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## Factors Associated with Suicide Risk Behavior Outcomes Among Black High School Adolescents

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### Abstract

There is an urgent need for youth suicide research, particularly among Black adolescents, for whom there have been significant increases over time. This study examines associations between eight covariates and suicide ideation, planning, and attempts among a national sample of Black high school adolescents to inform prevention efforts. Utilizing the 2019 National Youth Risk Behavior Survey data, a sample of  $N = 6225$  Black high school participants was analyzed. A weighted classification tree and network analysis were used to visualize data features, and weighted multinomial ordered logistic regression analyses with multiple imputation pooled using Rubin's rules were performed. Suicide ideation rates of 16% were found in the sample and a higher reported rate of suicide attempts (56%) for those who have reported both ideation and planning. Interpersonal and multilevel factors, including suffering from bullying/cyberbullying, carrying a weapon, or being a sexual minority, were significantly associated with all three suicide behaviors. Findings support an interrelated and multilevel nature of suicide risk factors. Prevention programs for Black adolescents should consider the intersectionality of identities and experiences.

### Keywords

Black; Suicide; Culture; Suicide risk factors; Adolescents

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**Ethical Approval** The data used for this study was approved by the Centers for Disease Control and Prevention Institutional Review Board.

**Consent to Participate** This study utilized publicly available data.

An examination of the Centers for Disease Control and Prevention (CDC) Youth Risk Behavior Survey (YRBS) data from 2003 to 2017 revealed that among racially diverse populations, the largest increase in deaths by suicide occurred among Black high school adolescents (BHSA) ages 15–17 (4.9%) [1]. Along the same lines, researchers noted variances in suicidal thoughts and behaviors (STB) among BHSA between 2009 and 2019 [2]. Notably, significant linear increases over time were found in suicide attempts among BHSA, and differences in suicide ideation and planning were noted based on sex and sexual minority status. However, the layering of these specific identities with race was not reported.

Researchers have suggested disaggregating data in suicide research and examining intersecting identities, such as race, gender, and sexual identity [1, 3-6]. Much is known about adolescent risk factors for suicide; however, researchers have found that these risk factors are not always applicable to Black adolescents [1, 7] due to the lack of representation in suicide-related studies and the lack of published articles featuring this population [8]. A gendered, race-based, and sexual-minority status approach is necessary to understand diverse adolescent experiences [9, 10] and inform epidemiology and prevention efforts [11].

Factors have been associated with increased STB for general adolescent populations, including race, gender, sexual minority status, bullying at school, cyberbullying, carrying a weapon, academic grades, grade level, and weight perception [12-16]. A deeper exploration of STB among BHSA, with attention to potential associated factors from a cross-sectional lens, will provide further insight into this population. This study seeks to examine STB among BHSA and the risk factors associated with them.

## Methods

Data was collected from the anonymous 2019 National CDC YRBS and included 44 publicly available state high school datasets [17]. Responses from high school students who identified as Black were extracted. Three outcomes of interest relating to STB, and eight explanatory variables, were compiled. Some states do not participate in YRBS, while others are excluded due to insufficient response rates. Also, states can add or delete questions [18]. The dataset was restricted to states for which none of the questions in our study were excluded, and responses were reported, even if missing.

Weighted and unweighted descriptive statistics were tabulated for all variables. All analyses and visualizations were weighted using the YRBS-calculated weights. A chi-square test and pie chart were produced to demonstrate the association between suicide ideation and planning among those who responded to both questions. A classification tree further describes their association with suicide attempts among those who responded to all three questions. A complete case graphical lasso (glasso) network representation of the polychoric and tetrachoric correlations between all variables was performed. Due to substantial missingness in the data, Little's missing completely at random (MCAR) test was performed [19]. A multivariable, multinomial logistic regression model was used to estimate associations between suicide ideation only, suicide planning only, and joint ideation and planning, with the explanatory variables. For attempts, a multivariable, multinomial-ordered logistic regression model was used. For both models, multiple imputation using chained

equations with  $m = 5$  imputations was used to impute missing values [20], and Rubin's rules were used to pool estimates [21]. Pooled adjusted odds ratios, and corresponding 95% confidence intervals and p-values, were computed. All analyses were performed in Version 4.0.3 of R [22].

## Results

The study sample was comprised of  $N = 6225$  BHSA from the 15 states (Alabama, Arizona, Arkansas, Florida, Iowa, Illinois, Kentucky, Michigan, Mississippi, North Carolina, Pennsylvania, South Carolina, Texas, Utah, and Wyoming) where all three outcomes and eight covariates were at least partially collected. Table 1 includes descriptive statistics (counts and weighted and unweighted frequencies) for outcomes (STB metrics) and covariates. Suicide ideation and planning were reported by 16.50% and 14.02% of participants, respectively; whereas, suicide ideation alone was reported by 6.61% of participants, and suicide planning alone was reported by 4.00% of participants. Both suicide ideation and planning were reported by 10.16% of participants, while 79.23% reported neither ideation nor planning. The association between ideation and planning was not random (weighted  $\chi^2 = 2,132.1$ ;  $p < 0.0001$ ) and can be visualized in a weighted pie chart in Fig. 1a. The weighted classification tree depicted in Fig. 1b represents how suicide attempt status (expressed in binary form and only among those who responded to all three outcomes, solely for the purpose of this plot) can be explained by suicide ideation and planning. For example, among the 12% of respondents who reported both suicide ideation and planning, 56% attempted suicide. Among the 6% who had ideation but no planning, 21% of them attempted suicide. If no ideation occurs, planning is not relevant to explain whether suicide attempts occur, and 3% of this group (representing 82% of respondents) attempted suicide.

Nearly 10% of study participants declared carrying a weapon. Even more were bullied at school (14.41%) or cyberbullied (11.13%), with a strong weighted association between them, as demonstrated in Fig. 2, portraying a weighted network analysis of associations among all variables. Other relevant weighted associations include: males and weapons (positively associated), and males and both grades and non-heterosexual identity (negatively associated with both variables). STB metrics were strongly, positively associated. Weapon carrying was highly associated with both suicide planning and suicide attempt.

Little's MCAR test yielded strong indication of missingness not completely at random within the sample ( $\chi^2 = 4,399.69$ ;  $p < 0.0001$ ). Table 2 includes results from the weighted multinomial logistic regression model for suicide ideation only, suicide planning only, and suicide ideation and planning (jointly) after imputation, all measured against the reference of no suicide ideation or planning. Males experienced lower suicide ideation (OR = 0.51; 95% CI 0.46–0.56), and both ideation and planning (OR = 0.41; 95% CI 0.35–0.48), with  $p < 0.0001$ , compared to females. No significant differences by sex were found in suicide planning. Class, a proxy for age, was non-significant across all levels and outcomes except for suicide planning only, where those in 11th and 12th grade were found to experience lower odds of planning (OR = 0.83;  $p = 0.0162$ ) than those in 9th grade. Weapon carrying was strongly associated with 63% higher odds of suicide ideation (95% CI 1.37–1.94), 108% higher odds of suicide planning (95% CI 1.70–2.54), and 241% higher odds of both suicide

ideation and planning (95%CI 2.80–4.15). Being bullied at school was also associated with increased STB, with 113% higher odds of suicide ideation (95%CI 1.97–2.30), 134% higher odds of planning (95%CI 2.02–2.72), and 114% higher odds of both suicide ideation and planning (95%CI 1.94–2.36). Similar findings are reported for cyberbullying, which was associated with 84% higher odds of suicide ideation (95%CI 1.40–2.41), 108% higher odds of suicide planning (95%CI 1.50–2.87), and 306% higher odds of both suicide ideation and planning (95%CI 3.41–4.84). Weight perception was generally significantly associated with STB. Students who self-perceive as very underweight were estimated to have at least 79% higher odds of suicide ideation or planning (but not both), than students who self-perceive as about the right weight. Students who were slightly underweight experienced 63% higher odds of suicide ideation (95%CI 1.42–1.88), while those slightly overweight experienced 51% higher odds of suicide ideation (95%CI 1.28–1.79) and 20% higher odds of planning (95%CI 1.00–1.43). Those who perceived themselves as very overweight experienced the largest STB, with 161% increased odds of suicide ideation (95%CI 2.30–2.96), 119% higher odds of suicide planning (95%CI 1.56–3.07), and 98% higher odds of both ideation and planning (95%CI 1.63–2.39). Students with mostly C grades experienced higher ideation than those with mostly As (OR = 1.31; 95%CI: 1.02–1.68). Those with mostly Ds experienced higher odds of suicide ideation (OR = 1.98; 95%CI 1.32–2.97), planning (OR = 2.42; 95%CI 1.10–5.34), and both suicide ideation and planning (OR = 1.94; 95%CI 1.52–2.49). Increased odds of planning were also found for students reporting mostly Fs (OR = 3.43; 95%CI 1.44–8.13), though both this group and those unsure about their grades experienced large variability due to low counts. Sexual minority students and those unsure about their sexual identity experienced higher odds of suicide ideation (OR 1.95;  $p = 0.0011$ ), planning (OR 2.24;  $p = 0.0005$ ), or both ideation and planning (OR 1.77;  $p = 0.0074$ ).

Table 3 reports associations between suicide attempts and covariates. Males were found to experience lower odds of attempting suicide (OR = 0.56; 95%CI 0.47–0.68), and class was not found to be a relevant factor. Carrying a weapon was strongly associated with higher odds of suicide attempts (OR = 3.41; 95%CI 1.93–6.04). Being bullied at school was found to be associated with 69% higher odds of suicide attempts (95%CI 1.15–2.48), while cyberbullying was associated with 178% higher odds of attempts (95%CI 1.80–4.29). Those who self-perceived as very underweight (OR = 1.89; 95%CI: 1.44–2.47) or slightly underweight (OR = 1.26; 95%CI: 1.02–1.56) reported higher suicide attempts compared to those who self-perceive as about the right weight. Low grades were associated with greater odds of having attempted suicide, with ORs ranging from 1.29 (95%CI 1.00–1.65; mostly Bs) to 2.89 (95%CI 2.15–3.87; mostly Fs), with all groups compared to mostly As. Sexual minorities and those unsure about their sexual identity were also found to experience at least 99% higher odds of suicide attempts ( $p = 0.0184$ ).

## Discussion

### STB and Black Youth

Due to the limited suicide research among BHSA populations [1, 23], this study investigates associations between STB and eight key explanatory variables. When examining STB

outcomes, individual suicide trajectories and sequences toward suicidal behaviors differ [24]. For example, BHSA reporting ideation and planning were very likely to report engaging in suicide attempts (56%). Among BHSA who reported ideation only, 21% attempted suicide, indicating differences in trajectories. When considering practice standards for responding to STB, the National Action Alliance for Suicide Prevention suggests that practitioners screen all clients for STB utilizing a standardized scale or assessment instrument and stratify based on risk levels in outpatient practice settings [25]. If clients present elevated risk, then interventions are recommended. Based on our findings, we suggest that elevated risk should also encompass suicidal ideation, as this risk could differ for BHSA [7, 23]. Practitioners need to regularly assess adolescents for STB and conduct further assessments if they present any form of STB. As suicide trajectories differ [24], practitioners should act when BHSA report suicide ideation by engaging in additional assessment, implementing a safety plan, or seeking additional assistance.

Differences in STB among BHSA were found based on sex and sexual minority status. Congruent with current literature [2, 26], Black males reported significantly less STB than Black females. While this research does not confirm if Black males are underreporting or experiencing less STB, the propensity for Black females to acknowledge these risk behaviors demands additional exploration. Practitioners should be aware of these patterns when they screen BHSA populations for suicide risk. More significant differences were noted with sexual minority BHSA. Sexual minorities reported significantly higher odds of STB than heterosexual peers, congruent with previous findings [2]. Practitioners exploring developmental issues with adolescents should be open to exploring issues of identity, as adolescence is a time of sexual development and awareness [27]. Including an intersectional perspective is critical to understanding and assessing STB and ensuring the safety of BHSA [8].

### **Factors Associated with STB Outcomes**

Our findings demonstrate factors associated with STB congruent with existing research, including bullying at school, cyberbullying, weapon carrying, academic grades, grade level, and weight perception [12, 15, 16]. Cyberbullying was associated with increased STB outcomes for BHSA beyond associated suicide attempts, as noted in previous research [13]. Further investigation of cyberbullying experiences is necessary and critical for BHSA.

Carrying a weapon was reported more among males and was highly associated with all STB outcomes. These findings are congruent with other literature and indicate that adolescents who carry a weapon are more likely to experience STB [28]. Though adolescents can use other means to complete suicide, firearms are the leading means of suicide, with prevalence rates highest for Black males [29, 30]. Thus, by reducing access to weapons, suicide prevention models could prioritize safety and reduce suicide attempts.

Significant findings between weight perceptions and STB outcomes were found for BHSA who perceived themselves as very overweight, with higher odds of reporting suicide ideation and planning. Additionally, being overweight often results in more bullying from peers [31]. These experiences can compound, thereby increasing adolescents' risk of STB. Thus, all

factors must be considered by suicide prevention models to support the needs of adolescents holistically.

The findings from this study support an interrelated and multilevel nature of STB factors among BHSA. Prevention programs among these adolescents should be implemented holistically, considering the intersectionality of identities and experiences. The development of culturally competent services to meet the needs of BHSA can cater to the unique challenges they face. In addition, having inclusive and supportive environments can help reduce issues that significantly impact their mental health, like bullying, weapon carrying, academic performance, and weight perceptions. Finally, the integration of psychological and physical health services to coordinate care is integral to addressing mental health crises comprehensively.

Though this research has substantial merit, it also has limitations. This study is cross-sectional, which limits generalizability. Furthermore, we cannot infer causality between the examined factors and STBs. Not all state-level data were available, and some states did not include or report all data. States can choose what questions they want to include within their administration of YRBS, and some states may opt out of specific questions for varying reasons. Youth included in this sample may also be influenced by their own beliefs and the environment that they are in, leading them to misreport their experiences.

## Conclusion

Black youth suicide is a pressing issue but there is limited research to examine the specific needs of BHSA [7, 23]. It is essential to examine how race, sex, and sexual identity connect and interact to create a unique perspective. Along with intersecting identities, additional factors (i.e., bullying at school, cyberbullying, carrying a weapon, academic grades, grade level, and weight perception shaping these experiences) are associated with and can compound STB among BHSA. Suicide prevention strategies must match the needs of BHSA to help decrease their risk of suicide across a wide range of experiences and factors.

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## Data Availability

A secondary data analysis was completed of the National YRBS, publicly available and de-identified data. Data is available for download at: <https://www.cdc.gov/healthyouth/data/yrbs/data.htm>

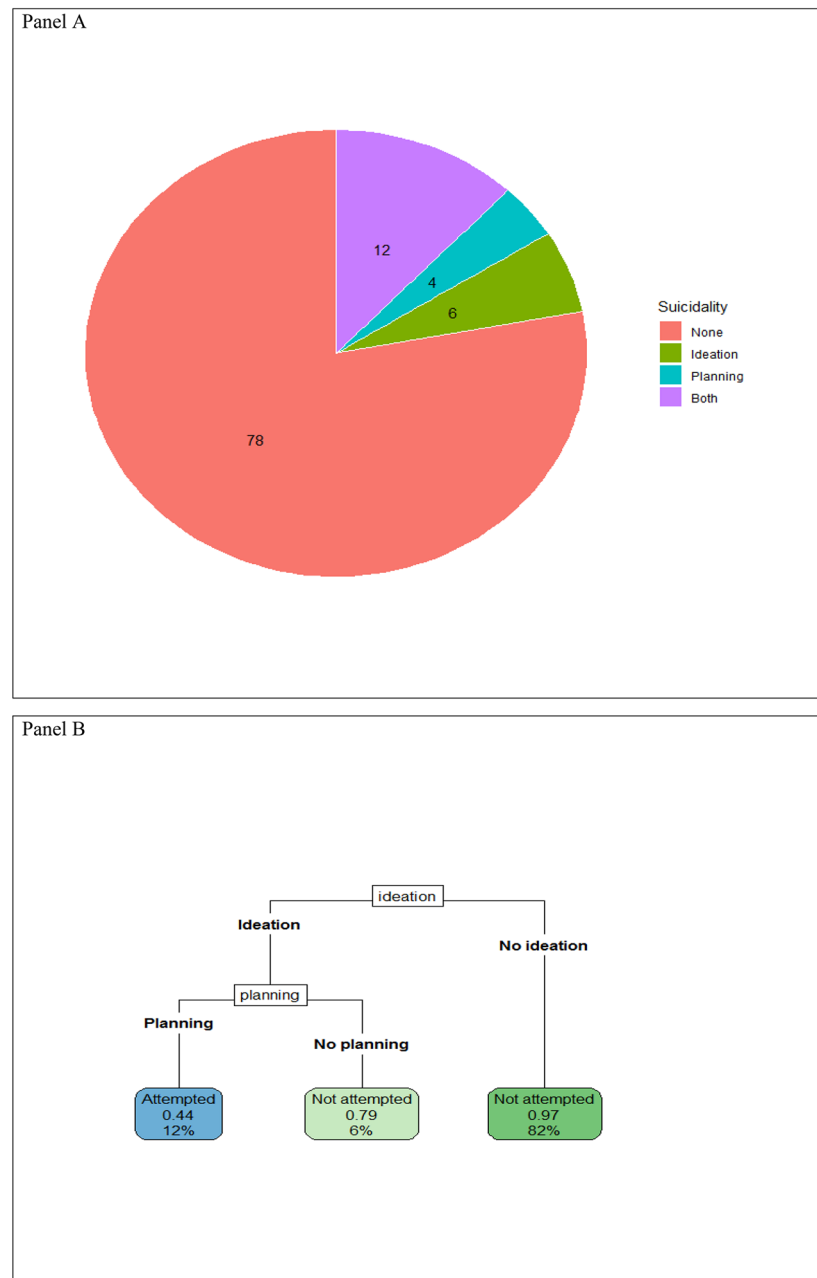
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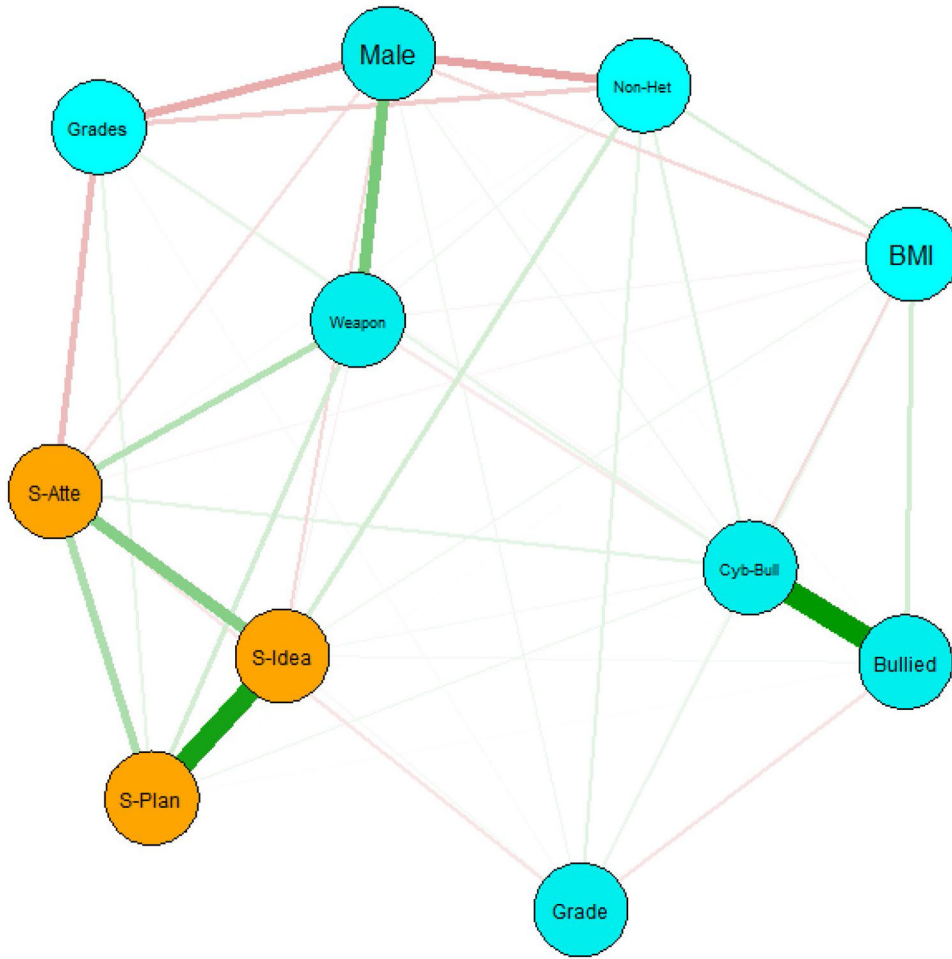
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**Fig. 1.**

**A** (above) displays a weighted pie chart representing percentages of BHSA who had suicide ideation, planning, both, or none among participants who responded to both questions. **B** (below) includes a weighted classification tree for suicide ideation and planning to describe whether attempts occurred, represented in binary form, among those who responded to all three questions. Branches of the tree indicate the split of the data using suicide ideation and planning. The nodes at the bottom indicate characteristics of the resulting group, including the most likely attempts outcome (top row in the node), the percentage of participants who did not attempt suicide in that group (e.g., 0.44 representing that 44% did not attempt suicide; middle row in the node), and the percentage of participants who compose that node



**Fig. 2.** Complete case weighted graphical lasso (glasso) network representation of the polychoric and tetrachoric correlations with a tuning parameter of 0.2 between all variables (STB outcomes and covariates). Circles (nodes) represent variables, and lines (edges) represent pairwise associations between variables. Orange nodes indicate STB outcomes, and blue nodes represent covariates. Red edges portray negative associations while green edges represent positive associations. Edge thickness represents the strength of the pairwise associations. For ordinal variables, nodes represent higher values of the variable (e.g., higher grades are negatively associated with higher numbers of suicide attempts). For sexual identity, sexual minority and not sure were grouped together as non-heterosexual (“Non-Het”). For grades, “not sure” responses were categorized below ‘Mostly Fs’, as they may be an indication of low or no school engagement

**Table 1**

Descriptive statistics (counts and percentages, weighted and unweighted) of STB outcomes and covariates

	N	Unweighted %	Weighted %
STB outcomes			
Suicide ideation			
No	5027	80.76	81.46
Yes	1027	16.50	16.16
Missing	171	2.75	2.38
Suicide planning			
No	5184	83.28	83.41
Yes	873	14.02	13.89
Missing	168	2.70	2.70
Suicide attempts			
0 times	4147	66.62	67.28
1 time	325	5.22	4.95
2–3 times	175	2.81	3.10
4–5 times	43	0.69	0.59
6 + times	38	0.61	0.56
Missing	1497	24.05	23.54
Covariates			
Sex			
Female	3241	52.06	48.97
Male	2961	47.57	50.71
Missing	23	0.37	0.32
Class			
9th grade	1825	29.32	27.46
10th grade	1667	26.78	24.78
11th grade	1495	24.02	24.64
12th grade	1205	19.36	22.53
Missing	33	0.53	0.59
Carry weapon			
No	5334	85.85	86.69
Yes	617	9.91	8.84
Missing	264	4.24	4.47
Bullied at school			
No	5223	83.90	84.29
Yes	897	14.41	14.09
Missing	105	1.69	1.62
Cyberbullied			
No	5421	87.08	87.97
Yes	693	11.13	10.47
Missing	111	1.78	1.55

	N	Unweighted %	Weighted %
Weight perception			
Very underweight	407	6.54	6.03
Slightly underweight	838	13.46	12.59
About the right weight	2962	47.58	49.69
Slightly overweight	1,293	20.77	20.70
Very overweight	314	5.04	4.91
Missing	411	6.60	6.10
Grades			
Mostly As	1728	27.76	25.04
Mostly Bs	2165	34.78	37.05
Mostly Cs	1214	19.50	17.92
Mostly Ds	228	3.66	3.20
Mostly Fs	89	1.43	1.51
Not sure	344	5.53	5.78
Missing	457	7.34	9.49
Sexual identity			
Heterosexual	4822	77.46	77.68
Sexual minority	850	13.65	13.13
Not sure	240	3.86	3.99
Missing	313	5.03	5.19

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Adjusted odds ratios (OR), 95% confidence intervals (CI), and p-values for each covariate in the multivariable, multinomial weighted logistic regression model for suicide ideation and/or planning, upon performing multiple imputation (m = 5) using chained equations and pooling results using Rubin's rules

Table 2

	Suicide ideation only			Suicide planning only			Suicide ideation and planning		
	OR	95%CI	p-value	OR	95%CI	p-value	OR	95%CI	p-value
Intercept	0.05	0.04–0.07	< <b>0.0001</b>	0.03	0.02–0.03	< <b>0.0001</b>	0.08	0.08–0.09	< <b>0.0001</b>
Sex: male	0.51	0.46–0.56	< <b>0.0001</b>	0.88	0.70–1.11	0.2116	0.41	0.35–0.48	<b>0.0001</b>
Class									
10th grade	0.97	0.89–1.06	0.4580	0.91	0.70–1.19	0.3799	0.90	0.79–1.02	0.0794
11th grade	0.89	0.75–1.06	0.1380	0.80	0.68–0.94	<b>0.0162</b>	0.97	0.88–1.06	0.3994
12th grade	1.15	0.88–1.50	0.2212	0.83	0.76–0.90	<b>0.0022</b>	1.02	0.91–1.14	0.7132
Carry weapon	1.63	1.37–1.94	<b>0.0012</b>	2.08	1.70–2.54	<b>0.0004</b>	3.41	2.80–4.15	<b>0.0001</b>
Bullied at school	2.13	1.97–2.30	< <b>0.0001</b>	2.34	2.02–2.72	< <b>0.0001</b>	2.14	1.94–2.36	< <b>0.0001</b>
Cyberbullied	1.84	1.40–2.41	<b>0.0034</b>	2.08	1.50–2.87	<b>0.0033</b>	4.06	3.41–4.84	< <b>0.0001</b>
Weight perception									
Very underweight	1.89	1.34–2.67	<b>0.0069</b>	1.79	1.10–2.91	<b>0.0294</b>	1.42	0.93–2.19	0.0823
Slightly underweight	1.63	1.42–1.88	<b>0.0004</b>	1.14	0.78–1.67	0.3863	1.06	0.97–1.16	0.1321
Slightly overweight	1.51	1.28–1.79	<b>0.0021</b>	1.20	1.00–1.43	<b>0.0470</b>	1.07	0.93–1.22	0.2413
Very overweight	2.61	2.30–2.96	< <b>0.0001</b>	2.19	1.56–3.07	<b>0.0028</b>	1.98	1.63–2.39	<b>0.0005</b>
Grades									
Mostly Bs	0.97	0.77–1.24	0.7781	1.13	0.90–1.44	0.2116	0.89	0.70–1.12	0.2154
Mostly Cs	1.31	1.02–1.68	<b>0.0403</b>	1.04	0.75–1.44	0.7571	1.14	0.90–1.44	0.1913
Mostly Ds	1.98	1.32–2.97	<b>0.0093</b>	2.42	1.10–5.34	<b>0.0364</b>	1.94	1.52–2.49	<b>0.0015</b>
Mostly Fs	0.80	0.29–2.22	0.5809	3.43	1.44–8.13	<b>0.0174</b>	1.07	0.30–3.81	0.8851
Not sure	1.25	0.67–2.32	0.3724	1.24	0.73–2.10	0.3239	1.08	0.79–1.48	0.5272
Sexual identity									
Sexual minority	1.95	1.56–2.43	<b>0.0011</b>	2.24	1.79–2.82	<b>0.0005</b>	3.24	2.73–3.84	< <b>0.0001</b>
Not sure	2.17	1.86–2.52	<b>0.0001</b>	2.36	1.91–2.92	<b>0.0002</b>	1.77	1.29–2.42	<b>0.0074</b>

Reference categories: Sex = Female; Grade = 9th Grade; Weight perception: About the Right Weight; Grades = Mostly As; Sexual Identity = Heterosexual. The reference response group in all cases is participants with no suicide ideation nor planning

p-values below  $\alpha = 0.05$  are bolded to emphasize statistical significance. (N = 6225)

**Table 3**

Adjusted odds ratios (OR), 95% confidence intervals (CI), and p-values for each covariate in the multivariable, multinomial weighted ordered logistic regression model for suicide attempts, upon performing multiple imputation ( $m = 5$ ) using chained equations and pooling results using Rubin's rules

	Suicide attempts		
	OR	95%CI	p-value
Sex: male	0.56	0.47–0.68	<b>0.0009</b>
Class			
10th grade	0.99	0.75–1.31	0.9193
11th grade	0.86	0.63–1.17	0.2494
12th grade	0.99	0.78–1.27	0.9526
Carry weapon	3.41	1.93–6.04	<b>0.0039</b>
Bullied at school	1.69	1.15–2.48	<b>0.0191</b>
Cyberbullied	2.78	1.80–4.29	<b>0.0028</b>
Weight perception			
Very underweight	1.89	1.44–2.47	<b>0.0026</b>
Slightly underweight	1.26	1.02–1.56	<b>0.0393</b>
Slightly overweight	0.93	0.80–1.08	0.2653
Very overweight	1.33	0.79–2.24	0.2023
Grades			
Mostly Bs	1.29	1.00–1.65	<b>0.0479</b>
Mostly Cs	2.03	1.71–2.42	<b>0.0003</b>
Mostly Ds	2.25	1.89–2.68	<b>0.0001</b>
Mostly Fs	2.89	2.15–3.87	<b>0.0004</b>
Not sure	2.54	2.04–3.17	<b>0.0002</b>
Sexual identity			
Sexual minority	2.32	1.79–3.00	<b>0.0008</b>
Unsure	1.99	1.21–3.29	<b>0.0184</b>
Ordinal regression thresholds			
0 times   1 time	2.87	2.62–3.11	< <b>0.0001</b>
1 time   2–3 times	3.82	3.57–4.07	< <b>0.0001</b>
2–3 times   4–5 times	5.21	4.84–5.76	< <b>0.0001</b>
4–5 times   6+ times	5.95	5.62–6.28	< <b>0.0001</b>

Reference categories: Sex = Female; Grade = 9th Grade; Weight perception: About the Right Weight; Grades = Mostly As; Sexual Identity = Heterosexual

The intercept was set to zero for identifiability. p-values below  $\alpha = 0.05$  are bolded to emphasize statistical significance. (N = 6225)