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“Do adolescent risk behaviors mediate health and school bullying? Testing the Stress Process and General Strain Frameworks.”

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Abstract

Adolescent bullying is a significant public health issue in the United States. The health consequences of bullying may vary, however, according to the social position and characteristics of victims and bullies within the bullying subculture. For example, research suggests that bully involved youth are more likely to engage in risky health behaviors, including social withdrawal, tobacco, and alcohol use. Yet, the extent to which health outcomes are shaped by involvements in bullying or the risk behaviors associated with bullying remains unclear. In this study we assess the extent to which risk behaviors mediate the links between health outcomes of bully-involved youth using data from the Health Behavior of School Aged Children 2005-2006 Study (N=8066). School-level fixed-effects regression models assessed whether risk behaviors mediate relationships between bullying statuses and somatic and depressive symptoms. Results show that mediational risk behavior pathways vary across outcomes for youth situated differently in the bullying subculture, with substantially more mediation for bullies than victims. This study advances the current bullying and health research by accounting for risk behavior pathways linking bullying and health.

Keywords

Adolescence; bullying; health; risk behaviors; mediation; fixed-effect

1 Introduction

Each year approximately 7 million students are involved in school bullying (Moore et al. 2012). This estimate is striking both for its magnitude and because involvement in different facets of bullying are so commonly associated with adverse health outcomes that bullying is now recognized as an important public health issue (Bogart et al. 2015). Bullying is consistently associated with risks for depression, anxiety, suicide, somatic complaints, and

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behavioral problems for adolescents (Bauman et al. 2013; Gini & Pozzoli 2009). Additionally, the somatic and depressive outcomes associated with bullying can last for years, persisting into adulthood and significantly decreasing quality of life (Bauman et al. 2013; Gini & Pozzoli 2009; Heino et al. 2000). Yet, there are important distinctions to be made about bullying involvement because victims, bullies, and bully-victims experience different negative health consequences resulting from their positioning within the bullying subculture (O'Brennen et al. 2009; Houbre et al. 2006; Heino et al. 2000).

The problem of bullying and health is complicated by the nature of the interactions in which bullying takes place. Being a bully different than being a victim, thus raising questions about how health is differentially shaped for youth who occupy different positions within the bullying subculture. Indeed, being a victim is associated with greater isolation and social withdrawal (Guerra et al. 2011; O'Brennen et al. 2009; Houbre et al. 2006). However, social isolation, withdrawal, and loss of social supports are also associated with poorer physical and mental health (e.g. Woodhead et al. 2014; Thoits 2010). Likewise, although bullies and bully-victims tend to report worse somatic and depressive symptoms than the non-involved, bullies and bully-victims are also more likely to use alcohol, tobacco, or fight when compared to their non-involved peers (Pepler et al. 2008; Houbre et al. 2006; Heino et al. 2001). Thus, the negative health outcomes among victims, bullies, and bully-victims may be at least partially explained by these groups' higher likelihoods of engaging in risky health behaviors.

This study tests whether risk behaviors help explain the association between bullying and health. Prior research is clear that victims, bullies, and bully-victims experience more negative somatic and depressive symptoms than the non-involved. However, the extent to which differences in health outcome among bullying groups are explained by engaging in certain types of risk behaviors remains unclear. This study therefore has two goals: a) to assess the levels somatic and depressive symptoms among adolescents involved in school bullying, and b) to determine whether and how certain adolescent health risk behaviors account for variation in somatic and depressive symptoms among victims, bullies, and bully-victims. In doing so, this study assesses the degree to which somatic and depressive symptoms vary among bully-involved adolescents, whether the pathways to risk behaviors differ among the bully-involved, and finally whether adolescent health risk behaviors help account for the health differences noted among victims, bullies, and bully-victims.

2 Literature Review

2.1 Defining School Bullying and Health

School bullying is defined as “aggressive behavior or intentional harm-doing, which is carried out repeatedly and over time, and in an interpersonal relationships characterized by an imbalance in power” (Olweus 1997: 496). Researchers outline roles within this context as victim, bully, and bully-victim. Victims are often viewed by peers both as unpopular and as having poor social skills. Victims often report feeling excluded, report lower self-esteem, and are more likely to withdraw and isolate from their peers relative to bullies or the non-involved (Thornberg et al. 2011; Toblin et al. 2005). Additionally, victimization may occur occasionally or in some cases can be “persistent and extreme” (Schwartz 2000, p. 191). In

terms of health, victims of school bullying report higher levels of depression, anxiety, suicidal ideation, and isolation than non-victims (Bauman et al. 2013; Campbell et al. 2013; Gini & Pozzoli 2009). Victims also report more frequent depressive symptoms and somatic complaints including headaches, stomachaches, difficulty sleeping, feeling low and feeling tired (Gini et al. 2009; Jellesma et al. 2006; Natvig et al. 2001). Victims may also cope with victimization through withdrawal, self-blame, and internalization of negative feelings, which may consequently perpetuate the cycle of victimization and worsen health outcomes.

Bullies tend to be of average or slightly below or above average popularity with small but relatively close-knit groups of friends (Houbre et al. 2006). Studies show that bullies tend to report lower self-esteem than the non-involved and may be more likely to use substances or fight relative to victims and the non-involved (Houbre et al. 2006; Schwartz 2000). Research shows that the health consequences of bullying are similar to that of victims, though to a lesser degree. Bullies report more depression, substance use, and more behavioral problems than the non-involved (Gini et al. 2008; Heino et al. 2000). Bullies may also experience heightened feelings of anxiety and hypervigilance resulting from the bullying role (O'Brennen et al. 2009). Yet, bullies tend to report fewer somatic and depressive symptoms than victims or bully-victims. Prior research suggests that the lesser health consequences among bullies compared to victims or bully-victims may reflect higher self-esteem, higher levels of social support, and less internalized stress among bullies (Thornberg et al. 2011; Andreuo et al. 2005). Additionally, the social positioning of bullies may allow these adolescents to release frustrations on lower-status peers (Schwartz 2000). These positional and social characteristics of bullies may explain why bullies report fewer somatic and depressive symptoms than victims or bully-victims.

Lastly, bully-victims have recently become recognized as a third group in the bullying typology. Schwartz (2000) defines bully-victims as “aggressive victims”, or victims who retaliate towards others in response to their victimization. Prior research suggests that bully-victims are similar to victims and bullies in their social characteristics and health outcomes. However, bully-victims may have the most serious somatic and depressive outcomes among the bullying subtypes. Bully-victims may have higher likelihoods of depression, anxiety, eating disorders, and suicide rates compared to victims or bullies (Lester et al. 2012; O'Brennen et al. 2009; Houbre et al. 2006; Toblin et al. 2005). Bully-victims also report more somatic symptoms than bullies or the non-involved (Houbre et al. 2006). Similar to bullies, bully-victims are also more likely to engage in substance use and aggressive behaviors or fighting than victims or the non-involved (Houbre et al. 2006; Schwartz 2000). Bully-victims may also be more susceptible to the long-term physical and mental health consequences of bullying (O'Brennen et al. 2009).

2.2 Victims and Stress Process

Studies show that school victimization is stressful for adolescents (e.g. Olafsen & Viemero 2000; Sharp et al. 2000). In fact, some research suggests that school bullying may be one of the most pronounced stressors throughout childhood and adolescence (e.g. Vanaelst et al. 2011). Victimization in school can occur in both direct and relational ways including name-calling, hitting, spreading rumors, cyberbullying, or social exclusion. In the case of ongoing

(and perhaps occasional) victimization, it is likely the accumulation of stress that leads to the decreased mental and physical health outcomes noted among bullied adolescents as compared to the non-involved (Vanaelst et al. 2011; O'Brennen et al. 2009; Sharp et al. 2000).

Researchers suggest the links between stress and health can be understood as a *stress process*. Stress process theory suggests that somatic and depressive symptoms can result from elevated stressors (i.e. chronic events, major traumas, daily hassles, and life events) beyond which the person is effectively able to cope (Aneshensel 2009, 1992; Pearlin 1989). Given the absence of effective resources to buffer the influence of the accumulating stressors, stress levels increase and positive health outcomes decrease. Individuals who are unable to access positive coping resources (i.e. supportive social networks, social bonds, sense of self-mastery), may rely more heavily on negative coping strategies including social withdrawal and isolation, aggression, internalization, or alcohol abuse (Woodhead et al. 2014; Thoits 2006). These risk behaviors have been associated with decreased physical and mental health outcomes in adolescence (e.g. Hall-Lande 2007; Poikolainen et al. 1995).

Importantly, stress process theory can help elucidate the link between victimization and health. First, being bullied is stressful for adolescents. Second, victims and bully-victims often have fewer social bonds and resources on which to rely for support, and are also more likely to isolate or withdraw from their peers (e.g., O'Brennen et al. 2009). Third, social withdrawal and isolation are considered negative coping strategies that are themselves associated with poorer physical and mental health outcomes (Pearlin & Bierman 2013; Umberson & Montez 2010). However, prior research has not examined whether the somatic and depressive symptoms associated with victimization can be explained by the higher likelihood of victims and bully-victims engaging in negative coping risk behaviors. Thus, the first goal of this paper is to test the hypothesis that the somatic and depressive health outcomes for victims and bully-victims will be at least partially explained by victims and bully-victims' reliance on risk behaviors such as social isolation, high levels of computer gaming and television, and junk food as a means of coping with victimization stress.

2.3 Bullies and General Strain

Prior research suggests that the family, school, and community environments may all play roles in the emergence or desistence of bullying (Chaux & Castellanos 2015; Twemlow and Sacco 2013; Beaty and Alexeyev 2008; Baldry & Farrington 2000). Thus, the mechanisms used to explain what leads to bullying can be situated in terms of general strain theory. Agnew (2001) suggests that various forms of delinquency (e.g. bullying, vandalism, truancy, substance use) result from negative emotions in response to blocked goals or identities, unfair treatment, negative relationships, or conflict with wider social or cultural values. Adolescent strain can lead to delinquency through the expression of negative emotions (i.e. anger, frustration, depression) as well as through attempts to alleviate the experience of the strain (Moon & Jang 2014; Agnew 2001). In other words, fighting may thus be an expression of anger or an attempt to alleviate the feelings of anger. Additionally, individuals often engage in more than one type of delinquency and delinquent behaviors tend to cluster while under strain (e.g. vandalism and substance abuse) (Agnew 2001; Agnew 1992). In

short, bullying may be one of many other problem behaviors in adolescence that occurs alongside alcohol use, tobacco use, and/or fighting.

Relatively few studies have used general strain theory to help explain bullying in schools. In their application of general strain theory, Moon and Jang (2014) found that strains associated with family arguments and conflicts, negative experiences with teachers (i.e. feeling ignored, lack of motivation, compared negatively to others), and anger were positively associated with bullying. Similarly, Patchin and Hinduja (2011) found that increased strain (i.e. disagreements with parents and peers, negative relationships, problems at school) were positively associated with both 'traditional bullying' and 'cyberbullying' among adolescents. Thus, bullying and other problems may likely emerge from many areas of potential strain in adolescence.

Regarding the link between risk behaviors and bullying, research suggests that bullies and bully-victims are more likely to use substances, fight, carry weapons, and engage in more aggressive or impulsive acts than victims or the non-involved (e.g. Pepler et al. 2008; Houbre et al. 2006; Heino et al. 2000). General strain theory posits that such risk behaviors may be grouped together with bullying as a more general expression of strain. However, despite the suggestions that bullies and bully-victims are more likely to engage in various risk behaviors concurrently with their involvement in bullying and theoretically resulting from their experience of strain, the role of risk behaviors on bully and bully-victim health outcomes has not been adequately examined. Thus, the second goal of this paper is to test the hypothesis that the somatic and depressive health outcomes among bullies and bully-victims will partially explain bullies and bully-victims higher likelihoods of engaging in potentially risky health behaviors such as alcohol use, tobacco, and fighting as specified by the general strain pathway.

2.4 This Study

The purpose of this study therefore is to examine the extent to which risk behaviors serve as a potential alternative pathway linking bullying and health. Based upon prior findings and theory linking bullying involvement to both somatic and depressive symptoms and risk behaviors, this study proposes the three organizing hypotheses. First, that victims, bullies, and bully-victims experience more negative somatic and depressive symptoms than the non-involved. Second, that risk behaviors associated with the stress process pathway (i.e. social isolation, computer gaming, television and junk food) mediate the somatic and depressive symptoms of victims and bully-victims. Third, that risk behaviors associated with the general strain pathway (i.e. junk food, alcohol, tobacco, and fighting) mediate the somatic and depressive symptoms of bullies and bully-victims. Testing these hypotheses advances bullying and health research by accounting for and clarifying risk behavior pathways linking bullying broadly construed to important dimensions of health during adolescence.

3 Method

3.1 Data

This study uses the Health Behavior of School-Aged Children 2005-2006 Study (HBSC). The HBSC is a nationally representative, repeated cross-sectional survey of US adolescents in grades 6th-10th across public and private schools. The HBSC assesses adolescent health and development including exercise and eating habits, school, family, and peer relationships, and risk behaviors alongside core demographic variables. The 2005-2006 HBSC was conducted using a stratified random design across three phases. Public and private schools were selected at random from identified school districts and resulting in 227 schools. Classrooms were then randomly selected and students randomly selected from the classrooms. The survey was administered in school and resulted in a total of 9,227 surveyed students. The student response rate was 87.2%. School administrators were also surveyed, with 195 out of 227 school supervisors completing the survey for an 85.9% response rate.

Due to a subsample of 6th graders who did not complete the bullying portion of the survey ($N = 1161$), these students were not available for inclusion in the analysis. The resulting available sample for the analysis was 8,066 students across grades 6th-10th. Missing values ranged from 0-21.37% for all study covariates. As we describe below, the analyses were based on a multiple imputation analysis using 8,066 students who provided at least partial information across the exogenous variables (von Hippel 2007; Little & Rubin 2002). Descriptive statistics and percent missing for all variables prior to imputation are reported in Table 1. A weight variable adjusting for selection probabilities by race and grade derived from national totals provided by the National Center of Educational Statistics was applied to the analysis (Iannotti 2006).

3.2 Measures

3.2.1 Focal dependent variables—Two focal dependent variables are used in the analysis. First, the *somatic symptoms* scale ($\alpha = .73$) was created by mean scaling the following 6 items: frequency of a) headaches, b) stomachaches, c) backaches, d) feeling dizzy, e) difficulty sleeping, and f) feeling like not eating. Frequency of headaches, stomachaches, backaches, feeling dizzy, and difficulty sleeping was asked “over the past 6 months” and ranged from 1 = “rarely or never” to 5 = “about everyday”. Not feeling like eating was asked “over the past 30 days” and ranged from 1 = “never” to 5 = “always”. Measures of headache, stomachache, backache, and dizziness frequency were consistent with the Somatic Complaints Scale used in prior bullying research (e.g. Gini et al. 2009). Cases missing on two or more of the somatic scale items were not included in the analysis ($N = 130$). The final somatic measure ranges from 1 = “low” to 5 = “high” and was standardized for the analysis.

Second, the *depressive symptoms* scale ($\alpha = .78$) was created by mean scaling the following three items: a) frequency of feeling low, b) feeling sad, and c) feeling hopeless. Feeling low was asked “over the past 6 months” and coded 1 = “rarely or never” to 5 = “about everyday”. Frequency of feeling sad and hopeless were asked “over the past 30 days” and was coded where 1 = “never” to 5 = “always”. The variables for feeling irritable, nervous, and having

trouble concentrating were omitted from the scale due to low promax factor loading with the depressive symptoms items. Cases missing on one or more of the depressive scale items were not included in the analysis ($N = 105$). All three depressive items are consistent with the “negative affect” construct of the CES-D (see Perreira et al. 2005). The depressive measure ranges from 1 = “low” to 5 = “high” and was standardized in the analysis.

3.2.2. Focal independent variables—Eight focal independent variables are used in the analysis. First, victimization was assessed by mean scaling the following ten victim specific items ($\alpha = .87$): frequency of a) reporting victimization (1 = not being bullied to 5 = bullied several times per day), b) being teased or called names, c) left out of activities, d) hit or pushed, e) spread rumors, f) victimized for one’s race, g) sexuality, h) religion, and whether the respondent had been bullied via i) a computer interaction or j) a cellphone. Response choices for each of the items ranged from 1 = “have not bullied in this way” to 5 = “several times a week”. The scale was then divided into three categories; a) those reporting no victimization, b) those reporting at least some victimization but less than or equal to the median value of victimization across all respondents (median = 0.40) (0 = no, 1 = yes), and c) those reporting greater than the median value of victimization across all respondents (0 = no, 1 = yes). The three categories were labeled “no victim”, “low victim”, and “high victim” respectively. Cases missing on five or more of the victimization items were omitted from the analysis.

Perpetration of bullying was assessed by mean scaling ten items similar to those asked for bullies; however, rather than asking respondents how often they are victims of teasing, being hit or pushed, or rumors, the bullying items ask how often *do you* engage in these actions towards others ($\alpha = .90$). Response choices ranged from 1 = “do not bully in this way” to 5 = “several times a week”. Similar to the victimization scale, the perpetration scale was subsequently divided into three categories; a) those reporting no perpetration, b) those reporting at least some perpetration but less than or equal to the median value of perpetration across all respondents (median = 0.20) (0 = no, 1 = yes), and c) those reporting greater than the median value of perpetration across all respondents (0 = no, 1 = yes). The three categories were labeled “no bully involvement”, “low bullying”, and “high bullying” respectively. Cases missing on five or more of the perpetration items were not included in the analysis. Both the victimization and perpetration items used in the analysis are consistent with items asked in the Olweus Bully/Victimization Questionnaire, a survey often employed in bullying research (Solberg & Olweus 2003).

Lastly, because the bullying and victim scales are disassociated, their cross-tabulation provided key information on the overlap in their distributions, from which it was possible to identify four bully-victim groups. The analyses thus use categories for bullies who are not also victims, victims who are not also bullies, and their combinations resulting from the construction of the victim and bully categories specifically; low victim-low bullies, high victim-low bullies, low victim-high bullies, and high victim-high bullies. Those reporting no involvement in either bullying or victimization are the omitted reference group in the analysis.

3.2.3 Risk behaviors—Seven risk behaviors were used in the analysis: a) isolation, b) high computer gaming, c) high television viewing, d) junk food consumption, e) alcohol use, f) tobacco use, and g) fighting. First, *isolation* ($\alpha = .63$) was constructed by mean scaling the following three items; a) number of days spent with friends after school, b) number of nights spent with friends, and c) how often you call or text with your friends. Number of days spent after school and during the night with friends ranged from 0 = none to 6 = 6 days. How often the respondent called or texted with friends ranged from 1 = rarely or never to 5 = every day. The final scale ranges from 0 = never meet with friends after school, on weekends, and rarely to never call or text with friends to 6.5 = meet with friends after school and on weekends every day and call and text with friends every day. Cases missing on two or more of the isolation items were omitted prior to imputation.

Second, level of computer gaming use was assessed using one item asking the respondents how much time they spend during the week and on weekends using the computer to play games (range 1 = not at all to 9 = seven or more hours on average daily). Third, level of television watching was similarly assessed using one item (range = 1 not at all to 9 = seven or more hours daily). The computer gaming and television items are included as risk behaviors because prior research suggests higher levels of computer gaming and television use may be associated with increased social isolation as well as negative physical and mental health effects (Brown et al. 2011; Colwell and Payne 2010; Bickham and Rich 2006). Both the computer gaming and television items were kept in their original continuous metric for the analysis.

Third, *junk food consumption* ($\alpha = .76$) was assessed by mean scaling the following five items: frequencies of consuming a) sweets, b) french fries, c) potato chips, d) soda and e) fast food. Frequency of eating sweets, french fries, potato chips, and drinking soda were “how often do you eat/drink” where 1 = never and 7 = everyday, more than once. Frequency of eating fast food was asked “how often do you eat” where 1 = never to 7 = five or more days per week. Promax factor analyses confirmed the intercorrelation of the junk food items relative to other food items including fruits, vegetables, milk products, cereals, breads, and low-fat food items. Cases missing on three or more of the junk food items were not included in the analysis.

Fourth, *alcohol use* ($\alpha = .89$) was measured by mean scaling the following four items: frequency of consuming a) beer, b) wine, c) spirits, d) other pre-mixed drinks, and e) any other type of alcoholic drink. Each item ranged from 1 never to 5 every day. The alcohol use scale was subsequently coded where 0 = never use alcohol to 4 = use alcohol every day.

Fifth, *tobacco use* ($\alpha = .80$) was measured by mean scaling the following two items: frequency of smoking in the past 30 days and number of cigarettes smoked per day in the past 30 days. Frequency of smoking in the past 30 days ranged from 1 = never to 7 = 40 or more times. Number of cigarettes smoked per day in the past 30 days ranged from 1 = not at all to 7 = more than 20 cigarettes per day. The tobacco scale was then coded where 0 = do not use tobacco to 6 = use tobacco frequently and every day. Lastly, *fighting* was assessed using one item during the past year, how many times were you in a physical fight where 0 = never to 4 = four or more times. With the exception of the fighting item, all risk behavior variables were standardized for the following analysis.

3.2.4 Controls—Eight control variables are included in the study (age, grade, sex, race, body mass index (BMI), family structure, number of siblings, and family SES). *Age* ranged from 10-17 and *grade* ranged from 6th -10th. *Female* was dummy-coded so that females were the comparison category and males were the reference category. *Race* was dummy-coded into African American, Hispanic, and other race groups with whites as the reference group. Gender and age-adjusted *body mass index* (BMI) according to international BMI cutoffs points was calculated using the “zanthro” command in Stata. Normal weight served as the reference group for indicators for underweight, overweight, and obese. *Family structure* was assessed with indicator variables for living with the mother only, living with the father only, living with a stepparent, and living with a grandparent or other arrangement. Living with both parents was the omitted category. The count of the *number of siblings* was also included. Lastly, *SES* was derived from “what is your mother or father’s occupation” and was transcribed by the HBSC into 5 categories where 1 = low (restaurant worker, factory worker, transportation), 2 = skilled worked, military (craftsperson, construction, military, farm, mechanic), 3 = technical/office/sales (technical, office worker, sales worker), 4 = business person (business owner, executive, director), and 5 = professional work. Family SES was then calculated by taking the average of the mother’s and father’s reported SES when both were present. Otherwise, the value for the available parent was used. Family SES was standardized in the analysis.

3.3 Analytic Strategy

This analysis employs a fixed-effects regression model that adjusts for fixed school characteristics so that coefficients capture average differences in somatic and depressive symptoms among students who attend the same schools. In other words, fixed-effects regression models estimate average within-school effects, leveraging between-adolescent variation within schools by differencing-out fixed school characteristics (Allison 2005). Preliminary analyses showed that both dependent variables were slightly left truncated. Results were consistent when using a tobit estimator for both dependent variables. However, tobit results indicated slightly larger coefficients, but the larger magnitude may reflect the condition that temporally invariant school fixed effects were not adjusted for in the models. Analyses were conducted using Stata 13.

Missing data was imputed across 10 data sets using the Stata 13 “ice” command and were combined using the Stata “mi” function suite. This analysis employs a multiple imputation then deletion approach (MID) (von Hippel 2007). The MID approach imputes on both the independent and dependent variables, then omits the imputed values of the dependent variable(s) in the analyses following imputation. This method preserves the underlying covariance relationship between the independent and dependent variables, while maintaining the assumption that the independent variable is associated with the dependent variable (von Hippel 2007). Additionally, the MID method helps protect imputation estimates from problematic imputed values of the dependent variable and unnecessary statistical error resulting from imputed values of the dependent variable being used in the estimates (von Hippel 2007 p. 113). Robustness checks were conducted on the MID datasets by comparing the estimates to imputation models that a) did not impute on missing cases of the dependent variables b) that imputed on all study variables, but did not omit imputed cases of the

dependent variables following the imputation. All models imputed separately by gender. Results were consistent across all three models (see Appendix I). School-level means were calculated for both the dependent and independent bullying variables prior to imputation and included in the imputation model to reflect the fixed-effects estimator employed. Student-level weights are also applied in the analysis across all models to capture the complex survey design.

The analysis progression was designed to follow Barron and Kenny's (1986) model for statistical mediation: a) first we assess whether the independent variable (bullying) affects the mediating variables (e.g., junk food, alcohol); b) next, we assess the extent to which the independent variable is associated with the dependent variable in the absence of the mediating variables; c) then the mediating and independent variables independently affect the dependent variable is estimated in a joint model; finally, d) we examine the extent to which the association between the independent and dependent variable is fully or partially attenuated by the presence of the mediator variable in the model (Barron and Kenny 1986).

Additional robustness checks were conducted to test for moderation across analytic subgroups. The presented results are robust to the analyses of ten imputed datasets for a) within-bully group specific analysis (low-level was the omitted reference category in each regression) and b) within-bully group and between the non-involved (non-involvement was the omitted reference group), and c) by gender. Together, these robustness checks indicated that the mediational processes under investigation did not differ across bully-involved groups and were consistent for male and female students.

4 Results

4.1 Descriptive Statistics

Table 1 shows that the distribution of somatic and depressive symptoms is similar among the sampled adolescents (mean for somatic = 2.09, SD = 0.86; mean for depressive = 2.11, SD = 0.99). The majority of adolescents (29%) reported they were not involved in bullying, followed by 14% reporting a low-level of victimization and 11% reporting a high level of bully-victimization. Table 1 also shows that the majority of adolescents reported little to no alcohol use, tobacco use, or fighting, while frequency of junk food consumption and social isolation are more normally distributed. Approximately 52% of the sample was female, 43% identified as White, 54% were currently living with both biological parents, and 62% were classified as being within normal weight.

4.2 Somatic and Depressive Symptoms by Risk Behaviors

Table 2 shows school fixed-effect regression results for each risk behavior, the hypothesized mediator variables, by bullying categories. Establishing the links between bullying and these different mediational pathways is a critical component of establishing mediation. Table 2 demonstrates that high victims are more likely to isolate ($\beta = .16$) than bullies or non-involved peers. Conversely, both low and high-level bullies reported statistically lower levels of social isolation than the non-involved ($\beta = -.18$ and $\beta = -.51$ respectively). High-level victims, bullies, and bully-victims reported higher frequency of computer gaming and

television than low-level victims or the non-involved. Bullies and bully-victims in particular reported higher levels of junk food consumption, alcohol, tobacco use, and fighting than victims or non-involved peers. Coefficients for alcohol use and fighting are particularly high among high-level bullies and high-level bully-victims. Additionally, high-level victims reported more fighting than low-level victims or the non-involved ($\beta = .12$). Here it is suggested that high-level victims report more fighting because they are more likely to have been physically victimized than low-level victims by their bullies. Low-level victims were not significantly more likely to engage in any of the risk behaviors relative to the non-involved. Thus, Table 2 demonstrates that the pathways through which risk behaviors may mediate the relationship between bullying and health follow the proposed theoretical sets of risk behaviors associated with victimization and bullying according to the stress process and general strain pathways.

Table 3 Model 1 estimates the direct within-school associations between bullying statuses and somatic symptoms in the absence of the mediators. Each category is statistically associated with increased somatic symptoms relative to the non-involved. On the lower end, low bullying is associated with a .12 standardized increase in somatic symptoms compared to the non-involved. On the high end, high victim-high bullying is associated with a .79 standardized increase compared to the non-involved. These findings are consistent with prior health research that suggests bully-involved adolescents, on average, have worse somatic outcomes than the non-involved. Moreover, these health disparity gaps between children who attend the same schools are large, indicating that the health gaps reported in prior studies were not due to biases reflecting omitted contextual and school characteristics.

Following the basic analytic structure for somatic symptoms, Table 4 Model 1 shows depressive outcomes by bullying statuses. Unlike somatic symptoms, low-level bullies are not statistically different from the non-involved in terms of depressive symptoms. However, other categories are each significantly associated with increased depressive symptoms. On the low end, high bullying is associated with a .30 standardized difference in depressive symptoms relative to the non-involved. On the high end, high victim-low bullies are associated with a .93 standardized increase in depressive symptoms. As noted for somatic symptoms, these are strong standardized differences between the groups.

Model 2 in Tables 3 and 4 adds control variables. The main effects of bullying on somatic symptoms are consistent between Models 1 and 2 suggesting that the presence of the control factors do not significantly account for the negative effect of bullying on somatic outcomes. In Table 3 Model 2, being female ($\beta = 0.44$), living with the father only ($\beta = 0.29$), living with a stepparent ($\beta = 0.12$), and living with a grandparent or other living arrangement ($\beta = 0.15$) are all positively associated with somatic symptoms. African American adolescents ($\beta = -0.14$) report fewer somatic symptoms than white adolescents. Other control factors did not significantly predict somatic symptoms. Similarly, depressive symptoms were not significantly attenuated by control variables. Model 2 Table 4 show higher grade level ($\beta = 0.11$), female adolescents ($\beta = 0.45$), Hispanic adolescents ($\beta = 0.11$), living with the mother only ($\beta = 0.16$), living with the father only ($\beta = 0.30$), living with a stepparent ($\beta = 0.09$), and living with a grandparent or other living arrangement ($\beta = 0.23$) were all positively associated with depressive symptoms. African American adolescents reported significantly

fewer depressive symptoms than White adolescents ($\beta = -0.10$). Thus, Model 2 in Tables 3 and 4 demonstrates that bullying status is adversely associated with somatic and depressive outcomes in the absence of the theoretical risk behavior mediator variables and while accounting for a number of sociodemographic characteristics.

Model 3 in Tables 3 and 4 introduces risk behaviors. For somatic symptoms, results indicate that computer gaming, junk food, alcohol, tobacco, and fighting are all significantly associated with increased somatic symptoms in the presence of the independent variables. In addition, Table 3 suggests significant mediation of somatic symptoms by risk behaviors. The effect of low level bullying on somatic symptoms is fully mediated when including risk behaviors. The somatic symptoms of high bullies, low victim-high bullies, and high victim-high bullies are also modestly attenuated when including risk behaviors. Isolation and television were not associated with somatic symptoms. For depressive symptoms, Table 4 Model 3 suggests partial mediation through the effects of isolation, computer gaming, alcohol, tobacco, and fighting for all bullying groups except low-level bullies. Junk food and television viewing were not associated with depressive symptoms among bully-involved youth. Alcohol had the greatest association overall on both somatic ($\beta = 0.13$) and depressive ($\beta = 0.09$) symptoms.

4.3 Mediation by Risk Behaviors across Bullying Groups

Table 5 shows indirect mediation effects of risk behaviors using the Sobel-delta method. Beginning with somatic symptoms, computer gaming ($\beta = 0.03$), junk food ($\beta = 0.04$), alcohol ($\beta = 0.08$), tobacco ($\beta = 0.02$), and fighting ($\beta = 0.05$) all significantly mediated somatic symptoms among high-level victims. Among high-level bullies, junk food ($\beta = 0.02$), alcohol ($\beta = 0.03$), and fighting ($\beta = 0.02$) significantly mediated somatic symptoms. Similar patterns were noted for somatic symptoms across bully-victim categories. No significant mediation is noted for low-level bullies by somatic symptoms. For depressive symptoms, the effects of isolation, computer games, alcohol, tobacco, and fighting mediated depressive symptoms across all bullying groups except low-level bullies. Television viewing was not involved with any mediating pathway although high victims, bullies, and bully-victims reported higher frequency of television watching (see Table 2). The indirect effect of alcohol was notably high across all bullying groups. Additionally, the effect of isolation is significant for depressive symptoms but not for somatic symptoms, while the effect of junk food is significant for somatic symptoms but not for depressive symptoms. This suggests differing mediational pathways of junk food and social isolation on somatic and depressive symptoms respectively.

In order to test the hypothesized pathways linking bullying with risk behaviors and health, grouping models were estimated for a) the victimization constellation of risk behaviors only (i.e. isolation, computer gaming, television watching, junk food) and b) for the bully constellation of risk behaviors only (i.e. junk food, alcohol, tobacco, fighting). Table 6 shows the total percentage of mediation for all risk behaviors across bullying groups, as well as the percentage of mediation captured through victim's risk behaviors (designated as Group 1) and through bully's risk behaviors (designated as Group 2). Beginning with somatic symptoms, Table 6 shows that the total proportion of mediation of somatic

symptoms was highest among high-level bullies (49.4%), followed by low victim-high bullies (34.9%), and high victim-high bullies (23.8%). Although the percent mediation noted among low-level bullies is high (49.1%), no significant mediating pathways between risk behaviors and health were noted for low-level bullies. Table 6 shows that risk behaviors associated with bullying (Group 2) account for more of the somatic symptom mediation across all bullying groups as compared to the victim constellation of risk behaviors (Group 1). Additionally, the proportion of mediation was highest for high-level bullies and low victim-high bullies across both groups of risk behaviors, with high victim-high bullies showing a higher percentage of mediation by the bully risk behaviors. Thus, the findings suggest that the somatic symptoms noted among high-level bullies and bully-victims are modestly mediated through their involvement in risk behaviors, in particular by those specified by the general strain pathway. Risk behaviors did not substantially mediate the somatic symptoms noted among victims, although significant mediating pathways linking risk behaviors to somatic outcomes for victims are shown in Table 5.

Results for depressive symptoms are similar to somatic symptoms. Table 6 shows that the total mediation of all risk behaviors was highest for high-level bullies (39.7%), followed by low victim-high bullies (21.6%) and high victim-high bullies (13.7%). Conversely, total risk behaviors accounted for only 3.5% of depressive symptoms among high-level victims and 5.7% among high victim-low bullies. Comparison of Group 1 and Group 2 demonstrates that Group 2 risk behaviors (i.e. junk food, alcohol, tobacco, fighting) account for more of the depressive symptoms among bully-involved adolescents than the victim constellation of risk behaviors (i.e. isolation, computer games, television, fighting). Additionally, the percent mediation was highest among high-bullies and bully-victims regardless of the risk behavior pathway. These findings suggest that risk behaviors associated with the general strain pathway also account for a modest amount of the depressive symptoms observed among bullies and bully-victims in particular.

5. Discussion

This study assesses whether risk behaviors associated with bullying help explain the differential somatic and depressive symptoms among victims, bullies, and bully-victims. Prior bullying and health research suggests that victims, bullies, and bully-victims are more likely to have poorer physical and mental health (e.g. Gini & Pozzoli 2009), that victims are more likely to withdraw from peers and report fewer social bonds (e.g. Olweus 1997), and that bullies and bully-victims are more likely to engage in aggressive or substance use behaviors (e.g. O'Brennen et al. 2009; Houbre et al. 2006). However, this study fills a gap by addressing whether these characteristics of victims, bullies, and bully-victims help account for their differential somatic and depressive outcomes relative to their non-involved peers.

Consistent with prior research, victims, bullies, and bully-victims reported significantly higher somatic and depressive symptoms than the non-involved (Gini & Pozzoli 2009; Heino et al. 2000). Specifically, victimization is harmful for both somatic and depressive health; both low and high-level victims reported greater somatic and depressive symptoms than the non-involved. Bullies reported significantly greater somatic and depressive symptoms than the non-involved, however bullies also reported fewer somatic and

depressive symptoms than either victims or bully-victims. Lastly, bully-victims reported higher somatic and depressive symptoms than the non-involved, with high-level bully-victims reporting the most significant somatic and depressive symptoms. Thus, the results support hypothesis 1 that victims, bullies, and bully-victims experience greater somatic and depressive symptoms than the non-involved.

The extent to which risk behaviors mediated somatic and depressive symptoms differed across bullying groups. All bullying groups except low-level victims were more likely to engage in the risk behaviors compared to their non-involved peers. Additionally, the pathways of risk behaviors differed across bullying groups. For example, computer gaming, junk food, alcohol, tobacco, and fighting all significantly mediated the association between high-level victimization and somatic symptoms, however computer gaming and tobacco did not mediate this relationship among high-level bullies. Similarly, isolation, computer gaming, alcohol, tobacco, and fighting significantly mediated the depressive symptoms of victims, but isolation was not a significant mediator for bullies. Additionally, the total proportion of mediation across all risk behaviors and by risk behaviors grouped by bullying status was substantially higher for bullies and bully-victims reporting high levels of bullying than for victims. These findings suggest two things.

First, the findings suggest that victimization is a stressful process that leads to poorer health outcomes. In this study, the effect of victimization was largely independent of risk behaviors that may have accounted for the differential somatic and depressive symptoms relative to the non-involved. Here, it is important to consider that victim role involves subordinacy and hierarchy. Cliques and other status hierarchies are common in adolescence and are important means through which youth discover and shape their identities (Pattiselanno et al. 2015). However, those in subordinate positions are likely to have fewer social supports and heightened feelings of unpredictability and loss of control that can lead to increased stress and poorer health outcomes (Sapolsky 2004). These characteristics largely parallel the features of victimization (e.g. Olweus 1997), which suggests the stress and health consequences of victimization are perhaps social-hierarchical in nature and not as easily explained by the risk behaviors or coping strategies that victims or bully-victims may be more likely to engage in.

Second, while victims and bully-victims may engage in all risk behaviors more often than their non-involved peers, these behaviors do not explain the somatic or depressive symptoms for victims when compared to non-involved youth. In terms of stress process, the risk behaviors assessed here are in essence *ineffective coping strategies* for the adolescents. Although prior research suggests that engaging in negative coping strategies (i.e. alcohol, isolation) may lead to or exacerbate negative health outcomes (Woodhead et al. 2014; Vanaelst et al. 2011), the somatic and depressive outcomes for victims and bully-victims in this study were not substantially explained by engaging in these behaviors. In other words, higher isolation among victims or alcohol among bully-victims does not appear to effectively buffer the stress associated with the condition of being a victim. Thus, the results do not provide support for hypothesis 2 that risk behaviors will mediate the somatic and depressive symptoms of victims and bully-victims through risk behaviors associated with the stress-process pathway.

On the other hand, results provided partial support for hypothesis 3 that risk behaviors mediate the somatic and depressive outcomes for bullies and bully-victims as specified by the general strain pathway. As noted, total risk behaviors mediated approximately 49% of the magnitude of somatic symptoms and 42% for depressive symptoms for high-level bullies. When comparing the percentage of mediation estimated by victims' risk behaviors (Group 1) to bullies' risk behaviors (Group 2), results show that risk behaviors associated with bullying mediate substantially more of the somatic and depressive symptoms than risk behaviors associated with victimization. Additionally, high-level bullies and bully-victims who reported a high level of bullying showed the highest percentage of depressive symptom mediation.

General strain theory suggests that bullying may be a manifestation of various social strains while occurring in conjunction with other problem behaviors such as alcohol or fighting (e.g. Agnew 2001; 1992). Additionally, engaging in risk behaviors such as alcohol and fighting can lead to poorer physical and mental health outcomes (e.g. Seitz et al. 2013). For bullies and bully-victims reporting high levels of perpetration, this study finds that risk behaviors stemming from general strain in adolescence may at least partially explain why bullies report higher somatic and depressive symptoms than the non-involved. In other words, the health consequences of bullying may be less about being a bully and more about the constellation of risk behaviors that accompany bullying, in particular according to the general strain pathway.

Additionally, research suggests that the lessened health consequences noted among bullies may be due to the social positioning of bullies above victims, allowing bullies to release frustrations more easily (Schwartz 2000). This idea links to the discussion of subordination and hierarchies. Bullies are positioned above victims in the bullying dynamic, and bullies are often situated more favorably in school cliques and other social hierarchies relative to victims (Thornberg et al. 2011; Houbre et al. 2006). This higher positioning and ability to release frustrations on others likely helps explain why bullies experience fewer physical and mental health consequences than victims (Sapolsky 2004). Thus, the somatic and depressive consequences of bullying may be more about the social and personal characteristics of being a bully than about the stress associated with victimization in the bullying subculture.

As with any study, this study has its limitations. First, we use cross-sectional data and therefore cannot determine causal ordering. For example, it is possible that adolescents who are socially isolated are ideal targets for bullies, or that adolescents reporting greater somatic or depressive symptoms are more likely to "act out" by bullying. Second, it is possible that risk behaviors and coping strategies not measured may account for the health differences among bully-involved adolescents. Some research suggests that bully-victims may be at higher risk for eating disorders, other drug abuse, and criminality (Lester et al. 2012). However, these factors were not available for this analysis. Other research suggests that bullies may be quite popular and have wide social circles (e.g. Swearer et al. 2010), however this study does not assess social networks nor does it assess behavior within the networks. Lack of direct network information is a limitation insofar as we are unable to determine how negative coping or risk behaviors are shaped by the differing relational contexts of victims, bullies, and bully-victims (Ennett et al. 2006). Additionally, the analysis does not account for

more positive coping strategies or factors such as family and peer supports, self-esteem, or self-agency (Kendrick et al. 2012). It is possible that family and social psychological factors may shape both health outcomes and the likelihood of engaging in risk behaviors (e.g. Dougherty et al. 2015). Future research should continue to examine how health outcomes associated with bullying are shaped by these family, social psychological, and network contextual factors.

Despite these limitations, this study does have a number of unique strengths. Bullying is a significant public health issue associated with numerous negative health and social outcomes. This study contributes to the current literature by examining how health outcomes associated with bullying are differentially shaped by engaging in risk behaviors. Understanding how bullying intersects more broadly with risk is important as future research and intervention can begin to address the health outcomes associated with bullying in different ways. For example, victims may benefit from strategies and interventions that target the stress associated with victimization. For bullies, strategies and interventions that target concurrent risk behaviors and strain may benefit health outcomes. Thus, crafting strategies and interventions separately for victims and bullies may improve their differential health outcomes resulting from bullying.

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Appendix I

Table 1

Multiple imputation model results: MID, imputation on DVs no MID, omitting missing on DVs and gender:

	Somatic symptoms						Depressive symptoms											
	Model 1 ^a			Model 2 ^b			Model 3 ^c			Model 1			Model 2			Model 3		
	Coef.	Sig.	SE	Coef.	Sig.	SE	Coef.	Sig.	SE	Coef.	Sig.	SE	Coef.	Sig.	SE	Coef.	Sig.	SE
Bullying status																		
Low victim	0.22	***	0.04	0.22	***	0.04	0.23	***	0.04	0.31	***	0.04	0.31	***	0.04	0.31	***	0.04
High victim	0.62	***	0.06	0.62	***	0.06	0.63	***	0.06	0.73	***	0.06	0.73	***	0.06	0.73	***	0.06
Low bully	0.08		0.05	0.07		0.05	0.08		0.05	0.05		0.05	0.05		0.05	0.06		0.05
High bully	0.24	**	0.08	0.24	**	0.08	0.25	**	0.08	0.19	**	0.07	0.19	**	0.07	0.19	**	0.07
Low victim-low bully	0.22	***	0.04	0.22	***	0.04	0.22	***	0.04	0.33	***	0.04	0.33	***	0.04	0.32	***	0.04
High victim-low bully	0.62	***	0.06	0.62	***	0.06	0.62	***	0.06	0.84	***	0.06	0.84	***	0.06	0.83	***	0.06
Low victim-high bully	0.34	***	0.06	0.34	***	0.06	0.33	***	0.06	0.37	***	0.06	0.37	***	0.06	0.36	***	0.06
High victim-high bully	0.62	***	0.06	0.61	***	0.06	0.63	***	0.06	0.74	***	0.05	0.74	***	0.05	0.75	***	0.06
Risk Behaviors																		
Isolation	0.00		0.02	0.00		0.01	0.00		0.02	0.03	*	0.01	0.03	*	0.01	0.03		0.01
Computer games	0.04	*	0.02	0.04	*	0.02	0.04	*	0.02	0.05	***	0.02	0.05	***	0.02	0.06	***	0.02
Television	0.01		0.02	0.01		0.02	0.01		0.02	0.00		0.02	0.00		0.02	0.00		0.02
Junk food	0.06	***	0.02	0.06	***	0.02	0.06	***	0.02	0.02	***	0.02	0.02	***	0.02	0.03	***	0.02
Alcohol	0.13	***	0.02	0.13	***	0.02	0.13	***	0.02	0.09	***	0.02	0.08	***	0.02	0.08	***	0.02
Tobacco	0.04	*	0.02	0.04	*	0.02	0.04	*	0.02	0.05	**	0.02	0.05	**	0.02	0.05	**	0.02
Fighting	0.08	***	0.02	0.08	***	0.02	0.08	***	0.02	0.04	**	0.01	0.04	**	0.01	0.03	**	0.01
Controls																		
Age	-0.01		0.02	-0.01		0.02	-0.01		0.02	0.02		0.03	0.02		0.03	0.02		0.03
Grade	0.06		0.04	0.05		0.04	0.06		0.04	0.10	**	0.04	0.10	**	0.04	0.11	**	0.04
Female	0.50	***	0.03	0.50	***	0.03	0.50	***	0.03	0.50	***	0.03	0.50	***	0.03	0.50	***	0.03
Black	-0.16	**	0.06	-0.16	**	0.06	-0.17	**	0.06	-0.10		0.05	-0.10		0.05	-0.11	*	0.06
Hispanic	0.01		0.05	0.00		0.05	0.00		0.05	0.10	*	0.05	0.10	*	0.05	0.10	*	0.05
Other race	-0.08		0.04	-0.08		0.04	-0.08		0.04	-0.03		0.04	-0.03		0.04	-0.03		0.04
Mother-only	0.05		0.04	0.05		0.04	0.06		0.04	0.14	***	0.04	0.15	***	0.04	0.15	***	0.04
Father-only	0.25	**	0.09	0.25	**	0.09	0.25	**	0.09	0.27	***	0.08	0.27	***	0.08	0.26	***	0.08

	Somatic symptoms						Depressive symptoms					
	Model 1 ^a			Model 2 ^b			Model 3 ^c			Model 1		
	Coef.	Sig.	SE	Coef.	Sig.	SE	Coef.	Sig.	SE	Coef.	Sig.	SE
Step-parent	0.10	*	0.04	0.10	*	0.04	0.10	*	0.04	0.08	*	0.04
Grandparent/other	0.08		0.06	0.08		0.06	0.08		0.06	0.18	**	0.06
Siblings	0.01		0.01	0.01		0.01	0.01		0.01	0.00		0.01
Family SES	0.03	*	0.02	0.03	*	0.02	0.03	*	0.02	0.01		0.01
Underweight	-0.02		0.06	-0.02		0.06	-0.03		0.06	0.02		0.06
Overweight	0.07	*	0.03	0.07	*	0.03	0.07	*	0.03	0.06		0.03
Intercept	-0.94	***	0.29	-0.93	***	0.29	-0.93	***	0.29	-1.88	***	0.28
	N = 7936			N = 8066			N = 7926			N = 7961		
										N = 8066		
										N = 7926		

* p<.05, ** p<.01, *** p<.001

^aModel 1 = Multiple imputation then deletion (MID) approach results (final models)

^bModel 2 = Imputation on IVs and DVs without omitting imputed values of DVs after imputation

^cModel 3 = Imputation after omitting missing values on DVs and gender variable

Appendix II

Table 1

Wald postestimation matrix (p-values) for somatic and depressive symptoms differences by bullying categories (Model 3):

	LV	HV	LB	HB	LV/LB	HV/LB	LV/HB	HV/HB
Somatic symptoms:								
LV ^b	--							
HV ^c	0.00	--						
LB ^d	0.00	0.00	--					
HB ^e	0.00	0.00	0.01	--				
LV/LB ^f	0.00	0.00	0.00	0.00	--			
HV/LB ^g	0.00	0.00	0.00	0.00	0.00	--		
LV/HB ^h	0.00	0.00	0.00	0.00	0.00	0.00	--	
HV/HB ⁱ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	--
	LV	HV	LB	HB	LV/LB	HV/LB	LV/HB	HV/HB
Depressive symptoms:								
LV	--							
HV	0.00	--						
LB	0.00	0.00	--					
HB	0.00	0.00	0.02	--				
LV/LB	0.00	0.00	0.00	0.00	--			
HV/LB	0.00	0.00	0.00	0.00	0.00	--		
LV/HB	0.00	0.00	0.00	0.00	0.00	0.00	--	
HV/HB	0.00	0.00	0.00	0.00	0.00	0.00	0.00	--

^aNo involvement is the omitted bullying reference group for both somatic and depressive symptoms

^bLV = Low victim

^cHV = High victim

^dLB = Low bully

^eHB = High bully

^fLV/LB = Low victim-low bully

^gHV/LB = High victim-low bully

^hLV/HB = Low victim-high bully

ⁱHV/HB = High victim-high bully

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Table 1

Descriptive Statistics

Variables:	Mean	Std. Dev.	Min	Max	% missing
Dependent variables:					
Somatic symptoms	2.09	0.86	1	5	1.61
Depressive symptoms	2.11	0.99	1	5	1.30
Independent variables:					
No involvement	0.26		0	1	4.98
Low victim	0.14		0	1	4.98
High victim	0.07		0	1	4.98
Low bully	0.09		0	1	4.98
High bully	0.05		0	1	4.98
Low victim-low bully	0.13		0	1	4.98
High victim-low bully	0.08		0	1	4.98
Low victim-high bully	0.07		0	1	4.98
High victim-high bully	0.11		0	1	4.98
Risk behaviors:					
Isolation	3.18	1.40	0	6.5	1.83
Computer games	1.61	1.68	0	8	2.14
Television	3.29	1.94	0	8	2.95
Junk food	3.17	1.28	0	6	1.09
Alcohol	0.42	0.69	0	4	3.89
Tobacco	0.34	1.01	0	6	3.67
Fighting	0.73	1.17	0	4	3.79
Controls:					
Age	13.67	1.47	11	17	1.45
Grade	8.05	1.36	6	10	0.00
Female	0.52		0	1	0.36
White	0.43		0	1	4.01
Black	0.18		0	1	4.01
Hispanic	0.20		0	1	4.01
Other	0.18		0	1	4.01
Both parents	0.54		0	1	0.94
Mother-only	0.23		0	1	0.94
Father-only	0.03		0	1	0.94
Step-parent	0.15		0	1	0.94
Grandparent/other	0.06		0	1	0.94
Siblings	2.09	1.82	0	22	0.00
Family SES	2.78	1.37	1	5	21.37
Underweight	0.06		0	1	11.01
Normal weight	0.62		0	1	11.01
Overweight	0.32		0	1	11.01

N = 8066

Table 2

School fixed-effect regression of risk behaviors on bullying status (N=8066)

	Isolation			Computer games			Television			Junk food			Alcohol			Tobacco			Fighting		
	Coef.	Sig.	SE	Coef.	Sig.	SE	Coef.	Sig.	SE	Coef.	Sig.	SE	Coef.	Sig.	SE	Coef.	Sig.	SE	Coef.	Sig.	SE
Bullying status^a																					
Low victim	0.07		0.04	-0.06		0.04	-0.01		0.04	0.04		0.04	0.02		0.04	0.00		0.04	-0.07		0.04
High victim	0.16	***	0.05	0.18	***	0.05	0.12	*	0.05	-0.05		0.05	0.05		0.05	0.07		0.05	0.12	*	0.06
Low bully	-0.18	***	0.04	0.03		0.04	0.13	**	0.04	0.15	***	0.04	0.24	***	0.04	0.16	***	0.04	0.28	***	0.05
High bully	-0.51	***	0.06	0.27	***	0.05	0.20	***	0.06	0.47	***	0.05	0.87	***	0.05	0.54	***	0.06	0.98	***	0.07
Low victim-low bully	-0.15	***	0.04	-0.10	**	0.04	0.06		0.04	0.13	***	0.04	0.20	***	0.04	0.08	*	0.04	0.11	*	0.04
High victim-low bully	0.07		0.05	0.02		0.05	0.05		0.04	0.08		0.04	0.21	***	0.04	0.14	**	0.04	0.24	***	0.05
Low victim-high bully	-0.28	***	0.05	0.18	***	0.05	0.18	***	0.05	0.37	***	0.05	0.62	***	0.05	0.34	***	0.05	0.69	***	0.06
High victim-high bully	-0.15	***	0.04	0.22	***	0.04	0.23	***	0.04	0.36	***	0.04	0.70	***	0.04	0.53	***	0.04	0.76	***	0.05
Intercept	0.07	**	0.02	-0.04		0.02	-0.08	***	0.02	-0.13	***	0.02	-0.23	***	0.02	-0.15	***	0.02	0.50	***	0.03

* p<.05, ** p<.01, *** p<.001

^aNo involvement is the omitted reference group^bLV-LB = Low victim-low bully^cHV-LB = High victim-low bully^dLV-HB = Low victim-high bully^eHV-HB = High victim-high bully

Table 3

School Fixed-Effects Models of Somatic Symptoms by Bullying Statuses and Risk Behaviors (N=7936)

	Model 1			Model 2			Model 3		
	Coef.	Sig.	SE	Coef.	Sig.	SE	Coef.	Sig.	SE
Bullying status ^a									
Low victim	0.29	***	0.05	0.24	***	0.04	0.22	***	0.04
High victim	0.66	***	0.07	0.64	***	0.07	0.62	***	0.06
Low bully	0.12	*	0.06	0.15	**	0.05	0.08		0.05
High bully	0.45	***	0.08	0.47	***	0.08	0.24	**	0.08
Low victim-low bully	0.30	***	0.05	0.27	***	0.05	0.22	***	0.04
High victim-low bully	0.74	***	0.06	0.70	***	0.06	0.62	***	0.06
Low victim-high bully	0.49	***	0.07	0.52	***	0.06	0.34	***	0.06
High victim-high bully	0.79	***	0.06	0.81	***	0.06	0.62	***	0.06
Risk Behaviors									
Isolation							-0.00		0.02
Computer games							0.04	*	0.02
Television							0.01		0.02
Junk food							0.06	***	0.02
Alcohol							0.13	***	0.02
Tobacco							0.04	*	0.02
Fighting							0.08	***	0.02
Controls									
Age				0.01		0.03	-0.01		0.02
Grade				0.06		0.04	0.06		0.04
Female				0.44	***	0.03	0.50	***	0.03
Black ^b				-0.14	*	0.06	-0.16	**	0.06
Hispanic				0.02		0.05	0.01		0.05
Other race				-0.06		0.04	-0.08		0.04
Mother-only ^c				0.08	*	0.04	0.05		0.04
Father-only				0.29	**	0.09	0.25	**	0.09
Step-parent				0.12	*	0.04	0.10	*	0.04
Grandparent/other				0.15	*	0.07	0.08		0.06
Siblings				0.02		0.01	0.01		0.01
Family SES				0.03		0.02	0.03	*	0.02
Underweight ^d				-0.01		0.06	-0.02		0.06
Overweight				0.06		0.03	0.07	*	0.03
Intercept	-0.36	***	0.03	-1.25	***	0.29	-0.94	***	0.29

* p<.05, ** p<.01, *** p<.001

^aNo-involvement is the omitted reference group^bWhite is the omitted reference group

^cHealthy weight is the omitted reference group

^dLiving with both parents is the omitted reference group

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Table 4

School Fixed-Effects Models of Depressive Symptoms by Bullying Statuses and Risk Behaviors (N=7961)

	Model 1			Model 2			Model 3		
	Coef.	Sig.	SE	Coef.	Sig.	SE	Coef.	Sig.	SE
Bullying status ^a									
Low victim	0.37	***	0.04	0.32	***	0.04	0.31	***	0.04
High victim	0.76	***	0.07	0.75	***	0.06	0.73	***	0.06
Low bully	0.07		0.05	0.09		0.05	0.05		0.05
High bully	0.30	***	0.07	0.32	***	0.07	0.19	**	0.07
Low victim-low bully	0.38	***	0.04	0.35	***	0.04	0.33	***	0.04
High victim-low bully	0.93	***	0.06	0.89	***	0.06	0.84	***	0.06
Low victim-high bully	0.44	***	0.06	0.47	***	0.06	0.37	***	0.06
High victim-high bully	0.84	***	0.06	0.86	***	0.05	0.74	***	0.05
Risk Behaviors									
Isolation							0.03	*	0.01
Computer games							0.05	***	0.02
Television							0.00		0.02
Junk food							0.02		0.02
Alcohol							0.09	***	0.02
Tobacco							0.05	**	0.02
Fighting							0.04	**	0.01
Controls									
Age				0.03		0.03	0.02		0.03
Grade				0.11	**	0.04	0.10	**	0.04
Female				0.45	***	0.03	0.50	***	0.03
Black ^b				-0.09		0.05	-0.10		0.05
Hispanic				0.11	*	0.05	0.10	*	0.05
Other race				-0.01		0.04	-0.03		0.04
Mother-only ^c				0.16	***	0.04	0.14	***	0.04
Father-only				0.30	***	0.08	0.27	***	0.08
Step-parent				0.09	*	0.04	0.08	*	0.04
Grandparent/other				0.23	***	0.06	0.18	**	0.06
Siblings				0.01		0.01	0.00		0.01
Family SES				0.00		0.02	0.01		0.02
Underweight ^d				0.03		0.06	0.02		0.06
Overweight				0.06		0.03	0.06		0.03
Intercept	-0.37	***	0.03	-2.07	***	0.28	-1.88	***	0.28

* p<.05, ** p<.01, *** p<.001

^aNo-involvement is the omitted reference group^bWhite is the omitted reference group

^cHealthy weight is the omitted reference group

^dLiving with both parents is the omitted reference group

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Table 5
Sobel indirect mediation effects of risk behaviors on bullying statuses and somatic and depressive symptoms:

	Isolation		Computer gaming		Television		Junk Food		Alcohol		Tobacco		Fighting	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
Somatic symptoms (N=786)														
Bullying status														
Low victim	0.00	0.00	0.01	*	0.00	0.00	0.00	0.00	0.03	***	0.01	0.00	0.02	0.00
High victim	0.00	0.01	0.03	*	0.01	0.00	0.00	0.00	0.08	***	0.01	0.02	0.01	0.00
Low bully	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00
High bully	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	***	0.01	0.00	0.02	0.00
Low victim-low bully	0.00	0.00	0.01	*	0.00	0.00	0.01	0.01	0.03	***	0.01	0.00	0.02	0.00
High victim-low bully	0.00	0.01	0.05	***	0.01	0.00	0.01	0.00	0.03	***	0.01	0.00	0.02	0.00
Low victim-high bully	0.00	0.01	0.05	***	0.01	0.00	0.01	0.00	0.03	***	0.01	0.00	0.02	0.00
High victim-high bully	0.00	0.01	0.03	*	0.01	0.00	0.04	0.01	0.08	***	0.01	0.02	0.05	0.01
Depressive symptoms (N=786)														
Bullying status														
Low victim	0.01	0.00	0.02	**	0.01	0.00	0.00	0.01	0.03	***	0.01	0.01	0.01	*
High victim	0.02	*	0.01	0.04	***	0.01	0.02	0.01	0.06	***	0.01	0.04	0.03	**
Low bully	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
High bully	0.01	0.00	0.01	*	0.00	0.00	0.00	0.00	0.02	**	0.01	0.01	0.01	*
Low victim-low bully	0.01	0.00	0.02	**	0.01	0.00	0.01	0.01	0.03	***	0.01	0.02	0.01	**
High victim-low bully	0.02	*	0.01	0.05	***	0.01	0.02	0.01	0.07	***	0.02	0.04	0.03	**
Low victim-high bully	0.01	0.01	0.02	**	0.01	0.00	0.01	0.01	0.03	***	0.01	0.02	0.01	*
High victim-high bully	0.02	*	0.01	0.04	***	0.01	0.02	0.01	0.06	***	0.01	0.04	0.05	**

* p<.05, ** p<.01, *** p<.001

^aNo involvement is the omitted bullying reference group for both somatic and depressive symptoms

Table 6

Total and partial mediation effects of risk behaviors on bullying statuses and somatic and depressive symptoms:

Somatic symptoms: (N = 7936)	% Total mediation	Group 1 ^b	Group 2 ^c
Bullying status: ^a			
Low victim	7.4%	1.6%	6.4%
High victim	3.7%	0.0%	2.1%
Low bully	49.1%	12.4%	50.7%
High bully	49.4%	13.7%	48.7%
Low victim-low bully	19.1%	5.4%	19.1%
High victim-low bully	11.6%	2.3%	11.0%
Low victim-high bully	34.9%	11.0%	34.3%
High victim-high bully	23.8%	5.4%	23.1%
Depressive symptoms: (N = 7961)			
Bullying status:			
Low victim	4.5%	1.7%	2.8%
High victim	3.5%	1.6%	1.0%
Low bully	42.0%	3.9%	47.8%
High bully	39.7%	7.3%	40.3%
Low victim-low bully	7.6%	1.2%	8.1%
High victim-low bully	5.7%	1.3%	4.9%
Low victim-high bully	21.6%	5.1%	21.0%
High victim-high bully	13.7%	2.6%	12.6%

^aNo involvement is the omitted bullying reference group for both somatic and depressive symptoms

^bGroup 1 = Victim constellation of risk behaviors (i.e. isolation, computer games, television, junk food)

^cGroup 2 = Bully constellation of risk behaviors (i.e. junk food, alcohol, tobacco, fighting)