Association Between Aggressive and Non-Fatal Suicidal Behaviors Among U.S. High School Students

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Abstract

Objective: This study quantified the association between aggressive and non-fatal suicidal behaviors (NFSB) among U.S. high school students and examined whether the association could be explained by substance use, bullying and sexual/dating violence victimization, and other potential risk factors.

Method: Data were based on self-reports from 14,765 students who responded to the 2017 National Youth Risk Behavior Survey. Confirmatory latent class analysis (LCA) identified two distinct, dichotomous latent class variables manifested by indicators of past-year NFSB (i.e., ideation, plan, and attempt) and aggressive behavior (i.e., physical fighting in general and on school property). The structural model estimated the odds ratios between NFSB, aggressive behavior, and their potential risk factors.

Results: Without adjusting for covariates, the confirmatory LCA estimated an odds ratio (OR) of 2.55 (95% confidence interval [CI]: 1.93, 3.37) between two latent class variables for violence against self (NFSB) and others (physical fighting). The net association, however, was rendered nonsignificant (OR = 1.08 [95% CI: 0.88, 1.31]) when adjusted for covariates. Significant common risk factors included exposure to physical dating violence, being bullied on school property and/or electronically, being threatened or injured by someone with a weapon on school property, and lifetime illegal drug use and prescription opioid misuse.

Limitations: Cross-sectional data do not allow assessment of causal relationships.

Conclusions: Findings elucidated the association between NFSB and aggressive behavior, with serious implications for prevention and intervention. Targeting substance use, bullying, and sexual and dating violence will protect students from engaging in both types of violent behaviors.

Keywords

Substance use; Dating Victimization; violence; Suicidal Behavior; bullying victimization; Alcohol use

Introduction

Violence against self and others among young people are a significant public health concern, with serious consequences for educational, health care, treatment services, and judicial sectors. Both forms of violence are important causes of premature deaths in the United States. Among high-school youth ages 14–18, suicide and homicide were either the second or the third leading cause of death between 1999 and 2015 (Centers for Disease Control and Prevention [CDC], 2015). Whereas aggressive behavior (i.e., physical fighting) has declined since 1991, suicidal behavior has been on an upward trend in recent years from 2009 to 2017 (Kann et al., 2018).

Despite the divergent trends, reviews of the literature on aggression and self-harm (Hillbrand, 2001; O'Donnell et al., 2015) have produced empirical evidence suggesting that aggression and self-harm co-occur in individuals more commonly than would be expected by chance. A large Swedish population-based longitudinal cohort study (Sahlin et al., 2017) has established a link between exposure to deliberate harm at baseline and violent crime conviction during follow-up and vice versa (crude hazard ratio = 4.9) in a cohort of 1,850,525 patients ages 15 to 32. The similar hazard ratios suggested a shared vulnerability rather than a causal relationship between impulsive and aggressive acts, although the hazard ratios remained significant when adjusted for psychiatric comorbidities and socioeconomic status.

Some studies on high school populations have largely focused on the co-occurrence of both suicidal and aggressive behaviors versus one of these behaviors alone and their risk factors (Harford et al., 2012; Swahn et al., 2013a). Analyzing the pooled data of the National Youth Risk Behavior Survey (YRBS) in 2003, 2005, and 2007, Harford and colleagues (2012) found that lifetime use of illicit drugs, such as cocaine, heroin, and methamphetamines, and past-month cigarette use and frequent (10+ times) heavy episodic drinking (HED) (i.e., having five or more drinks of alcohol within a couple of hours) were found to be significantly associated with increased risk for combined violence versus self-directed (i.e., suicide attempt) or other-directed violence (i.e., physical fighting). Using a similar typology based on the 2009 YRBS, Swahn and colleagues (2013a) found that depressed mood (i.e., feeling sad or hopeless every day for two weeks) was associated with combined versus other-directed violence. By contrast, HED and weapon carrying were associated with combined violence versus either other- or self-directed violence.

Bullying and dating victimization, which arise especially in peer and social contexts among high school students, also have been linked to suicidal or aggressive behavior (Bossarte et

al., 2008; Cleary, 2000; Gunn and Goldstein, 2017; Holt et al., 2015; Swahn et al., 2010; van Geel et al., 2014; Whiteside et al., 2013). A review of the literature indicated that approximately 20–35% of adolescents reported involvement in bullying as victims, bullies, or both (Levy et al., 2012). A meta-analytic review found that traditional (off-line) bullying was twice as common as cyber (on-line) bullying among adolescents ages 12–18 (Modecki et al., 2014). Findings from the 2013 national YRBS indicated that among 72.8% of male and 75.0% of female high school students who dated, 10.4% and 20.9%, respectively, experienced some form of dating violence (Vagi et al., 2015). Several studies have indicated significant associations between victimization from teen dating or physical and cyber bullying and reports of suicidality and 2-week periods of feeling sad (Litwiller and Brausch, 2013; Merrill and Hanson, 2016; Messias et al., 2014; Romo and Kelvin, 2016; Vagi et al., 2015). Other studies also reported significant associations between bullying and dating violence victimization and violent behavior (Jeong et al., 2013; Litwiller and Brausch, 2013; Nansel et al., 2003; Vivolo-Kantor et al., 2016). Examining victimization and violence among 1,569 high school students in New York State (excluding New York City), Cleary (2000) found that victimized students who were threatened with a weapon or had property stolen or damaged on school property or felt unsafe at school were at greater risk of experiencing either suicidal or violent behavior and both behaviors than students who reported no victimization.

Dating violence victims may be susceptible to substance use, sexual intercourse, history of forced sex, and health-risk behaviors and health problems (Basile et al., 2006; Eaton et al., 2007; Silverman et al., 2004; Taquette and Monteiro, 2019; Vagi et al., 2015). Bullying victims likewise may have psychosomatic problems (Fekkes et al., 2006; Gini and Pozzoli, 2013; Srabstein et al., 2006; Wolke and Lereya, 2015), depression, and other severe mental health problems (Arseneault et al., 2010), as well as behavioral problems, such as weapon carrying (Nansel et al., 2003), poor academic performance (Wang et al., 2014), missing school due to safety concern (Steiner and Rasberry, 2015), prescription opioid misuse (Baiden and Tadeo, 2019), being overweight, substance use, and sexual risk-taking behavior (Merrill and Hanson, 2016). In line with the problem behavior theory, the constellation of problems presumably involves common antecedents and aggregately increases the risk for suicidal and aggressive behaviors among adolescents (Borowsky et al., 2017).

In a review of literature, Plutchik (1995) noted that suicidality and violence involved common risk factors (e.g., schizophrenia, substance use disorders [SUD], history of psychiatric hospitalization, poor impulse control) and protective factors (e.g., large social network, social supports, religiosity). According to the Two-Stage Model of Countervailing Forces (Plutchik et al., 1989), stage I risk and protective factors may amplify and attenuate an innate aggressive impulse that underlies violence toward self and others. Stage II of the model proposes that other risk factors determine the object of the aggressive impulse (self or others). An individual with the same risk factors is likely to be at risk for both self- and other-directed aggression (Hillbrand, 2001). The model, however, lacks specificity regarding stage II risk factors (externalizing or internalizing disorders or trait-like vulnerabilities) (O'Donnell et al., 2015).

Although numerous studies have tried to identify the risk factors for suicidal or aggressive behavior, few studies have examined the association between these two violent behaviors and whether their risk factors jointly explain this association in the youth population. On the other hand, studies focusing on the co-occurrence of both suicidal and aggressive behaviors in the youth population often made no specific reference to their association and overlooked the fact that combined violent behaviors might still exist even in the absence of the association between suicidal and aggressive behaviors. To fill the gap in the literature, we built on our previous studies (Harford et al., 2012; 2013; 2016) that focused on identifying potential characteristics and risk factors associated with combined violent behaviors and sought to quantify the association between aggressive and non-fatal suicidal behaviors (NFSB) and to test the research hypothesis that risk factors, including substance use and sexual and bullying victimization, might account for the association between these two violent behaviors among U.S. high school students. Only when we understand the common risk factors and underlying problems that attenuate the association between suicidal and aggressive behaviors can we develop effective strategies to prevent and reduce combined violence.

Methods

Sample

This study analyzed data from the 2017 national YRBS, a component of the Youth Risk Behavior Surveillance System developed by the CDC to monitor a wide range of priority health risk behaviors. Conducted biennially since 1991, the national YRBS collected data from a representative sample of all regular public and non-public school students in grades 9 through 12 in the 50 states and the District of Columbia. The sample was drawn using a stratified, three-stage cluster sample design stratified by racial/ethnic status and urban/rural status, with an oversample of Black and Hispanic students. The school response rate and student response rate for 2017 national YRBS were 75% (144 of the 192 sampled schools that participated) and 81% (14,765 of the 18,324 sampled students who completed usable questionnaires), respectively, yielding an overall response rate of 60%. Excluding 23 respondents who had missing data on all the behavioral indicators on which our violence typology was based, our study comprised a final analytic sample of 14,742 respondents. More details about the YRBS methodology are available in CDC reports (Brener et al., 2013; Kann et al., 2018).

Outcome Measures

Our violence typology was derived from responses to six survey questions about past-year aggressive behavior and NFSB. The two questions about aggressive behavior asked how many times respondents were in a fight and how many times they were in a fight specifically on school property. The four questions about NFSB asked whether respondents ever seriously considered attempting suicide, whether they made a plan about how they would attempt suicide, how many times respondents attempted suicide, and whether any suicide attempt resulted in an injury, poisoning, or overdose that required medical attention. The latter two questions were combined into one behavioral indicator for analysis. Table 1 shows

the exact question wording and the response options for the resultant five behavioral indicators.

Covariates

Covariates included demographics and sexual characteristics such as sex (male, female); race/ethnicity (Hispanic, non-Hispanic White, Black, and other); grade level (9th grade, 10th grade, 11th grade, 12th grade/others); sexual identity (heterosexual, sexual minority [i.e., gay, lesbian, and bisexual], not sure); and sex of sexual contacts (never had sexual contacts, opposite sex only, same sex only or both sexes). Additional categorical covariates encompassed a host of student characteristics, victimization experiences, and behavioral items in the following.

Academic performance and body weight pertained to grades in school (mostly As, mostly Bs, mostly Cs, mostly Ds or Fs/other grades/not sure); and body mass index (BMI) percentiles (underweight or normal weight [< 85th percentile], overweight [85th percentile and < 95th percentile], and obese [95th percentile]), respectively.

Depressed mood and cognitive difficulty specifically concerned feeling so sad or hopeless almost every day for two weeks or more in a row that interfered with usual activities in the past 12 months (yes, no); and having serious difficulty concentrating, remembering, or making decisions because of a physical, mental, or emotional problem (yes, no), respectively.

Victimization concerned exposure to sexual violence (a composite measure of none, past-year sexual violence from kissing and touching only, lifetime forced sexual intercourse); exposure to physical dating violence (i.e., being hit, slammed into something, or injured with an object or weapon) in the past 12 months (did not date or go out with anyone, 0 times, 1 or more times); being bullied on school property or electronically in the past 12 months (no, on school property only, electronically only, both); being threatened or injured by someone with a weapon on school property (yes, no). Additionally, gun carrying in the past 12 months, which was originally measured by frequency categories, was collapsed into a dichotomous covariate (yes, no).

Lifetime alcohol, cigarette, and marijuana use were measured separately with respect to initiation prior to age 13 or not (never used, 13 years or older, and 12 years or younger). Lifetime use of illegal drugs was derived into a dichotomous variable (yes, no) from nine question items for any use of cocaine (i.e., powder, crack, or freebase); inhalants (i.e., glue, aerosol spray cans, paints); heroin (i.e., smack, junk, or China White); methamphetamines (i.e., speed, crystal, crank, or ice); ecstasy (i.e., MDMA); synthetic marijuana (i.e., K2, Spice, fake weed, King Kong, Yucatan Fire, Skunk, or Moon Rocks); hallucinogenic drugs; steroid pills or shots without a doctor's prescription; and a needle to inject any illegal drug into the body. Using prescription pain medicine (i.e., codeine, Vicodin, OxyContin, Hydrocodone, and Percocet) without a doctor's prescription or differently from the doctor's instruction was coded into a separate, dichotomous covariate (yes, no). Corresponding survey questions for the correlates are available in the 2017 YRBS Data User's Guide (CDC, 2018).

Statistical Analysis

This study analyzed the national YRBS data using confirmatory latent class analysis (LCA), a data-reduction technique that identifies a smaller number of homogeneous subgroups (i.e., latent classes) of individuals from large combinations of categorical responses (i.e., indicators). LCA groups individuals who have a similar scoring pattern on the indicators into the same classes and those who have distinct scoring patterns from one another into different classes (Kongsted and Nielsen, 2017). Based on theoretical expectations, our analysis derived two distinct, dichotomous latent class variables for NFSB (yes, no) and aggressive behavior (yes, no) in the past 12 months based on the five behavioral indicators shown in Table 1. Cross-tabulating these two dichotomous latent variables internally by LCA produced a violence typology of four latent class patterns comparable to prior studies (Harford et al., 2012; 2013; 2016)—no violent behaviors, aggressive behavior, NFSB, and combined violent behaviors. This analysis was a type of categorical structural equation modeling (Feingold et al., 2014), including a measurement model for the relationship between behavioral indicators and two latent class variables, as well as a structural model for the relationship between the two latent class variables and covariates. Specifically, it quantified the correlation between the two latent class variables for aggression and NFSB in terms of odds ratio. It further examined to what extent covariates changed the magnitude and statistical significance of this odds ratio. The model with covariates fixed the thresholds of the behavioral indicators to be the same as those in the model without covariates to avoid the undue effect of covariates that could potentially change the profiles of NFSB and aggressive behavior represented by the two latent variables. Incorporating covariates into the model helped identify demographics and potential risk factors and quantified their effect size based on odds ratios.

The analysis was conducted using Mplus 7 (Muthén and Muthén, 1998–2012), a latent variable modeling program that incorporates the complex survey design (i.e., strata, primary sampling units, and sampling weight) into parameter estimation including 95% confidence intervals (CI) and p-values. For all statistical tests, statistical significance was determined by a two-tailed p-value < 0.05. Missing data on the indicators of aggression and NFSB were handled by Mplus using the maximum likelihood estimation with robust standard errors. Missing data on covariates were grouped with either the reference category or the largest category, except for sexual identity and grades in school, where missing data were grouped with the "not sure" category.

Results

The crosstabulation of the two dichotomous latent variables for NFSB and aggressive behavior from confirmatory LCA resulted in four latent class patterns in Table 1. With no covariates, they were distributed as follows: no violent behaviors, 71.6%; NFSB, 8.4%; aggressive behavior, 15.5%; and combined violent behaviors, 4.6%, yielding an odds ratio of 2.55 (95% CI: 1.93, 3.37; p < 0.001) between these two behaviors. When adjusted for covariates, the net odds ratio became not significantly different from 1 (1.08 [95% CI: 0.88, 1.31]; p = 0.473), even though the four latent class patterns remained little changed: no

violent behavior, 70.2%; NFSB, 9.4%; aggressive behavior, 15.4%; and combined violent behaviors, 5.0%.

With or without covariates, the response profiles of NFSB and aggressive behavior showed good classification quality (entropy > 0.9). The response profiles were little changed by the covariates because the thresholds of the behavioral indicators were fixed to be the same as those with no adjustment for covariates. Adjusted for covariates, the "no violent behavior" pattern had almost zero probabilities of engaging in violent behaviors, notwithstanding a small possibility of physical fighting (0.043). The "NFSB" pattern had high probabilities of seriously considering attempting suicide (0.950) and planning for a suicide attempt (0.788), a moderate probability of attempting suicide (0.392), and a small probability of physical fighting (0.050). The "aggressive behavior" pattern had low probabilities of NFSB similarly to the "no violent behavior" pattern but had a 100% chance of physical fighting and a relatively good chance of physical fighting on school property (0.413). Comparable to the "aggressive behavior" pattern, the "combined violent behaviors" pattern had a 100% chance of engaging in physical fighting (1.000) and a relatively good chance of physical fighting on school property (0.440). Similarly, the "combined violent behaviors" pattern was comparable to the "NFSB" pattern with respect to the probabilities of seriously considering attempting suicide and planning for a suicide attempt, although with a higher probability of attempting suicide (0.622).

The percentage distributions of covariates weighted by the posterior probabilities of the four violent class patterns were presented in Table 2. Notably, "combined violent behaviors" shared mixed characteristics of "aggressive behavior" and "NFSB," comprising disproportionately 9th graders; those who had poorer academic performance (mostly Cs, Ds, or Fs, or others); those who were overweight or obese; those who experienced persistent sadness and hopelessness in the past 12 months; those who had serious difficulty concentrating, remembering, or making decisions; non-heterosexuals; those who had sexual contacts, regardless of sex of sexual contacts; those who were ever forced to have sexual intercourse or otherwise victims of past-year sexual violence such as kissing and touching; victims of past-year physical dating violence; those who were bullied electronically and/or on school property in the past 12 months; those who were threatened or injured by someone with a weapon on school property in the past 12 months; those who carried a gun in the past 12 months; those who first drank alcohol before age 13; those who used cigarettes or marijuana regardless of the age of onset; those who ever used illegal drugs; and those who ever misused prescription pain medications.

Table 3 shows the mutually adjusted odds ratios for covariates associated with NFSB and aggressive behavior in the structural model. For aggressive behavior, the odds were significantly higher among students with the following characteristics versus the reference categories: male (OR = 2.58); non-Hispanic Black or African American (OR = 2.28); 9th (OR = 3.35), 10th (OR = 2.34), and 11th graders (OR = 1.28); mostly Bs (OR = 1.51), mostly Cs (OR = 1.60), and mostly Ds or Fs or others (OR = 2.32) in academic performance; sexual contacts with opposite sex only (OR = 1.72) or either same sex only or both sexes (OR = 1.58); exposure to physical dating violence (OR = 3.10) or not (OR = 1.43) in the past 12 months; being bullied on school property only (OR = 1.71), electronically only (OR = 1.49),

or in both circumstances (OR = 1.75); being threatened or injured by someone with a weapon on school property in the past 12 months (OR = 2.80); carrying a gun in the past 12 months (OR = 3.05); initiating at least one drink of alcohol at age 13 or older (OR = 1.39) or at age 12 or younger (OR = 1.71); initiating cigarette smoking with even one or two puffs at age 13 or older (OR = 1.58) or at age 12 or younger (OR = 1.51); initiating marijuana use at age 13 or older (OR = 1.26) or at age 12 or younger (OR = 2.17); and lifetime use of illegal drugs (OR = 1.43) or prescription pain medications without a doctor's prescription (OR = 1.47).

For NFSB, the odds were significantly higher among students with the following characteristics versus the reference categories: non-Hispanic other races (OR = 1.36); obesity (OR = 1.34); feeling sad or hopeless almost every day for two weeks or more in a row in the past 12 months (OR = 9.85); having difficulty concentrating, remembering, or making decisions because of a physical, mental, or emotional problem (OR = 2.08); sexual minorities (OR = 3.43) or uncertain sexual identity (OR = 1.50); ever being forced to have sexual intercourse (OR = 2.64) or otherwise exposed to sexual violence such as kissing and touching in the past 12 months (OR = 1.73); being exposed to physical dating violence in the past 12 months (OR = 1.42); being bullied on school property only (OR = 1.93), electronically only (OR = 1.95), or in both circumstances (OR = 2.17) in the past 12 months; being threatened or injured by someone with a weapon on school property in the past 12 months (OR = 1.64); and lifetime use of illegal drugs (OR = 1.33) or prescription pain medications without a doctor's prescription (OR = 1.84).

Discussion

A major objective of this study was to quantify the association between NFSB and aggressive behavior among U.S. high school students. The findings indicated an odds ratio of 2.55 between these two violent behaviors and a prevalence estimate of 4.6% for combined violent behaviors, suggesting that students who engaged in NFSB were more likely than those who did not to engage in aggressive behavior or vice versa. The association between NFSB and aggressive behavior, however, became practically nonexistent and statistically nonsignificant when covariates were included in deriving the violence typology. Even when adjusted only for significant covariates common to both NFSB and aggressive behavior, the nonsignificant association was observed (OR = 1.09 [95% CI: 0.89, 1.34]; p = 0.387). Taken together, the findings supported our research hypothesis that the purported association between NFSB and aggressive behavior, at least among U.S. high school students, might be attributable to common and specific risk factors. By identifying and accounting for the overlap of risk factors with the two latent class variables for NFSB and aggressive behavior, our study substantiated the presumption that the moderate and positive association between suicidal and aggressive behaviors was likely to be mediated by risk factors (Farrell and Zimmerman, 2019) or attributable to the same underlying anger, emotion dysregulation, and aggressive impulse (Ammerman et al., 2015; Plutchik, 1995).

The distinct risk profiles for aggressive behavior (male gender, non-Hispanic Black or African American, younger school grades, poorer academic performance, sexual contacts, and substance use) and NFSB (obesity, sexual identity, use of illegal drugs other than

alcohol, persistent sadness and hopelessness, and difficulty concentrating) are well-established in the extant literature (Baiden et al., 2019a, 2019b, 2019c; Bushman et al., 2018; di Giacomo et al., 2018; Franklin et al., 2017; Sheats et al., 2018; Swahn et al., 2009, 2013b). One contrast particularly noteworthy is that sexual identity was predictive of NFSB rather than aggressive behavior, but that sex of sexual contacts was predictive of aggressive behavior rather than NFSB. Non-heterosexual students who experienced discrimination and felt shame and distress from their peers/teachers and the society as a whole for the reason of not conforming to the social norms might be more vulnerable to suicidal thoughts and behaviors (DeCou and Lynch, 2018). Students who had had sexual intercourse in high school, irrespective of sex of sexual contacts, might also be prone to aggression by engaging in other externalizing, risk-taking behaviors such as substance abuse (Mereish et al., 2017; Slater et al., 2017). Taking into account the effect of bullying/dating violence victimization and other competing risk factors, our study found that substance use (i.e., alcohol, cigarette, marijuana, or other drug use) had a significant net effect on aggressive behavior and that only illegal drug use and prescription opioid misuse had a significant net effect on NFSB. Among alcohol and cigarette users, early onset of use (age 12 years or younger versus 13 years or older) did not appear to be associated with either NFSB or aggressive behavior; only early onset of marijuana use showed significantly higher risk for violent behaviors.

An important finding from the current study affirmed and quantified the association between victimization and violent behaviors among U.S. high school students. Students who were exposed to physical dating violence, bullied on school property and/or electronically, and threatened or injured by someone with a weapon on school property and those who ever used illegal drugs and misused prescription opioid medications were at greater risk for both NFSB and aggressive behavior than other students with no such experiences. Lifetime and past-year sexual victimization, however, were associated only with NFSB. Although this study lacks specific information on bullying and dating violence perpetration, the association between victimization and aggression helps corroborate the reports of bully-victims (Nansel et al., 2001) and reciprocal dating violence (Bossarte et al., 2008; Swahn et al., 2010; Whiteside et al., 2013). Bully-victims have been found to be more susceptible to suicidal ideation and internalizing and externalizing problems (Kelly et al., 2015).

Aggressive behavior and NFSB could be attributed to childhood abuse (Harford et al., 2014). Maltreated children and youth who experienced polyvictimization from various trauma stressors were developmentally associated with SUD diagnosis and treatment, post-traumatic stress disorder (PTSD), other behavioral, biological, and psychological consequences (Margolin and Gordis, 2004), and internalizing and externalizing problems (Davis et al., 2019; Dierkhising et al., 2019). Given the trajectory from exposure to parental and community violence to bullying victimization (Davis et al., 2018), students exposed to bullying or sexual and physical dating violence may have similarly experienced trauma- and stressor-related disorders and consequently developed anger, irritability, or heightened startle response to stressful situations or stimuli reminiscent of trauma. Trauma-related arousal and reactivity, a criterion of PTSD, may create difficulties for traumatized students to control their impulses. Without behavior interventions, they may resort to aggressive behaviors for self-protection when facing a threat or in danger. They may self-medicate with substances as a coping mechanism to alleviate distress and further engage in risky sexual behaviors and

self-injurious behaviors (Danielson et al., 2006). From the perspective of developmental traumatology, trauma symptoms presumably mediate violence exposure and the increased risk for alcohol and substance use (De Bellis, 2002; Kobulsky et al., 2016). Conversely, according to lifestyle and routine activity theories (Pratt and Turanovic, 2016), youth exhibiting problematic maladaptive behaviors such as substance use may be more vulnerable to being bullied or victimized (Begle et al., 2011; Espelage et al, 2018). Future studies should clarify to what extent substance use or victimization is a mediator or an antecedent in their relationship with suicidal and aggressive behaviors and whether they are driven mainly by low self-control. Our finding about violent behaviors was compatible with the developmental framework of substance use, whereby the link between substance use and externalizing symptoms has been attributed to behavioral undercontrol, behavioral disinhibition, and emotion dysregulation following the deviance proneness pathways (Chassin et al., 2013). The null substance use findings about NFSB may reflect equivocal associations between internalizing symptoms and substance use in the literature.

As with other cross-sectional studies, our study had limitations in making causal inferences and establishing directionality, although the correlates were temporally plausible as risk factors for violence. Self-reports from a school-based survey invariably induced reporting bias in study findings. Our handling of missing data also induced some bias. Many intercorrelated risk factors were included in the analysis; however, multicollinearity was not a serious concern, since the variance inflation factors (Liao and Valliant, 2012) were all less than 2. YRBS comprised very limited numbers of questions to measure potential risk factors and violence and, if available, lacked specificity. No psychopathology items were available to measure impulsivity, emotion dysregulation, and personality traits, except depression symptoms. Our measure of aggressive behavior was limited to physical fighting, which did not distinguish reactive from proactive aggression. To what extent the association with victimization found in this study was due to proactive aggression warrants further research. Finally, divergent trends in suicidal and aggressive behaviors over the past decade likely contributed to disparate findings with prior studies. Compared with previous violence typologies derived from the cross-tabulation between single measures of suicidal and aggressive behaviors, our violence typology derived from the LCA was more inclusive. Two dichotomous latent variables (yes and no) were selected a priori based on theoretical expectations and clear interpretations to measure the association between suicidal and aggressive behaviors. A data-driven approach using Bayesian information criterion for model selection, however, yielded a more complex model with two trichotomous latent variables representing different levels (low, medium, high) of NFSB and aggressive behavior. The potential risk factors identified in this model explained to a large extent but not completely the association between the high (frequent) levels of violent behaviors. Accordingly, more studies are needed to understand the root causes of recurrent combined violent behaviors. The LCA results and Mplus output are presented as online supplemental materials.

In conclusion, our study extended the literature by providing some empirical evidence to elucidate the association between suicidal and aggressive behaviors and important risk factors. By quantifying the association between NFSB and aggressive behavior, this study helped assess the likelihood and the extent of combined violent behaviors, which might

instill fear among students, disrupt safe school environments for learning, lead to long-term consequences, and potentially be a precursor of lethal violence (i.e., completed suicide and homicide) that too many times has been observed in school shootings or mass shootings in the adulthood. In that regard, our study might indirectly help prevent premature deaths and the loss of productivity to our nation. By identifying common risk factors, our study might also help stimulate more research to better understand the shared vulnerability and thereby prevent or reduce combined violence. The finding that the association might be attributable to common risk factors has serious implications for prevention and intervention. Teachers, counselors, and other educators should be cognizant of the possibility of combined violence and develop comprehensive and integrated strategies (e.g., school counseling, behavioral therapies, family and community engagement, staff and empathy training, legal aid, or other programs for anger management, conflict resolutions, and coping skill development) to safeguard the well-being of all students, targeting substance use, bullying, sexual violence, and relevant risk factors, as well as the underlying anger, emotion dysregulation, and aggressive impulse, to protect students from engaging in suicidal and aggressive behaviors. Implementation of multifaceted, comprehensive evidence-based prevention and intervention programs and strategies that target risk factors across multiple levels is more likely to have a community wide impact on reducing youth violence (Matjasko et al., 2016). Among the many community- and school-based youth violence prevention programs (Massetti et al., 2016), the Youth Empowerment Solutions Program, which engages key stakeholders and empowers youth to make positive changes in their community (Zimmerman et al., 2018), stands out as one successful example featured in *Healthy People 2020* (U.S. Department of Health and Human Services, 2015) and incorporated into the CDC's Striving to Reduce Youth Violence Everywhere initiative (David-Ferdon and Simon, 2012). Our study is intended to inform these programs to make continuous quality improvements.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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Limitations

Self-reports from a school-based survey induced reporting bias in study findings. Missing data also induced bias. The violence typology derived from the latent class analysis was more inclusive and hence not comparable to the typology based on the cross-tabulation between single measures (i.e., physical fight and suicide attempt) proposed in prior studies. Divergent trends in suicidal and aggressive behaviors over the past decade further contributed to disparate findings. The two dichotomous latent variables (yes and no) used to measure the association between aggressive and non-fatal suicidal behaviors were selected a priori based on theoretical expectations and clear interpretations. A data-driven approach may suggest more latent classes or continuous latent variables that differentiate subtypes or levels within and between aggressive and non-fatal suicidal behaviors. The YRBS comprised very limited numbers of questions to measure potential risk factors and violence. The aggressive behavior, limited to physical fighting, did not distinguish reactive from proactive aggression; to what extent the association with victimization found in this study was due to proactive aggression is not clear.

Highlights

- This national study identifies a violence typology among US high school students: no violent behaviors, 71.6%; aggressive behavior, 15.5%; non-fatal suicidal behavior, 8.4%; and combined violent behaviors, 4.6%

- Students who exhibited combined violent behaviors were disproportionately 9th graders; non-heterosexuals, overweight/obese, victims of bullying, sexual, and dating violence, and users of alcohol and other substances.

- The association between aggressive and non-fatal suicidal behaviors was moderate (odds ratio = 2.55) and could be explained by the common and specific risk factors.

- Significant common risk factors included exposure to physical dating violence, being bullied on school property and/or electronically, being threatened or injured by someone with a weapon on school property, and lifetime illegal drug use and prescription opioid misuse.

- Substance use (i.e., alcohol, cigarette, marijuana, or other drug use) had a significant net effect on aggressive behavior; however, only illegal drug use and prescription opioid misuse had a significant net effect on non-fatal suicidal behavior.

- Bullying and dating victimization also were significant risk factors for aggressive behavior. This finding lent support to the reports of bully-victims and reciprocal dating violence in the literature.

Table 1.

Probability distributions of behavioral indicators within four latent class patterns of violent behavior, as derived from the cross-tabulation of two dichotomous latent class variables for aggressive and non-fatal suicidal behaviors among high school students, United States, 2017, National Youth Risk Behavior Survey

Behavioral indicators	Latent class patterns of violent behavior			
	No violent behaviors	Non-fatal suicidal behavior	Aggressive behavior	Combined violent behaviors
Class size ($N = 14,742$)	70.2% (71.6%)	9.4% (8.4%)	15.4% (15.5%)	5.0% (4.6%)
During the past 12 months, how many times were you in a physical fight?				
0 times	0.957 (0.954)	0.950 (0.955)	0.000 (0.000)	0.000 (0.000)
1 time	0.037 (0.041)	0.043 (0.040)	0.371 (0.360)	0.325 (0.324)
2 or more times	0.005 (0.005)	0.008 (0.005)	0.629 (0.640)	0.675 (0.676)
During the past 12 months, how many times were you in a physical fight on school property?				
0 times	1.000 (1.000)	1.000 (1.000)	0.587 (0.576)	0.560 (0.576)
1 time	0.000 (0.000)	0.000 (0.000)	0.283 (0.288)	0.250 (0.240)
2 or more times	0.000 (0.000)	0.000 (0.000)	0.130 (0.135)	0.191 (0.184)
During the past 12 months, did you ever seriously consider attempting suicide?				
No	0.958 (0.946)	0.050 (0.033)	0.955 (0.938)	0.078 (0.055)
Yes	0.042 (0.054)	0.950 (0.967)	0.045 (0.062)	0.922 (0.945)
During the past 12 months, did you make a plan about how you would attempt suicide?				
No	0.973 (0.970)	0.212(0.137)	0.970 (0.965)	0.232 (0.176)
Yes	0.027 (0.030)	0.788 (0.863)	0.030 (0.035)	0.768 (0.824)
During the past 12 months, how many times did you actually attempt suicide? If you attempted suicide during the past 12 months, did any attempt result in an injury, poisoning, or overdose that had to be treated by a doctor or nurse?				
Did not attempt suicide	0.994 (0.994)	0.608 (0.555)	0.992 (0.991)	0.378 (0.348)
Non-injurious attempt				
1 time	0.003 (0.003)	0.161 (0.181)	0.002 (0.002)	0.185 (0.199)
2 or more times	0.000 (0.001)	0.122 (0.138)	0.004 (0.004)	0.200 (0.207)
Injurious attempt				
1 time	0.002 (0.002)	0.051 (0.058)	0.001 (0.001)	0.065 (0.067)
2 or more times	0.000 (0.001)	0.058 (0.068)	0.001 (0.001)	0.172 (0.179)

Note. Entropy = 0.914 (0.905). Odds ratio between aggressive and non-fatal suicidal behaviors = 1.08 [95% CI: 0.88, 1.31] (2.55 [95% CI: 1.93, 3.37]). CI = confidence interval. Estimates not adjusted for covariates are shown in parentheses.

Table 2.

Percent distributions of covariates within four latent class patterns of violent behavior, as derived from the cross-tabulation of two dichotomous latent class variables for aggressive and non-fatal suicidal behaviors, among high school students, United States, 2017, National Youth Risk Behavior Survey

Covariates	n	No violent behaviors		Non-fatal suicidal behavior		Aggressive behavior		Combined violent behaviors	
		%	95% CI	%	95% CI	%	95% CI	%	95% CI
Sex									
Female	7,644	52.5	[49.4, 55.6]	73.8	[70.5, 76.9]	29.2	[26.3, 32.4]	55.5	[50.3, 60.6]
Male	7,098	47.5	[44.4, 50.6]	26.2	[23.1, 29.5]	70.8	[67.6, 73.7]	44.5	[39.4, 49.7]
Race/ethnicity									
Non-Hispanic White	6,590	56.5	[51.0, 61.8]	55.4	[51.0, 59.7]	46.8	[41.0, 52.6]	47.5	[39.6, 55.4]
Non-Hispanic Black or African American	2,788	11.6	[9.6, 14.0]	10.2	[8.2, 12.7]	20.9	[16.5, 26.1]	16.2	[11.9, 21.8]
Non-Hispanic Other	1,721	9.8	[8.4, 11.5]	13.8	[11.3, 16.8]	8.4	[6.9, 10.1]	10.9	[8.8, 13.4]
Hispanic	3,643	22.1	[18.1, 26.6]	20.5	[17.4, 24.1]	24.0	[20.0, 28.5]	25.4	[21.5, 29.7]
Grade									
9th grade	3,916	25.7	[23.8, 27.7]	22.5	[20.1, 25.2]	34.0	[31.4, 36.6]	34.1	[29.7, 38.7]
10th grade	3,710	24.6	[23.6, 25.6]	25.4	[21.6, 29.6]	29.6	[26.8, 32.6]	25.5	[22.1, 29.3]
11th grade	3,596	24.5	[23.7, 25.4]	26.3	[23.3, 29.6]	19.7	[18.2, 21.3]	20.1	[16.7, 24.0]
12th grade/others	3,520	25.2	[24.0, 26.5]	25.8	[23.0, 28.8]	16.8	[14.2, 19.7]	20.3	[17.4, 23.5]
Grades in school									
Mostly As	4,254	40.1	[37.1, 43.1]	31.6	[27.3, 36.4]	18.9	[16.4, 21.6]	18.1	[13.7, 23.5]
Mostly Bs	4,382	33.9	[31.3, 36.7]	33.8	[30.0, 37.8]	36.1	[32.7, 39.8]	28.8	[25.1, 32.9]
Mostly Cs	2,056	13.3	[11.6, 15.3]	18.2	[15.2, 21.5]	20.4	[17.6, 23.5]	22.5	[18.7, 26.9]
Mostly Ds or Fs or others	4,050	12.7	[9.1, 17.4]	16.4	[12.3, 21.5]	24.6	[20.0, 29.9]	30.5	[25.4, 36.2]
BMI percentile									
Underweight or normal weight (< 85th percentile)	10,647	74.6	[73.0, 76.1]	66.6	[63.3, 69.8]	71.5	[69.1, 73.7]	64.7	[60.6, 68.5]
Overweight (85th percentile and < 95th percentile)	2,149	13.2	[12.3, 14.2]	16.9	[13.7, 20.7]	14.1	[12.2, 16.3]	18.7	[15.2, 22.7]
Obese (95th percentile)	1,946	12.2	[11.3, 13.2]	16.5	[13.9, 19.6]	14.4	[12.6, 16.5]	16.7	[13.4, 20.6]
Persistent sadness and hopelessness in the past 12 months	4,631	20.6	[19.1, 22.2]	85.3	[83.4, 87.0]	28.2	[25.2, 31.4]	86.9	[83.3, 89.9]
Serious difficulty concentrating, remembering, or making decisions	3,440	20.1	[17.5, 23.0]	60.9	[54.4, 67.0]	28.1	[24.3, 32.2]	62.8	[53.9, 70.8]
Sexual identity									
Heterosexual	11,999	84.0	[77.7, 88.8]	57.5	[52.8, 62.0]	84.2	[80.1, 87.6]	60.7	[54.4, 66.8]
Sexual minority	1,493	6.1	[5.2, 7.2]	32.7	[28.0, 37.7]	7.2	[5.4, 9.6]	26.4	[21.7, 31.8]
Not sure	1,250	9.9	[5.4, 17.5]	9.9	[7.0, 13.8]	8.6	[4.9, 14.5]	12.8	[9.2, 17.7]
Sex of sexual contacts									
Never had sexual contacts	8,757	61.6	[57.2, 65.9]	42.0	[38.3, 45.8]	36.4	[30.4, 43.0]	26.8	[21.3, 33.1]
Opposite sex only	5,132	34.8	[30.8, 38.9]	40.2	[36.3, 44.2]	57.2	[51.5, 62.7]	50.6	[45.1, 56.1]

Covariates	n	No violent behaviors		Non-fatal suicidal behavior		Aggressive behavior		Combined violent behaviors	
		%	95% CI	%	95% CI	%	95% CI	%	95% CI
Same sex only or both sexes	853	3.6	[3.1, 4.2]	17.8	[15.3, 20.5]	6.3	[4.6, 8.7]	22.6	[18.6, 27.0]
Victimization from sexual violence									
None	12,776	92.5	[91.8, 93.2]	65.4	[61.8, 68.7]	88.8	[86.4, 90.8]	54.5	[50.7, 58.4]
Past-year sexual violence only	863	3.7	[3.2, 4.3]	12.4	[10.1, 15.0]	6.2	[4.6, 8.2]	13.9	[11.5, 16.7]
Lifetime forced sexual intercourse	1,103	3.8	[3.3, 4.3]	22.3	[19.5, 25.3]	5.1	[4.2, 6.1]	31.6	[27.9, 35.4]
Victimization from physical dating violence in the past 12 months									
Did not date or go out with anyone	5,190	39.7	[35.6, 43.9]	31.8	[28.6, 35.1]	22.6	[19.4, 26.1]	19.6	[16.4, 23.3]
0 times	8,709	58.3	[54.2, 62.3]	58.1	[54.7, 61.3]	68.4	[64.9, 71.6]	52.8	[49.1, 56.5]
1 or more times.	843	2.0	[1.8, 2.3]	10.2	[8.4, 12.2]	9.1	[7.9, 10.4]	27.6	[24.2, 31.3]
Bullied on school property or electronically in the past 12 months									
No	11,322	83.0	[81.5, 84.5]	51.4	[47.6, 55.2]	73.0	[70.9, 75.1]	35.1	[30.8, 39.6]
On school property only	1,309	7.2	[6.5, 7.9]	15.4	[12.6, 18.7]	11.0	[9.3, 12.9]	17.8	[13.9, 22.4]
Electronically only	756	4.0	[3.4, 4.6]	9.4	[7.8, 11.4]	5.5	[4.6, 6.7]	9.6	[8.0, 11.4]
Both	1,355	5.8	[5.0, 6.8]	23.7	[20.9, 26.8]	10.5	[9.1, 12.0]	37.6	[32.0, 43.6]
Threatened or injured by someone with a weapon on school property in the past 12 months	933	2.3	[1.8, 2.8]	7.3	[6.0, 8.9]	13.8	[12.0, 15.9]	31.0	[26.2, 36.2]
Carried a gun in the past 12 months	727	1.9	[1.4, 2.7]	2.4	[1.5, 3.9]	13.4	[11.2, 16.0]	18.4	[15.1, 22.1]
Age at onset of drinking at least one drink of alcohol									
Never used	7,141	54.4	[51.7, 57.0]	33.4	[30.6, 36.3]	32.4	[28.8, 36.2]	21.7	[18.0, 25.8]
13 years or older	5,436	36.2	[34.0, 38.6]	47.2	[43.8, 50.6]	40.5	[37.9, 43.1]	40.8	[35.7, 46.1]
12 years or younger	2,165	9.4	[8.2, 10.7]	19.4	[17.5, 21.4]	27.1	[23.9, 30.5]	37.5	[32.3, 43.1]
Age at onset of cigarette smoking, even one or two puffs									
Never used	11,423	80.2	[77.3, 82.8]	63.5	[58.2, 68.4]	55.1	[49.8, 60.3]	43.0	[36.3, 50.0]
13 years or older	2,245	14.6	[12.7, 16.6]	24.8	[21.6, 28.2]	27.9	[25.0, 31.0]	27.2	[22.9, 32.0]
12 years or younger	1,074	5.2	[4.3, 6.3]	11.7	[8.7, 15.7]	17.0	[13.8, 20.8]	29.8	[24.4, 35.9]
Age at onset of marijuana use									
Never used	9,595	73.5	[71.0, 75.9]	51.5	[47.5, 55.4]	46.0	[42.5, 49.5]	33.7	[29.7, 37.9]
13 years or older	4,166	23.6	[21.6, 25.7]	41.1	[37.3, 45.0]	36.2	[33.1, 39.3]	42.7	[37.2, 48.4]
12 years or younger	981	2.9	[2.4, 3.6]	7.4	[5.3, 10.4]	17.8	[15.3, 20.7]	23.6	[19.4, 28.4]
Ever used illegal drugs	2,245	8.9	[8.0, 10.0]	25.4	[21.5, 29.8]	27.5	[24.8, 30.4]	52.1	[48.1, 56.2]
Ever taken prescription pain medicine without a doctor's prescription	2,047	7.6	[6.7, 8.6]	26.8	[22.9, 31.0]	23.1	[21.0, 25.3]	48.3	[44.4, 52.3]

Note. CI = confidence interval.

Table 3.

Adjusted odds ratios of selected demographics and potential risk factors for two dichotomous latent class variables of aggressive and non-fatal suicidal behaviors among high school students, United States, 2017, National Youth Risk Behavior Survey

Covariates	Aggressive behavior		Non-fatal suicidal behavior	
	OR	95% CI	OR	95% CI
Sex (Ref: Female)				
Male	2.58**	[2.17, 3.06]	0.99	[0.79, 1.24]
Race/ethnicity (Ref: Non-Hispanic White)				
Non-Hispanic Black or African American	2.28**	[1.91, 2.73]	1.04	[0.85, 1.28]
Non-Hispanic other races	1.15	[0.90, 1.47]	1.36*	[1.07, 1.72]
Hispanic	1.15	[0.96, 1.39]	1.01	[0.83, 1.22]
Grade (Ref: 12th grade/others)				
9th grade	3.35**	[2.65, 4.23]	1.07	[0.82, 1.38]
10th grade	2.34**	[1.88, 2.91]	0.94	[0.66, 1.34]
11th grade	1.28*	[1.02, 1.60]	0.92	[0.66, 1.27]
Grades in school (Ref: Mostly As)				
Mostly Bs	1.51**	[1.26, 1.80]	0.85	[0.69, 1.05]
Mostly Cs	1.60**	[1.31, 1.97]	1.00	[0.79, 1.27]
Mostly Ds or Fs or others	2.32**	[1.86, 2.89]	1.23	[0.96, 1.59]
Body mass index percentile (Ref: Underweight or normal weight [< 85th percentile])				
Overweight (85th percentile and < 95th percentile)	1.09	[0.92, 1.29]	1.34	[0.92, 1.94]
Obese (95th percentile)	0.96	[0.79, 1.15]	1.34*	[1.04, 1.71]
Persistent sadness and hopelessness in the past 12 months	1.18	[0.97, 1.42]	9.85**	[8.01, 12.10]
Serious difficulty concentrating, remembering, or making decisions	1.15	[0.94, 1.41]	2.08**	[1.73, 2.49]
Sexual identity (Ref: Heterosexual)				
Sexual minority	0.96	[0.72, 1.29]	3.43**	[2.72, 4.34]
Not sure	1.40	[0.95, 2.06]	1.50*	[1.06, 2.13]
Sex of sexual contacts (Ref: Never had sexual contacts)				
Opposite sex only	1.72**	[1.42, 2.07]	1.16	[0.91, 1.49]
Same sex only or both sexes	1.58*	[1.05, 2.36]	1.02	[0.70, 1.48]
Victimization from sexual violence (Ref: None)				
Past-year sexual violence only	1.24	[0.94, 1.63]	1.73**	[1.28, 2.33]
Lifetime forced sexual intercourse	0.87	[0.70, 1.09]	2.64**	[1.99, 3.51]
Victimization from physical dating violence in the past 12 months (Ref: Did not date or go out with anyone)				
0 times	1.43**	[1.22, 1.67]	0.98	[0.84, 1.15]
1 or more times	3.10**	[2.49, 3.85]	1.42*	[1.02, 1.97]
Bullied on school property or electronically in the past 12 months (Ref: No)				

Covariates	Aggressive behavior		Non-fatal suicidal behavior	
	OR	95% CI	OR	95% CI
On school property only	1.71**	[1.30, 2.24]	1.93**	[1.50, 2.48]
Electronically only	1.49**	[1.11, 2.01]	1.95**	[1.38, 2.75]
Both	1.75**	[1.37, 2.22]	2.17**	[1.69, 2.79]
Threatened or injured by someone with a weapon on school property in the past 12 months	2.80**	[2.23, 3.53]	1.64**	[1.14, 2.36]
Carried a gun in the past 12 months	3.05**	[2.14, 4.35]	1.13	[0.80, 1.60]
Age at onset of drinking at least one drink of alcohol (Ref: Never used)				
13 years or older	1.39*	[1.07, 1.80]	1.09	[0.89, 1.33]
12 years or younger	1.71**	[1.26, 2.32]	1.16	[0.87, 1.53]
Age at onset of cigarette smoking, even one or two puffs (Ref: Never used)				
13 years or older	1.58**	[1.35, 1.84]	0.86	[0.68, 1.10]
12 years or younger	1.51**	[1.20, 1.91]	1.18	[0.80, 1.74]
Age at onset of marijuana use (Ref: Never used)				
13 years or older	1.26*	[1.02, 1.56]	1.09	[0.86, 1.38]
12 years or younger	2.17**	[1.54, 3.07]	0.87	[0.58, 1.31]
Ever used illegal drugs	1.43**	[1.18, 1.74]	1.33**	[1.13, 1.58]
Ever taken prescription pain medicine without a doctor's prescription	1.47**	[1.19, 1.82]	1.84**	[1.42, 2.38]

Note. OR = odds ratio. CI = confidence interval.

*
$p < 0.05$.

**
$p < 0.01$.