lower level of education (high school or below), or have chronic illnesses were found to have higher rates of substance misuse.

The independent variable, accumulated childhood trauma experience ($\beta = 0.136$, $p < 0.001$), significantly influenced substance misuse. This suggests that a greater diversity of

TABLE 3. The impact of accumulated childhood trauma experiences on substance misuse.

Categories		B	S.E	β
(Constant)		0.082	0.055	
Control variables				
	Age (yr)	0.002	0.001	0.047
	Presence of Spouse (ref. = no spouse)	−0.048	0.024	−0.066*
	Educational Attainment—High school diploma (ref. = Above graduate degree)	−0.135	0.024	−0.152***
	Subjective economic status	−0.004	0.011	−0.010
	Chronic illness (ref. = no)	0.073	0.020	0.099***
Independent variable	Accumulated childhood trauma	0.024	0.005	0.136***
R^2			0.064	
F			14.973***	

*$p < 0.05$, ***$p < 0.001$.
B: Unstandardized Regression Coefficient; S.E: Standard Error; ref.: reference.

childhood trauma experiences is associated with higher levels of substance misuse. However, age and subjective economic status were not found to significantly influence substance misuse.

In the second model, we examined the effects of the independent variable, accumulated childhood trauma experience, and the mediator, substance misuse, on the dependent variable, adult depression. The results are presented in Table 4 and Fig. 2. The model explained 17.5% of the variance in adult depression (R^2 = 0.175), and its fit was confirmed to be strong (F = 40.200, $p < 0.001$). The analysis revealed that control variables such as presence of spouse (β = −0.089, $p < 0.01$), subjective economic status (β = −0.173, $p < 0.001$), and chronic disease status (β = 0.172, $p < 0.001$) significantly influenced adult depression. Specifically, adult depression was higher among individuals without a spouse, those with a lower subjective economic status, and those with chronic diseases. Both the independent variable, accumulated childhood traumatic experience (β = 0.171, $p < 0.001$), and the mediator, substance misuse (β = 0.173, $p < 0.001$), had significant effects on adult depression. This indicates that a greater diversity of childhood trauma experiences and a higher level of substance misuse are associated with increased adult depression. In contrast, the control variables of age and education level did not have a significant effect on adult depression.

To investigate the mediating role of substance misuse in the relationship between accumulated childhood trauma experience and adult depression, we employed PROCESS Macro Model 4, bootstrapping set to 5000 iterations and a 95% confidence interval. The results are presented in Table 5. The analysis revealed that for the pathway of accumulated childhood trauma experience → substance misuse → adult depression, the 95% confidence interval ranged from 0.027 to 0.102, excluding zero, which confirmed that the mediating effect was statistically significant.

3.4 The effect of substance misuse on adult depression and the moderating effect of gender

To examine the effect of substance misuse on adult depression and the moderating effect of gender, PROCESS Macro Model 1 was used for analysis. The results are presented in Table 6 and Fig. 3. The explanatory power for adult depression as the dependent variable was 15.2% (R^2 = 0.152), and the research model was confirmed to be a good fit (F = 29.725, $p < 0.001$). The analysis revealed that control variables such as presence of spouse (B = −0.919, $p < 0.01$), subjective economic status (B = −1.050, $p < 0.001$), and chronic illness (B = 2.135, $p < 0.001$) significantly influenced adult depression. Specifically, adult depression was higher for individuals without a spouse, those with a lower subjective economic status, and those with chronic diseases. The independent variable, substance misuse (B = 3.296, $p < 0.001$), and the moderating variable, gender (B = 0.742, $p < 0.05$), were found to significantly influence adult depression. These results indicate a positive correlation whereby an increase in substance misuse is associated with elevated levels of adult depression, with female individuals showing more pronounced effects as compared to their male counterparts. Conversely, the control variables, including age and education level, did not significantly affect adult depression. The interaction term, substance misuse × gender, did not have a significant effect on adult depression, suggesting the absence of a moderating effect of gender in the relationship between substance misuse and adult depression.

3.5 Gender-moderated mediating effect

To examine whether gender moderates the mediating effect substance misuse in the relationship between accumulative childhood trauma experiences and adult depression, we employed PROCESS Macro Model 14, which was proposed for our analysis. The findings showed the following conditional mediating effects based on gender: for males, the 95% confidence interval was from 0.028 to 0.120, while for females, it was found to range from 0.020 to 0.100. Since neither of these

TABLE 4. The impact of accumulated childhood trauma experiences and substance misuse on adult depression.

Categories		B	S.E	β
(Constant)		7.108	0.772	
Control variables				
	Age (yr)	0.002	0.015	0.004
	Presence of Spouse (ref. = no spouse)	−0.970	0.339	−0.089**
	Educational Attainment (ref. = Below Highschool diploma)	−0.265	0.341	−0.020
	Subjective economic status	−0.980	0.149	−0.173***
	Chronic illness (ref. = no)	1.883	0.282	0.172***
Independent variable	Accumulated childhood trauma	0.445	0.067	0.171***
Mediator variable	Substance misuse	2.579	0.384	0.173***
R^2			0.175	
F			40.200***	

$^{**}p < 0.01$, $^{***}p < 0.001$.
B: Unstandardized Regression Coefficient; S.E: Standard Error; ref.: reference.

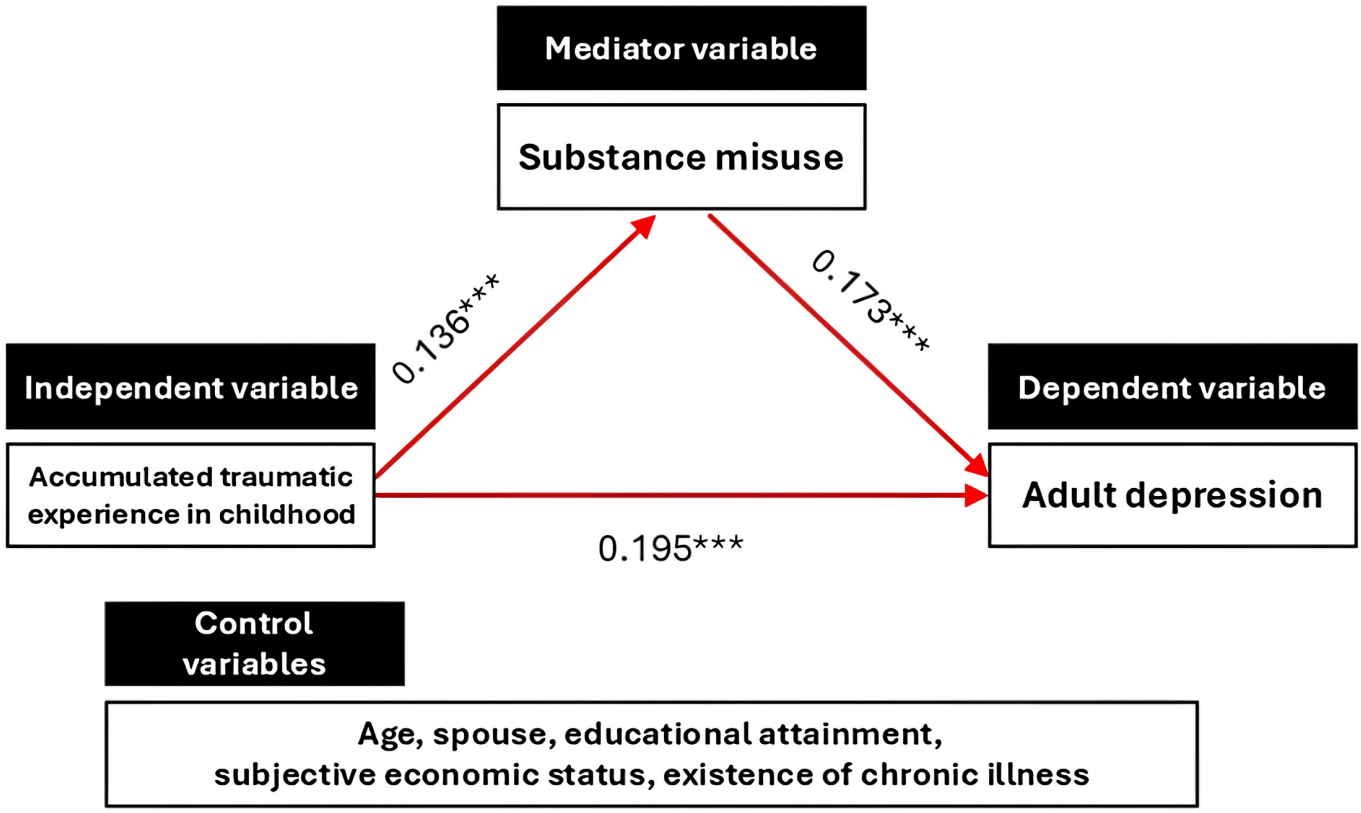

FIGURE 2. The effect of accumulated childhood traumatic experience on adult depression and the mediating effect of substance misuse (standardized coefficients). ***: $p < 0.001$.

TABLE 5. Mediating effect verification.

Pathway between variables	B	S.E	95% CI	
			LLCI	ULCI
Accumulated childhood trauma experience → substance misuse → adult depression	0.061	0.019	0.027	0.102

B: Unstandardized Regression Coefficient; S.E: Standard Error; CI: Confidence Interval; LLCI: Lower Limit of Confidence Interval; ULCI: Upper Limit of Confidence Interval.

TABLE 6. The effect of substance misuse on adult depression and the moderating effect of gender.

Categories		B	S.E
(Constant)		8.613	0.745
Control variables			
	Age (yr)	−0.015	0.015
	Presence of Spouse (ref. = no spouse)	−0.919	0.346**
	Educational Attainment (ref. Below Highschool diploma)	−0.260	0.346
	Subjective economic status	−1.050	0.151***
	Chronic illness (ref. = no)	2.135	0.284***
Independent variable	Substance misuse	3.296	0.556***
Moderator variable	Gender (ref. = male)	0.742	0.287*
Interaction term	Substance misuse	−0.776	0.761
R^2		0.152	
F		29.725***	

$*p < 0.05$, $**p < 0.01$, $***p < 0.001$.
B: Unstandardized Regression Coefficient; S.E: Standard Error; ref.: reference.

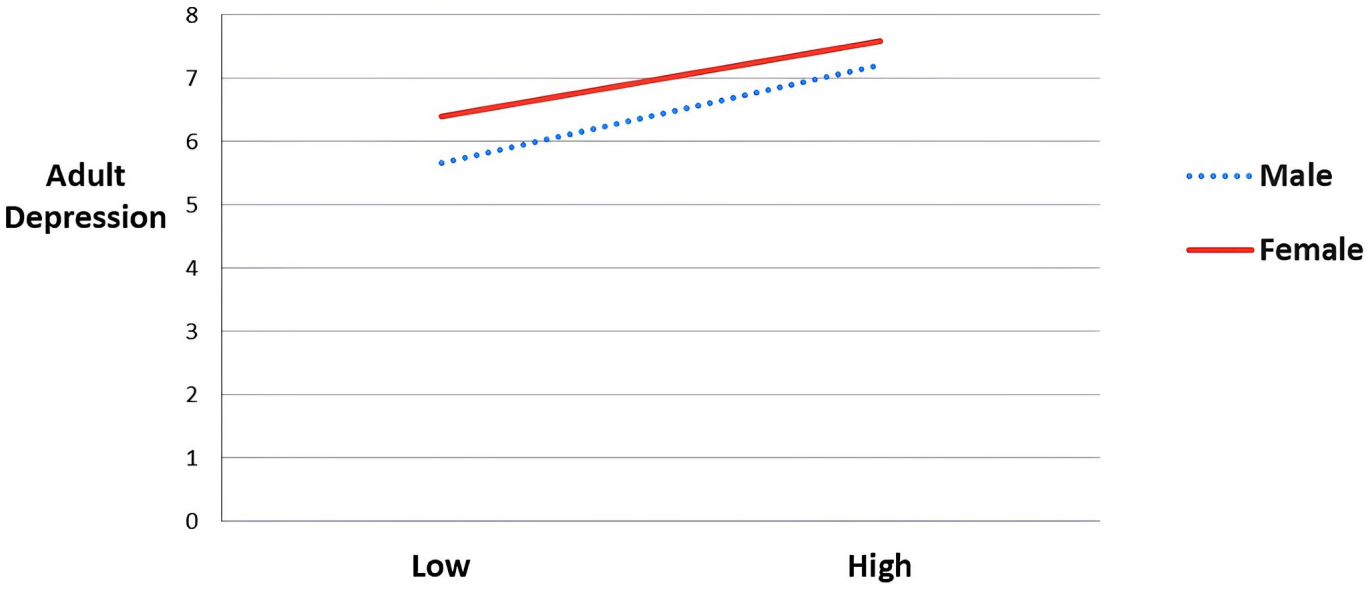

FIGURE 3. Moderating effect graph of gender on adult depression.

intervals includes 0, the moderated mediating effect was found to be significant.

To evaluate the statistical significance of the moderated mediating effect, the results are presented in Table 7. The moderated mediation index for gender was −0.012, with a 95% confidence interval ranging from −0.062 to 0.029. Because this interval includes 0, the moderated mediating effect was classified as non-significant. In conclusion, gender does not moderate the mediating effect of substance misuse in the relationship between accumulative childhood trauma experiences and adult depression.

TABLE 7. Conditional mediating effect by gender.

Gender	B	S.E	95% CI	
			LLCI	ULCI
Male	0.067	0.024	0.028	0.120
Female	0.055	0.020	0.020	0.100

B: Unstandardized Regression Coefficient; S.E: Standard Error; CI: Confidence Interval; LLCI: Lower Limit of Confidence Interval; ULCI: Upper Limit of Confidence Interval.

4. Discussion

This study utilized data from the "2021 Life Events and Trauma Experience Survey" to explore the impact of cumulative childhood trauma on adult depression, specifically examining whether the mediating effect of substance misuse is influenced by gender. The key findings are as follows:

Firstly, it was found that the greater the diversity of accumulated childhood trauma experiences, the higher the likelihood

of experiencing substance misuse. This can be interpreted as indicating that the accumulation of negative childhood experiences can lead to substance misuse, as individuals frequently select and use substances as a means of coping with the psychological distress resulting from such negative experiences [40, 68, 69].

Secondly, it was found that a wider range of childhood trauma experiences is associated with a heightened risk of depression in adulthood. This finding indicates that individuals who have experienced childhood trauma are more susceptible to depression in adulthood than those who have not faced such experiences. The risk of depression increases significantly with the number of childhood trauma experiences: having one trauma experience raises the risk by 1.85 times, two experiences by 2.57 times, and five experiences by 3.08 times, compared to individuals without any trauma history. These results align with previous studies on the subject [70].

Thirdly, the more diverse the accumulative childhood trauma experiences, the higher the level of substance misuse, which in turn increases adult depression. These findings indicate that adults with depression are more likely to have encountered various forms of childhood trauma, categorizing them as a vulnerable group at risk for substance misuse.

Fourth, it was found that gender did not show a moderated mediating effect in the relationship between accumulated childhood trauma experiences, substance misuse and adult depression. This suggests that for both males and females who experienced childhood trauma, substance misuse may equally contribute to an increase in depression. Childhood trauma may impair an individual's physical, emotional and cognitive development, weakens their ability to cope with and regulate stress, and causes severe psychological distress. Trauma experienced during childhood and adolescence—periods that demand developmental tasks and changes—aggravates and accumulates stress, leading individuals to choose substances as a means of self-healing to alleviate negative emotions. However, according to the Stress Process Model and the Self-Medication Hypothesis, these immature coping mechanisms can exacerbate or accumulate stress, ultimately resulting in depression in adulthood [28, 40]. Therefore, mental health policies and programs aiming to address substance misuse should prioritize the timing of interventions rather than differentiating by gender, and a proactive and comprehensive approach toward trauma is necessary. Based on the findings of this study, the following policy and practical recommendations are proposed.

First, it is essential to implement preventive efforts to minimize childhood trauma and to provide psychological support services that are specifically tailored to the unique characteristics of childhood. While it is impossible to completely prevent traumatic events, there are effective ways to mitigate their occurrence based on their nature. For instance, although we cannot directly avoid natural disasters, we can manage the indirect experiences shaped by media coverage or the information shared by those around us, thereby reducing their impact through proactive social initiatives. Moreover, policy efforts are necessary to block pathways through which children who are physically, cognitively, and emotionally immature may experience trauma. Additionally, children who have experienced trauma need both immediate and long-term psychological support services, whether the trauma is direct or indirect. Trauma-induced psychological difficulties can manifest right after the event and may persist for months, potentially leading to chronic conditions such as anxiety, depression or post-traumatic stress disorder (PTSD). Despite this severity, the psychological difficulties of children who have experienced trauma are often misinterpreted as typical confusion associated with adolescence or rapid developmental changes.

In addition, when professional counseling or treatment services for psychological difficulties are needed over the long term, guardian consent is essential, particularly if the patient is underage. However, if the guardian's cooperation lacks, the likelihood of dropout from mental health services increases. According to the 2023 child abuse statistics in South Korea [71], out of 48,522 suspected child abuse reports, 25,739 cases were confirmed as child abuse, and among them, 85.9% identified the parents as perpetrators. In cases where trauma is caused by familial factors, such as child abuse, it is necessary to expand the concept of guardianship beyond the family to include the community and the state, and ensure that long-term support is provided at both community and national levels. It is critical to strengthen child protection systems and enhance the sensitivity of families and communities in identifying and addressing the psychological difficulties stemming from negative experiences at each developmental stage. Moreover, for children who have experienced trauma unrelated to familial factors, long-term parental education and support programs must be provided to ensure continued access to appropriate mental health services. This approach is supported by research showing that family support can reduce substance use stemming from trauma and has a positive effect on recovery [62].

Currently, psychological support services for children in South Korea are mainly focused on issues such as suicide and child abuse, and primarily target high-risk children who have directly experienced trauma [72]. Since investigating a broad range of trauma experiences can help predict and prevent trauma-related mental health issues, it is necessary to conduct regular surveys of children's trauma experiences and expand the types of incidents that trigger psychological support services beyond suicide cases. For example, it is important to also include children who have experienced or are at high risk of experiencing various trauma-inducing events, such as natural disasters, social disasters, accidents within communities, parental divorce, serious physical or mental illness and economic hardship [23]. Early identification and intervention efforts should be made targeting children with multiple trauma experiences. The type of intervention should differ depending on the nature of the trauma. For instance, for children whose trauma is not caused by family members, interventions should be centered around family-based support, as the family environment greatly influences recovery. In contrast, if trauma is caused by family members, interventions should prioritize separation, protection, caregiving, and fostering independence through state-led efforts rather than family-centered approaches. A welfare policy framework and institutional reinforcement are needed to enable regular trauma experience surveys among children and adolescents, early identification of psychological difficulties, and the provision of medium- and

long-term interventions through phased practical measures.

Second, a comprehensive survey and strengthened monitoring and supervision of prescribed substance misuse and illegal substance use are necessary, along with the integration and unification of services to promote proper substance use. Recently, as incidents involving substance use by celebrities have become a major social issue in Korea, the government has expanded the "judicial-treatment-rehabilitation linkage model" for individuals who used illegal substances nationwide, and has increased the budget allocation to strengthen substance safety management and focus on the recovery and rehabilitation of individuals [73].

In the field of mental health social work in Korea, various prevention and rehabilitation programs related to substance misuse are actively being implemented, especially through the Korea Narcotics Control Foundation. Preventive education on substance misuse is being conducted for children, adolescents and adults. However, although the current Narcotics Information Management System (NIMS) in Korea effectively tracks the entire life cycle of medical narcotics from production and import to distribution, use and disposal [74], it tends to predominantly emphasize law enforcement for punitive measures rather than enabling healthcare providers to identify patients who require intervention [75].

Additionally, pharmacists do not possess the authority to access patients' prescription history or medication details when dispensing medical narcotics. This limitation restricts the system's effectiveness in addressing issues at the medication consumption stage [75].

Moreover, the "Mental Health Survey" conducted every five years in Korea focuses primarily on substance use related to nicotine and alcohol. This narrow scope hampers a comprehensive assessment of the extent of substance misuse of over-the-counter drugs. Also, treatment and rehabilitation services for individuals with substance use disorders are largely provided by specialized recovery institutions and hospitals, while services addressing substance misuse remain fragmented, with facilities such as the Integrated Addiction Management Support Center handling these concerns separately.

In order to comprehensively address the serious social problems related to substances, it is necessary for the government to take the lead in conducting real-time monitoring and comprehensive investigations of substance use, including the use of prescribed medications. Additionally, the authority to access individuals' prescription and medication histories should be expanded to include pharmacists, thereby establishing a safety net for substance use. Even when medications are prescribed, a secondary check of the prescription and dispensing history during the dispensing process is needed. If individuals at risk of substance misuse are identified, a system should be established to refer them to community mental health professionals for assessment and intervention regarding their substance misuse problems.

Australia's Real-Time Prescription Monitoring (RTPM) system is designed and operated to allow healthcare providers to identify patients who may require intervention in real time, providing risk analysis information at the prescription and dispensing stages to enhance patient safety [76]. Similarly, individuals at risk of substance misuse should be connected to community mental health services to implement a prevention-treatment-rehabilitation model in Korea. Furthermore, specialized mental health services related to substance use must be operated, and relevant policies should be improved to prevent substance misuse from developing into secondary mental health issues.

Third, interventions for adults with depression should place a dual focus on both the various childhood traumas they experienced and their substance misuse. Mental health policies and programs aimed at addressing substance misuse should not be based on gender differences but instead provide mental health services tailored to generational and life-cycle characteristics. In this study, no significant gender differences were found in the relationships among accumulated childhood trauma, adult depression and substance misuse. This finding differs from previous studies [77], which reported that substance misuse and disorders were more frequent in males and depression more prominent in females. Instead, in contrast, this study identified that gender was not a predictive factor in the impact of substance misuse on adult depression. These results emphasize that when exploring and intervening in substance misuse problems among adults with depression, it is crucial to adopt customized support approaches based on life stages and socio-environmental factors rather than just differentiating by gender.

The study results also showed that the absence of a spouse, having a low subjective economic status, and having a chronic illness were closely related to the accumulated childhood trauma experiences, adult depression and substance misuse, and served as important variables. Thus, adults with chronic illnesses who have a history of childhood trauma are at an increased risk of substance misuse and adult depression, highlighting the need for customized medication management and substance misuse prevention programs based on their illnesses. Additionally, individuals having no presence of a spouse (*i.e.*, single, divorced, separated or widowed) with childhood trauma experiences are particularly vulnerable to substance misuse and adult depression, suggesting the importance of expanding community-based opportunities to supplement family support. Lastly, individuals with low subjective economic status who have experienced childhood trauma face a higher risk of substance misuse and adult depression, indicating a need for policy efforts to integrate financial support services with mental health services.

This study focused on exploratorily analyzing the impact of childhood trauma experiences on adult depression and examining the mediating role of substance misuse and the moderating effect of gender in this process. Childhood trauma is known to be a major factor influencing an individual's mental health, and understanding the various pathways related to adult depression is highly important. In particular, through moderated mediation analysis, this study investigated how the pathway from childhood trauma experiences to adult depression differs according to gender. This approach contributes to a deeper understanding of the relationship between childhood trauma and adult depression by exploring the role of gender, which has been relatively overlooked in previous research. Additionally, as an exploratory study, this study provides foundational data for future research by conducting an initial investigation of

these pathways and offers meaningful insights into clarifying the impact of childhood trauma on adult mental health. These findings can contribute to the development of prevention and intervention strategies in the mental health field and serve as important foundational data for understanding the influence of childhood trauma experiences on adult depression.

Finally, the limitations of this study are as follows:

In addition to the experience of substance misuse, it was impossible to rule out the influence of other psychosocial factors on adult depression. Moreover, due to the nature of using secondary data, this study could not measure overlapping experiences or the severity of harm when examining the impact of accumulated childhood trauma experiences on adult depression, but instead used only the cumulative trauma experience as a variable. Additionally, substance misuse experiences were assessed using single binary items, which limited the ability to explore in detail the frequency and severity of misuse, types of substances used, attitudes toward use and the timing of use. Furthermore, the proportion of participants with substance misuse experiences was small and skewed, posing limitations in verifying the influence of substance misuse. Therefore, future research should more deeply investigate the impact of substance misuse on adult depression by not only identifying the presence of substance misuse experiences, but also measuring the severity and degree of harm through variables such as timing of use, types of substances, and attitudes toward substance use.

Lastly, because this study employed a cross-sectional design, it could not clearly establish causal relationships among accumulated childhood trauma experiences, adult depression and substance misuse experiences, which constitutes another limitation.

5. Conclusions

The findings of this study provide meaningful insights by conducting an exploratory investigation into the complex relationships among childhood trauma experiences, substance misuse, and adult depression, and by identifying additional, more nuanced pathways to depression. Moreover, this study holds significance in the field of mental health social work practice by not only addressing treatment, protection, and recovery efforts related to substance use, but also by raising issues concerning the prevention and management of over-the-counter substance misuse from a social welfare perspective and offering policy and practice-based foundations. According to this study, the accumulated childhood trauma experiences could develop into substance misuse problems, which in turn contribute to an increase in adult depression, and that substance misuse partially mediates this relationship.

These results emphasize the importance of early intervention regarding trauma experiences and substance misuse in the preventive approach to adult depression and suggest that intervention strategies should consider generational and life-cycle characteristics rather than relying on gender-based approaches.

AVAILABILITY OF DATA AND MATERIALS

The data presented in this study are available publicly online and upon request at: https://www.kihasa.re.kr/dataportal/main.html.

AUTHOR CONTRIBUTIONS

KHJ and YK—designed the research study; wrote first draft; reviewed the manuscript. KHJ—performed the research and analyzed the data. YK—authored the discussion and the conclusion section of the manuscript. SL and YH—contributed to drafting and revising the introduction. All authors contributed to editorial changes in the manuscript, and all authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

All methods were performed in accordance with the Declaration of Helsinki. Since the study used secondary data, it was exempted from approval by the institutional review boards (IRB) of the Clinical Research Ethics Committee of Jeonbuk National University (IRB number: JBNU 2024-12-015). Every participant gave a written consent prior to their participation in the original survey.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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