

Assessing Risk and Protective Factors of Pain Reliever Misuse in US Adolescents: Results from a National Survey

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Abstract:

Background: The U.S. Department of Health and Human Services highlighted pain relievers as the most abused substance after marijuana. Pain reliever misuse (PRM) promotes other substance use (SU) disorders, organ dysfunction, overdose, death, family conflicts, and harmful risk-taking behaviors. Investigating adolescent PRM is critical to combatting overdose-related deaths, however, current evidence remains insufficient.

Materials and Methods: We employed the Health Belief Model and Social Learning Theory framework to investigate PRM-related proximal risk (substance use risk perceptions, deviance, alcohol use, and depression) and protective (religiosity, mental health service utilization, emotional support, and negative substance use attitudes) factors in a sample of adolescents (NSDUH 2019, n = 13,397, 51% males). Data on PRM, risk, and protective factors were collected using validated scales. Data analysis examined variable distribution, multicollinearity across key predictors, impact of PRM risk, and protective factors using adjusted binary logistic regression.

Results: Our results showed that greater levels of substance use risk perceptions (p = 0.013), religiosity (p = 0.044), and negative substance use attitudes (p = 0.0065) were associated with lower likelihood of engaging in PRM. Deviant behaviors (p < .0001), alcohol use (p < .0001), experiencing ≥1 major depressive episode (MDE) (p = 0.038), female (p = 0.0017), and family income below \$20,000 (p = 0.036) significantly associated with PRM.

Conclusion: Our findings demonstrate that adolescents with greater risk perception and negative attitudes towards SU are less prone to PRM. Conversely, adolescents who engaged in deviant behaviors, alcohol, and experienced ≥1 MDE were more inclined to PRM. Targeting at-risk adolescents, risk perceptions, and attitudes in PRM prevention interventions may mitigate SU and future PRM.

Key Words: pain reliever misuse; adolescents; risk factors; protective factors; national survey

Introduction

Public records from the U.S. Department of Health and Human Services have marked pain relievers as the most abused substance after marijuana [1]. While the use of pain relievers under the supervision of a physician is safe and medically useful, their misuse has been repeatedly associated with adverse outcomes such as opioid use disorder, organ dysfunction, overdose, and mortality [2-4]. The high accessibility and legitimacy of pain relievers as over-the-counter medication contributes to its higher potential for abuse and, subsequently, to an array of deleterious health effects [5]. More specifically, pain relievers such as those sold under the names of Darvocet, Percocet, Vicodin, and Codeine act as depressants to the central nervous

system, which could cause respiratory depression and death if consumed improperly [3].

Apart from the harmful physiological consequences, pain reliever misuse (PRM) may also result in unfavorable social impairments. One study has linked PRM with conflicts in the family environment, other substance use disorders, engagement in criminal activity, and harmful risk-taking behaviors, amongst other adverse sequelae [3]. Examining PRM among adolescents is a particularly pressing public health issue, as the number of adolescent overdose-related deaths has doubled over the past decade [6]. Indeed, 2.3 percent of U.S. adolescents reported PRM in 2019. Adolescence

is a developmental period characterized by identity formation, changes in peer and family dynamics, and role confusion [7]. All these factors may heighten the engagement in risk behaviors, including the potential risk of prescribed drug misuse, especially pain relievers, which may be more accessible to adolescents than illicit drugs [7]. Initiation into PRM at this age is of particular concern, given that early drug use places an individual at greater risk and severity of use later in life [8].

Prior research has suggested that proximal individual-level factors, such as the social or intrapersonal elements of one's behaviors and attitudes, could play a risk or protective role in prescribed drug misuse [9, 10]. The Health Belief Model (HBM) and Social Learning Theory (SLT) are prominent frameworks that explain the interplay between social and individual factors and health outcomes. HBM suggests that an individual's health behavior is influenced by their perceptions of the severity of a health problem, their susceptibility to it, the benefits of taking a specific action to reduce the risk, and the barriers to taking that action [11]. HBM is used to explore how adolescents' perceptions of the severity of PRM and their susceptibility to its negative consequences influence their likelihood of engaging in PRM. SLT emphasizes the role of observational learning and social reinforcement in shaping behavior. Individuals learn by observing the behaviors of others and the consequences of those behaviors [12]. Several studies have concluded that HBM and SLT frameworks are appropriate for analyzing the risk and protective factors associated with PRM among adolescents. Their results indicate a correlation between individual traits and the likelihood of drug misuse, either increasing or decreasing the risk [13-17]. For example, the results of a study support the relevance of social learning theory in understanding nonmedical prescription drug use [15]. Key findings indicate that adolescents with favorable attitudes towards substance use, those whose peers use drugs, and those whose parents and peers have lenient attitudes towards substance use are more likely to engage in nonmedical prescription drug use [18]. Combining the HBM and SLT elements generates a comprehensive theoretical framework that considers both individual perceptions and social influences in understanding adolescent PRM. This integrated approach will provide a more nuanced perspective on the factors influencing PRM and help guide targeted prevention interventions for at-risk adolescents. The present study employs the HBM and SLT theoretical frameworks to examine the proximal individual-level risk and protective factors associated with PRM in a national sample of adolescents in the U.S. The focus on individual-level factors is based on the importance of understanding the influence of the most proximal factors associated with PRM when attempting to place them in the context of more distal factors at the interpersonal, community, and societal levels.

Research has found strong evidence for individual-level risk factors associated with substance misuse in U.S. adolescents [19]. Demographic and socioeconomic factors (i.e., age, gender, ethnicity, sexual orientation, household income, and composition) have been found to serve as risk factors for substance misuse [19, 20]. For instance, Edlund et al. [19] reported that adolescent females were more likely to use opioids than adolescent males, a finding that contradicts previous findings indicating a higher PRM prevalence among males [21]. Past research has also revealed racial or ethnic differences in adolescent substance use, with studies indicating the highest lifetime and past-month substance use rates reported among Hispanic adolescents, with the lowest rates of use reported by Asians, compared to non-Hispanic Whites [22]. In relation to prescription opioid misuse, data from the 2020 National Survey of Drug Use and Health (NSDUH) has reported that Blacks and Hispanics had a modest increase in the prevalence of opioid misuse (3.7%) compared to the national average (3.4%), while Asians had the lowest prevalence (2.3%) [1].

Overall, the literature is inconclusive on which race/ethnicity has the highest PRM prevalence, as other studies have also observed White adolescents to be the leading users [23, 24]. Population density has also been identified as an influential factor, as a higher likelihood of prescribed opioid misuse has been reported for adolescents who live in rural or small urban areas [25]. Lower socioeconomic status has also been linked to an increased probability of adolescent substance use [26-28]. The composition of the household has also been investigated for substance use, and results have shown higher levels of problematic substance use in single-parent families compared to mother-father families [29]. Lastly, the educational status of adolescents may also play a role in the likelihood of prescription drug misuse, as research has documented the highest rates of substance use in those who are not in school or are poorly adjusted to school [30].

Various individual-level factors, including attitudes and perceptions related to substance use, have been linked to substance use behaviors. For instance, greater perception of substance-use-related risk of harm has been associated with lower levels of substance-use behaviors [31]. Conversely, lower perceived substance-use-related risk has been associated as a significant risk factor for substance use in adolescents [32, 33]. Additionally, the presence or absence of negative attitudes toward SU has been found to predict actual substance use behaviors among adolescents, with increased negative attitudes toward substance use predicting a lower prevalence of substance use behaviors among adolescents [34].

There is a vast body of literature linking adverse mental health outcomes to increased substance use [35]. Specifically, major depression (MD) has been identified as one of the leading causes of disability, with prevalence rates steadily increasing throughout the past decade and reaching 15.8% of U.S. adolescents in 2019 [36]. The prevalence of depression amongst U.S. children and adolescents has risen to up to 4% between 2016 and 2020 [37]. Studies in this area have established a strong association between the presence of a lifetime major depressive episode (MDE) and adolescent opioid abuse and dependence [38, 39]. Hence, at least one MDE in an adolescent's life could substantially elevate the likelihood of PRM in this population.

Adolescent behavioral patterns have also been linked to substance abuse. Deviant behavior, classified as actions that violate social norms, has been strongly associated with SU behaviors among adolescents [40]. National studies have indicated declines in deviant behaviors among adolescents. Examining data collected between 2002 and 2014, Moss and colleagues found a 2.0% decrease in selling drugs, a 2.6% decrease in stealing, and a 4.8% decrease in attacking someone [41]. Nevertheless, while deviant behaviors among adolescents have decreased, the positive association between substance use and deviant behaviors has remained stable [41]. Indeed, epidemiological studies have found that severe adolescent delinquency has at least some causal influence on drug use initiation, which extends into mid-life usage [42].

Similarly, the increased frequency of delinquent behavior at grade 10 has been positively associated with problematic substance use at grade 12 [43]. Additionally, disruptive behavior disorders have been identified as predictors of smoking initiation among adolescents [44]. Given the link found in previous studies between deviant behaviors and substance use, it stands to reason that these behaviors may also be a risk factor for PRM in this population.

The concomitant use of multiple substances has been linked with worse substance use outcomes among adolescents [45]. Empirical research has found that adolescents who use other substances (i.e., tobacco and marijuana) are more likely to engage in prescription opioid misuse [10]. Such co-use is

relatively common in adolescence and contributes to substance use-related morbidity and mortality [46]. Therefore, adolescents who use other substances are likely at a greater risk for engaging in PRM.

Research has also found various individual-level factors that mitigate risk and promote healthy development among adolescents. Prior studies have found that these protective factors decrease the likelihood of adolescent substance misuse, including pain relievers [28, 47-49]. According to epidemiological studies, the presence of religious and spiritual beliefs can have health-promoting effects, including decreasing the risk of substance use among adolescents [49, 50]. It has been argued that religiosity may indirectly diminish adolescent risk behaviors by impacting one’s values or acting as an external control factor. According to Marsiglia et al. [52], greater religious involvement may directly protect against drug misuse by adhering to religious norms prohibiting certain substances.

Higher socioeconomic status (SES) has also been found to act as a protective factor against adolescent drug use [26-28]. Notably, the link between SES and substance use should be interpreted with caution, as contradictory findings in this association have been found in previous studies. For example, a study obtained self-reported data on SES and substance use among 113 adolescents, from which they concluded that adolescents with higher SES were more likely to use substances compared to those with low SES [67]. Researchers posited these findings may be due to the higher availability of financial resources that enable greater access to drugs among more affluent adolescents. Given the inconclusive findings between SES and substance use among adolescents, the present study will examine associations between SES and PRM among adolescents in the U.S. without an a priori hypothesis regarding its association.

Mental health services utilization has been found to be protective [51]. Regardless of the peaking public awareness of adolescents’ diminished mental health, a significant proportion of adolescents still do not receive the care they need [51]. Mojtabai et al. [53] reported that approximately one-fifth of U.S. adolescents surveyed from 2005 to 2018 received some form of mental health treatment. Given that increased mental health service utilization (MHSU) has been observed to contribute to a decrease in the prevalence of mental disorders among adolescents [54], it has been identified as a protective factor. Directly related to MHSU is the provision of emotional support from one’s network of family and friends. Previous reports have established a relationship between higher availability of emotional support and lower adolescent substance use [55]. Thus, the adolescent’s availability

of emotional support is hypothesized to serve as a protective factor against PRM.

Objective

The objective of the current study was to explore the individual-level risk and protective factors associated with PRM among adolescents in the U.S.

Materials and Methods

Data Source

Data for this study utilized public-use files of the 2019 NSDUH. This cross-sectional survey provides annual data on the level and patterns of drug, alcohol, and illegal substance use and abuse, and mental health issues in a national sample of adolescents and adults [1]. The NSDUH obtained a sample of non-institutionalized, community-dwelling civilians aged 12 and older in the United States and used a multistage area probability design with demographic stratification [1, 5]. An audio computer-assisted self-interviewing method was used to collect the data. Respondents could read or listen to the questions and answer them on an NSDUH laptop. A more personal approach was followed for questions on illicit drug use and other sensitive behaviors. The audio computer-assisted self-interviewing feature enabled the respondents to read or listen to a question (on headphones) and enter the response into the computer themselves [1]. The present secondary analysis of the 2019 NSDUH was reviewed and approved by a prominent South Florida public University’s Institutional Review Board Protocol Exemption #: IRB-21-0518.

Measures

Dependent variables: The dependent outcome was any self-reported lifetime pain reliever misuse. The NSDUH adopted the item from the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) [56]. Pain reliever misuse was defined as the use of unprescribed prescription pain relievers for recreational purposes. Participants answered the following question: “Have you ever, even once, taken (names of prescription pain reliever) that was not prescribed for you or that you took only for the experience or feeling it caused?” Any use was recoded into a binary variable identifying a history of pain reliever misuse (0 = “Did not misuse” 1 = “Misused”).

Independent variables: The NSDUH provided measurements that encompassed variables related to the risk and protective factors from multiple scales, including the National Comorbidity Survey Replication Adolescent Supplement (NCS-A) [1, 57], The National Longitudinal Study of Adolescent Health (ADD Health) [1, 58], and DSM-IV [1, 56]. We identified nine risk and protective factors to test our hypothesis [3, 10, 20, 28, 32, 39, 42]. Table 1 provides a summary of all measured items.

Item	Scale range
Risk perception towards substance use ($\alpha = .76$)	1 = No risk
How much do people risk harming themselves physically and in other ways when they smoke one or more packs of cigarettes per day?	2 = Slight risk
How much do people risk harming themselves physically and in other ways when they smoke marijuana once a month?	3 = Moderate risk
How much do people risk harming themselves physically and in other ways when they smoke marijuana once or twice a week?	4 = Great risk
How much do people risk harming themselves physically and in other ways when they have five or more drinks of an alcoholic beverage once or twice a week?	
How much do people risk harming themselves physically and in other ways when they have five or more drinks of an alcoholic beverage once or twice a week?	
Deviance ($\alpha = .66$)	1 = 0 times
During the past 12 months, how many times have you argued or had a fight with at least one of your parents?	2 = 1 or 2 times
During the past 12 months, how many times have you gotten into a serious fight at school or work?	3 = 3 to 5 times
During the past 12 months, how many times have you taken part in a fight where a group of your friends fought against another group?	4 = 6 to 9 times
During the past 12 months, how many times have you carried a handgun?	5 = 10 or more times

During the past 12 months, how many times have you stolen or tried to steal anything worth more than \$50?	
During the past 12 months, how many times have you attacked someone with the intent to seriously hurt them?	
Substance use attitudes ($\alpha = .77$)	1 = Neither approve nor disapprove
How do you feel about someone your age smoking one or more packs of cigarettes a day?	2 = Somewhat disapprove
How do you feel about someone your age trying marijuana?	3 = Strongly disapprove
How do you feel about someone your age having one or two drinks of an alcoholic beverage nearly every day?	
Mental health service utilisation	0 = No
Received emotional treatment from therapist in the past year	1 = Yes
Received emotional treatment in Mental Health Clinic in the past year	
Attended School or program for emotional problems in the past year	
Talked with school social worker for emotional problem in past year	
Depression	0 = No
Lifetime major depressive episode	1 = Yes
Emotional support	0 = No support
Who adolescent talks with about serious problems	1 = Supported
Religiosity ($\alpha = .84$)	1 = Strongly Disagree
Religious beliefs very important in adolescent life	2 = Disagree
Religious beliefs influence life decisions	3 = Agree
Important for friends to share religious beliefs	4 = Strongly Agree
Alcohol use	0 = Never Used
Alcohol – Ever used	1 = Ever Used
Gender	0 = Males
Gender	1 = Females
Ethnicity	
Hispanic vs. White	0 = Hispanics
	1 = non-Hispanic White
Hispanic vs. Black	0 = Hispanics
	1 = non-Hispanic Black
Hispanic vs. others	0 = Hispanics
	1 = non-Hispanic others
Family income	
Low vs. mid	0 = low (less than \$20,000)
	1 = mid (\$20,000 - \$49,000)
Low vs. mid to high	0 = low (less than \$20,000)
	1 = mid to high (\$50,000 - \$74,999)
Low vs. high	0 = low (less than \$20,000)
	1 = (more than \$75,000)
Poverty	
Poverty: High vs. mid	0 = income more than 2x poverty threshold
	1 = income up to 2x poverty threshold
Poverty: High vs. low	0 = income more than 2x poverty threshold
	1 = living in poverty
Household composition	0 = single-parent household
	1 = two-parent household
Population density	0 = CBSA > 1 million people
	1 = CBSA < 1 million people

Table 1: Scales of Measured Items

Data Analysis

All data analyses were conducted using SPSS Version 28 [59]. A descriptive analysis was conducted to examine the study variables' distribution. Multicollinearity was assessed across all key predictors and based on a cutoff above four for the variance inflation factors (VIFs) and below 0.25 for tolerance. No multicollinearity was evident across key predictor variables. A binary logistic regression was conducted to examine the effect of individual-level risk and protective factors on PRM among adolescents in the US while controlling for the influence of demographic and socio-economic covariates. Unadjusted binary logistic regression models, including predictors of interest and covariates, were conducted to show the associations of each unique variable on PRM in the unadjusted models. The unadjusted model p-value was set to 0.05 to be selected for the adjusted model. We estimated adjusted odds ratios and 95% confidence intervals for

the associations between risk and protective factors of interest on PRM while adjusting for significant covariates found in the unadjusted model. Survey methods and weighting were used for complex statistical analyses to account for the study design in NSDUH (i.e., stratification and primary sampling unit) [5]. To be considered statistically significant in the adjusted model, the p-value was set at $p < 0.05$.

Results

Table 2 summarizes the sample demographics and the descriptive statistics of the key study variables. The study sample consisted of $n = 13,397$ adolescents aged 12-17 years using the NSDUH definition of adolescents, with a relatively equal distribution of males (51%) and females (49%). More than half of the respondents were non-Hispanic whites (51%) and were living in a core-based statistical area (CBSA) with less than one million people

(53%). Approximately 55% of participants reported a family income of more than \$75,000, while most adolescents reported living in a two-parent household (69%).

Concerning individual protective factors, most of the respondents indicated having emotional support (91%), never having a major depressive episode (76%), or ever using alcohol (73%). In addition, more than half of the adolescents reported a family income more than twice the poverty threshold

(58%). Moreover, negative attitudes towards substance use ($M = 2.62, SE = .006$) were reported, and most participants did not endorse pain relievers misuse (96%). Regarding risk factors, participants reported low levels of risk perceptions towards substance use ($M = 3.10, SE = .01$) and relatively low rates of deviant behavior ($M = 1.53 SE = .004$). Lastly, adolescents in this national sample reported moderate levels of religiosity ($M = 2.49, SE = .011$).

	<i>N</i>	<i>%</i>	<i>SE</i>
Gender			
Males	6856	50.92	0.52
Females	6541	49.08	0.52
Ethnicity			
Non-Hispanic white	6863	51.51	0.78
Non-Hispanic black	1781	13.49	0.61
Non-Hispanic other	1567	10.12	0.41
Hispanic	3186	24.88	0.64
Family income			
Less than \$20,000	1997	13.96	0.41
\$20,000 - \$49,000	3687	26.33	0.72
\$50,000 - \$74,999	2022	14.47	0.44
\$75,000 or more	5691	45.24	0.93
Household composition			
Single household	4388	30.72	0.67
Two-parent household	9009	69.28	0.67
Population density			
In a CBSA with < 1 million people	5571	52.90	0.66
In a CBSA with > 1 million people	6607	41.14	0.78
Not in a CBSA	1219	5.97	0.36
Depression			
Had a major depressive episode	2869	21.22	0.44
Did not have a major depressive episode	10146	75.92	0.44
Missing	382	2.86	0.19
Alcohol			
Have never used	9653	72.92	0.56
Have ever used	3744	27.08	0.56
Poverty			
Living in poverty	2766	20.62	0.60
Income up to 2x poverty threshold	2975	21.18	0.55
Income more than 2x poverty threshold	7656	58.20	0.85
Emotional support			
No	776	5.52	0.26
Yes	12189	91.24	0.31
Missing	432	3.24	0.18
Pain reliever misuse			
Misused	483	3.77	0.22
Did not misuse	12914	96.23	0.22
	<i>Mean</i>		<i>SE</i>
Risk substance use perceptions	3.10		0.010
Deviance	1.53		0.004
Religiosity	2.49		0.011
Substance use attitudes	2.62		0.006

Table 2: Descriptive Analysis of Demographic, Socio-Economic Sample Characteristics, and Risk and Protective Factors of Pain Reliever Misuse ($N = 13,397$)

A binary logistic regression accounting for the study strata and weighting was conducted to examine the effect of individual-level risk and protective factors on PRM among adolescents in the US ($n = 13,397$) while controlling for the influence of demographic and socio-economic covariates. The results of the unadjusted and adjusted models are reported in Table 3. In the final adjusted model ($n = 12,374$), greater substance use risk perceptions ($AOR=0.56, CI: [0.35,0.88], p < .05$), higher levels of religiosity

($AOR=0.85, CI: [0.73,0.99], p < .05$), and more negative attitudes towards substance use ($AOR=0.72, CI: [0.58,0.91], p < .01$) were associated with lower a likelihood of engaging in PRM. Adolescents who engaged in deviant behaviors were four times more likely to report PRM ($AOR=4.44, CI: [3.24,6.09], p < .001$). Adolescents reporting alcohol use were twice as likely to endorse PRM ($AOR=2.38, CI: [1.78,3.19], p < .001$). Adolescents that had experienced at least one major depressive episode were also 1.34 times more

likely to report PRM (AOR=1.34, CI: [1.02,1.77], $p < .05$). Compared to males, females were more likely to report PRM (AOR=1.50, CI: [1.18,1.92], $p < .01$). Adolescents with an annual family income less than \$20,000 were

two times more likely to report PRM (AOR=2.28, CI: [1.06,4.93], $p < .05$) compared to those with an annual family income more than \$75,000.

	Unadjusted Model		Adjusted Model	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Substance use risk perception	0.51 (0.43, 0.60)	<.0001	0.56 (0.35, 0.88)	0.013
Deviance	6.51 (4.69, 9.02)	<.0001	4.44 (3.24, 6.09)	<.0001
Depression	2.53 (1.85, 3.46)	<.0001	1.34 (1.02, 1.77)	0.038
Alcohol	4.61 (3.44, 6.19)	<.0001	2.38 (1.78, 3.19)	<.0001
Mental health service utilization	1.42 (1.22, 1.65)	<.0001	1.02 (0.87, 1.21)	0.76
Poverty: High vs. mid ^d	0.75 (0.56, 1.01)	0.059	1.38 (0.92, 2.06)	0.11
Poverty: High vs. low ^b	0.63 (0.44, 0.90)	0.012	1.23 (0.66, 2.27)	0.51
Emotional support	0.46 (0.32, 0.68)	0.0002	0.81 (0.56, 1.18)	0.26
Religiosity	0.64 (0.55, 0.75)	<.0001	0.85 (0.73, 0.99)	0.044
Negative substance use attitudes	0.43 (0.36, 0.52)	<.0001	0.72 (0.58, 0.91)	0.0065
Gender ^c	1.58 (1.23, 2.03)	0.0006	1.50 (1.18, 1.92)	0.0017
Income: Low vs. mid ^d	1.01 (0.76, 1.35)	0.93	0.96 (0.54, 1.73)	0.89
Income: Low vs. mid to high ^e	1.54 (1.02, 2.33)	0.041	1.84 (0.89, 3.80)	0.096
Income: Low vs. high ^f	1.77 (1.19, 2.62)	0.0053	2.28 (1.06, 4.93)	0.036
Ethnicity: Hispanics vs. Whites ^g	1.22 (0.86, 1.72)	0.26	1.06 (0.75, 1.52)	0.72
Ethnicity: Hispanics vs. Blacks ^h	1.01 (0.66, 1.54)	0.96	0.90 (0.53, 1.51)	0.68
Ethnicity: Hispanics vs. others ⁱ	1.75 (1.03, 2.98)	0.038	1.36 (0.83, 2.20)	0.21
Population density ^j	1.19 (0.88, 1.61)	0.24	NA	NA
Household composition ^k	0.70 (0.55, 0.90)	0.0068	1.16 (0.83, 1.62)	0.37

^a 0 = income more than 2x poverty threshold, 1 = income up to 2x poverty threshold. ^b 0 = income more than 2x poverty threshold, 1 = living in poverty. ^c 0 = men, 1 = women. ^d 0 = low (less than \$20,000), 1 = mid (\$20,000 - \$49,000). ^e 0 = low (less than \$20,000), 1 = mid to high (\$50,000 - \$74,999). ^f 0 = low (less than \$20,000), 1 = (more than \$75,000). ^g 0 = Hispanics, 1 = non-Hispanic whites. ^h 0 = Hispanics, 1 = non-Hispanic blacks. ⁱ 0 = Hispanics, 1 = non-Hispanics other. ^j 0 = CBSA > 1 million people, 1 = CBSA < 1 million people. ^k 0 = single-parent household, 1 = two-parent household. ** $p < .001$, * $p < .05$

Table 3: Results of Logistic Regression with Pain Reliever Misuse (PRM) as the Outcome Variable and PRM Risk and Protective Factors.

Discussion

The primary aim of the present study was to assess the relationship between individual-level risk and protective factors and the likelihood of PRM in adolescents in the U.S. Specifically, the present study utilized the HBM and SLT as a conceptual framework to explore the relationship between a series of individual-level factors (i.e., risk perceptions towards substance use, deviance, depression, alcohol consumption, mental health service utilization, poverty, emotional support, religiosity, and negative attitudes towards substance use) and PRM in adolescents. Our findings revealed various individual-level risk and protective factors associated with PRM among adolescents in the U.S.

Our findings revealed that adolescents with greater substance use risk perceptions were less likely to engage in PRM. These findings are in line with previous work that has suggested lower substance use risk perceptions act as a risk factor for substance use among adolescents [32, 33]. The current findings also indicated that greater negative attitudes toward substance use were associated with a decreased likelihood of PRM among adolescents. This finding is supported by previous research indicating that greater negative attitudes towards SU were associated with a lower prevalence of substance use in adolescents [60]. Based on the present findings, it could be concluded that adolescents who strongly disapproved of their peers' smoking (cigarettes and marijuana) and drinking were less likely to misuse pain relievers. Therefore, our findings suggest that both higher risk perception and stronger negative attitudes towards SU may act as protective factors against adolescent PRM. As such, intervention efforts should focus on developing prevention programs that shape and monitor adolescents' attitudes and behaviors toward PRM. Risk perception and negative attitudes towards substances could also be used as indicators to identify adolescents with an implicit predisposition toward PRM. Such early adolescents as follow-up interventions could encompass targeted educational components focused on building protective attitudes against PRM among adolescents.

Mental health problems in adolescents have also been recognized as critical risk factors for substance abuse in this population, as mental health and SU problems may frequently be dually diagnosed [61]. Major depressive episodes (MDE), which are prevalent in adolescents with a history of substance use, have been consistently associated with opioid abuse and dependence [39, 62]. In line with these findings, the current study found that lifetime MDE was associated with an increased likelihood of adolescent PRM. As a single MDE appears to be predictive of PRM, screening and early identification of depressive symptoms could aid timely interventions (i.e., school counselor consultations or professional therapeutic services) depending on the severity and causes of depression. Subsequently, this would diminish the likelihood of PRM and potentially unfavorable health or social outcomes. In accordance, future research should investigate other commonly observed psychological/psychiatric conditions in adolescents and their association with PRM. As mental health disorders frequently occur in clusters, the identification of different predictors (e.g., anxiety disorders, stress-related disorders) would better inform the development of screening tools to minimize, if not prevent, PRM in this population.

Moreover, considering that low MHSU has been observed to contribute to increases in mental disorders' prevalence among adolescents [37], the study examined whether professional mental health treatment by a therapist, a specialized clinic, or a school counselor was associated with PRM. Surprisingly, no relationship was found between MHSU and PRM in adolescents. One potential reason for the unexpected finding could be the underutilization of mental health services by those in need. Adolescents with a high risk for pain reliever misuse may not be accessing mental health services due to stigma, lack of resources, or lack of awareness of available services [63]. Additionally, the type and quality of mental health services being offered may not be appropriate or effective for addressing pain reliever misuse [64].

Additionally, based on previous reports, we hypothesized that greater availability of emotional support would be associated with a lower likelihood of PRM [65]. However, no relationship between the two constructs was found in the present study.

In line with previous studies, our findings also revealed that adolescents involved in deviant behaviors were more likely to engage in PRM [41, 42]. Our results suggest that deviant behaviors, including fighting, carrying a handgun, stealing, and attacking others, are critical risk factors for PRM. Along with the other risk factors, the expression of deviant behavior could also be implemented in potential risk-assessment screening tools for use at risk for PRM.

Additionally, our findings indicated that adolescents reporting ever using alcohol were more likely to report PRM. A few existing studies have noted that the co-occurrence of alcohol and opioid use is quite common and contributes to substance-use-related morbidity and mortality [46]. The present study suggests that this is also the case with PRM use among adolescents. Empirical research has established an association between prescribed opioid misuse and the co-use of other substances, such as tobacco and marijuana, among adolescents [10]. Our findings highlight how substance co-use, particularly drinking, could be detrimental to future PRM in adolescents. More specifically, the use of alcohol at least once was related to an increased likelihood of engaging in PRM. Using this single finding to inform interventions and develop screenings would be challenging. As such, further research should aim at exploring the association between drinking patterns (i.e., binge drinking) and PRM, as a measure of single alcohol use does not provide sufficient information regarding individual drinking habits.

Previous literature suggests that stronger religious beliefs may serve as a protective factor against substance use [27, 28]; the results of this study also observed such a relationship within the adolescent sample. This implies that promoting religious beliefs may be a potential strategy for reducing substance use among adolescents.

Furthermore, we examined the relationship between socioeconomic status and PRM [26-28]. Specifically, socioeconomic status was assessed in terms of the U.S. Federal Poverty Threshold by delineating between high (> 2 times the poverty threshold) versus middle status (up to 2 times the poverty threshold) and high (> 2 times the poverty threshold) versus low status (living in poverty). Further longitudinal research is needed to examine this positive correlation between low-income adolescents and PRM.

In summary, PRM could also lead to unfavorable social outcomes, such as family conflicts, substance use disorders, engagement in illegal activities, and risk-taking behaviors, in addition to heightened health-related risks [3]. Considering the multitude of impairments that PRM could impose on an adolescent's life, the importance of studies that directly examine the risk and protective factors associated with PRM occurrence is essential.

The present cross-sectional study aimed to identify the individual-level protective and risk factors of PRM using publicly available data from the 2019 NSDUH. To the best of our knowledge, no previous studies have focused exclusively on the relationship between individual-level risk and protective factors and PRM among adolescents. Additionally, the present methods approach allowed for a large national sample highly representative of the U.S. adolescent population. It should be noted that the present study observed a slightly larger proportion of adolescents who engaged in PRM (3.8%) compared to previous reports of U.S. adolescent PRM in 2019 (2.3%).

However, the findings from the study should be interpreted in light of its methodological biases. The respondents could have exhibited a response bias as data was obtained using a self-report method. Substance misuse, except for being a susceptible topic, is also considered illegal and could result in

stigmatization from others, thus lending itself to social desirability [66]. The study also utilized a cross-sectional research design; thus, the causal or directional order of the associations found cannot be implied. Further investigation in this area should strive to implement longitudinal designs to identify predictors of PRM among adolescents and potential changes over time. Additionally, this study was a secondary data analysis, and as such, the instruments and variables were limited to what was available in the existing data set. For most constructs, one-item proxy measures could have led to over-simplification of complex and multi-dimensional constructs (e.g., depression, emotional support, religiosity).

Conclusions

The findings suggested the risk for PRM, and other substance use among adolescents are similar. Adolescents who perceive substance use to be of greater risk and hold more negative attitudes toward substance use are less likely to misuse pain relievers. Conversely, adolescents who engaged more in deviant behaviors, used alcohol, and had experienced at least one major depressive episode in their lifetime were more likely to have engaged in PRM.

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