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Article

Association of Substance Use and Mental Health among U.S. High School Students from 2023 YRBS

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Abstract: This study investigated the association between substance use and mental health among U. S. high school students. The 12679 adolescents (50.68% female) sample data was pooled from the 2023 Youth Risk Behavior Survey (YRBS). The multivariate logistic regression models were used for explaining its potential relationship. The dependent variables were the mental health issues, and the independent variables were the use of substance, including cigarette, electronic vapor product, alcohol, marijuana and prescription pain medication. The results suggested that the female or male students who reported the use of different substances had increased risks of having mental health issues compared to the counterparts who had never used substances. The research findings will be useful for professionals and governments when they are considering an intervention strategy to reduce the mental health issues among teenagers.

Keywords: Substance use; Mental health; High school students; Youth Risk Behavior Survey (YRBS); Logistic regression

1. Introduction

In the present day, adolescents are frequently exposed to various challenges, pressures, and temptations, making them particularly vulnerable to a range of risk factors. Among these, the interplay between mental health and substance use among high school students in the United States (U.S.) has emerged as a significant public health concern [1]. Adolescence is a developmental stage characterized by identity exploration, increasing independence, and expanding social relationships, which heightens susceptibility to behaviors that may have long-term consequences for both physical and mental health [2]. Substance use-including cigarettes, electronic vapor products, alcohol, marijuana, and prescription drugs-has become increasingly prevalent among high school students in recent years [3]. According to the 2023 Youth Risk Behavior Survey (YRBS), concerning trends have been identified: 20% of high school students reported using electronic vapor products, 12% reported misusing prescription opioids, and 18% reported marijuana use within a 30-day period [4]. These behaviors coincide with a growing mental health crisis, as 41% of students reported persistent feelings of sadness or hopelessness, and 10% reported attempting suicide in the past year [4].

The relationship between substance use and mental health issues is complex and bidirectional, influencing emotional, cognitive, and behavioral dimensions of adolescent well-being. Existing research has provided important insights into these interconnected issues. Studies based on YRBS data have examined associations between insufficient sleep and health-risk behaviors among adolescents [5], as well as the relationship between sedentary behavior and mental health outcomes [6]. Further analyses using recent YRBS datasets have demonstrated that the use of electronic vapor products is associated with insufficient sleep, which is in turn linked to poorer mental health outcomes [7]. Longitudinal analyses using data from multiple YRBS cycles have also explored the

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relationship between behavioral factors such as sports participation and suicidal ideation, applying advanced statistical models to identify significant associations [8]. Additional research has investigated the relationship between vaping behaviors and mental health indicators while controlling for demographic variables such as sex and race [9].

Despite these advancements, relatively few studies have examined the combined effects of multiple substances on different dimensions of adolescent mental health, including emotional distress and suicidal ideation. This represents a critical gap in the literature, as patterns of substance use vary across individuals, with some adolescents engaging in single-substance use while others participate in polysubstance use. Such differences may significantly influence the level of risk associated with mental health outcomes. A comprehensive understanding of these relationships is essential for developing more targeted and effective public health interventions aimed at improving adolescent well-being [10].

The primary objective of this study is to examine the association between substance use and mental health outcomes among U.S. high school students. By analyzing how specific substances relate to mental health indicators, this research seeks to generate evidence that can inform adaptive intervention strategies. This study extends existing literature by simultaneously examining the associations between the use of cigarettes, electronic vapor products, alcohol, marijuana, and prescription pain medication misuse, and five key mental health outcomes. Using data from the 2023 YRBS, multivariate logistic regression models were applied to quantify these relationships while controlling for sex. The findings support the hypothesis that substance use is significantly associated with adverse mental health outcomes, with different substances exhibiting varying levels of risk across emotional, cognitive, and behavioral domains.

2. Methods

2.1 Study Design

We analyzed data from the Youth Risk Behavior Survey, a national survey conducted every 2 years among representative samples of U. S. high school students by the Centers for Disease Control and Prevention (CDC), and collected information on cigarette, electronic vapor, drug, alcohol, pain medicine usage and mental health issues and the determinants of those usages among adolescents [11]. The YRBS recruited 9th to 12th graders both from public and private schools, and utilized a three-stage cluster sample design to complete self-administered surveys. A nationally representative sample of schools and a random sample of classes within those schools were selected to participate in the 2023 YRBS. There are 20,103 students that have answered the questionnaires of 2023 YRBS, and weighting factors were applied to each student record to adjust for over sampling and nonresponse of every race and gender [11]. Students who participated in this survey were anonymous and voluntary. The use of a stratified sampling approach ensures that data from various geographic regions, including urban and rural areas, is adequately represented, allowing for a more comprehensive analysis of adolescent behaviors across different socio-economic and demographic groups. This methodological rigor enhances the generalizability of the study findings to the broader U.S. high school student population. Figure 1 illustrates the steps involved in the study design of the Youth Risk Behavior Survey (YRBS). It begins with the selection of a nationally representative sample of U.S. high school students, utilizing a three-stage cluster sampling method. This process includes the recruitment of students from both public and private schools across various geographic regions, ensuring a diverse student population. The flow then proceeds to the data collection phase, where students voluntarily completed self-administered surveys covering substance use, mental health issues, and the factors contributing to these behaviors. Finally, the flow highlights the use of weighting factors to adjust for oversampling and nonresponse, ensuring that the results accurately reflect the broader U.S. high school student population.

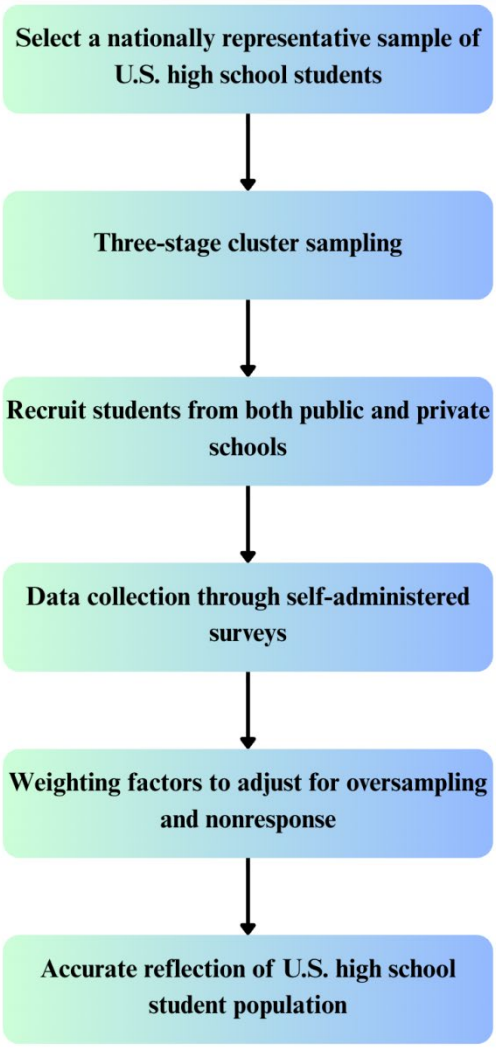

Figure 1. Flowchart of the Study Design for the 2023 Youth Risk Behavior Survey (YRBS)

2.2 Sample

In the 2023 YRBS, data of U. S. high school students were used to provide adequate sample size for investigating the substance use-mental health association. As shown in the previous subsection, the initial data size of 2023 national YRBS was 20,103. The analytic sample for this study consisted of adolescents aged from 13 to 18 years. However, the missing data were erased, and the final sample size was 12679, where the proportions of male and female were 49.32% and 50.68%, respectively.

2.3 Variables

In studies of adolescent behaviors, by using CDC's Youth Risk Behavior Survey (YRBS), the dependent variables are the behavior outcomes, which are the outcomes and consequences of substance exposure, and the independent variables, represented exposure to psychoactive substances, serve as predicated variables in the model. The answers of those questions(variables) in the data are transferred to corresponding values range from 0 to 1 for processing the model.

2.3.1 Student Characteristics

The U.S high school students were asked, "What is you sex?" There were two options presented for responses, which were "Male" or "Female", and they were corresponded to "0" or "1" in our model, respectively.

2.3.2 Mental health problems

Over the past 12 months, U.S. high school students suffered from different mental health problems, including persistent sadness, hopelessness, depression, suicidal ideation and others [11,12]. To assess these issues comprehensively, the survey included a series of questions designed to evaluate various aspects of mental health, such as emotional well-being, stress levels, and suicidal thoughts. This broad scope allows for a nuanced understanding of how substance use intersects with mental health challenges across different student populations.

Persistent sadness and hopelessness were assessed with the following question, "During the past 12 months, did you ever feel so sad or hopeless almost every day for two weeks or more in a row that you stopped doing some usual activities?" Responses options were as follows: "Yes" and "No". Responses were dichotomized (Yes=1, No=0). Additionally, poor mental health was assessed by "During the past 30 days, how often was your mental health not good? (Poor mental health includes stress, anxiety, and depression)." Response options were: "Never", "Rarely", "Sometimes", "Most of the time", "Always". Responses were dichotomized as follows, "Never", "Rarely" and "Sometimes" are coded as 0, while "Most of the time" and "Always" are coded as 1.

Students responded to the following questions related to depression and suicide during the past 12 months using a dichotomous (yes or no) response scale: did you ever seriously consider attempting suicide?; did you make a plan about how you would attempt suicide?; how many times did you actually attempt suicide? Multiple responses were available with these options, including 0 times, 1 time, 2 or 3 times, 4 or 5 times, 6 or more times. Response options were also dichotomized, so students who endorse attempting suicide 1 or more times were considered to have attempted suicide in the past 12 months.

2.3.3 Substance Use

Current substance uses behaviors within the last 30 days, were assessed with the following questions: on how many days did you smoke cigarettes?; on how many days did you use an electronic vapor product?; on how many days did you have at least one drink of alcohol? The responses were characterized into two secessions. Responses for students who smoke cigarettes, electronic vapor products, or/and drink alcohols were as follows: "0 days", "1 or 2 days", "3 to 5 days", "6 to 9 days", "10 to 19 days", "20 to 29 days", and "All 30 days". During the past 30 days, how many times did you use marijuana?; During your life, how many times have you taken prescription pain medicine without a doctor's prescription or differently than how a doctor told you to use it? The responses to the use of marijuana and prescription medicine were ranged from "0 times" to "40 or more times". Students who reported using the above substances within the last 30 days were identified as current users of the assessed substance, while the use of prescription pain medicine in the student life was considered as ever use of the corresponding substance. The responses to current or ever use of the mentioned substances were also dichotomized.

3. Results

3.1 Characteristics for 2023 YRBS samples

For sample data from 2023 YRBS, we used descriptive statistics to illustrate the characteristics for U.S. high school students' mental health issues and substances use behaviors. This descriptive analysis provides a comprehensive understanding of the prevalence of mental health problems and substance use patterns among adolescents, helping to establish baseline data for further statistical analysis [13].

Table 1 reveals not just the total number and percentage of U. S. high school students getting mental health problems, but also differences among the two genders (Females and Males). We could discover that the percentage of U. S. high school students getting poor mental health and feeling sad was pretty high, and among them almost half felt sad or hopeless. Next, we noticed that a lot of female students felt sad or hopeless, and the percentage was over half. Furthermore, the data suggests a significant gender disparity, with females being more likely to experience mental health challenges, including sadness

and suicidal ideation. More surprisingly, almost 30% of them had considered the idea of suicide. On the other hand, the number and percentage of male students for mental health issues were lower, and it seemed like they would less likely to consider and attempt suicide than females. In comparison, females reported a higher rate of feeling sad or hopeless (54.55% vs. 28.40%), considering suicide (28.4% vs. 14.52%), making suicide plan (22.69% vs. 12.01%), attempting suicide (13.24% vs. 6.12%), and suffering from poor mental health (41.04% vs. 19.51%) compared to males (all 95% CIs non-overlapping).

Table 1 Mental health characteristics for 2023 YRBS samples

	Total		**Female**		**Male**	
Variables	N(%)	95%CI	N(%)	95%CI	N(%)	95%CI
Sex	6253(49.32)	(48.45,50.19)	6253	--	6426	--
Sad or hopeless	5236(41.30)	(40.44,42.16)	3411(54.55)	(53.31,55.78)	1825(28.40)	(27.31,29.52)
Poor mental health	3820(30.13)	(29.34,30.93)	2566(41.04)	(39.82,42.26)	1254(19.51)	(18.56,20.50)
Considered suicide	2713(21.40)	(20.69,22.12)	1775(28.39)	(27.28,29.52)	938(14.52)	(13.75,15.48)
Made a suicide plan	2191(17.28)	(16.63,17.95)	1419(22.69)	(21.67,23.75)	772(12.01)	(11.24,12.83)
Attempted suicide	1211(9.63)	(9.13,10.16)	828(13.24)	(12.42,14.10)	393(6.12)	(5.56,6.73)

Tables 2 shows the number and percentage of U.S. high school students using substances. The total part suggested that almost 80% of them did not take substances, and the percentage of them currently using cigarettes was surprisingly low. The substance that was used the most time for female students was alcohol, while it's the same for males. Meanwhile, the substances use patterns showed female high school students had higher rates of electronic vapor use (21.35% vs. 15.47%), alcohol use (23.16% vs. 19.19%), marijuana use (18.93% vs. 14.97%) and prescription pain misuse (13.66% vs. 9.23%), while males reported slightly higher cigarette use (4.22% vs. 3.71%).

Table 2 Substance use characteristics for 2023 YRBS samples

	Total		**Female**		**Male**	
Variables	N(%)	95%CI	N(%)	95%CI	N(%)	95%CI
Current cigarette use	503(3.97)	(3.64,4.32)	232(3.71)	(3.27,4.21)	271(4.22)	(3.75,4.74)
Current electronic vapor use	2329(18.37)	(17.70,19.05)	1335(21.35)	(20.35,22.38)	994(15.47)	(14.60,16.37)
Current alcohol use	2681(21.15)	(20.44,21.86)	1448(23.16)	(22.13,24.22)	1233(19.19)	(18.24,20.17)

Current marijuana use	2146(16.93)	(16.28,17.59)	1184(18.93)	(17.98,1992)	962(14.97)	(14.12,15.86)
Ever prescription pain medicine use	1447(11.41)	(10.87,11.98)	854(13.66)	(12.83,14.53)	593(9.23)	(8.54,9.96)

3.2 Association between substances use and mental health issues

We considered multivariate logistic regression for investigating the potential relationship between substances use and mental health issues among U. S. high school students from 2023 YRBS samples. The tested samples in our model were consisted of three categories, namely the total students, female students and male students. The model results including odds rate (OR), 95% confidence interval (95%CI) and p-value were presented to confirm the hypothesis that substance use significantly predicts adverse mental health outcomes.

Interestingly, all the tables demonstrated that all the substances used had an OR greater than 1, meaning that they were linked to a higher risk of mental health issues (such as the five symptoms: sadness, poor mental health, suicidal ideation, planning, and attempts). This suggests that substance use is a significant risk factor for the development of mental health problems in adolescents, with the magnitude of the risk varying by substance type. Among all the substances used, "Prescription Pain Medication Use" consistently showed the strongest association with all the mental health outcomes. For the total samples in Table 3 and Table 4, it had increased odds of persistent sadness (OR=2.67), poor mental health (OR=1.92), suicide consideration (OR=2.87), making suicide plans (OR=3.07), and suicide attempts (OR=3.36). These findings suggest that prescription pain medication misuse may have a particularly detrimental effect on adolescent mental health, emphasizing the need for focused interventions in this area.

Table 3 Logistic regression results for attempted suicide and substance use

	Total			**Female**			**Male**		
Variable	OR	95%CI	p-value	OR	95%CI	p-value	OR	95%CI	p-value
Sex	2.17	(1.90,2.48)	<0.001	--	--	--	--	--	--
Current cigarette use	1.57	(1.24,1.99)	<0.001	1.47	(1.08,20.01)	0.016	1.78	(1.24,2.55)	0..002
Current electronic vapor use	1.92	(1.61,2.29)	<0.001	2.07	(1.67,2.57)	<0.001	1.63	(1.18,2.24)	0.003
Current alcohol use	1.40	(1.20,1.64)	<0.001	1.39	(1.44,1.68)	<0.001	1.45	(1.11,1.91)	0.007

Current marijuana use	1.89	(1.59,2.25)	<0.001	1.91	(1.54,2.36)	<0.001	1.88	(1.38,2.55)	<0.001
Ever prescription pain medicine use	3.36	(2.90,3.89)	<0.001	3.47	(2.90,4.15)	<0.001	3.18	(2.46,4.11)	<0.001

Table 4 Logistic regression results for feeling sad or hopeless and substance use

	Total			**Female**			**Male**		
Variable	OR	95%CI	p-value	OR	95%CI	P-value	OR	95%CI	p-value
Sex	2.99	(2.77,3.23)	<0.001	--	--	--	--	--	--
Current cigarette use	1.25	(0.99,1.57)	<0.001	1.37	(0.90,2.09)	<0.001	1.30	(0.98,1.74)	<0.001
Current electronic vapor use	1.87	(1.65,2.13)	<0.001	2.33	(1.95,2.78)	<0.001	1.46	(1.20,1.76)	<0.001
Current alcohol use	1.43	(1.29,1.60)	<0.001	1.43	(1.23,1.66)	<0.001	1.46	(1.25,1.70)	<0.001
Current marijuana use	1.82	(1.61,2.07)	<0.001	1.87	(1.56,2.24)	<0.001	1.84	(1.53,2.20)	<0.001
Ever prescription pain medicine use	2.67	(2.36,3.04)	<0.001	3.02	(2.52,3.62)	<0.001	2.38	(1.99,2.86)	<0.001

Table 4 shows that all independent variables are significantly correlated with "feeling sad or hopeless". Female students had an increased odds of feeling sad or hopeless compared to male students (OR=2.99). Students who reported current cigarette use (OR=1.25), electronic vapor use (OR=1.87), alcohol use (OR=1.43), marijuana use (OR=1.82) and ever prescription pain medicine use (2.67) had higher odds of feeling sad or hopeless when compared to their counterparts who did not have these behaviors. The association between feeling sad or hopeless and different substances use was further investigated among female and male groups, respectively. Interestingly, the impact of most substance use behaviors on female students was slightly higher than on male students, especially the use of electronic vapor (2.33 vs. 1.46) and prescription pain medicine (3.02 vs. 2.38). This difference may reflect both biological and socio-cultural factors that contribute to how females are affected by substance use, emphasizing the need for gender-sensitive interventions.

Table 5 suggests the impact of substances use on poor mental health among U. S. high school students, the OR values for all independent variables are larger than 1. For female or male students, the use of cigarette was not significantly associated with poor mental health, where the corresponding p-value were 0.282 and 0.048, respectively. Female students had higher odds of having poor mental health issue if they reported cigarette use (OR=1.18), electronic vapor use (OR=1.55), alcohol use (OR=1.18), marijuana use (OR=1.50) and prescription pain medicine use (OR=1.93), compared to female students who never use substances. Similar results were found from the logistical regression model for male students.

Table 5 Logistic regression results for poor mental health and substance use

	Total			**Female**			**Male**		
Variable	OR	95%CI	p-value	OR	95%CI	p-value	OR	95%CI	p-value
Sex	2.78	(2.56,3.01)	<0.001	--	--	--	--	--	--
Current cigarette use	1.25	(1.01,1.54)	0.037	1.18	(0.87,1.60)	0.282	1.34	(1.99,1.80)	0.048
Current electronic vapor use	1.47	(1.29,1.67)	<0.001	1.55	(1.31,1.82)	<0.001	1.35	(1.09,1.67)	0.005
Current alcohol use	1.19	(1.07,1.33)	<0.001	1.18	(1.03,1.36)	0.02	1.21	(1.02,1.44)	0.030
Current marijuana use	1.48	(1.30,1.68)	<0.001	1.50	(1.27,1.76)	<0.001	1.47	(1.20,1.80)	<0.001
Ever prescription pain medicine use	1.92	(1.70,2.16)	<0.001	1.93	(1.66,2.24)	<0.001	1.90	(1.57,2.30)	<0.001

The logistic regression findings for the relation between considered suicide and substance use were showed in Table 6. The rate of considering suicide among U. S. high school students was significantly and positively associated with the use of cigarette, electronic vapor, alcohol, marijuana and prescription pain medicine. For male students, the use of cigarette showed no significant association with the mental issue of considering suicide (p=0.104>0.05).

Table 6 Logistic regression results for considered suicide and substance use

	Total			**Female**			**Male**		
Variable	OR	95%CI	p-value	OR	95%CI	p-value	OR	95%CI	p-value
Sex	2.21	(2.01,2.42)	<0.001	--	--	--	--	--	--

Current cigarette use	1.43	(1.16,1.77)	<0.001	1.73	(1.26,2.36)	<0.001	1.29	(0.95,1.75)	0.104
Current electronic vapor use	1.83	(1.60,2.10)	0.001	2.03	(1.71,2.40)	<0.001	1.52	(1.21,1.91)	<0.001
Current alcohol use	1.36	(1.21,1.53)	<0.001	1.34	(1.15,1.56)	<0.001	1.41	(1.16,1.70)	<0.001
Current marijuana use	1.62	(1.41,1.85)	<0.001	1.63	(1.38,1.94)	<0.001	1.61	(1.29,2.01)	<0.001
Ever prescription pain medicine use	2.87	(2.54,3.25)	<0.001	3.02	(2.58,3.53)	<0.001	2.71	(2.22,3.30)	<0.001

Similar results can be found from suicide planning and attempted suicide issues, see Table 6 and Table 3. The findings revealed that all the use substances, expect drinking alcohol, had linked to higher suicidal consideration risk to female high school students than male students. For female students, the use of electronic vapor had 2.07 times higher odds of suicide planning compared to their counterparts who have never used electronic vapor products. By Table 6, prescription pain medicine misuse demonstrated the strongest association with suicide attempts, resulting in a threefold increase in the odds of this outcome compared to non-users. Similar results were presented in Table 3.

Table 6 Logistic regression results for made a suicide plan and substance use

	Total			**Female**			**Male**		
Variable	OR	95%CI	p-value	OR	95%CI	p-value	OR	95%CI	p-value
Sex	2.01	(1.82,2.22)	<0.001	--	--	--	--	--	--
Current cigarette use	1.26	(1.02,1.57)	0.035	1.41	(1.04,1.91)	0.027	1.19	(0.86,1.65)	0.282
Current electronic vapor use	1.73	(1.50,2.00)	<0.001	2.01	(1.68,2.40)	<0.001	1.31	(1.03,1.68)	0.03
Current alcohol use	1.31	(1.16,1.49)	<0.001	1.29	(1.10,1.51)	0.002	1.37	(1.11,1.68)	0.003
Current marijuana use	1.71	(1.48,1.97)	<0.001	1.63	(1.36,1.96)	<0.001	1.87	(1.48,2.36)	<0.001

Ever prescription pain medicine use	3.07	(2.71,3.48)	<0.001	3.14	(2.68,3.68)	<0.001	3.00	(2.44,3.69)	<0.001

4. Discussions

This study focused on the association between substance use behaviors and mental health issues among U.S. high school students, utilizing data from the 2023 Youth Risk Behavior Survey (YRBS). The multivariate logistic regression revealed several critical findings that underscore the urgent need for targeted public health interventions.

In this large national representative survey of U.S. high school students, female students reported the highest prevalence of mental health symptoms, including making suicide plans, considering suicide, attempting suicide, feeling sad or hopeless, and experiencing poor mental health [13]. These findings suggest that adolescent females are particularly vulnerable to mental health issues, with a significantly higher rate of psychological distress compared to their male counterparts. The reasons behind this elevated vulnerability could be multifaceted, involving hormonal changes, social pressures, and societal expectations placed on young females. These factors may exacerbate the mental health risks already associated with substance use.

The analytical results suggested that the misuse of prescription pain medicine was the riskiest factor contributing to mental health issues in both gender groups. The odds ratios (OR) for suicide attempt (3.36), suicide planning (3.07), and suicidal consideration (2.87) were strikingly high, indicating that prescription pain medication misuse is a major predictor of severe mental health outcomes. These high OR values underscore the dangerous cycle that can develop when adolescents self-medicate their underlying depressive symptoms, leading to an escalating pattern of substance use and deteriorating mental health. This vicious cycle may contribute to an increased likelihood of severe psychological distress, including suicidal ideation and attempts.

Furthermore, the study highlighted notable gender differences in substance use and mental health risks. Female students exhibited higher mental health risks across all outcomes, which may be influenced by a combination of biological factors and heightened social pressures [14]. For instance, social expectations regarding appearance, academic success, and peer relationships may disproportionately affect adolescent girls, potentially heightening their vulnerability to mental health issues. Specifically, female high school students demonstrated a strong association between electronic vapor product use and suicidal events, with an average OR greater than 2, and an OR of 2.33 for feeling sad or hopeless. In comparison, the ORs for male students on these two mental health issues were significantly lower. This gender disparity could reflect not only differences in substance use patterns but also variations in how substance use affects males and females physiologically and psychologically.

On the other hand, male students showed significant associations between alcohol, marijuana, and prescription pain medicine use and suicide planning [15]. This suggests that substance-induced impulsivity, which may be more prominent in males, could play a major role in shaping mental health outcomes. Males may be more prone to engage in risk-taking behaviors such as substance use, which can directly influence their mental health, particularly their propensity for impulsive decision-making related to suicide planning.

Given the findings outlined above, interventions aimed at improving high school students' mental health should adopt a comprehensive, multi-faceted approach that integrates efforts across various levels of society. High schools can provide a more holistic approach by incorporating courses that combine mental health education and substance use prevention. These programs should emphasize teaching students scientific and

healthy methods for coping with stress, emotions, and societal pressures, reducing the temptation to turn to substances as a form of relief. Additionally, schools can offer more resources such as counseling services and peer support groups, which may help students process emotions in a safe environment.

Support networks involving family and community members are also crucial. After-school activities, mentorship programs, and social clubs can provide students with a constructive outlet for their time and energy, thus preventing them from engaging in risky behaviors. Public health initiatives should work to widely promote mental health resources, aiming to destigmatize seeking help and encouraging adolescents to talk openly about their struggles. Furthermore, medical institutions should strengthen coordinated interventions by incorporating regular mental health screenings alongside substance use assessments in routine check-ups for adolescents. This approach would ensure early detection and intervention, reducing the long-term impact of mental health and substance abuse issues.

Finally, government departments should increase funding for mental health services, specifically in schools, and provide financial support for the recruitment of mental health professionals to address the rising demand. Additionally, more stringent regulations on the sale of electronic vapor products and enhanced enforcement of prescription drug monitoring programs could help mitigate some of the most harmful substance use behaviors in adolescents.

In conclusion, this study underscores the importance of addressing the intersection of substance use and mental health in a comprehensive and gender-sensitive manner. The findings point to the need for tailored interventions that address the unique challenges faced by both male and female adolescents. By strengthening school-based mental health programs, fostering support networks, and enforcing stricter substance use regulations, society can better protect the mental and emotional well-being of future generations.

5. Conclusions

This study found that the substances use was significantly associated with mental health issues among U.S. high school students from 2023 YRBS. The multivariate logistic regression models for three sample categories showed that the students who reported the use of substance had higher odds of having mental health problems compared to the counterparts who never used these substances. Finding resulted from this study provided a new insight to the connection between the substance use and mental health. This will be helpful for providing efficient interventions for professional and government departments.

Although our study revealed some important findings, some limitations should be further considered. First, even though the data size was still substantial, it suggested a great reduction of number size from the original data version due to missing data. Future research could benefit from utilizing multiple imputation techniques or adding in datasets on previous/other years, which not only increase the sample size, and we can further compare the potential difference revealing from each year. Second, the present research only focused on substance use behaviors. However, there may be other risk factors that could influence the mental health issues. Factors including being bullied in school, insufficient sleep, sexual harassment, and family support are not included in this model, yet they may further alternate the results and the relationships. Future work should incorporate these variables to develop more comprehensive models for mental health issues among high school students.

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