

### **Physical Health Risk Factors across Traditional Bullying and Cyberbullying Victim and Offender Groups**

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## INTRODUCTION

Bullying is a relatively common phenomenon among adolescents, and for some the experience as a victim seems relentless. Data from the 2015 School Crime Supplement to the National Crime Victimization Survey (NCVS-SCS) indicate that 21% of students were bullied at school during the course of the school year (Musu-Gillette, Zhang, Wang, Zhang, Kemp, Diliberti, & Oudekerk, 2018). Bullying victimization among respondents included whether another student made fun of them, called them names, insulted them, spread rumors about them, threatened them with harm, tried to make them do something they did not want to do, excluded them from activities on purpose, destroyed their property on purpose, or pushed, shoved, tripped, or spat on them. While the majority of those who were bullied (67%) only experienced one or two incidents, a small group of victims (4%) were bullied almost every day and another 10% of victims were bullied at least once a week (Musu-Gillette et al., 2018). Data from the NCVS-SCS indicate that an overall smaller percentage of students (7%) report being victims of cyberbullying—measured as whether another student had posted hurtful or private information about the respondent on the Internet, threatened or insulted the respondent through instant messaging, threatened or insulted the respondent through text messaging, e-mail, or gaming, or excluded the respondent online (Musu-Gillette et al., 2018). Once again, the overwhelming majority of these cyberbullied students (73%) report just one or two incidents throughout the course of a school year, but 4% of those victims reported daily cyberbullying victimization, and another 8% reported being cyberbullied once or twice per week (Musu-Gillette et al., 2018).

Given the prevalence of bullying, and its persistence for some, it is important to understand the characteristics— whether those characteristics be causes or consequences—of those involved as offenders and victims. In an attempt to expand our knowledge of the characteristics of both traditional and cyber-based bullying victims and offenders, we add to a

growing line of inquiry within criminology that compares individuals who are victims with those who are offenders, both victims and offenders, and “total abstainers” (neither victims nor offenders, also referred to as “the uninvolved”). Such comparisons have been made in relation to general delinquency victimization and offending (TenEyck & Barnes, 2018) as well as specific victimization and offending types including homicide, assault among college students, intimate partner violence, and cybersecurity violations (e.g., Broidy, Daday, Crandall, Sklar, & Jost, 2006; Kerstens & Jansen, 2016; Klevens, Duque, & Ramirez, 2002; Weulen Kranenbarg, Holt, & van Gelder, 2017; Mustaine & Tewksbury, 2000; Tillyer & Wright, 2014). While still tentative, a general picture is emerging which indicates that victim-offenders tend to be on one end of a spectrum, marked by the presence of many indicators of a risky or deviant lifestyle, while total abstainers are typically at the other end of such a spectrum, thus exhibiting few risky behaviors (TenEyck & Barnes, 2018, p. 79). Research addressing such victim-offender group comparisons with respect to *bullying* specifically also suggests that risky/deviant lifestyle differentiate “traditional” (i.e., non-cyber) bullying victim-offender groups, but indicators of psycho-social well-being are also given a good deal of attention. Thus, aspects of personality (i.e., dislikability), psychological distress (i.e., anxiety, loneliness), and social adjustment problems (i.e., social status, peer rejection) have been shown to distinguish bully victims, offenders, victim-offenders, and those uninvolved (Juvonen, Graham, & Schuster, 2003; Nansel, Overpeck, Pilla, Ruan, Simons-Morton, & Scheidt, 2001; Veenstra, Lindenberg, Zijlstra, De Winter, Verhulst, & Ormel, 2007).

Although differential levels of risky lifestyle and psycho-social well-being across bullying victim-offender groups are certainly important to note, differential levels of physical well-being are likely evident as well. Studies that have examined traditional bullying victim and offender groups in relation to what might be classified as indicators of physical well-being have largely

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3 done so by examining varying levels of behaviors such as fighting and substance use across  
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5 bullying groups—behaviors that are typically seen as detrimental to physical health but that also  
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7 clearly fall within criminology’s realm of “deviant/risky behavior” (e.g., Nansel et al., 2001.  
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10 However, a number of other physical health-related lifestyle factors not often associated with  
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12 deviance could indeed be associated with bullying victimization, offending, victim-offending  
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14 versus abstaining—factors such as body weight, nutrition, exercise habits, and so on (e.g., see  
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16 Kahle & Peguero, 2017; Kulig, Pratt, Cullen, Chouhy, & Unnever, 2017). Thus, in an attempt to  
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18 broaden the view that experiences with crime and health/well-being are potentially inter-related,  
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20 this study compares a range of indicators of physical health across victim-offender groups in  
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22 relation to both traditional bullying and cyberbullying. It presents descriptive and multivariate  
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24 analyses using a national sample of over 8,000 7<sup>th</sup>-10<sup>th</sup> graders from the 2009-2010 United States  
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26 Health Behavior in School-Aged Children (HBSC) survey. It is important to note that our study  
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28 does not suggest a causal direction between poor physical health and experiences with bullying  
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30 offending and victimization; instead we recognize that indicators of poor health could be both  
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32 causes and consequences of such experiences. Our aim is, more generally, to provide an  
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34 examination of the extent to which non-delinquent indicators of poor physical health overlap with  
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36 traditional and cyber-based bullying victimization, offending, victim-offending, and non-  
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38 involvement. In the process, we highlight the value in continuing to foster a perspective that  
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40 views criminology (and the study of bullying specifically) and public health as complementary  
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42 (e.g., Moore, 1995; Prothrow-Stith, 1991; Spivak & Prothrow-Stith, 2001).  
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## 49 **BACKGROUND**

### 50 **Bullying Victim and Offender Groups: Previous Research**

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52 As alluded to above, studies on victim and offender groups regarding adolescent bullying  
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54 report that these groups differ in terms of the extent to which they engage in risky/delinquent  
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3 activities and exhibit individual traits indicative of psycho-social maladjustment. For instance,  
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5 Nansel et al. (2001) examined the extent to which such factors were related to bullying  
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7 victimization, bully offending, and bullying victimization and offending, using data from over  
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9 15,000 U.S. students in grades 6 through 10 who participated in the 1998 version of the HBSC  
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11 survey. Proportional odds models indicated that fighting was positively associated with all three  
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13 outcomes (each estimated in relation to no involvement in bullying as a victim or offender).  
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15 Alcohol use and smoking were both positively related to bullying offending but negatively related  
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17 to bullying victimization. Smoking, but not alcohol use, was also positively related to  
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19 victimization-offending. In terms of psycho-social risk factors, poor peer relations and loneliness  
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21 were positively associated with bullying victimization and bullying victimization-offending.  
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23 Similarly, difficulty in making friends was positively related to bullying victimization but  
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25 negatively related to bullying offending.  
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31 Some other studies have examined victim-offender groups among students sampled from  
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33 states or smaller geographic units within the United States. For example, Haynie, Nansel, Eitel,  
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35 Crump, Saylor, Yu, and Simons-Morton (2001) examined the correlates of being in bullying  
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37 offender and victim groups using a sample of 4,263 middle school students sampled from one  
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39 suburban Maryland school district. The results of their analysis of variance revealed that bullying  
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41 victim-offender group exhibited the most “problem behaviors” (i.e., physical fighting, weapon  
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43 carrying, theft, damage to property, cigarette use, alcohol use, and illicit drug use), followed by  
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45 the offender group, the victim group, and, finally, the non-involved group. While the differences  
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47 in problems behaviors were the strongest, Haynie and colleagues also found that the victim-  
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49 offender group exhibited the highest levels of depressive symptoms and the lowest levels of self-  
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51 control and social competence across the groups; the non-involved group was at the opposite end  
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53 of the spectrum on each of these measures. However, the authors noted that, while bullying  
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3 offenders tended to be ranked second behind victim-offenders in terms of unfavorable  
4 characteristics, there was an exception to that ordering when depressive symptoms were  
5 considered, whereby victims ranked second and offenders third. In another study, Juvonen et al.  
6 (2003) performed analysis of covariance in order to compare bully victims, bully offenders,  
7 victim-offenders, borderline, and uninvolved students on various psychological dimensions, using  
8 a sample of nearly 2,000 6th graders from Los Angeles. Their analyses showed that victims  
9 appeared to suffer more emotional distress and social marginalization than other groups, but  
10 victim-offenders were the most troubled group when considering all risk factors, as they  
11 displayed the highest levels of conduct problems, school problems, and peer relationship  
12 problems.  
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26 Other work on bullying victim-offender groups has been conducted outside the United  
27 States. For example, research by Veenstra and colleagues (2007) compared the psycho-social  
28 well-being of bullying victims, bullying perpetrators, bullying victim-offenders, and uninvolved  
29 elementary school students in the Netherlands. Their analyses revealed that dislikability was  
30 positively related to victimization, offending, and victim-offending, relative to being uninvolved.  
31 Aggressiveness was significantly higher in bullying offender and victim-offender groups, relative  
32 to the uninvolved group. Externalizing disorder was only significantly related to being a bullying  
33 victim-offender relative to being uninvolved.  
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45 Overall, the results reviewed above suggest that risky/delinquent lifestyle behaviors (i.e.,  
46 aggression, fighting, smoking, drinking), coincidentally often linked to poor physical health,  
47 generally appeared more commonly among bullying offenders than victims, with victim-offenders  
48 often exhibiting the riskiest lifestyles. In contrast, the pattern regarding indicators of poor psycho-  
49 social health appear more nuanced. Victim-offender groups generally suffered the most, but  
50 loneliness, depression, and other signs of internalizing appeared more common among bullying  
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3 victims (or victim-offenders) while signs of externalizing were more common among bullying  
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5 offenders (or victim-offenders).  
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### 7 **Does Physical Health Distinguish Bullying Victim-Offender Groups?**

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10 There is theory and research to support the idea that physical health indicators can be both  
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12 causes and consequences of bullying offending and/or victimization. For example, poor health  
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14 can be a strain in the form of a negative stimulus that leads to frustration and anger, and, in turn,  
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16 antisocial behavior (Agnew, 1992). Indicators of poor health can be related to neurological  
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18 deficits, neurotransmitter dysfunction, hormonal imbalances, endocrinological difficulties and  
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20 other biological problems—all of which can trigger, directly or indirectly antisocial behavior  
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22 (e.g., Beaver & Walsh, 2011; Brennan, Grekin, & Mednick, 1999; Perron, Vaughn, Ryan, Salas-  
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24 Wright, Ruffolo, & Guerrero, 2015; Peskin, Gau, Glenn, Rudo-Hutt, Yang, and Raine, 2013;  
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26 Semenza, 2018; Stogner & Gibson, 2010; Wright, Tibbets, & Daigle, 2008). Somewhat relatedly,  
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28 certain indicators of physical health might indicate low self-control. After all, it seems reasonable  
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30 that those with low self-control would, in fact, be less likely to eschew junk food, moderate their  
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32 time spent playing video games, or engage in strong oral hygiene, assuming some level of agency  
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34 regarding such behaviors.<sup>1</sup> In turn, since low self-control is a correlate of both victimization and  
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36 offending (Gottfredson & Hirschi, 1990; Schreck, 1999), it makes sense that victim-offenders  
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38 might exhibit particularly poor health. On the other hand, poor health behaviors might well be  
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40 driven less by individual agency and instead by poverty (e.g., Kennedy, Kawachi, Glass, &  
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42 Prothrow-Stich, 1998; O'Connell, Boat, & Warner, 2009), which is also related to increased risk  
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44 of victimization and offending (e.g., Rigby, 2001). Further, indicators of poor health can also be  
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46 attributes that makes one a vulnerable, gratifiable, or antagonistic target for offenders, including  
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56 <sup>1</sup> We recognize that full agency regarding health behaviors is unlikely given the adolescent age of the respondents in  
57 this study, and such agency would also be diminished substantially among impoverished respondents.  
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3 bullies, thus increasing victimization risk (Finkelhor & Asdigian, 1996; Kahle & Peguero, 2017;  
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5 Kulig et al., 2017; see also Due, Holstein, Lynch, Diderichsen, Gabhain, Scheidt, & Currie,  
6  
7 2005). Finally, both offending and victimization can result in negative health outcomes and  
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9 behaviors, either due to injury or a stress response (Kilpatrick, Ruggiero, Acierno, Saunders,  
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11 Resnick, & Best, 2003; Van der Wal, De Wit, & Hirasing, 2003).

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14 We are aware of only a few studies that have examined physical health indicators across  
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16 bullying victim and offender groups in order to differentiate victims, offenders, and victim-  
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18 offenders in relation to those uninvolved. In one of those studies, Nansel, Craig, Overpack,  
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20 Saluja, and Ruan (2004) examined the correlates of bullying across 25 countries with HBSC data  
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22 collected between 1997 and 1998, and used a single composite measure—“health problems”—  
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24 with little information provided on what specific problems were part of the measure. The authors  
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26 reported relatively few differences in health problems across bullying victim and offending  
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28 groups in the 25 countries examined. Other studies in single countries have shown different  
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30 results. For example, Forero, McLellan, Rissel, and Bauman (1999) examined bullying victim and  
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32 offender groups among Australian students. Their multinomial analyses revealed that an index of  
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34 “psychosomatic symptoms” (i.e., headache, stomach ache, backache, feeling low, irritable or bad  
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36 temper, feeling nervous, difficulties getting to sleep, feeling dizzy) was positively related to being  
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38 an offender or victim-offender relative to being uninvolved in bullying. Additionally, smoking  
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40 significantly discriminated being a bullying offender versus being non-involved.  
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47 In perhaps the most granular analysis to date of bullying groups vis-à-vis physical health  
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49 indicators, Houbre, Tarquinio, Thuillier, and Hergott (2006) explored the role of health problems  
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51 across victim-offender groups using a sample of 291 elementary school students in France. Their  
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53 analysis revealed that bullying victim-offenders had the most behavioral problems and also the  
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55 most health problems, including neurovegetative disorders, digestive problems, somatic pain, and  
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3 skin conditions in comparison to all other groups. However, cognitive difficulties were observed  
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5 more so among only-victims relative to other groups. Moreover, the victim-only group also had  
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7 the second highest scores on somatic pain and sleeping disorders behind the victim-offender  
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9 group. Further work with such varied and detailed indicators of physical health indicators is  
10  
11 needed in order to have a clearer understanding of the overlap between poor health and bullying  
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13 victimization and/or offending.  
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### 16 17 **Is Cyberbullying Unique?** 18

19 We believe that the overlap between poor health and bullying victimization and/or  
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21 offending should be examined while distinguishing traditional bullying and cyberbullying so as to  
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23 better understand whether cyberbullying is an extension of traditional bullying or whether it,  
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25 instead, represents a unique form of victimization, offending, or victim-offending. Such inquiry  
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27 parallels work in the stalking literature, where there is question about whether cyberstalking is a  
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29 form of traditional stalking (using high-tech methods) or a distinct offense (e.g., see Nobles,  
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31 Reynolds, Fox, & Fisher, 2014; Sheridan & Grant, 2007). In fact, though we realize cyberbullying is  
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33 not a new phenomenon, relatively little is known about the uniqueness versus overlap across the  
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35 correlates of traditional and cyber-based bullying offending and victimization because only a few  
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37 studies have examined cyberbullying and traditional bullying groups.  
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42 In one such study, Gradinger, Strohmeier, and Spiel (2009) investigated differences across  
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44 traditional and cyber-based bullying victim groups only (not offending groups) using a sample of  
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46 761 9<sup>th</sup> graders selected from 10 schools in Vienna, Austria. The groups examined were defined  
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48 as “no victim,” “cybervictim only,” “traditional victim only,” and “combined victim” (traditional  
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50 and cyber). They found that students in the combined victim group experienced more depressive  
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52 and somatic symptoms compared to students in non-involved, traditional, or cyber victim groups  
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54 alone. In another study, Perren, Dooley, Shaw, and Cross (2010) examined the correlates of  
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3 victim-offender groups for both traditional bullying and cyberbullying with a sample of 1,700  
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5 students from Switzerland and Australia. Their tobit regression analysis revealed that, with  
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7 respect to traditional bullying, victims and victim-offenders reported more depressive symptoms  
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9 than offenders or those not involved. With respect to cyberbullying, Perren et al. (2010) reported  
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11 significantly higher levels of depressive symptoms in the victim-only group, followed by the  
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13 victim-offender group, the offender-only group, and the non-involved. Finally, Wang, Nansel,  
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15 Iannotti (2011) examined the associations between depression and three types of traditional  
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17 bullying (physical, verbal, and relational) as well as cyberbullying using the U.S.-based sample  
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19 from the 2005-2006 HBSC survey. Similar to previous studies of victim-offender groups,  
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21 depression tended to be highest among those in the victim-offender group for verbal and  
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23 relational forms of traditional bullying. For physical forms of traditional bullying, offenders and  
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25 victim-offenders had similar levels of depression. In contrast, cyberbullying victims exhibited  
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27 substantially higher levels of depression than cyberbullying offenders or victim-offenders. The  
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29 authors speculate that the findings may be due to the unique nature of cyberbullying: “cyber  
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31 victims may experience an anonymous attacker who instantly disperses fabricated photos  
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33 throughout a large social network; such as, cyber victims may be more likely to feel isolated,  
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35 dehumanized, or helpless at the time of the attack” (Wang et al., 2011, p. 417). Overall, there is  
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37 still a good deal to learn about the similarities and differences across traditional bullying victim-  
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39 offender groups and cyberbullying victim-offender groups. In particular, none of the studies of  
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41 cyber and traditional bullying involvement have emphasized a range of possible physical health  
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43 factors differentiating victim-offender groups as is the focus here.  
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### 51 **THE PRESENT STUDY**

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54 The present study extends research on victim-offender groups by exploring the similarities  
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56 and differences in a range of physical health-related risk factors among bullying victims,  
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3 offenders, victim-offenders, and uninvolved adolescents, while also considering similarities and  
4 differences in more commonly-studied indicators of risky/deviant lifestyle and psycho-social  
5 well-being. Moreover, we conduct such group comparisons in relation to both traditional bullying  
6 victims and offenders as well as cyberbullying victims and offenders. Our comparisons are  
7 centered around three main research questions:  
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- 14 1) Do the average values of physical health indicators vary across victim and offender  
15 groups?  
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- 18 2) Are indicators of physical health associated with the likelihood of being a bullying  
19 victim, offender, or victim-offender, relative to being uninvolved (i.e., neither a victim  
20 nor an offender), controlling for other known correlates of bullying offending and  
21 victimization (e.g., risky activities, psycho-social adjustment, and sociodemographic  
22 factors)?  
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- 25 3) Do indicators of physical health, as well as indicators of risky/deviant lifestyle and  
26 psycho-social well-being, differentiate traditional bullying versus cyberbullying victim  
27 and offender groups similarly or differently?  
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### 38 **Data**

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40 The data analyzed here come from the Health Behavior in School-Aged Children (HBSC)  
41 cross-sectional survey coordinated by the World Health Organization (WHO) and conducted  
42 every four years.<sup>2</sup> For this paper, we used the 2009-2010 version of the survey and included the  
43 sample of students from the United States (ICPSR study # 34792). The HBSC survey is a  
44 nationally representative survey of American school-aged children in grades 5 through 10 in the  
45 50 states and the District of Columbia. The student survey asked questions about traditional  
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57 <sup>2</sup> The HBSC uses a repeated cross-sectional design rather than a longitudinal panel design.

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3 bullying offending and victimization, cyberbullying offending and victimization, nutrition,  
4 physical activity, the quality of relationships with family and friends, and substance use. The  
5 student survey dataset originally included 12,642 cases nested within 314 schools. For the  
6 purpose of our analyses, we restricted the sample to those students in 7<sup>th</sup> through 10<sup>th</sup> grades  
7 (N=8,875), as theoretically relevant questions were not available for other grades. As Table 1  
8 shows, there were 8,183 to 8,873 cases that had valid values across the various study variables.  
9 We used multiple imputation techniques for retaining cases with missing values on particular  
10 variables (described more fully below).  
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## 22 **Measures of Variables**

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24 Bullying victimization and offending (both traditional and cyber-based), physical health  
25 risk factors, deviant/risky lifestyles, and psycho-social well-being are the key variables used to  
26 answer the study's research questions. Measurement of these variables, as well as additional  
27 control variables, is described below. Table 1 displays descriptive statistics for the study  
28 variables, and bivariate correlations are provided in Appendix 1.  
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### 35 *Traditional bullying victimization and offending*

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38 Prior to survey items asking about traditional bullying victimization and offending,  
39 students encountered the following definition:  
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42 It is bullying when another student, or a group of students, say or do nasty and  
43 unpleasant things to him or her. It is also bullying when a student is teased  
44 repeatedly in a way he or she does not like or when he or she is deliberately left  
45 out of things. But it is NOT BULLYING when two students of about the same  
46 strength or power argue or fight. It is also not bullying when a student is teased  
47 in a friendly and playful way.  
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50 With this definition in mind, *traditional bullying victimization* was constructed from a single  
51 survey item asking respondents, "How often have you been bullied at school in the past couple of  
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3 months?”<sup>3</sup> Responses to the traditional bullying victimization item ranged from 1= “I haven’t  
4 been bullied” to 5= “several times a week.” A binary measure was created from this original item  
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6 for use in our analyses to follow (0 = no victimization; 1 = any victimization)<sup>4</sup>. As shown in Table  
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8 1, the mean of this dichotomous measure is .26, which indicates that approximately one in four  
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10 students experienced at least one-time traditional bullying victimization. *Traditional bullying*  
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12 *offending* was constructed from a single item. “How often have you taken part in bullying another  
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14 student(s) at school in the past couple of months?” While original responses ranged from 1 = “I  
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16 haven’t bullied” to 5 = “several times a week,” another binary measure was created for analysis  
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18 purposes (0 = none; 1 = any traditional bullying offending).<sup>5</sup> Descriptive statistics indicate that  
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20 30% of the sample engaged in traditional bullying offending at least once.  
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### 26 *Cyberbullying victimization and offending*

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28 *Cyberbullying victimization* was measured through use of four survey items that asked if  
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30 the following experiences occurred within the last couple of months in school: 1) “I was bullied  
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32 using a computer or e-mail messages or pictures,” 2) “I was bullied using a cell phone,” 3) “I was  
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34 bullied outside of school using a computer or e-mail messages or pictures,” and 4) “I was bullied  
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36 outside of school using a cell phone.” Responses were combined and dichotomized (0 = no  
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38 cyberbullying victimization; 1 = any cyberbullying victimization).<sup>6</sup> In order to measure  
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40 *cyberbullying offending*, we drew from four similar items that tapped perpetration as opposed to  
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42 victimization (i.e., the wording of the items listed above was changed to “I bullied another  
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48 <sup>3</sup> Unfortunately, time of year that the survey was administered is not available within the survey handbook.

49 <sup>4</sup> The frequency distribution for the original traditional bullying victimization item was as follows: I haven't been  
50 bullied (73.85%), only happened once or twice (16.07%), 2 or 3 times a month (3.93%), about once a week (2.46%),  
51 and several times a week (3.69%).

52 <sup>5</sup> Responses to the original 5-category variable indicated that 69.76% of students did not offend, 21.84% offended  
53 once or twice, 4.11% offended 2-3 times a month, 1.99% offended about once a week, and 2.29% reported offending  
54 several times a week.

55 <sup>6</sup> Responses to the four original 5-category questions indicated that between 91.94% and 92.54% of students reported  
56 no victimization. Of those reporting any cyberbullying victimization, “only once or twice” was the modal category  
57 for all four items, with very few students reporting more frequent victimization.

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3 student(s) using a cell phone,” etc.). Again, if the respondent responded positively to any of these  
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5 items, they were coded as “1 = cyberbullying offender.” All others were coded as “0 = no  
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7 cyberbullying offending.”<sup>7</sup> Descriptive statistics show that 12% of the sample experienced  
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9 cyberbullying victimization, while 8% of the sample reported cyberbullying offending.

### 12 *Victim-Offender groups*

14 For analysis purposes, we classified sampled students into one of four groups, for both  
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16 traditional bullying and cyberbullying. The first group, labeled “*victim*,” includes students that  
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18 report bullying victimization but not offending. The second group, “*offender*,” contains students  
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20 that reported bullying offending but not victimization. The third group of students, labeled  
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22 “*victim-offender*,” reported both bullying victimization and offending. Finally, those in the “*no*  
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24 *involvement*” group experienced neither bullying victimization nor bullying offending.  
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### 28 *Physical health risk factors*

30 Physical health risk was measured with eight variables that tapped hunger, nutrition,  
31  
32 weight, illness symptomology, dental hygiene, and physical inactivity. First, we used a single  
33  
34 survey item for creating a *hunger* variable. This survey item asked: “Some young people go to  
35  
36 school or to bed hungry because there is not enough food at home. How often does this happen to  
37  
38 you?” The responses originally ranged from 1 = “always” to 4 = “never,” but they were reverse  
39  
40 coded such that higher values indicate more frequent hunger. Our second physical health risk  
41  
42 factor was *feeling over/under weight*. This variable was created using responses to a survey  
43  
44 question asking students whether they thought their bodies were much too thin, a bit too thin,  
45  
46 about the right size, a bit too fat, much too fat. We recoded this variable so as to create a 3-  
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52  
53 <sup>7</sup> As with cyberbullying victimization, responses across the five categories of each of the four cyberbullying  
54  
55 offending items were highly skewed, with 92.27%-93.99% of students indicting no offending. Further, the majority  
56  
57 of those reporting any offending responded that the cyberbullying behavior had happened only once or twice. The  
58  
59 percentages of students reporting more frequent cyberbullying offending were very small, ranging from 0.54%-  
60  
1.25%.

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2  
3 category ordinal measure that tapped the degree to which respondents felt either over or under  
4 weight: respondents felt okay with body (0), respondents felt a bit too thin/a bit too fat (1), or  
5 respondents felt much too thin/much too fat (2).<sup>8</sup> A third physical health risk factor, *somatic*  
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10 *problems*, was created with responses to a survey question asking respondents how frequently, in  
11 the six months preceding the survey, they had experienced headaches, stomachaches, back aches,  
12 feeling low, irritability or bad temper, nervousness, difficulty sleeping, and dizziness. Response  
13 categories originally ranged from “about everyday” (1) to “rarely or never” (5). Responses were  
14 reverse coded and averaged, with higher values indicating more somatic problems (Cronbach’s  
15 alpha=.82).

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24 Another physical health risk factor tapped the extent to which respondents had a non-  
25 nutritious “*junk food*” diet. This variable was created using five items asking students how many  
26 times per week they usually ate: (1) fruits, (2) vegetables, (3) sweets (candy or chocolate), (4)  
27 coke or other soft drinks containing sugar, and (5) fast food (for example, McDonalds, KFC,  
28 Pizza Hut, Taco Bell). Responses to each of the five items originally ranged from 1 = “never” to 7  
29 = “everyday.” The responses to items (1) and (2) mentioned above (tapping consumption of fruits  
30 and vegetables) were reverse coded. Then, the values of these items were summed, resulting in an  
31 index with values ranging from 5 to 35, higher values indicating a relatively less nutritious diet  
32 (mean = 18.93, std. dev. = 5.11). *Poor dental hygiene* was measured using a single item asking  
33 respondents “How often do you brush your teeth?” Responses to this question ranged from 1 =  
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<sup>8</sup> We interpreted being much too overweight and much too underweight as equally risky from a physical health standpoint, though we recognize this is debatable. However, in order to assess whether the two states might be differently related to victimization/offending, we conducted supplemental analyses with three alternative binary measures: “underweight” (1= much too thin or a bit too thin; 0 = other); “overweight” (1 = a bit too fat or much too fat; 0 = other); and “normal weight” (1 = about the right size; 0 = other). In the supplemental analysis, “normal weight” (58% of the sample) was reference category while examining the effects of underweight (11.5% of the sample) and overweight (29% of the sample). Results from this supplemental analysis are referenced, where appropriate, within the Results section.



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2  
3 “more than once a day” to 5 = “never,” with higher values indicating poorer dental hygiene  
4  
5 (mean= 1.39 and std.dev. =.63). Finally, we also included several measures of sedentary lifestyle  
6  
7 as physical health risk factors. First, *physical inactivity* was measured with a single item which  
8  
9 asked respondents to indicate how often they exercised, outside of school hours, to the point of  
10  
11 getting out of breath or sweating. Responses ranged from 1 =” everyday” to 7 = “never” (mean =  
12  
13 2.90, std. dev. = 1.67). Other indicators of a sedentary lifestyle were *TV Watching* and  
14  
15 *Computer/Video Games*. Measurement for each was based on the respondents’ reported daily  
16  
17 average hours watching television and playing computer/video games, respectively, with values  
18  
19 for each ranging from 1 to 9. As indicated by Table 1, students watched, on average 4 hours of  
20  
21 television per day and engaged in 2.75 hours of computer/video gaming (std. dev. = 1.91 and  
22  
23 1.70, respectively).

#### 24 25 26 27 28 *Risky/deviant lifestyle*

29  
30 Risky/deviant lifestyle was measured with six variables: fighting, weapon carrying,  
31  
32 cigarette use, alcohol use, marijuana use, and peer deviance. For measuring *fighting*, respondents  
33  
34 were asked: “During the past 12 months, how many times were you in a physical fight?” The  
35  
36 answers to this question ranged from 1 = “I have not been in a physical fight” to 5 = “four times  
37  
38 or more” (mean=1.75 and std. dev. =1.22).<sup>9</sup> A *weapon carrying* measure was created with answer  
39  
40 to a question: “During the past 30 days, on how many days did you carry a weapon, such as a gun,  
41  
42 knife or club?” The answers to this question ranged from 1 = “I did not carry a weapon” to 5 =  
43  
44 “six or more days” (mean=1.35 and std. dev. =0.96).  
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54  
55 <sup>9</sup> We recognize that there might be overlap between “fighting” and some aspects of traditional bullying victimization  
56  
57 or offending, generally speaking. However, given that HBSC student respondents were instructed that “it is NOT  
58  
59 BULLYING when two students of about the same strength or power argue or fight,” we see the constructs as distinct  
60  
in this study.



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3           *Drinking alcohol and smoking cigarettes* were measured by using the responses to two  
4 similar items that asked “On how many occasions have you smoked cigarettes/drunk alcohol in  
5 the last 30 days?” Responses ranged from 1 = “never” to 7 = “40 times or more” (mean for  
6 cigarette use = 1.37, std. dev. = 1.20; mean for drinking alcohol = 1.59, std. dev. = 1.28).  
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Marijuana use was measured with a single item which asked about the frequency of marijuana use  
in the last 12 months, with responses also ranging from 1 = “never” to 7 = “40 times or more”  
(mean = 1.42, std. dev. = 1.25).

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*Peer deviance* was measured by combining responses to five survey questions asking  
respondents how many of their friends (1) smoke cigarettes, (2) drink alcohol, (3) get drunk at  
least once a week, (4) smoke/use marijuana (pot, weed, hash, joint), and (5) carry a weapon, such  
as gun, knife, or club. The answers to each item ranged from 1 = “none” to 5 = “all.” Our overall  
measure of peer deviance was computed as the average of the five responses (Cronbach’s alpha =  
.89, mean = 1.64, std. dev.= 0.83).

### *Psycho-social adjustment*

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We also included several measures of psycho-social adjustment, including life  
satisfaction, positive body image, positive peer relations, parental support, and school  
performance. *Life satisfaction* was measured as the students’ responses to a question asking them  
to rate on, a 0 to 10 scale, how they felt about their lives, with 0 = “worst possible life” and 10 =  
“best possible life” (mean = 7.34, std. dev. = 1.98). *Positive body image* was measured by  
combining responses to three items: (1) “I am frustrated with my physical appearance,” (2) “I hate  
my body”, and (3) “I feel anger toward my body.” The responses originally ranged from 1 =  
“strongly disagree” to 5 = “strongly agree.” We reverse coded the responses, and then took the  
average of the three items, with higher values on resulting scores indicating more satisfaction with  
body appearance (Cronbach’s alpha =.82; mean = 3.96, std. dev. = 1.02).

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3           *Positive peer relations* was measured with responses to questions asking students their  
4 level of agreement with the following” (1) “the students in my class(es) enjoy being together,” 2)  
5  
6 “most of the students in my class(es) are kind and helpful,” and 3) “other students accept me as I  
7  
8 am.” The responses to this question ranged from 1= “strongly agree” to 5 = “strongly disagree.”  
9  
10 However, we reverse coded these questions and then computed an average score on a positive  
11  
12 peer relations index (Cronbach’s alpha = 0.74, mean = 3.66, std. dev. = 0.83). *Parental support*  
13  
14 was measured as an index that combined responses from four items that asked respondents to  
15  
16 indicate the extent to which their parent/guardian helped them, they were loving, they understood  
17  
18 their problems, and they made them feel better when they were upset. We recoded these items  
19  
20 (ranging from 1 to 4) so that higher scores indicated relatively more parental support and then  
21  
22 computed an average score across these four responses (Cronbach’s alpha = .83, mean = 3.42,  
23  
24 std.dev. = 0.54). *School performance* was measured with a single survey question which asked  
25  
26 students; “in your opinion, what does your class teacher(s) think about your school performance  
27  
28 compared to your classmates?” Responses was ranged from 1 = “very good” to 4 = “below  
29  
30 average,” but we reverse coded this item such that higher scores indicate better school  
31  
32 performance (mean = 2.92; std. dev. = .86).

#### 33 34 35 36 37 38 39 40 *Control variables*

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42           The multivariate analyses presented herein control for older friends, the level of  
43  
44 supervision from parents, gender, age, race, family affluence, and foreign-born status of the  
45  
46 respondents. *Older friends* was measured dichotomously (1 = yes; 0 = no) to indicate whether the  
47  
48 respondent reported that most of the friends in his/her group were older (than the respondent).  
49  
50  
51 *Parental supervision* was measured with an index that was calculated as the average of 10 items  
52  
53 that asked respondents to indicate the extent to which their mothers/fathers know: (1) who their  
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55 friends are, (2) how they spend money, (3) where they are after school, (4) where they go at night,  
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3 and (5) what they do with their free time. Responses were recoded such that higher values  
4  
5 indicate relatively more parental supervision (Cronbach's alpha = 0.88, mean = 3.29, std.dev.=  
6  
7 0.60).  
8  
9

10 Age was measured as a metric variable ranging from 10 to 17<sup>10</sup>. Gender was measured as  
11  
12 binary variable (male=1, female=0). A family affluence scale was imputed from within the survey  
13  
14 dataset downloaded from ICPSR (so previously computed) as an ordinal scale ranging from 0 to  
15  
16 9, with higher values indicating relatively greater affluence. Race was presented as another pre-  
17  
18 computed variable in the dataset, with eight subcategories. However, for purposes of our analysis,  
19  
20 we combined some of the categories with small percentages, leaving us with four dichotomous  
21  
22 variables: (1) Black/African American (18%), (2) White (48%), (3) Hispanic (21%), and (4)  
23  
24 Others (13%). Finally, non-nativity (to the U.S.) was measured with a dichotomous variable  
25  
26 (1=foreign born, 0=not foreign born).  
27  
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31 Before proceeding with a discussion of the analytic strategy, it should be noted that a  
32  
33 potentially important limitation of the measures described above is that different time referents  
34  
35 were used in the original survey questions. For example, students were asked to report about  
36  
37 bullying offending and victimization that had occurred "in the past couple of months." They were  
38  
39 asked to report fighting within the past 12 months, whereas drinking, smoking, and weapon  
40  
41 carrying questions were asked in relation to the past 30 days. Finally, questions about peer  
42  
43 deviance, physical health indicators, and psycho-social well-being were not associated with a  
44  
45 specific time referent. While the time-referent variability is admittedly awkward, we do not think  
46  
47 it jeopardizes the overall validity of our study since our primary purpose is *not* to establish  
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52  
53 <sup>10</sup> We checked the frequencies with a grade\*age crosstab and realized that the majority of students' age range  
54  
55 between 12 to 16. However, there were 31 students 11 years old or younger, and 131 students 17 years or older.  
56  
57 These age statistics might indicate two main possibilities: 1) there are some exceptional students, either gifted or  
58  
59 developmentally delayed ones, in these grades. Second, these might be the result of measurement error, either by  
60  
researchers or by students who might have made a mistake in answering this question.

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3 causality but rather to observe the associations between bullying experiences (as victims,  
4 offenders, victim-offenders, or uninvolved) and physical health indicators. On the other hand, as  
5  
6 with most survey-based studies, readers should keep the time referent associated with the  
7  
8 variables in mind when interpreting results.  
9  
10

### 11 **Analytic Strategy**

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14 Prior to statistical analysis, we examined patterns of missingness among our study  
15 variables. The most common method for dealing with missing cases is the listwise deletion of the  
16 cases. However, a clear disadvantage of listwise deletion is that it might systematically drop cases  
17 due to non-random missing values patterns in the data. To address this issue, we first conducted  
18 Little's (1988) MCAR test to find out whether missing data followed a completely random  
19 pattern—referred to as “missing completely at random (MCAR).” The result of this test revealed  
20 that the data were not MCAR. Thus, we used multivariate sequential imputation, with chained  
21 equations (MICE) in Stata 15.1 (StataCorp, College Station, TX, 2017) in order to create 20  
22 datasets<sup>11</sup> with imputed, complete data. Simply put, chained equations impute missing values by  
23 using other variables as predictors in the imputation code.<sup>12</sup> Simulations have indicated that  
24 multiple imputation (MI) can perform well in situations where as much as 50% of observations  
25 are missing on study variables (Allison, 2002). The percent of cases imputed for each study  
26 variable in our analysis was as follows (from highest to lowest): junk food (7.8%), cyber  
27 offending (7.1%), satisfaction with body appearance (7.0%), somatic problems (6.6%), cyber  
28 victimization (6.5%), peer deviance (6.3%), marijuana use (5.5%), parental support (5.4%),  
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52 <sup>11</sup> We decided to use 20 imputations based on the largest FMI (Fraction of Missing Information) statistics, with FMI  
53 representing the proportion of total sampling variance that is due to missing data. The largest FMI for traditional  
54 bullying and cyberbullying were 12% and 20% respectively. A good rule of thumb is to have the number imputations  
55 (at least) equal the highest FMI percentage (Multiple Imputation in SAS Part 1, n.d.). So, we imputed 20 datasets.

56 <sup>12</sup> For imputing race variable, we used mlogit (multinomial logit model). We used binary logit regression for  
57 imputing binary variables, and pmm (predictive mean matching) for imputing metric variables.  
58

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3 parental supervision (5.1%), alcohol use (4.7%), cigarette use (4.6%), older friends (4.5%),  
4  
5 positive peer support (4.4%), foreign born (3.9%), fighting (3.9%), weapon (3.7%), TV watching  
6  
7 (3.5%), traditional bullying victimization (3.7%), computer/video gaming (3.1%), and race (3.1%).  
8  
9  
10 For the rest of the variables, imputed values were less than 3%. We did not impute data for cases  
11  
12 missing on either age or gender. Since there were fewer than 10 cases missing on these variables,  
13  
14 we simply deleted those cases. Dropping these few cases left us with 8,864 cases for imputation  
15  
16 and analysis.  
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19 After imputation, we used the 8,864 cases to create the four victim-offender groups with  
20  
21 respect to both traditional and cyber-bullying. We then proceeded with analysis of variance  
22  
23 (ANOVA), regarding physical health risk factors across the four victim-offender groups for both  
24  
25 traditional and cyberbullying<sup>13</sup>. PROC GLM and the least squares means option in SAS 9.4 were  
26  
27 used for producing ANOVA tests, least squares (LS) means, confidence intervals (CI) for LS-  
28  
29 mean differences, and all pair-wise differences<sup>14</sup>. We also used Bonferroni adjustments for  
30  
31 ANOVA tests, as such adjustments are appropriate when the same test is repeated in many  
32  
33 subsamples (Perneger, 1998). After analyzing mean differences across the four victim and  
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35 offender groups for each type of bullying, we proceeded with multinomial logistic regression  
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37 models in which we estimated the effects of physical health risk factors, risky/deviant lifestyles,  
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39 psycho-social adjustment, and control variables on the likelihood of being within three victim-  
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47 <sup>13</sup> In addition to ANOVA, we also created pairwise two-sided multiple comparisons with the non-parametric version  
48 of the ANOVA (PROC NPAR1WAY)—Kruskal-Wallis test—using Dwass, Steel, Critchlow-Flinger (DSCF) option.  
49 Assumptions for the Kruskal-Wallis test are that within each sample the observations are independent and identically  
50 distributed, and the samples are independent of each other. Normal distribution and equal variance assumptions are  
51 not required. Overall the non-parametric results were very similar to parametric results, though the non-parametric  
52 tests revealed more differences among groups regarding cyberbullying victimization specifically. However, we  
53 elected to show the ANOVA results here (the more conservative estimates of differences) because plots could be  
54 created to visually display the differences. Findings from the non-parametric tests are available from the first author  
55 upon request.

56 <sup>14</sup> We computed the averages of LS-means and CI scores for all factors across the 20 imputed datasets before plotting  
57 the mean differences across groups.  
58

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3 offender typologies relative to being in the no involvement group<sup>15</sup>. We adjusted the regression  
4  
5 results by taking the sampling design into account. Specifically, we used a student weight, and  
6  
7 two cluster variables (district id and school id) were specified in order to account for the  
8  
9 dependence of the student cases selected from the same district or school.  
10

## 11 RESULTS

### 12 **Traditional Bullying: ANOVA**

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15 The plots in Figure 1 display the least squares mean differences (using 95% confidence  
16  
17 intervals) in physical health risk factors across the typologies of traditional bullying. Results  
18  
19 indicate that the not-involved group had the lowest mean for all physical health risk factors except  
20  
21 physical inactivity and junk food. In contrast, the bullying victim-offender group had the highest  
22  
23 mean scores for four of the eight physical health risk factors: hunger, somatic problems, poor  
24  
25 dental hygiene, and time spent video/computer gaming. For two other risk factors—junk food and  
26  
27 TV watching—bullying offenders exhibited the highest mean levels of risk, while physical  
28  
29 inactivity was highest among victims. Consideration of overlapping confidence intervals gives us  
30  
31 a sense of whether there are significant mean differences across groups regarding these physical  
32  
33 health indicators. In this regard, the plots in Figure 1 indicate that the not-involved group reported  
34  
35 significantly lower levels of hunger, somatic problems, and poor dental hygiene than all other  
36  
37 groups, while the victim-offender group had significantly higher mean scores on these three risk  
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39 factors compared to other groups. The other two groups (offenders only, victims only) did not  
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41 have significantly different means compared to each other on these three risk factors.  
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49 For the other risk factors, the patterns of significant differences varied. Regarding poor  
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51 nutrition (i.e., junk food diet), offenders and victim-offenders displayed significantly higher levels  
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56 <sup>15</sup> The maximum Variance Inflation Factor (VIF) value is less than 2, which indicates that the collinearity among  
57 independent variables is likely not a concern.

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3 of risk in comparison to victims and those not involved in traditional bullying, but the levels of  
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5 junk food consumption among the offender and victim-offender groups were not significantly  
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7 different from one another. Being over/under weight was associated with a somewhat different  
8  
9 pattern. Here, bullying victims and victim-offenders were not different from one another, but both  
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11 groups exhibited significantly higher levels of over/underweight in comparison to offenders and  
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13 those not involved. Time spent on video/computer gaming was significantly higher among victim-  
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15 offenders than those not involved, but generally speaking, the four groups did not starkly  
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17 differentiate themselves with the risk factors addressing sedentary lifestyle (physical inactivity,  
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19 hours spent watching TV, and hours spent video/computer gaming).  
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24 <INSERT FIGURE 1 ABOUT HERE>  
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### 26 **Cyberbullying: ANOVA**

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28 The plots in Figure 2 display the least squares mean differences for physical health risk  
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30 factors across the typologies of cyberbullying. The results here are quite similar to those reported  
31  
32 for traditional bullying (Figure 1) in that those not involved in cyberbullying present the lowest  
33  
34 mean levels of risk while victim-offenders present the highest mean levels of risk for hunger,  
35  
36 somatic problems, over/underweight, and poor dental hygiene. That said, victim-offenders are  
37  
38 only significantly higher than all other groups in terms of hunger, and those uninvolved are only  
39  
40 significantly lower than all other groups in terms of somatic problems. Otherwise, there tends to  
41  
42 be substantial overlap across the four groups across all of the other physical health risk factors. As  
43  
44 with traditional bullying, the overlap (i.e., lack of distinction across groups) appears most obvious  
45  
46 in relation to the measures that tap sedentary lifestyle—physical inactivity, hours spent watching  
47  
48 TV, and hours spent on video/computer games. There were somewhat less obvious distinctions in  
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50 levels of over/under weight and poor dental hygiene across the cyberbullying groups in  
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52 comparison to the traditional bullying groups.  
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<INSERT FIGURE 2 ABOUT HERE>

### **Traditional Bullying: Multinomial Logistic Regression Results**

The next step in the analysis was to estimate bullying group membership through the use of multinomial logistic regression models. In these models, four groups (for each type of bullying) served as nominal categories of the dependent variable (with “not involved” serving as the reference category), and physical health risk factors, risky/deviant lifestyle factors, and indicators of psycho-social adjustment serving as independent variables. These models provide estimated the relative risk ratios (RRR), and the standard errors for the RRRs<sup>16</sup>, associated with the independent variable in distinguishing three comparisons: (1) offenders versus those not involved, (2) victims versus those not involved, and (3) victim-offenders versus those not involved. These three comparisons are shown in separate columns in Table 2. Reporting the RRRs is important since several of the statistically significant coefficients were associated with rather small increases or decreases in relative risk.

The first column in Table 2 compares respondents classified as offenders versus those in the reference category (those not involved). The results reported in this column reveal that only two of physical health lifestyle variables were associated with significantly more relative risk of being a traditional bullying offender. Controlling for other variables in the model, one-unit increases in somatic problems and junk food consumption were associated with relative risks of being in the offender group, in comparison to being uninvolved, by factors of 1.25 and 1.04 respectively. Moreover, risky lifestyle measures such as fighting, weapon carrying, alcohol use,

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<sup>16</sup> The RRR of a coefficient indicates how the risk of the outcome falling in the comparison group compared to the risk of the outcome falling in the referent group changes with the variable in question. An RRR > 1 indicates that the risk of the outcome falling in the comparison group relative to the risk of the outcome falling in the referent group increases as the variable increases. In other words, the comparison outcome is more likely. An RRR < 1 indicates that the risk of the outcome falling in the comparison group relative to the risk of the outcome falling in the referent group decreases as the variable increases (Multinomial Logistic Regression, n.d.).



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3 and peer deviance were associated with significantly more relative risks of offending (relative to  
4 no involvement) by factors of 1.24, 1.18, 1.14, and 1.26, respectively. Among the psycho-social  
5 measures, peer support and school performance were all associated with significantly lower risk  
6 of offending, relative to no involvement, by factors of 0.85 and 0.84, respectively, holding all  
7 other variables constant.  
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15 The second column in Table 2 compares respondents who are traditional bullying victims  
16 versus those uninvolved. These results reveal that three of the physical health risk factors were  
17 associated with significantly higher or lower relative risks of being in the victim group relative to  
18 being in the not-involved group. Controlling for other variables in the model, one unit increases in  
19 feeling over/under weight<sup>17</sup> and somatic problems were associated with heightened risks of being  
20 a bullying victim, as opposed to not involved, by factors of 1.21 and 1.41, respectively. On the  
21 other hand, junk food was associated with a significant decline in the relative risk of being a  
22 victim by a factor of 0.97. Beyond physical health indicators, weapon carrying was associated  
23 with a significantly increased relative risk of being a victim in comparison to being uninvolved in  
24 traditional bullying, while marijuana use, body image, and positive peer relations were associated  
25 with significant declines in the relative risk of being a victim relative to being uninvolved.  
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40 The last column in Table 2 compares respondents classified as traditional bullying victim-  
41 offenders and those not involved in traditional bullying. Here, three of physical health risk factors  
42 were associated with significantly increased relative risk of being a victim-offender relative to  
43 being uninvolved. Specifically, controlling for other variables in the model, one unit increases in  
44 somatic problems, poor dental hygiene, and time spent on video/computer gaming were  
45 associated with increased risks of being victim-offenders by factors of 1.59, 1.23, and 1.07,  
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55 <sup>17</sup> The coefficients for the supplemental analysis of “underweight” and “overweight”, measured separately and  
56 examined in relation to “normal weight,” revealed that both coefficients were non-significant across all group models.  
57 Full results from this supplemental analysis is available from the first author upon request.  
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3 respectively. Additionally, three of the risky deviant lifestyle measures—fighting, weapon  
4 carrying, and alcohol use—were associated with significantly increased relative risks of being  
5 victim-offenders in comparison to uninvolved. Two indicators of psycho-social adjustment—  
6 body image and positive peer relations—were associated with significantly lower relative risks of  
7 being a traditional bullying victim-offender relative to being uninvolved.  
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### 16 17 **Cyberbullying: Multinomial Logistic Regression Results** 18

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20 Next, we replicated the multinomial logistic regression analyses presented above in  
21 relation to cyberbullying as opposed to traditional bullying. The first column in Table 3 compares  
22 respondents classified as offenders versus those in the reference category (not involved). The  
23 results reported in this column reveal that only one of the physical health risk factors was  
24 associated with significantly more relative risk of being a cyberbullying offender. Similar to what  
25 was found in our analysis of traditional bullying (Table 2), controlling for other variables in the  
26 model, a one unit increase in junk food was associated with a relative risk of being in the offender  
27 group, in comparison to being uninvolved, by a factor of 1.05. Moreover, three of risky lifestyle  
28 measures were significantly and positively associated with being in the cyber offender group  
29 (relative to no involvement). Specifically, one unit increases in fighting, weapon carrying, and  
30 peer deviance were associated with higher relative risks of being in the offender group by factors  
31 of 1.18, 1.24, and 1.42 respectively. None one of the psycho-social adjustment measures was  
32 significantly related to the outcome of being in the cyber offender group.  
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50 The second column in Table 3 compares respondents who were cyberbullying victims  
51 versus those uninvolved. The results of the analysis in this column reveal that two of physical  
52 health risk factors were positively and significantly associated with the relative risk of being in  
53 the cyber victim group relative to being in the not-involved group. Controlling for other variables  
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3 in the model, one unit increases in hunger and somatic problems were associated with heightened  
4 relative risks of being in the victim group by factors of 1.27 and 1.50 respectively.<sup>18</sup> Beyond  
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6 physical health indicators, fighting was associated with significantly increased relative risks of  
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8 being a victim in comparison to uninvolved by a factor of 1.16. Positive body image was  
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10 associated with significantly lower relative risks of being a victim, relative to uninvolved, by a  
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12 factor of 0.81.  
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17 The last column in Table 3 compares respondents classified as victim-offenders and those  
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19 not involved in cyberbullying. The results of the analyses in this column revealed that three of the  
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21 physical health risk factors were associated with significantly increased relative risk of being a  
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23 cyber victim-offender relative to being uninvolved. Specifically, controlling for other variables in  
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25 the model, one unit increases in hunger, somatic problems, and computer/video gaming were  
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27 associated with heightened relative risks of being a cyber victim-offender by factors of 1.53, 1.29,  
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29 and 1.13 respectively. Among risky lifestyle measures, fighting and weapon carrying were  
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31 associated with significant increases in the relative risks of being cyber victim-offender by factors  
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33 of 1.18 and 1.26, respectively. Positive body image was associated with a significant decline in  
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35 the relative risk of being cyber victim-offender by a factor of 0.70, while life satisfaction was  
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37 associated with a significant increase in the relative risk of being a cyber victim-offender by a  
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39 factor of 1.14.  
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## 47 **DISCUSSION AND CONCLUSIONS**

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49 Recall that the principal aim of this study was to look beyond traditional criminological  
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51 and psycho-social correlates of bullying victimization and offending by also exploring the  
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55 <sup>18</sup> Supplemental analysis using “underweight” and “overweight” as two distinct measures (examined in relation to  
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57 “healthy weight”) revealed an additional significant effect. Being underweight was associated with significantly  
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59 increased risks of being in the offender group versus being uninvolved by a factor of 1.36.

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3 relationships between the bullying experiences and indicators of physical health/well-being.  
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5 Additionally, we aimed to compare the correlates of victimization and offending across traditional  
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7 bullying and cyberbullying since limited research to date suggests they might have distinct  
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9 correlated in terms of psychological health (Wang et al., 2011). In order to realize these goals, we  
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11 first examined whether the average values of a range of physical health indicators vary across  
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13 groups. Next, in multivariate analysis, we estimated the risk of being in different traditional or  
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15 cyber victim-offender groups, relative to no involvement, by using the indicators of physical  
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17 health risk factors and controlling for risky lifestyles, psycho-social adjustment factors, and other  
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19 covariates.  
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24 To summarize, we found significant mean differences in terms of physical health risk  
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26 factors across groups for both traditional and cyber-based bullying. For the majority of the  
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28 physical health risk factors, victim-offenders had the highest average risk scores, while the  
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30 uninvolved group had the lowest average risk scores. These findings are consistent with the  
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32 general pattern from previous research on victim-offender groups indicating that victim-offenders  
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34 tend to appear at the end of the spectrum marked by more problems, and those not involved tend  
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36 to appear at the other end of the spectrum marked by fewer problems, with victim-only and  
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38 offender-only groups falling somewhere in between (TenEyck & Barnes, 2018).  
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43 But, our study importantly adds to previous research on victim and offender groups by  
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45 showing that specific physical health problems are among the problems differentially experienced  
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47 (but see also Forero et al., 2009; Houbre et al., 2006; Nansel et al., 2004). In fact, our multinomial  
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49 logistic regression results indicated that three of the eight physical health factors were associated  
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51 with the increased risk of being a victim-offender of traditional bullying relative to being  
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53 uninvolved. Three of the eight physical health risk factors were associated with the increased risk  
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55 of being a traditional bullying victim only relative to being uninvolved, and two of the eight  
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3 factors were associated with the increased risk of being a traditional bullying offender only  
4 relative to being uninvolved. With respect to cyberbullying, three of the eight physical health  
5 indicators associated with the increased risk of being a victim-offender relative to being  
6 uninvolved, two of the eight factors were associated with increased risk of being a victim only  
7 relative to being uninvolved, and just one of the eight factors was associated with increased risk  
8 of being an offender only relative to no involvement. Overall, in terms of physical health risk  
9 factors, victim-offenders seemed particularly unhealthy in our study, but a number of physical  
10 health indicators distinguished victims-only as well (especially in relation to traditional bullying).

11  
12 While our examination of the associations between indicators of physical health and  
13 bullying experiences was somewhat exploratory, and thus not guided by specific hypotheses, we  
14 believe that our findings set the stage for more refined a priori theorizing how specific indicators  
15 of physical health might relate to being in certain victim-offender groups. Why is being  
16 physically unhealthy related to experiencing bullying victimization and, in particular, both  
17 bullying offending and victimization? There are several speculative, yet reasonable, possibilities  
18 that emerge from our findings. First, as mentioned earlier, to the extent that indicators of physical  
19 health such as feeling overweight/underweight, eating junk food, or poor dental hygiene overlap  
20 with low self-control—a correlate of both victimization and offending (Gottfredson & Hirschi,  
21 1990; Schreck, 1999)—it makes sense that victim-offenders might exhibit particularly poor  
22 health. In short, our findings lend support to the idea that health behaviors might be part of the  
23 wide spectrum of human functioning that is related to low self-control and thus, in turn, also  
24 correlated with victimization and offending (De Ridder, Lensvelt-Mulders, Finkenauer, Stok, &  
25 Baumeister, 2012). Alternatively, low self-control might serve as a bridge, causally linking  
26 (indirectly) negative health behaviors and offending and victimization (Meldrum, Barnes, & Hay,  
27 2015). That said, the fact that health risk factors also differentiated (from those not involved) the

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3 victim-only group, but not the offender-only group, suggests that victimization theories, like  
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5 target congruence theory, might also be applicable. In that regard, the findings here are consistent  
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7 with previous studies indicating that being over/under weight or having physical limitations are  
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9 related to bullying victimization due to victim gratifiability and/or vulnerability (Kahle &  
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11 Peguero, 2017; Kulig et al., 2017). Finally, poor physical health could be *a result of* bullying  
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13 experiences, especially experiences as a victim.  
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17 Beyond adding to the literature to date examining indicators of physical health across  
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19 bullying victim and offender groups, our study is also important in that it conducted such an  
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21 examination in relation to both traditional bullying and cyberbullying. As such, it adds to the  
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23 knowledge base about the similarities and differences between traditional and cyber-based  
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25 bullying (see also Gradinger et al., 2009; Perren et al., 2010; Wang et al., 2011) In general, we  
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27 found similar patterns in the effects of physical health indicators, risky/deviant lifestyle, and  
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29 psycho-social adjustment on victim-offender group membership for traditional and cyber-based  
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31 bullying. Overall, such findings hint that cyberbullying offending and victimization might largely  
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33 be an extension of traditional bullying offending.  
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38 Though this study is one of a relative few that utilizes a nationally representative sample  
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40 of adolescents to systematically examine both traditional and cyberbullying victim-offender  
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42 groups with regard to physical health related risk factors, it still has important limitations that  
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44 should be noted. Most notably, due to the cross-sectional nature of our data/models, causality  
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46 remains a question. To the extent possible, future research should rigorously examine the causal  
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48 relationships among physical health risk factors, psycho-social adjustment, and bullying, with  
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50 particular attention given to the potential for reciprocal relationships. As stated throughout, we  
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52 recognize that indicators of poor physical health may be both causes and consequences of  
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54 bullying.  
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Beyond limitations associated with the cross-sectional design, different time referents were used in the survey questions that served as the basis for the measurement of variables studied here. Thus, our findings should be evaluated by taking these time periods into account, as it is difficult for us to ascertain if the relationships observed here hold true once different time references are used. For instance, when considering the relationships between our risky/deviant lifestyle measures and the bullying experiences, readers should keep in mind that risky behavior was measured in relation to the past 12 months appears and bullying experiences were measured in relation to the “past couple of months.” Different time references might produce different results regarding such relationships.

Once temporal order and causality can be more firmly established, future work could more fully address the possible mediation and moderation mechanisms linking indicators of physical health and bullying victimization, offending, and victim-offending—for example, examining the extent to which low self-control serves to bridge physical health risk and victim-offending (Meldrum et al., 2015). Finally, we see value in future work exploring the potentially developmental/age-graded and gendered nature of the overlap<sup>19</sup> between indicators of physical health and bullying victimization/offending (see Kahle & Peguero, 2017).

Despite the study limitations, the overlaps between physical and mental health and bullying victimization and victim-offending reported here point to the important intersection of public health and criminology/victimology. Of course, there has been growing recognition over the past two to three decades that interpersonal violence is a community health problem. Some 25

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<sup>19</sup> We also examined interactions between physical health risk factors and both age and gender. These supplemental analyses yielded two significant interactions: (1) being male exacerbated the positive association between tv watching and the risk of being in the cyberbullying victim-offender group relative to being in the uninvolved group by a factor of 1.18, and (2) being male exacerbated the positive association between somatic problems and the risk of being in the victim only group by a factor of 1.23, relative to the uninvolved group. The output of the interaction analyses are available upon request from the first author.



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3 years ago, scholars such as Deborah Prothrow-Stith (Prothrow-Stith & Weissman, 1991) and  
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5 Mark Moore (1995) famously described how interpersonal attacks—treated as “crime” by  
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7 motivated offenders in the world of criminal justice—were seen threats to the morbidity and  
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9 mortality of vulnerable citizens in the world of public health. In brief, a public health approach  
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11 changes the philosophical view of interpersonal violence from a crime problem to a health  
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13 problem. Our findings provide further support for the overlap between violence and health,  
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15 suggesting that not only might bullying experiences be medically harmful, they are correlated  
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17 with a number of other indicators of poor health. However, in extending the public health  
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19 approach further, our results suggest that engagement of health practitioners, such as school  
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21 nurses, might be an important avenue for bullying intervention and violence prevention, as such  
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23 personnel are able to provide less formal and potentially better support for students than  
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25 traditional crime prevention agencies. As Moore suggests (1995, p. 257 “*An army of white coats*  
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27 *can join the blue coats in dealing with violence*” Additionally, our findings support the  
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29 importance of other school personnel, such as educators, psychologists, and social workers, can  
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31 be an important part of the detection of and solution to youth violence by being attuned and  
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33 responsive to students’ hunger and activity levels, weight issues, and somatic problems. In sum,  
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35 examining youth bullying through a lens that extends beyond traditional criminogenic risk factors  
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37 might help to create multidisciplinary and more effective prevention strategies.  
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Table 1. Descriptive statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
<i>Dependent variables</i>					
Bully victim	8,573	0.26	0.44	0	1
Bully offender	8,483	0.30	0.46	0	1
Cyberbullying victim	8,293	0.12	0.32	0	1
Cyberbullying offender	8,235	0.08	0.28	0	1
<i>Physical health risk factors</i>					
Hunger	8,770	1.33	0.63	1	4
Feeling over/under weight	8,804	0.46	0.59	0	2
Somatic problems	8,285	2.09	0.87	1	5
Junk food	8,183	18.93	5.11	5	35
Poor dental hygiene	8,714	1.39	0.63	1	5
Physical inactivity	8,800	2.90	1.67	1	7
TV watching	8,567	4.00	1.91	1	9
Computer/video gaming	8,597	2.75	1.70	1	9
<i>Risky/Deviant lifestyle</i>					
Fighting	8,525	1.75	1.22	1	5
Weapon carrying	8,545	1.35	0.96	1	5
Cigarette smoking	8,460	1.37	1.20	1	7
Alcohol use	8,449	1.59	1.28	1	7
Marijuana use	8,386	1.42	1.25	1	7
Peer deviance	8,308	1.64	0.83	1	5
<i>Psycho-social adjustment</i>					
Life satisfaction	8,770	7.34	1.98	0	10
Positive body image	8,255	3.96	1.02	1	5
Positive peer relations	8,477	3.66	0.83	1	5
Parental support	8,387	3.42	0.54	1	4
School performance	8,628	2.92	0.86	1	4
<i>Control variables</i>					
Older friends	8,477	0.19	0.39	0	1
Parental supervision	8,421	3.29	0.60	1	4
Family affluence	8,780	5.90	1.98	0	9
Age	8,866	13.81	1.28	10	17
Male	8,873	0.52	0.50	0	1
White	8,600	0.48	0.50	0	1
Black	8,600	0.18	0.38	0	1
Hispanic	8,600	0.21	0.41	0	1
Others	8,600	0.13	0.34	0	1
Foreign born	8,524	0.09	0.29	0	1



Table 2. Multinomial logistic regression models for traditional bullying reporting the relative risk of being an offender, a victim, or a victim-offender relative to being uninvolved.

Variable	Offender (n=1,569)		Victim (n=1,198)		Victim-offender (n=1,123)	
	RRR	S.E.	RRR	S.E.	RRR	S.E.
Hunger	0.989	0.077	1.121	0.098	1.115	0.083
Feeling over/under weight	0.962	0.071	1.205*	0.101	1.012	0.095
Somatic problems	1.25**	0.073	1.412**	0.116	1.585**	0.091
Junk food	1.039**	0.009	0.973**	0.01	1.01	0.011
Poor dental hygiene	1.037	0.07	1.109	0.077	1.232*	0.097
Physical inactivity	0.975	0.021	1.002	0.029	0.962	0.031
TV watching	1.037	0.028	1.037	0.026	1.035	0.027
Computer/video gaming	0.991	0.027	1.031	0.031	1.07**	0.027
Fighting	1.239**	0.036	1.044	0.054	1.217**	0.053
Weapon carrying	1.176**	0.047	1.179**	0.069	1.225**	0.054
Cigarette smoking	1.031	0.044	1.059	0.055	1.009	0.051
Alcohol use	1.138**	0.042	1.035	0.058	1.127*	0.053
Marijuana use	0.987	0.043	0.855**	0.044	0.993	0.043
Peer deviance	1.262**	0.086	0.987	0.088	0.99	0.086
Life satisfaction	1.036	0.027	0.98	0.022	1.032	0.03
Positive body image	0.908	0.047	0.856**	0.045	0.699**	0.038
Positive peer relations	0.853**	0.044	0.564**	0.032	0.647**	0.036
Parental support	1.054	0.097	0.952	0.116	0.84	0.102
School performance	0.835**	0.043	0.999	0.052	0.943	0.059
Older friends	1.001	0.101	0.853	0.14	1.182	0.162
Parental supervision	0.794**	0.067	0.907	0.077	0.885	0.091
Family affluence	1.113**	0.024	1.06*	0.024	1.106**	0.027
Age	0.898*	0.037	0.774**	0.032	0.783**	0.036
Male	1.467**	0.133	1.129	0.109	1.491**	0.164
Black	0.694*	0.109	0.691*	0.099	0.803	0.146
Hispanic	0.856	0.173	0.675*	0.107	0.74	0.116
Others	0.947	0.156	0.817	0.092	0.763*	0.1
Foreign born	0.708*	0.111	1.049	0.193	1.171	0.178

\*p<.05; \*\*p<.01; uninvolved group served as the reference group  
uninvolved group n=4,974

Table 3. Multinomial logistic regression models for cyberbullying reporting the relative risk of being an offender, a victim, or a victim-offender relative to being uninvolved.

Variable	Offender (n=333)		Victim (n=610)		Victim-offender (n=437)	
	RRR	S.E.	RRR	S.E.	RRR	S.E.
Hunger	0.931	0.152	1.272*	0.116	1.528**	0.165
Feeling over/under weight	0.953	0.142	1.018	0.099	0.957	0.132
Somatic problems	1.081	0.114	1.502**	0.13	1.288*	0.128
Junk food	1.045*	0.017	0.986	0.016	1.017	0.019
Poor dental hygiene	1.047	0.102	0.977	0.093	1.032	0.119
Physical inactivity	0.958	0.052	0.981	0.035	1.024	0.054
TV watching	1.049	0.046	0.978	0.036	0.951	0.038
Computer/video gaming	1.026	0.053	1.026	0.035	1.126**	0.048
Fighting	1.175*	0.09	1.157**	0.047	1.179**	0.066
Weapon carrying	1.24**	0.087	1.046	0.055	1.26**	0.092
Cigarette smoking	1.07	0.064	0.998	0.066	1.066	0.05
Alcohol use	1.069	0.084	1.04	0.059	1.071	0.057
Marijuana use	0.985	0.058	0.968	0.054	1.044	0.057
Peer deviance	1.421**	0.156	1.167	0.102	1.051	0.108
Life satisfaction	1.044	0.049	0.981	0.033	1.136**	0.04
Positive body image	0.834	0.077	0.81**	0.05	0.695**	0.065
Positive peer relations	1.046	0.086	0.898	0.067	1.002	0.101
Parental support	1.13	0.164	0.89	0.103	0.967	0.141
School performance	0.853	0.07	1.022	0.075	1.157	0.105
Older friends	1.322	0.293	0.967	0.187	2.012**	0.38
Parental supervision	0.731*	0.101	1.036	0.112	0.664**	0.089
Family affluence	1.06	0.041	1.106**	0.038	1.09	0.048
Age	0.876*	0.05	0.895*	0.048	0.971	0.072
Male	1.288	0.219	0.656**	0.079	0.808	0.146
Black	1.366	0.31	0.753	0.169	1.606*	0.341
Hispanic	1.035	0.212	0.986	0.2	0.923	0.193
Others	0.852	0.234	0.882	0.146	0.792	0.177
Foreign born	0.727	0.237	1.437	0.283	1.979**	0.379

\*p<.05; \*\*p<.01; uninvolved group served as the reference group  
uninvolved group n=7,484



Figure 1. The plot of mean differences among the typologies of traditional bullying victims and offenders: physical health risk factors (Bonferroni adjusted least squares mean differences with 95% confidence intervals)

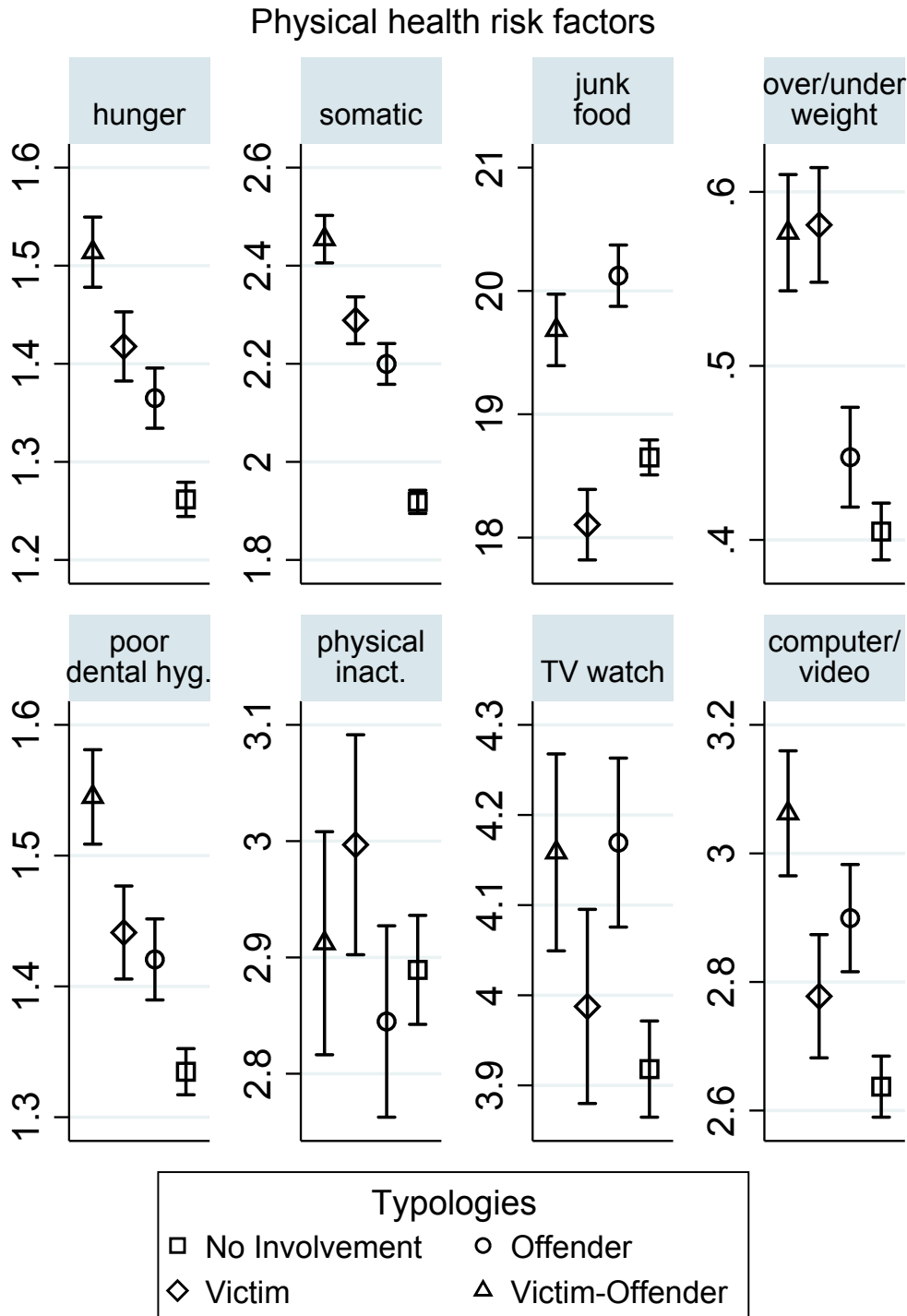


Figure 2. The plot of mean differences among the typologies of cyberbullying victims and offenders: physical health risk factors (Bonferroni adjusted least squares mean differences with 95% confidence intervals)

