

Protective Factors Against Substance Use in Gender-Based Violence Exposed Adolescents

Lindsey Huang and Junpei Tarashi
lindseyhuang09@gmail.com

ABSTRACT

Adolescents exposed to gender-based violence (GBV) face elevated risk of substance use (SU), yet little research has examined what protects some exposed youth from this outcome. This study used the 2023 Youth Risk Behavior Surveillance System (YRBSS), a nationally representative U.S. dataset, to identify factors associated with substance-use resilience among GBV-exposed adolescents. Of 19,856 students with complete study variables, 3,319 (16.7%) reported GBV exposure. GBV-exposed youth showed substantially higher substance use severity than non-exposed peers (mean severity score 5.39 vs. 1.47) and elevated prevalence across nearly every substance examined, including a 3-fold increase in vaping and a 2.7-fold increase in prescription pain medication use. Despite this vulnerability, 32.7% of GBV-exposed youth reported no substance use. Using propensity-score matching to control for demographic differences, nine of eleven candidate protective factors were associated with resilience in bivariate comparisons; six remained independently significant after mutual adjustment in multivariable logistic regression: academic achievement (aOR=1.96), family monitoring (aOR=1.98), good mental health (aOR=1.75), safety from bullying (aOR=1.63), safe neighborhood (aOR=1.56), and healthy social media use (aOR=1.59). These findings, while cross-sectional and unable to establish causal direction, identify concrete, modifiable factors that could inform screening and intervention design for this high-risk population.

INTRODUCTION

Gender-based violence (GBV) is an act perpetrated without consent and rooted in gender-related stereotypes, including sexual abuse, sexual assault, domestic violence, and normalized rape ideologies such as catcalling (1). An estimated 650 million girls and women (1 in 5 people) experienced sexual violence as children, including 370 million (1 in 8 people) who were victims of rape or sexual assault (2). Gender-based violence is a prevalent issue worldwide and thus a priority that must be examined. GBV survivors often face physical, social, and mental health consequences. The disruption in psychological health in this population is strongly correlated with mental health disorders and behaviors, including substance use (SU) (1). SU is significantly more common among adolescents, with use often continuing into adulthood (3). About 90% of adults with SU disorders began using in adolescence, and

students who begin drinking before age 15 have 4 to 6 times the rate of alcohol dependence compared to those who delay use. Moreover, substance use such as alcohol during adolescence has been shown to negatively affect neurodevelopment, including working memory, emotional perception, and attention (4,5).

Research on the relationship between GBV and SU has several limitations. First, previous studies have often focused on the immediate impacts of GBV rather than its long-term effects, particularly on risk-taking behaviors (6). One study found that women who reported experiencing GBV had 2.5 times the odds of a SU disorder (1). However, few studies have examined how this vulnerable population might be protected against SU. While some studies have assessed protective environments for substance use among transgender youth without considering GBV exposure (7, 8), to our knowledge no study has examined protective factors against SU specifically among adolescents exposed to GBV.

To conduct this study, we used the Youth Risk Behavior Surveillance System (YRBSS), a dataset created by the Centers for Disease Control and Prevention (CDC) to measure health-related behaviors among U.S. adolescents (9). We used the most recent available dataset, collected in 2023. Factors collected in this dataset and considered here as candidate protective factors include academic grades, neighborhood safety, freedom from discrimination, mental health, school connectedness, bullying victimization, sports participation, family monitoring, adult support, social media use, and sleep duration. These factors were selected based on associations reported in prior literature.

Grades and safe neighborhoods were included because prior studies have found that youth exposed to violence and lower-achieving students are more likely to use illicit drugs such as marijuana (10, 11). Freedom from discrimination was considered because ethnic identity exploration has been associated with decreased alcohol and cannabis misuse (12). Good mental health was considered a candidate protective factor because Spanish adolescents who scored higher on a positive mental health questionnaire showed lower tobacco and alcohol use (13). School connectedness, family monitoring, and adult support were included because connectedness has been associated with reduced health risks, including SU, in adolescents (14, 15, 16). Freedom from bullying was considered because bullying victimization is strongly correlated with increased SU (17). Sports participation was included because physical activity has been associated with lower tobacco and other drug use in some studies, though possibly higher alcohol consumption in others (18). Healthy social media use was included because screen time of 3–6 hours per day has been associated with nearly double the odds of nonmedical drug use compared to lower-use adolescents (19). Finally, adequate sleep was examined because shorter sleep duration has been associated with stronger cravings for alcohol and cannabis (20).

Given the cross-sectional nature of this dataset, we framed our analysis around association rather than causal protection: we hypothesized that each of these factors would be associated with a lower likelihood of SU initiation or a lower severity of use among GBV-exposed adolescents, while recognizing that the direction of these relationships cannot be established from this design alone.

MATERIALS AND METHODS

To address these gaps in the literature, this study used the 2023 Youth Risk Behavior Surveillance System (YRBSS), a nationally representative dataset of U.S. high school students (n=19,856), to examine factors associated with substance use resilience among GBV-exposed adolescents (28).

Data Extraction and Validation

Variables were extracted from the raw YRBSS ASCII data file using column positions specified in the CDC's 2023 YRBS Data User's Guide. All 33 column positions used in this study were verified against the codebook's own "Data Location" table using a script that programmatically parses every position-to-variable mapping in the codebook. An automated quality-assurance check was incorporated into the analysis pipeline, comparing each variable's observed missingness in the loaded data against the missingness reported in the codebook for that same variable; this check flags any variable whose missingness differs from the codebook-reported value, providing an ongoing safeguard against column-misalignment errors in fixed-width data extraction.

Descriptive Analysis

Descriptive statistics were calculated for the full sample and separately for GBV-exposed and non-exposed subgroups. Categorical variables were summarized using frequencies and percentages, while continuous variables (severity scores, protective factor counts) were summarized using means. Substance use prevalence was compared between GBV-exposed and non-exposed groups and expressed as prevalence ratios to quantify relative risk.

Severity Analysis

A substance use severity score was constructed by summing frequency-of-use points across all substances examined (cigarettes, vaping, alcohol, marijuana, prescription pain medication, cocaine, inhalants, heroin, methamphetamine, ecstasy, and injection drugs), yielding a continuous total severity score ranging from 0 to 54 in this sample. For categorical analyses, youth were grouped into four severity categories based on total score: No Use (0 points), Low severity (1-3 points), Moderate severity (4-8 points), and High severity (9+ points). This scoring scheme and these thresholds were constructed for this study and have not been independently validated against clinical measures of substance use disorder severity; they are intended as a descriptive, data-driven ordinal ranking rather than a diagnostic instrument. Among GBV-exposed youth, the distribution of severity categories and mean protective factor counts were examined across severity levels. One-way analysis of variance (ANOVA) was used to test for differences in protective factor prevalence across severity categories. Spearman rank correlations were calculated between individual protective factors and severity measures (total, current, and illicit severity scores) to assess dose-response relationships.

Propensity Score Matching Analysis

To identify factors associated with resilience among GBV-exposed youth while controlling for demographic confounding, propensity score matching was conducted using the MatchIt package in R

(29). The analysis was restricted to GBV-exposed youth with complete demographic data (n=3,266). Nearest-neighbor matching was used with a 1:1 ratio and a caliper of 0.2 standardized units, matching resilient youth to non-resilient youth based on propensity scores estimated from logistic regression including age, sex, grade level, and Hispanic ethnicity as covariates. Balance was assessed using standardized mean differences (SMD), with values below 0.10 considered indicative of good balance; balance statistics before and after matching are reported in Table 4. In the matched sample, protective factor prevalence was compared between resilient and non-resilient groups using two-sample tests for proportions, with statistical significance set at $\alpha=0.05$.

Multivariable Logistic Regression

Following matching, multivariable logistic regression was conducted in the matched sample to estimate adjusted odds ratios for the association between each protective factor and resilience, with all 11 protective factors entered simultaneously. Results are reported as adjusted odds ratios with 95% confidence intervals (Table 6).

Risk Stratification

A risk stratification system was developed to categorize GBV-exposed youth by vulnerability level. Risk scores were calculated as: Risk Score = Total Severity Score - Protective Factor Count. Risk proportion was defined as: Risk Proportion = Risk Score / (Total Severity Score + 1), where the denominator adjustment prevented division by zero for abstinent youth. Risk categories were defined as: Low Risk (risk proportion ≤ 0.25), Moderate Risk ($0.25 < \text{risk proportion} \leq 0.50$), High Risk ($0.50 < \text{risk proportion} \leq 0.75$), and Very High Risk (risk proportion > 0.75). Chi-square tests were used to evaluate the association between risk category and severity category, and Spearman correlation was used to assess the relationship between the continuous risk proportion and continuous total severity score as a sensitivity check.

Missing Data

Missing data analysis was conducted to assess data quality for each variable, drawing on both the codebook's reported missingness and the automated QA check described above. For the matching analysis, complete-case analysis was used, requiring non-missing values for the demographic matching variables and the resilience outcome. For protective factor analyses, statistics were calculated using all available data for each specific factor, with sample sizes reported for each analysis. Missing values were not imputed, given the exploratory nature of several analyses and concern that imputation could introduce bias in protective factor estimates.

RESULTS

To conduct the analysis, R and associated R packages (tidyverse, MatchIt, cobalt, broom) were used. All fixed-width column positions used to extract variables from the raw YRBSS data file were verified against the CDC's 2023 YRBS Data User's Guide codebook using an automated parsing script (see Materials and Methods).

Sample Characteristics

The initial dataset included 20,103 participants. After filtering for variables relevant to this study (GBV exposure, substance use, protective factors, and demographics), the final analytic sample comprised 19,856 adolescents. Among all youth, alcohol was the most commonly used substance (21.6%), followed by vaping (17.8%) and marijuana (17.4%) (Figure 3D).

Of these, 3,319 (16.7%) were classified as GBV-exposed (Figure 2A). Within this GBV-exposed group, 3,266 had complete data on the demographic variables used for propensity-score matching (age, sex, grade, and Hispanic ethnicity); these 3,266 youth constitute the analytic sample for the matching and multivariable regression analyses reported below. All other analyses of GBV-exposed youth use the full available sample (n=3,319) unless otherwise noted.

Among GBV-exposed youth (n=3,319), 1,084 (32.7%) were classified as resilient (no substance use), while 2,235 (67.3%) reported some substance use (Figure 2A). When stratified by severity, GBV-exposed participants were distributed as follows: 1,084 with no use, 879 with low severity, 598 with moderate severity, and 758 with high severity (Figure 2B).

Substance Use Patterns

GBV-exposed youth demonstrated substantially elevated substance use severity compared to non-exposed peers. Among non-GBV-exposed students (n=16,537), the mean total severity score was 1.47. Among GBV-exposed students (n=3,319), the mean total severity score was 5.39, a 3.67-fold increase (Table 2). GBV-exposed youth showed markedly elevated prevalence across every substance category examined compared to non-exposed peers (Table 3). The largest relative increases were observed for injection drug use (4.8% vs. 0.6%; 8.00-fold), heroin (5.5% vs. 0.7%; 7.86-fold), and methamphetamine (6.3% vs. 0.8%; 7.88-fold), followed by cocaine (8.5% vs. 1.4%; 6.07-fold) and ecstasy (9.2% vs. 1.6%; 5.75-fold). More common substances also showed substantial elevation: cigarettes (10.8% vs. 2.7%; 4.00-fold), inhalants (15.2% vs. 4.0%; 3.80-fold), vaping (40.3% vs. 13.5%; 2.99-fold), prescription pain medication (25.6% vs. 9.4%; 2.72-fold), marijuana (36.7% vs. 13.6%; 2.70-fold), and alcohol (41.6% vs. 17.7%; 2.35-fold) (Figure 3C).

Among non-resilient GBV-exposed youth (n=2,199), the most commonly used substances were alcohol (61.7%), vaping (60.0%), marijuana (54.2%), prescription pain medications (37.5%), inhalants (22.4%), cigarettes (16.1%), cocaine (12.3%), methamphetamine (9.3%), and heroin (8.0%) (Figure 3B). Severity-level analysis revealed a clear dose-response gradient. Among high-severity users, 93.5% reported vaping, 87.4% reported alcohol use, and 87.4% reported marijuana use; 55.1% had used prescription pain medications and 39.6% had used inhalants. Among moderate-severity users, 70.8% reported vaping and 55.7% reported alcohol use. Among low-severity users, alcohol was the predominant substance (44.0%), followed by prescription pain medications (29%) (Figure 2C, Figure 3A).

Protective Factor Analysis

One-way analysis of variance (ANOVA) comparing protective factor prevalence across severity groups (No Use, Low, Moderate, High) among GBV-exposed youth revealed significant differences for 9 of 11 factors. Academic grades showed the largest effect ($F=44.15$, $p<0.001$), followed by family monitoring ($F=33.80$, $p<0.001$), safe neighborhood ($F=33.77$, $p<0.001$), safety from bullying ($F=25.32$, $p<0.001$), strong adult support ($F=16.79$, $p<0.001$), adequate sleep ($F=10.26$, $p<0.001$), good mental health ($F=9.57$, $p<0.001$), healthy social media use ($F=7.01$, $p<0.001$), and freedom from discrimination ($F=6.50$, $p<0.001$). Sports participation and school connectedness did not differ significantly across severity groups (Figure 1A).

Spearman rank correlations between individual protective factors and total substance use severity score showed family monitoring with the strongest negative association ($\rho=-0.217$, $p<0.001$), followed by academic grades ($\rho=-0.201$, $p<0.001$) and safe neighborhood ($\rho=-0.197$, $p<0.001$), indicating that higher levels of each factor were associated with lower substance use severity (Figure 1B).

Demographic and Subgroup Differences

Resilience and protective factor patterns also varied by demographic subgroup among GBV-exposed youth. Resilience rates differed significantly by sex (chi-square=9.89, $p=0.002$): 36.4% of male GBV-exposed youth ($n=1,068$) were resilient compared to 30.9% of female GBV-exposed youth ($n=2,251$), despite similar mean protective factor counts across sexes (4.07 vs. 4.05, $p=0.87$). Despite their higher resilience rate, males showed a higher mean substance use severity score than females (6.48 vs. 4.87), suggesting that among male GBV-exposed youth who do use substances, use tends to be more severe than among female users (Table 1). Females showed higher rates of good grades (66.2% vs. 57.8%), while males showed higher rates of sports participation (57.6% vs. 46.5%).

Resilience rates and protective factor counts also differed significantly by grade level (chi-square=26.67, $p<0.001$ for resilience; $F=18.11$, $p<0.001$ for protective factor count) and by age (chi-square=21.43, $p=0.0003$ for resilience; $F=23.70$, $p<0.001$ for protective factor count), with older/higher-grade students showing lower resilience rates (from 38.1% in 9th grade to 27.1% in 12th grade) but higher mean protective factor counts and higher mean severity scores among those who did use substances, suggesting a shift toward more entrenched use patterns among older GBV-exposed adolescents despite comparable or greater protective factor presence (Table 1). Resilience and protective factor count did not differ significantly by Hispanic ethnicity ($p=0.37$ and $p=0.34$, respectively).

Propensity Score Matching

Propensity score matching was conducted within GBV-exposed youth to control for demographic confounding, using the MatchIt package in R with nearest-neighbor matching (1:1 ratio, caliper = 0.2 standardized units) on age, sex, grade, and Hispanic ethnicity. Of 3,266 GBV-exposed youth with complete demographic data, 1,067 resilient youth were matched to 1,067 non-resilient youth (matched sample $n=2,134$; 1,132 non-resilient youth remained unmatched). Matching substantially improved covariate balance (Table 4): standardized mean differences fell from 0.249 (propensity score), -0.133 (age), 0.116 (sex), -0.204 (grade), and -0.037 (Hispanic ethnicity) in the unmatched sample to 0.0004,

0.000, 0.014, 0.006, and 0.000, respectively, in the matched sample, all well below the conventional threshold of 0.10, indicating good balance.

In the matched sample, 9 of 11 protective factors showed significantly higher prevalence among resilient than non-resilient youth (Table 5). The largest absolute differences were observed for good grades (72.5% vs. 56.3%; difference = 16.1 percentage points, $p < 0.001$), safety from bullying (55.9% vs. 40.8%; $p < 0.001$), family monitoring (82.2% vs. 69.7%; $p < 0.001$), and safe neighborhood (66.6% vs. 52.9%; $p < 0.001$). Good mental health (24.4% vs. 15.7%, $p < 0.001$), freedom from discrimination (56.1% vs. 48.6%, $p = 0.001$), adequate sleep (20.6% vs. 13.3%, $p < 0.001$), healthy social media use (20.2% vs. 14.4%, $p = 0.001$), and strong adult support (82.5% vs. 78.2%, $p = 0.026$) were also significantly higher among resilient youth. Sports participation (50.5% vs. 49.8%, $p = 0.79$) and school connectedness (44.1% vs. 42.7%, $p = 0.61$) did not differ significantly between groups.

Multivariable Logistic Regression

Multivariable logistic regression, adjusting for all 11 protective factors simultaneously in the matched sample ($n = 1,215$ with complete data across all factors), identified 6 factors as independently significant predictors of resilience (Table 6): academic grades (adjusted OR=1.96, 95% CI 1.52-2.54, $p < 0.001$), family monitoring (aOR=1.98, 95% CI 1.46-2.69, $p < 0.001$), good mental health (aOR=1.75, 95% CI 1.27-2.42, $p < 0.001$), safety from bullying (aOR=1.63, 95% CI 1.28-2.08, $p < 0.001$), safe neighborhood (aOR=1.56, 95% CI 1.22-1.99, $p < 0.001$), and healthy social media use (aOR=1.59, 95% CI 1.14-2.22, $p = 0.007$).

Notably, strong adult support (significant in the bivariate matched comparison) did not remain independently significant after adjustment (aOR=0.82, 95% CI 0.59-1.13, $p = 0.23$). This attenuation likely reflects overlap between adult support and family monitoring, which were correlated with one another and which showed similar bivariate effects; once family monitoring was included in the model, adult support no longer contributed unique predictive information. Sports participation was not significantly associated with resilience in either the bivariate ($p = 0.79$) or multivariable analysis (aOR=0.93, 95% CI 0.73-1.18, $p = 0.55$). Freedom from discrimination (aOR=1.07, $p = 0.60$) and school connectedness (aOR=0.84, $p = 0.15$) were also not independently significant, though adequate sleep showed a trend toward significance (aOR=1.34, 95% CI 0.96-1.87, $p = 0.085$).

Intervention Improvement-Opportunity Analysis

Combining each protective factor's population-level prevalence gap with its effect strength from the multivariable regression identified adequate sleep, healthy social media use, and good mental health as the factors with the greatest improvement-opportunity scores (Figure 4), reflecting that 79-84% of GBV-exposed youth did not currently meet these factors, combined with meaningful (though not the largest) individual effect sizes. This improvement-opportunity ranking reflects where population-level room for change is largest and should be interpreted alongside, rather than in place of, the effect-size-based rankings from Table 6, since a factor can show a strong effect on resilience while already being common enough that further population-level gains are limited (as with academic grades

and family monitoring), or a more modest effect while being rare enough that broad improvement could still shift more youth toward resilience.

Risk Stratification

Risk scores were calculated as the difference between total severity score and protective factor count, converted to a risk proportion (see Materials and Methods). Among GBV-exposed youth with complete data ($n=3,266$), 2,162 (66.2%) were classified as low risk, 344 (10.5%) as moderate risk, 405 (12.4%) as high risk, and 355 (10.9%) as very high risk (Table 7). As expected by construction, all 1,067 resilient (no substance use) youth fell into the low-risk category, since risk score is non-positive by definition for youth reporting no substance use.

Risk category was strongly associated with severity category (chi-square=2692.9, $df=9$, $p<0.001$; Table 7). Among high-severity youth ($n=746$), 79.9% fell into the high or very high risk categories, compared to essentially none of the low- or no-use severity groups. A sensitivity check using the continuous risk proportion showed a very strong positive correlation with total severity score (Spearman's $\rho=0.923$, $p<0.001$). Because the risk score is calculated in part directly from severity score, this strong correlation indicates that the risk stratification measure substantially recapitulates the severity categorization, adjusted modestly by protective factor count, rather than functioning as an independent predictive model. We report it here as a descriptive, statistically validated re-expression of severity rather than as a novel independent risk-prediction tool.

DISCUSSION

This study examined factors associated with substance-use resilience among GBV-exposed adolescents using a nationally representative sample ($n=19,856$; 3,319 GBV-exposed). Several principal findings emerged. First, GBV-exposed youth demonstrated substantially elevated substance use severity (mean score 5.39 vs. 1.47) and elevated prevalence across nearly every substance category examined, relative to non-exposed peers. Second, despite this heightened vulnerability, roughly one third of GBV-exposed youth (32.7%) reported no substance use, indicating that resilience in this population is common rather than exceptional. Third, of the eleven candidate protective factors examined, nine were associated with resilience in bivariate comparisons, and six remained independently associated with resilience after mutual adjustment: academic achievement, family monitoring, good mental health, safety from bullying, neighborhood safety, and healthy social media use.

The elevated substance use severity among GBV-exposed youth is consistent with established literature linking trauma and addiction. Walsh and colleagues (2015) reported that women experiencing GBV have 2.5 times the odds of developing a substance use disorder; our cross-sectional findings are consistent with a broader pattern in which GBV exposure is associated with both higher rates of substance use and greater severity among those who use. We interpret this as an association rather than a demonstrated causal escalation pathway, since our design cannot establish temporal order.

The differential elevation of risk across substance categories may reflect self-medication patterns, though

this interpretation remains speculative given the cross-sectional design. The elevated prevalence of prescription pain medication use (25.6% vs. 9.4%) is consistent with several plausible mechanisms, including management of physical injury, coping with trauma-related distress, or intentional use for emotional numbing (21, 22, 23); mechanisms that would need to be tested directly in future research rather than inferred from prevalence differences alone.

Vaping showed the expected pattern in this sample of higher prevalence among GBV-exposed youth (40.3%) than non-exposed youth (13.5%), consistent with the pattern observed for every other substance examined and with prior literature linking trauma exposure to elevated substance use risk generally (24). Sports participation showed no significant association with resilience in either bivariate or multivariable analysis. This null finding is consistent with the mixed literature on adolescent sports participation and substance use, which has linked physical activity to lower use of some substances but potentially higher alcohol consumption (18); based on these data, we do not interpret sports involvement as either a risk or protective factor for this population.

Academic achievement was the strongest single correlate of resilience in both bivariate and multivariable analyses, consistent with prior work linking academic engagement to reduced adolescent substance use (10, 11, 15, 25, 26). Family monitoring showed a comparably strong, independent association, consistent with literature on parental monitoring as a protective factor (15). Notably, adult support in the household was significantly associated with resilience in bivariate comparison but not after adjustment for family monitoring, suggesting these two constructs, which both capture forms of consistent adult oversight and care, may represent overlapping rather than independent protective mechanisms in this population. Future work with larger samples or structural equation approaches could help disentangle whether one construct mediates the other.

Good mental health, safety from bullying, neighborhood safety, and healthy social media use each remained independently associated with resilience after adjustment, aligning with prior literature linking each construct to reduced adolescent substance use risk (13, 17, 19). Freedom from discrimination, adequate sleep, and school connectedness showed significant bivariate associations that did not reach significance in the fully adjusted model, which may reflect genuinely weaker independent effects, correlation with other included factors, or reduced power in the complete-case regression sample (n=1,215).

This study has several methodological strengths. First, it uses a large, nationally representative sample, supporting generalizability to the U.S. adolescent population. Second, propensity score matching controls for demographic confounding between resilient and non-resilient GBV-exposed youth, strengthening the comparison beyond an unadjusted association. Third, the severity-based approach provides more nuanced information than a binary substance-use measure, revealing a clear dose-response pattern between protective factor prevalence and severity. Fourth, to our knowledge this is among the first studies to systematically examine protective factors at the intersection of GBV exposure and substance use in a national adolescent sample.

Several limitations warrant acknowledgment. First, substantial missing data affected multiple protective factor variables, particularly family monitoring (45.7% missing), school connectedness (44.0%), sports participation (35.4%), and safe neighborhood (27.2%) . This missingness may have reduced statistical power and could bias estimates if missingness is related to the outcome. Second, the cross-sectional design precludes causal inference throughout this study; all associations reported here, including for academic achievement, family monitoring, and other significant factors, should be interpreted as correlational. Reverse causation (e.g., substance use impairing academic performance) and bidirectional relationships remain plausible alternative explanations that this design cannot rule out. Third, self-report measures are subject to recall bias, social desirability bias, and differential disclosure based on trauma history; the 16.7% GBV prevalence observed here likely underestimates true prevalence, consistent with evidence that self-reported GBV substantially underestimates true prevalence relative to formal and informal disclosure (27). Fourth, the YRBSS dataset does not capture some potentially important protective factors, such as access to mental health services or quality (rather than mere presence) of relationships, and its binary coding of protective factors obscures potentially meaningful gradations. Fifth, this analysis does not distinguish between types of GBV (e.g., sexual violence vs. physical dating violence), which may relate differently to substance use patterns and protective mechanisms.

Several research directions would advance this work. Longitudinal studies are needed to establish temporal relationships between GBV exposure, protective factor development, and substance use trajectories, and to clarify whether protective factors prevent initiation, slow escalation, or both. Research disentangling the overlapping roles of family monitoring and adult support would help clarify whether these represent distinct or redundant protective mechanisms. Cross-cultural replication would help determine whether findings generalize beyond the U.S. context. Finally, intervention research should test whether modifiable protective factors identified here (healthy social media use, adequate sleep, and good mental health) can be enhanced in GBV-exposed youth, and whether such enhancement is associated with reduced substance use outcomes over time.

Gender-based violence exposure is associated with substantially elevated adolescent substance use severity across nearly every substance category examined. Despite this vulnerability, resilience is common, with roughly one third of GBV-exposed youth reporting no substance use. Academic achievement, family monitoring, good mental health, safety from bullying, neighborhood safety, and healthy social media use each showed independent associations with resilience, while sports participation showed no significant association with resilience. These findings identify concrete, potentially modifiable correlates of resilience that may inform screening and intervention design, while underscoring that the cross-sectional nature of this study limits any claim to causal protection.

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TABLES

Table 1. Demographic characteristics and resilience outcomes among GBV-exposed youth, by subgroup

Resilience rates, mean protective factor counts, and mean substance use severity scores among GBV-exposed youth (n=3,319), broken down by sex, grade, age, and Hispanic ethnicity. Resilience declined steadily with increasing grade and age, while male GBV-exposed youth showed both a higher resilience rate and a higher mean severity score than female GBV-exposed youth. Resilience and protective factor counts did not differ significantly by Hispanic ethnicity.

Subgroup	n	Resilient (%)	Mean Protective Score	Mean Severity Score
Sex				
Female	2,251	30.9	4.05	4.87
Male	1,068	36.4	4.07	6.48
Grade				
9th	889	38.1	3.92	4.34
10th	809	34.9	3.99	5.03
11th	848	30.1	4.13	5.47
12th	724	27.1	4.36	6.07

Subgroup	n	Resilient (%)	Mean Protective Score	Mean Severity Score
Age				
14 years	342	39.2	--	4.16
15 years	824	35.7	--	4.11
16 years	866	33.9	--	5.52
17 years	827	29.5	--	5.32
18 years or older	425	26.6	--	6.83
Hispanic Ethnicity				
Yes	741	34.1	4.01	6.10
No	2,549	32.3	4.09	5.19

Note: n=3,319 GBV-exposed youth overall. Subgroup n's do not sum exactly to 3,319 in all cases due to missing demographic data and exclusion of grade/age categories with n<30 (ungraded/other grade, n=20; age 12 or younger, n=29; age 13, n=6) per the original subgroup analysis. See Results (Demographic and Subgroup Differences) for significance tests.

Table 2. Substance use severity by GBV exposure status

Mean total severity score and the distribution across severity categories (No Use, Low, Moderate, High), compared between non-GBV-exposed (n=16,537) and GBV-exposed (n=3,319) students. GBV-exposed youth showed a more than 3-fold higher mean severity score and were substantially more likely to fall into the moderate or high severity categories.

Characteristic	Non-GBV-Exposed (n=16,537)	GBV-Exposed (n=3,319)
Mean total severity score	1.47	5.39
No substance use, %	67.1%	32.7%
Low severity, %	19.2%	26.5%
Moderate severity, %	8.6%	18.0%
High severity, %	5.1%	22.8%

Table 3. Substance use prevalence by GBV exposure status

Prevalence of each substance examined among non-exposed and GBV-exposed students, with the corresponding fold increase in GBV-exposed prevalence relative to non-exposed. GBV-exposed youth showed elevated use of every substance examined; the largest relative increases were for injection drug

use, methamphetamine, and heroin, while the most prevalent substances in absolute terms were vaping and alcohol.

Substance	Non-Exposed (%)	GBV-Exposed (%)	Fold Increase
Cigarettes	2.7	10.8	4.00
Vaping	13.5	40.3	2.99
Alcohol	17.7	41.6	2.35
Marijuana	13.6	36.7	2.70
Prescription pain medication	9.4	25.6	2.72
Heroin	0.7	5.5	7.86
Injection drugs	0.6	4.8	8.00
Cocaine	1.4	8.5	6.07
Methamphetamine	0.8	6.3	7.88
Ecstasy	1.6	9.2	5.75
Inhalants	4.0	15.2	3.80

Note: fold increase = GBV-exposed prevalence / non-exposed prevalence, computed from unrounded values where available.

Table 4. Propensity score matching balance diagnostics

Standardized mean differences (SMD) for the propensity score and each matching covariate (age, sex, grade, Hispanic ethnicity), shown before (unmatched) and after (matched) 1:1 nearest-neighbor matching. All SMDs fell below the conventional 0.10 threshold after matching, indicating good covariate balance between resilient and non-resilient GBV-exposed youth.

Covariate	SMD (Unmatched)	SMD (Matched)
Propensity score	0.249	0.0004
Age	-0.133	0.000
Sex	0.116	0.014
Grade	-0.204	0.006
Hispanic ethnicity	-0.037	0.000

Table 5. Protective factors in matched sample (bivariate comparison)

Prevalence of each protective factor among resilient versus non-resilient GBV-exposed youth in the propensity score matched sample (n=2,134), with the percentage point difference and statistical significance for each comparison. Nine of eleven factors were significantly more prevalent among

resilient youth, led by good grades (16.1 percentage points), safety from bullying (15.1 points), and safe neighborhood (13.7 points), with family monitoring also showing a large and significant difference (12.5 points); only sports participation and school connectedness did not differ significantly between groups.

Protective Factor	Resilient (%)	Non-Resilient (%)	Diff. (pp)	p-value	Sig.
Good grades	72.5	56.3	16.1	<0.001	Yes
Plays sports	50.5	49.8	0.7	0.79	No
Healthy social media use	20.2	14.4	5.8	0.001	Yes
Good mental health	24.4	15.7	8.7	<0.001	Yes
Safe from bullying	55.9	40.8	15.1	<0.001	Yes
Safe neighborhood	66.6	52.9	13.7	<0.001	Yes
Free from discrimination	56.1	48.6	7.5	0.001	Yes
Adequate sleep	20.6	13.3	7.3	<0.001	Yes
Strong adult support	82.5	78.2	4.4	0.026	Yes
Feels school connected	44.1	42.7	1.4	0.61	No
Family monitoring	82.2	69.7	12.5	<0.001	Yes

Table 6. Multivariable logistic regression: adjusted odds ratios for resilience

Adjusted odds ratios (aOR) with 95% confidence intervals for all 11 protective factors entered simultaneously into a multivariable logistic regression model predicting resilience. Six factors remain independently significant after mutual adjustment: good grades, family monitoring, good mental health, safety from bullying, safe neighborhood, and healthy social media use. Strong adult support was significant in the bivariate comparison but not after adjustment, consistent with overlap between adult support and family monitoring.

Protective Factor	aOR	95% CI	p-value
Good grades	1.96	1.52-2.54	<0.001
Plays sports	0.93	0.73-1.18	0.55
Healthy social media use	1.59	1.14-2.22	0.007
Good mental health	1.75	1.27-2.42	<0.001
Safe from bullying	1.63	1.28-2.08	<0.001
Safe neighborhood	1.56	1.22-1.99	<0.001

Protective Factor	aOR	95% CI	p-value
Free from discrimination	1.07	0.84-1.36	0.60
Adequate sleep	1.34	0.96-1.87	0.085
Strong adult support	0.82	0.59-1.13	0.23
Feels school connected	0.84	0.65-1.06	0.15
Family monitoring	1.98	1.46-2.69	<0.001

Table 7. Risk stratification category by substance use severity category (n=3,266)

Cross-analysis of risk category (Low, Moderate, High, Very High) against substance use severity category among GBV-exposed youth with complete demographic data (n=3,266). The risk category was strongly associated with the severity category; nearly all resilient (no-use) youth fell into the low-risk category by construction, and high and very high risk classifications were concentrated almost entirely among high-severity users, reflecting the risk score's derivation from the severity score.

Risk Category	n	%	High Sev.	Mod. Sev.	Low Sev.	No Use
Low Risk	2,162	66.2	13	271	811	1,067
Moderate Risk	344	10.5	137	159	48	0
High Risk	405	12.4	270	128	7	0
Very High Risk	355	10.9	326	29	0	0

Note: chi-square test of risk category x severity category: chi-square=2692.9, df=9, p<0.001. Spearman correlation between continuous risk proportion and total severity score: rho=0.923, p<0.001, indicating substantial overlap between the risk stratification measure and the underlying severity score (see Discussion).

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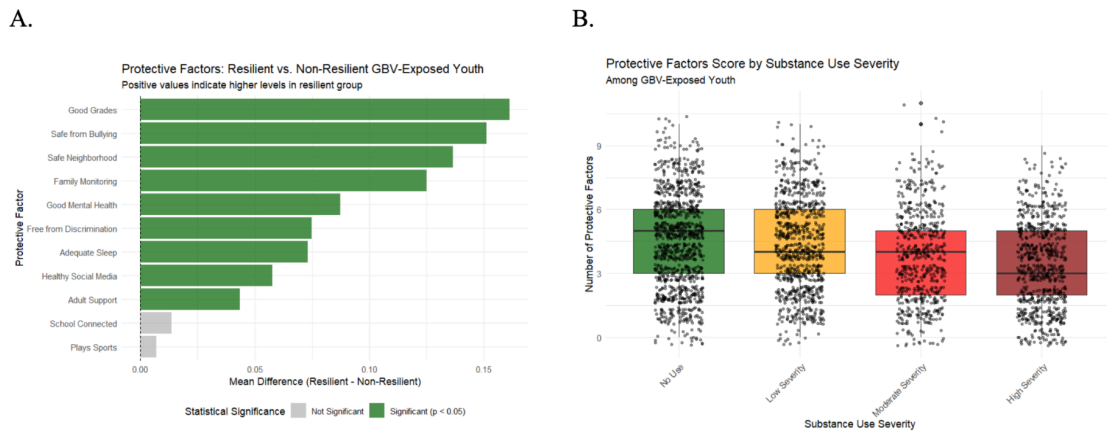


Figure 1. Protective factors associated with resilience among GBV-exposed youth.

(A) Bar graph showing the difference in prevalence of each protective factor between resilient and non-resilient GBV-exposed youth in the propensity-score-matched sample (n=2,134). Bars are colored to indicate statistical significance (p<0.05, shown in green) versus non-significance (shown in gray); sports participation and school connectedness were not significant whereas other examined factors were significant. (B) Bar graph showing the mean number of protective factors present, by substance use severity category, among GBV-exposed youth (n=3,319), illustrating a dose-response relationship between protective factor count and severity. No use groups had the highest average number of protective factors among all severity categories.

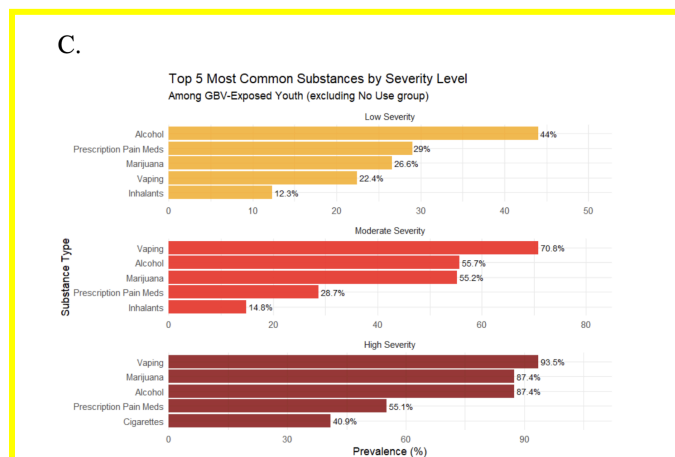
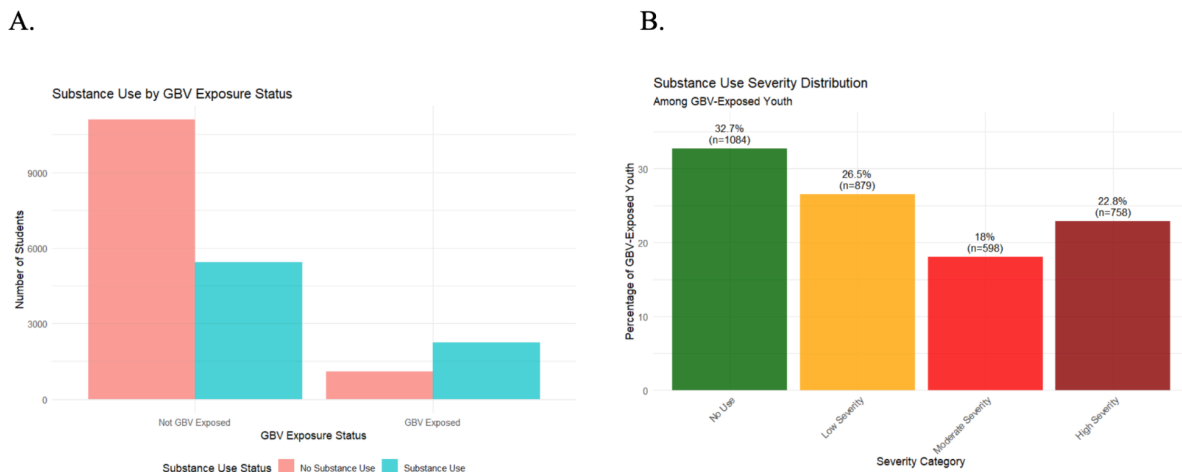


Figure 2. Adolescent substance use exposure and severity.

(A) Bar graph comparing the proportion of students reporting any substance use, by GBV exposure status (n=19,856). The GBV-exposed group consisted of more adolescents engaging in substances than not while the majority of the non-GBV-exposed group did not engage in substances. (B) Bar graph showing the number of GBV-exposed adolescents (n=3,319) in each substance use severity category (No Use, Low, Moderate, High). Most GBV-exposed adolescents engaged in substance use, most of whom were commonly a part of the low severity category. (C) Bar graph showing the top five most commonly used substances within each severity category (Low, Moderate, High) among GBV-exposed youth. Alcohol was the most common substance among low-severity users (44.0%), while vaping was most common among both moderate-severity (70.8%) and high-severity (93.5%) users.

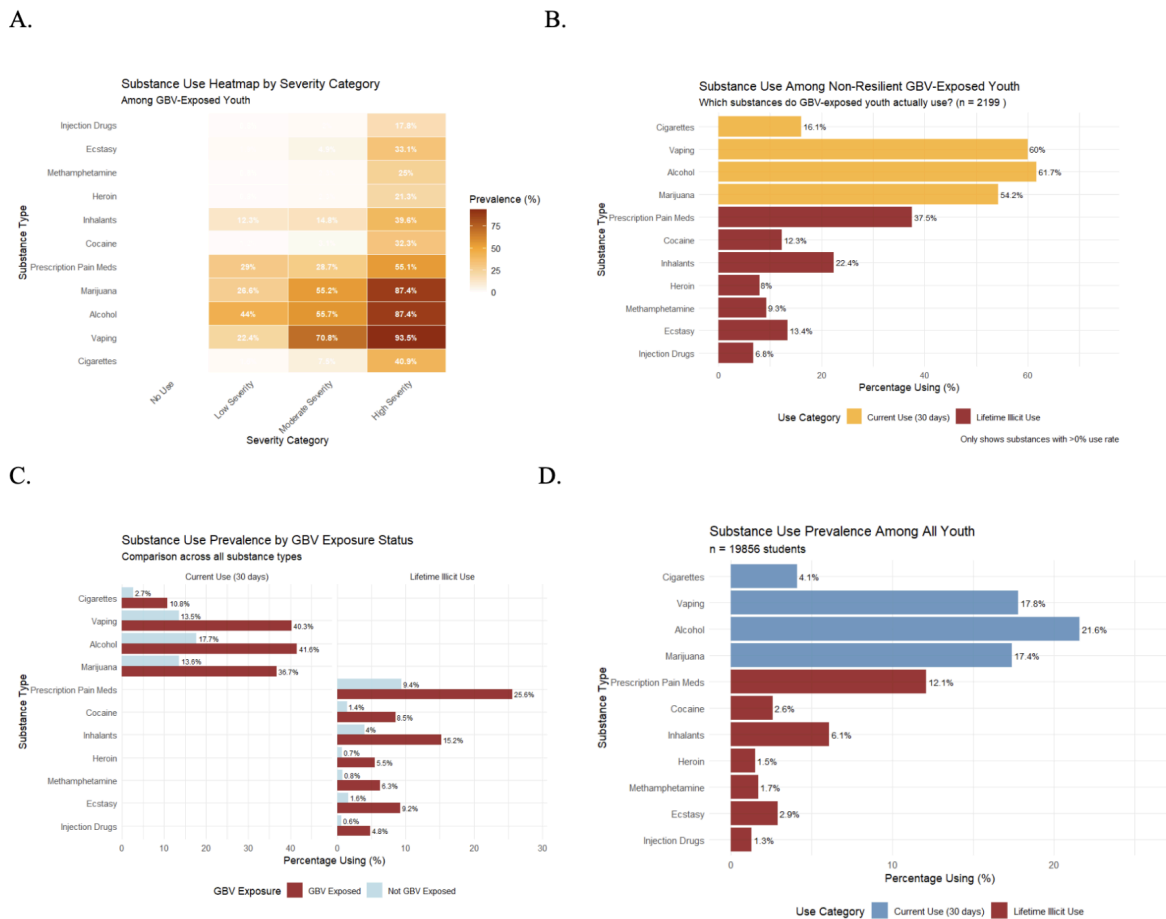


Figure 3. Substance use prevalence among adolescent groups.

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(A) Heatmap showing prevalence of each substance examined, by severity category, among GBV-exposed youth (n=3,319). Vaping had the highest prevalence in the highest severity group with 93.5% of GBV-exposed youth reporting engagement. (B) Bar graph showing the percentage of non-resilient GBV-exposed youth (n=2,199) who used each substance examined. Alcohol and vaping emerged as the most commonly used substances with 61.7% and 60% respectively of non-resilient GBV-exposed youth reporting use. (C) Bar graph comparing substance use prevalence between GBV-exposed (n=3,319) and non-exposed (n=16,537) adolescents, for each substance examined. GBV-exposed youth reported more use in every substance examined when compared to the non GBV-exposed group. (D) Bar graph showing substance use prevalence in the full study population (n=19,856), separating current-use substances from lifetime illicit-use substances. The adolescents surveyed tended to use current substances over illicit-use substances with the highest percent of youth consuming alcohol.

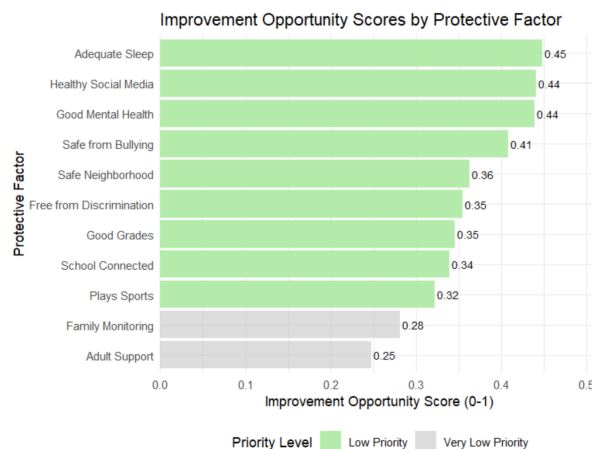


Figure 4. Protective factor improvement-opportunity analysis.

Ranked bar chart showing an improvement-opportunity score (0–1) for each of the eleven candidate protective factors among GBV-exposed youth, combining each factor's population-level prevalence gap with its effect strength from the multivariable regression (Table 6). Adequate sleep, healthy social media use, and good mental health showed the highest scores.

APPENDIX

Full R analysis code available [here](#).