

The Effect of Bullying on Attempted Suicide Among U.S. Adolescents

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Objective

Suicide and associated suicidal behaviors are deeply concerning events that can result in the tragic loss of life and other adverse outcomes. Adolescents have been shown to be particularly vulnerable to stressors that can lead to an increased risk of suicide and related behaviors, such as suicidal ideation and attempted suicide. Bullying has been identified as one of these critical stressors that can contribute to an increased risk of suicidal thoughts and actions. This study utilizes statistical methods to investigate the relationship between bullying experiences and the incidence of attempted suicide among U.S. adolescents. The control variables that are accounted for include sex, binge drinking frequency, hard drug usage, and exposure to sexual violence.

Introduction

In 2021, 48,183 people died by suicide in the United States, which equates to 1 suicide death every 11 minutes. In addition to the tragic loss of life, 12.3 million adults seriously thought about suicide, 3.5 million adults made a suicide plan, and 1.7 million adults attempted suicide (CDC, 2023a). Suicide and related behaviors do not only affect the average-aged adult, however. Teens and young adults are also very much at risk of engaging in suicidal thoughts and behaviors. In fact, suicide is the second leading cause of death among those aged 10-14 and the third leading cause of death for those aged 15-24. According to SAMHSA, rates of suicidal ideation and attempted suicide are the highest among young adults aged 18-25 (Piscopo et al., 2016).

Incidents involving suicide or attempted suicide may also result in profound emotional, physical, and economic repercussions for survivors and family members. The survivors of attempted suicide may struggle with serious injuries or long-term health complications and have an elevated risk of attempting suicide again in the future. Family members of those who have

committed or attempted suicide are at greater risk of engaging in the same behaviors (CDC, 2023a).

Several contributing factors have been identified that can increase the risk of suicidality. These risk factors include a history of mental illness, serious physical illness, criminal or legal issues, job or financial problems, substance use, adverse childhood experiences, loss of relationships, and high-conflict or violent relationships (CDC, 2022). Additionally, previous research has found sex-based differences, indicating that females are more likely than males to attempt suicide (Bommersbach et al., 2022). Past studies have also identified bullying, both offline and online, as a major contributing factor for increased risk of suicidal behavior (Gunn & Goldstein, 2017). Bullying is a risk factor that is especially relevant for teenage populations. Not only are teenage high school students in an environment where exposure to bullying may be more prevalent, but they are also particularly vulnerable to significant social stressors during these formative years. Those who are subjected to bullying are likely to experience feelings of social isolation and depression (Kaltiala-Heino & Frojd, 2011). Subsequently, they may engage in maladaptive behaviors such as binge drinking, substance use, or self-harm to cope with their distressing situation. These experiences and unhealthy coping mechanisms are all risk factors for suicidal behavior as well (Gaete et al., 2017; Myklestad & Straiton, 2021). Therefore, exposure to bullying may introduce a domino effect that leads the victimized individual to accumulate an even greater number of risk factors that are associated with the consequences of bullying.

Since the effect of bullying on suicidal behavior may be associated with a wide array of other risk factors, further research is necessary to comprehensively evaluate and more precisely

quantify the effect of bullying by controlling for potential confounders and accounting for possible interaction effects. This study will use data from the Youth Risk Behavioral Surveillance System's (YRBSS) 2021 national Youth Risk Behavior Survey (YRBS) to examine the relationship between bullying and attempted suicide among U.S. adolescents. We hope to obtain a more current and comprehensive understanding of such an association, while controlling for potentially confounding influences. Ultimately, analyzing this relationship may yield insightful, empirically supported conclusions that can encourage relevant stakeholders to develop and implement effective anti-bullying policies and strategies. The adoption of such measures can help to prevent and address instances of bullying in high schools and thereby reduce suicidal behaviors among the adolescent population.

Methods

Data

This study focuses on the relationship between bullying and attempted suicide among the adolescent population in the United States. Specifically, the population of interest is comprised of high school students from 9th to 12th grade who live in the 50 U.S. states and the District of Columbia. A sample of this population is drawn from the YRBSS's national 2021 Youth Risk Behavior Survey.

The YRBSS's Youth Risk Behavior Survey (YRBS) is conducted by the Centers for Disease Control and Prevention (CDC) every two years. The national survey collects demographic, health, behavioral, substance use, and student experience data that is representative of 9th to 12th grade students in public and private schools in the United States (CDC, 2023b). The YRBS uses

a three-stage cluster sample design to facilitate the attainment of a more representative sample of students. Additionally, a weighting mechanism is applied to adjust for nonresponses and the oversampling of specific ethnic groups. Data from the YRBS are used by educators, public health institutions, doctors, legislators, and community organizations to inform relevant programs, campaigns, and other efforts (CDC, 2023c). For example, a recent study used the 2019 YRBS data to examine the association between age at first alcohol use and weapon-carrying among adolescents (Baiden et al., 2021).

This study will make use of the 2021 YRBS data. Of the 17,232 survey participants, 7,784 (45%) satisfied the sample requirements for this study: was a high school student (9th to 12th grade), lived in one of the 50 states or the District of Columbia, and had complete data for all variables.

Model

The research objective of this study is to investigate the association between bullying and the incidence of attempted suicide. The model can be summarized by the following:

$$\text{SUICIDE_ATTEMPT} = f(\text{BULLIED}, \text{SEX}, \text{BD_FREQ}, \text{HARD_DRUG}, \text{SEXUAL_VIOLENCE})$$

SUICIDE_ATTEMPT represents whether a survey participant reported they had made a suicide attempt in the past 12 months (1 = yes; 0 = no); BULLIED represents whether the participant indicated they had been bullied on school property or electronically (online and via text) in the past 12 months (1 = yes; 0 = no); SEX is the reported biological sex of the survey participant (1 = female; 0 = male); BD_FREQ is coded as 1, 2, or 3 depending on whether the survey

participant reported binge drinking (consuming 4 or more drinks if female or 5 or more drinks if male, within a 2 hour period) on 0 to 2 days out of the past 30 days (BD_FREQ = 1, “Low”), 3 to 5 days out of the past 30 days (BD_FREQ = 2, “Moderate”), or 6 or more days out of the past 30 days (BD_FREQ = 3, “High”); HARD_DRUG indicates whether the survey participant has ever used highly addictive, illicit substances (cocaine, heroin, and methamphetamine were the only substances considered for this variable; 1 = yes; 0 = no); SEXUAL_VIOLENCE indicates whether the survey participant reported ever being forced to have intercourse or forced to engage in sexual acts in the past 12 months, including with a dating partner (1 = yes; 0 = no).

Statistical Analysis

The statistical analysis performed in this study consists of both tests of association and logistic regression. Pearson X^2 tests of association will be performed between the control variables and the exposure variable and are presented in Table 1 along with univariate statistics. Similar tests will be performed between the control and exposure variables and the outcome variable, presented in Table 2 along with univariate statistics. Logistic regression is used to estimate adjusted odds ratios and their 95% confidence intervals for the outcome variable (SUICIDE_ATTEMPT) with respect to the exposure (BULLIED) and control variables (SEX, BD_FREQ, HARD_DRUG, and SEXUAL_VIOLENCE), presented in Table 3.

With respect to the regression analysis, tests for confounding between the exposure and control variables are performed, goodness of fit statistics are reported, and interactions between the exposure and control variables are investigated. All statistical analysis is performed using SAS.

Results

Of the 17,232 YRBS participants, 7,784 (45%) had complete data for the objective. The demographic characteristics of this population are compared in Table 1 with respect to the exposure variable, whether the participant experienced being bullied (BULLIED).

Table 1. Characteristics of 7,784 YRBS 2021 participants by presence of bullying experiences.

Variable	Population		Bullied - No		Bullied - Yes		p value *
	N	%	n	%	n	%	
	7,784	100.0%	6,028	77.4%	1,756	22.6%	
Sex							
Male	3,998	51.4%	3,276	54.3%	722	41.1%	<0.0001
Female	3,786	48.6%	2,752	45.7%	1,034	58.9%	
Binge Drinking							
Low	7,427	95.4%	5,801	96.2%	1,626	92.6%	<0.0001
Moderate	193	2.5%	126	2.1%	67	3.8%	
High	164	2.1%	101	1.7%	63	3.6%	
Hard Drug Use							
No	7,576	97.3%	5,907	98.0%	1,669	95.0%	<0.0001
Yes	208	2.7%	121	2.0%	87	5.0%	
Sexual Violence							
No	6,649	85.4%	5,461	90.6%	1,188	67.7%	<0.0001
Yes	1,135	14.6%	567	9.4%	568	32.3%	

* p values based on Pearson chi-square test of association

Of the entire population, 48.6% were female, 2.1% had a high binge drinking frequency, 2.5% had a moderate binge drinking frequency, 2.7% had used hard drugs, and 14.6% had experienced sexual violence. There were proportionately more females than expected who reported being bullied (58.9% vs. 48.6%; $p < 0.0001$). With respect to binge drinking frequency, there were proportionately more moderate-frequency binge drinkers than expected who reported being bullied (3.8% vs. 2.5%; $p < 0.0001$), and proportionately more high-frequency binge drinkers than expected who reported being bullied (3.6% vs. 2.1%; $p < 0.0001$). There were proportionately

more hard drug users than expected who reported being bullied (5.0% vs. 2.7%; $p<0.0001$). With respect to sexual violence, there were proportionately more victims of sexual violence than expected who reported being bullied (32.3% vs. 14.6%; $p<0.0001$).

The demographic characteristics of this population are compared in Table 2 with respect to the outcome variable, attempted suicide (SUICIDE_ATTEMPT).

Table 2. Characteristics of 7,784 YRBS 2021 participants by incidence of attempted suicide.

Variable	Population		Attempted Suicide - No		Attempted Suicide - Yes		p value *
	N	%	n	%	n	%	
	7,784	100.0%	7,005	90.0%	779	10.0%	
Bullied							
No	6,028	77.4%	5,651	80.7%	377	48.4%	
Yes	1,756	22.6%	1,354	19.3%	402	51.6%	<0.0001
Sex							
Male	3,998	51.4%	3,759	53.7%	239	30.7%	
Female	3,786	48.6%	3,246	46.3%	540	69.3%	<0.0001
Binge Drinking							
Low	7,427	95.4%	6,762	96.5%	665	85.4%	
Moderate	193	2.5%	143	2.0%	50	6.4%	
High	164	2.1%	100	1.4%	64	8.2%	<0.0001
Hard Drug Use							
No	7,576	97.3%	6,901	98.5%	675	86.6%	
Yes	208	2.7%	104	1.5%	104	13.4%	<0.0001
Sexual Violence							
No	6,649	85.4%	6,269	89.5%	380	48.8%	
Yes	1,135	14.6%	736	10.5%	399	51.2%	<0.0001

* p values based on Pearson chi-square test of association

Overall, 10.0% of the entire population had reported attempting suicide. There were proportionately more females than expected who reported attempting suicide (69.3% vs. 48.6%; $p<0.0001$). With respect to binge drinking frequency, there were proportionately more moderate-

frequency binge drinkers than expected who reported attempting suicide (6.4% vs. 2.5%; $p<0.001$, and proportionately more high-frequency binge drinkers than expected who reported attempting suicide (8.2% vs. 2.1%; $p<0.0001$). There were proportionately more hard drug users than expected who reported attempting suicide (13.4% vs. 2.7%; $p<0.0001$). There were proportionately more victims of sexual violence than expected who reported attempting suicide (51.2% vs. 14.6%; $p<0.0001$). With respect to the exposure variable, BULLIED, there were proportionately more victims of bullying than expected who reported attempting suicide (51.6% vs. 22.6%; $p<0.0001$).

Table 3. Logistic regression analysis comparing the adjusted odds ratio of attempted suicide in 7,784 YRBS 2021 participants.

Variable	Attempted Suicide - No		Attempted Suicide - Yes		OR*	95% CI
	n	%	n	%		
	7,005	90.0%	779	10.0%	-----	-----
Bullied						
No	5,651	80.7%	377	48.4%	-----	-----
Yes	1,354	19.3%	402	51.6%	2.737	2.309 - 3.245
Sex						
Male	3,759	53.7%	239	30.7%	-----	-----
Female	3,246	46.3%	540	69.3%	1.706	1.424 - 2.045
Binge Drinking						
Low	6,762	96.5%	665	85.4%	-----	-----
Moderate	143	2.0%	50	6.4%	1.720	1.162 - 2.545
High	100	1.4%	64	8.2%	2.616	1.723 - 3.970
Hard Drug Use						
No	6,901	98.5%	675	86.6%	-----	-----
Yes	104	1.5%	104	13.4%	5.112	3.606 - 7.245
Sexual Violence						
No	6,269	89.5%	380	48.8%	-----	-----
Yes	736	10.5%	399	51.2%	4.872	4.068 - 5.834

* 95% confidence intervals are for reported odds ratios.

Adjusted odds ratios for attempted suicide with respect to the exposure variable and control variables obtained from logistic regression are presented in Table 3.

Females were at higher odds of attempted suicide when compared to males after controlling for binge drinking frequency, hard drug usage, history of sexual violence, and exposure to bullying (OR = 1.706; 95% CI = 1.424 – 2.045). High-frequency binge drinkers had higher odds of attempted suicide as compared to low-frequency binge drinkers after controlling for sex, hard drug usage, history of sexual violence, and exposure to bullying (OR = 2.616; 95% CI = 1.723 – 3.970). Moderate-frequency binge drinkers had higher odds of attempted suicide as compared to low-frequency binge drinkers after controlling for sex, hard drug usage, history of sexual violence, and exposure to bullying (OR = 1.720; 95% CI = 1.162 – 2.545). Those who reported hard drug usage had higher odds (411% higher) of attempted suicide as compared to those who reported no hard drug usage after controlling for sex, binge drinking frequency, history of sexual violence, and exposure to bullying (OR = 5.112; 95% CI = 3.606 – 7.245). Those who reported experiencing sexual violence had higher odds (387% higher) of attempted suicide as compared to those who reported not experiencing sexual violence after controlling for sex, binge drinking frequency, hard drug usage, and exposure to bullying (OR = 4.872; 95% CI = 4.068 – 5.834). With respect to the exposure variable, whether the participant had experienced bullying, bullied individuals had higher odds (2.7 times or 174% higher) of attempted suicide as compared to non-bullied individuals after controlling for sex, binge drinking frequency, hard drug usage, and history of sexual violence (OR = 2.737; 95% CI = 2.309 – 3.245).

The AUC statistic for the logistic regression was 0.805 and the rescaled R-squared was 0.250, indicating that the model can narrowly be considered to have excellent discrimination according to Hosmer and Lemeshow's general rule. A goodness-of-fit deviance test yielded a p-value of <0.001, indicating that the current model does not fit the data well, compared to a model with interactions. Thus, statistically significant two-way exposure variable interactions were added, yielding the following model:¹

$$\begin{aligned} \text{SUICIDE_ATTEMPT} = & \alpha + \beta_1\text{BULLIED} + \beta_2\text{SEX} + \beta_3\text{BD_FREQ} + \beta_4\text{HARD_DRUG} + \\ & \beta_5\text{SEXUAL_VIOLENCE} + \beta_6\text{BULLIED*SEX} + \beta_7\text{BULLIED*SEXUAL_VIOLENCE} + \\ & \beta_8\text{HARD_DRUG*SEXUAL_VIOLENCE} \end{aligned}$$

Estimation of this model involved a backward elimination procedure whereby interactions with a p-value greater than 0.10 were removed one-by-one, until only interactions with p-values less than 0.10 remained. The deviance statistic's p-value for this interacted model is statistically significant (0.0159) at the 0.05 alpha level. The AUC and rescaled R-squared have changed slightly to 0.804 and 0.254, respectively. The deviance test results suggest that a more complex model with additional interactions may fit the data better than the current interacted model. Future modeling attempts should examine whether the inclusion of three-way interactions substantially improves model fit. The AIC statistic for the main effects model is 4,086.828, while the AIC statistic for the interacted model is 4,075.251. This suggests that the interacted model has a better fit than the main effects model, while accounting for the number of parameters. Since the interacted model has a better fit than the main effects model and comparable predictive

¹ A 3-way interaction was not used due to complexity in interpretation.

power, as evidenced by the AUC and rescaled R-squared scores, we will adopt the interacted model for the remainder of this analysis. The exposure variable, BULLIED, interacts with both SEX and SEXUAL_VIOLENCE and these interactions are statistically significant at the 0.10 level. This indicates that the relationship between SUICIDE_ATTEMPT and BULLIED is modified by these control variables. Thus, the adjusted OR reported in Table 3 should be amended. Odds ratios with respect to BULLIED can be calculated for each category of SEX and SEXUAL_VIOLENCE yielding 4 values. For simplicity, these are reported as ranges in Table 4.

Table 4 OR for attempted suicide with respect to BULLIED accounting for effect modification with SEX and SEXUAL_VIOLENCE

BULLIED	OR Range
No	----
Yes	1.904 – 4.429

Thus, compared to non-bullied individuals, bullied individuals have between 1.9- and 4.4-times greater odds of attempting suicide, depending on their SEX and SEXUAL_VIOLENCE category (the average effect, calculated from the 4 profile estimates, is 3.0 times greater). Despite adjustment for effect modification, we still find that the odds of attempting suicide increase greatly with exposure to bullying. Moreover, the odds are higher for females vs. males, for high-frequency binge drinkers vs. low-frequency binge drinkers, for moderate-frequency binge drinkers vs. low-frequency binge drinkers, for hard drug users vs. non-users, and for sexual violence victims vs. non-victims.

Finally, we tested for confounding between the exposure variable BULLIED and the control variables SEX, BD_FREQ, HARD_DRUG, and SEXUAL_VIOLENCE. Employing a 10% rule

for whether the base BULLIED adjusted ORs are changed by more than 10% with the removal of either SEX, BD_FREQ, HARD_DRUG, and SEXUAL_VIOLENCE, we find that the removal of SEXUAL_VIOLENCE results in an OR change of approximately 40% (2.737 to 3.841). This suggests that SEXUAL_VIOLENCE is a confounder with respect to the effect of bullying on attempted suicide, and it should therefore be retained in the model to control for its influence. Thus, SEXUAL_VIOLENCE is both a confounder and an effect modifier with respect to the relationship between BULLIED and SUICIDE_ATTEMPT. The removal of other control variables (SEX, BD_FREQ, and HARD_DRUG) did not yield evidence of additional confounding relationships. Although no confounding has been detected for the other variables, their coefficients are statistically significant, so they will be retained in the model as well.

Strengths and Limitations

Strengths

This study was based on data obtained by one of the most preeminent public health organizations within the United States, the Centers for Disease Control and Prevention (CDC) via the Youth Risk Behavior Surveillance System (YRBSS). The data from the Youth Risk Behavior Survey (YRBS) and other surveys conducted by the CDC via the YRBSS are widely used by other health, governmental, medical, and community-based organizations to inform their policies and decision-making. In addition to being sourced from a well-established public health organization, the data was also obtained in 2021, which makes it quite recent. Another strength of the data is that the YRBS utilizes a sample design (three-stage cluster) and accompanying weighting mechanism that improves the representativeness of the sample. In terms of strengths related to analytical methods, this study investigates the relationship between bullying experiences and

incidence of attempted suicide while controlling for a variety of potential confounders. The inclusion of these controls gives us greater protection against making erroneous or spurious conclusions about the effect of bullying on attempted suicide.

Limitations

One major limitation of this study was the number of participants who were eliminated from the working subsample as a result of not meeting the study criteria. Of the initial total of 17,232 participants, only 7,784 participants met the study criteria. This represents a substantial loss of observations (55%), resulting in very sparse sub-groups (less than $n = 100$ in some cases) and prompting concerns about the validity of our subsequent conclusions. This issue may have been exacerbated by the way in which variables of interest were created. For example, the outcome variable, SUICIDE_ATTEMPT, was formed from 4 different raw survey responses. Question 26 of the YRBS asked if participants had seriously considered suicide in the past 12 months, Question 27 asked if participants had made a suicide plan in the past 12 months, Question 28 asked if participants had attempted suicide in the past 12 months, and Question 29 asked if participants had made a suicide attempt that led to serious injury in the past 12 months. If a participant indicated “no” for the first 2-3 items but had missing data for the last item or last two items, we believed it was not fair to conclude that the participant had not attempted suicide. Therefore, a participant like this was coded as “missing” for the SUICIDE_ATTEMPT variable, and hence was removed from the working subsample. We suspect that students may have refused to answer certain questions to avoid the risk of drawing unwanted attention from others, including authority figures. On the other hand, if a participant indicated a “yes” response for either of the two attempted suicide survey questions, they were coded as a “yes” for

SUICIDE_ATTEMPT, regardless of any missing data for other survey items. Overall, making the outcome variable dependent on up to four different survey items may have resulted in many participants being coded as “missing” for SUICIDE_ATTEMPT, and then being removed altogether. The HARD_DRUG control variable was coded with a similar methodology. A participant who indicated that they had never used cocaine or heroin but had missing data for whether they had used methamphetamine was coded as “missing” for the HARD_DRUG variable. In other words, a combination of nonresponse issues, missing data, and a conservative approach to variable encoding drastically reduced the available sample. In future research, it may be more advisable to limit the number of raw survey items from which the variables of interest are created. Other limitations of the study include the self-reported nature of the data and the fact that several survey questions were limited with respect to timeframes, asking participants if they had experienced an event or engaged in a behavior *within the past 12 months*. These limitations may have had an impact on the overall quality of the data and the validity of the results.

Conclusion

The objective of this study is to quantify the relationship between exposure to bullying and the incidence of attempted suicide, while controlling for sex, binge drinking frequency, hard drug usage, and history of sexual violence. The population of interest for this study was U.S. adolescents. The study employs data for a sample of this population from the 2021 YRBS survey of over 17,000 U.S. high school students between 9th and 12th grade. The YRBS provides demographic, behavioral, health, substance use, and student experience data on this population.

The study finds that the odds of attempting suicide are between 1.9 and 4.4 times higher for those who report having bullying experiences vs. those who report no bullying experiences, depending on their sex and history of experiencing sexual violence. Additionally, large effects on the odds of attempted suicide were found for hard drug users (between 3.7 and 6.8 times higher, depending on sexual violence experience) and victims of sexual violence (between 2.4 and 6.0 times higher, depending on bullying experience and hard drug usage). The odds of females attempting suicide were higher compared to the odds for males (between 1.3 and 2.1 times higher, depending on exposure to bullying), which is consistent with other research findings that females are more likely to attempt suicide than males.

The study advances our knowledge of the relationship between bullying and suicidal behaviors by accounting for the influence of several control variables, and focusing on the impact that bullying has on attempted suicide specifically. The results clearly indicate that U.S. adolescents who experience bullying are at a higher risk of attempted suicide and that policies and strategies that aim to reduce the prevalence of bullying are warranted. These findings can also be used as justification for additional funds to be allocated toward anti-bullying campaigns and measures at the local, state, and federal levels. With dedicated funding and the widespread adoption of effective anti-bullying policies and strategies, the goal of decreasing the incidence of adolescent suicide and related suicidal behaviors (e.g., attempted suicide) may be achievable.

Despite the current study's findings, there is ample opportunity for future research. Additional control variables should be considered from the YRBS in future efforts, as this study only utilized four control variables. Other risk factors like home-related stressors, presence of health

conditions, and the presence of social support systems should be accounted for in later studies. Another potential area of exploration relates to the form of the outcome variable. This study conceived of the outcome variable as a dichotomous variable, indicative of whether someone had attempted suicide or not. However, the variable could have been defined as a multi-category, ordinal variable instead, where the lowest level represents a “no suicidality” group, the next level represents a “suicidal ideation” group, and the highest level represents an “attempted suicide” group. A cumulative logit model could then be estimated to investigate the relationship between bullying (or another exposure variable) and the different levels of the ordinal suicidality variable. In such a case, researchers would need to consider whether the data meets the proportional odds assumption. Lastly, the current study suffered from a high degree of information loss. Future research should aim to limit the number of raw survey items that variables are constructed from or use a less conservative encoding methodology.

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