Int J Public Health (2015) 60:227–237
DOI 10.1007/s00038-014-0644-9

SSPH+ SWISS SCHOOL OF PUBLIC HEALTH +

ORIGINAL ARTICLE

Longitudinal associations between cyber-bullying perpetration and victimization and problem behavior and mental health problems in young Australians

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Received: 6 July 2014 / Revised: 16 December 2014 / Accepted: 17 December 2014 / Published online: 15 January 2015

Abstract
Objectives To investigate associations between Grade 9 and 10 cyber-bullying perpetration and victimization and Grade 11 problem behavior and mental health problems after controlling for risk factors for these outcomes in the analyses.
Methods The sample comprised 927 students from Victoria, Australia who completed a modified version of the self-report Communities That Care Youth Survey in Grades 9–11 to report on risk factors, traditional and cyber-bullying perpetration and victimization, problem behavior, and mental health. Complete data on over 650 participants were analyzed.
Results Five per cent of Grade 9 and 10 students reported cyber-bullying perpetration only, 6–8 % reported victimization only, and 8–9 % both cyber-bullied others and were cyber-bullied. Results showed that cyber-bullying others in Grade 10 was associated with theft in Grade 11, cyber-victimization in Grade 10 was linked with Grade 11 depressive symptoms, and Grade 10 cyber-bullying perpetration and victimization combined predicted Grade 11 school suspension and binge drinking.
Conclusions Prevention approaches that target traditional and cyber-bullying, and established risk factors are necessary. Such multi-faceted programs may also reduce problem behavior and mental health problems.

Keywords Cyber-bullying · Longitudinal study · Problem behavior · Mental health problems · Longitudinal consequences

This article is part of the special issue "Communication Technology, Media Use and the Health of Our Kids".

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Introduction

Cyber-bullying is a modern phenomenon that has generated worldwide concern due to the potentially serious consequences for victims. Discussion continues amongst researchers about how to define cyber-bullying relative to "traditional" bullying (bullying before the advent of technology). One definition of cyber-bullying is "any behavior performed through electronic or digital media by individuals or groups that repeatedly communicates hostile or aggressive messages intended to inflict harm or discomfort on others" (Tokunaga 2010, p. 278). Menesini et al. (2012) recently concluded that the criteria for traditional bullying of intentionality and imbalance of power between perpetrator and victim were essential for cyber-bullying; however, the importance of the criterion of repetition needs to be established. The power imbalance apparent in bullying can take multiple forms and may vary depending on the social context (e.g., differences in physical size or strength or status in the school community, technological prowess). Bullying behavior can be covert

(e.g., exclusion, spreading rumors) or overt (e.g., verbal and physical abuse). Given that cyber-bullying is a relatively new phenomenon, longitudinal studies of cyber-bullying are only now emerging to examine the long-term effects of cyber-bullying on young people. There are several characteristics of cyber-bullying that make its potential effects more insidious including that the perpetrator can remain anonymous (Patchin and Hinduja 2006), reducing the likelihood of being found out; large numbers of people can be involved in cyber-bullying perpetration relatively effortlessly, irrespective of the time of day or geographic location (Kowalski et al. 2014); and there is effectively no respite for the victim of cyber-bullying and it is therefore difficult for the person being bullied to defend against and it is very difficult for adults to contain. The current paper, one of only a few longitudinal studies, examines the associations between cyber-bullying perpetration and victimization and problem behavior and mental health problems over a 24-month period. The focus on perpetration and victimization, along with both perpetration and victimization is appropriate, given reports (see review below) that the outcomes differ for students in these groups.

Rates of cyber-bullying

The rates of cyber-bullying victimization range between 10 and 40 % (Kowalski et al. 2014). Rates vary considerably across studies due to differences in the ways cyber-bullying is defined and how it is measured, as well as the samples used. There is current debate about whether rates of cyber-bullying are increasing or have started to plateau (Kowalski et al. 2014). In a national Australian study, 6 % of boys and 9 % of girls were victims of cyber-bullying in Grade 9 and 4 % of boys and 3 % of girls reported cyber-bullying others (Cross et al. 2009). For Grade 9 students in Victoria, Australia, the rates of cyber-bullying perpetration and victimization were 13 and 14 %, respectively; 15 % of girls and 14 % of boys for perpetration and 21 % of girls and 12 % of boys for victimization (Hemphill et al. 2012).

Long-term effects of cyber-bullying perpetration and victimization

Anecdotally, the effects of cyber-bullying can be wide-reaching; however, given that cyber-bullying is a recent phenomenon, longitudinal research on the impact of cyber-bullying on problem behaviors and mental health problems is still growing. A meta-analysis of 34 studies demonstrated that associations between cyber-bullying victimization and suicidal ideation were stronger than for traditional bullying (van Geel et al. 2014); however, there were only three studies of cyber-bullying victimization available. In another meta-analysis of 131 studies of cyber-bullying perpetration and victimization, Kowalski et al. (2014) reported moderate associations between cyber-bullying perpetration and drug and alcohol use, and smaller associations with anxiety and depression. For cyber-bullying victimization, there were moderate associations with suicidal ideation, anxiety and depression, and smaller associations with conduct and emotional problems, and drug and alcohol use.

There are several studies on associations between cyber-bullying perpetration and victimization and problem behavior. Ybarra et al. (2007) reported that students harassed online had more detentions and suspensions, and a higher incidence of truancy. Ybarra and Mitchell (2004) have reported associations between cyber-bullying perpetration and/or victimization and tobacco, alcohol, and drug use, as well as symptoms of anxiety and depression. For victims of cyber-bullying, Hinduja and Patchin (2010) found links between cyber-bullying and suicide, and others have reported associations with increased self-injury (Schneider et al. 2012), self-harm (Hay and Meldrum 2010), psychological distress (e.g., depressive symptoms, fear, unease) (Hoff and Mitchell 2009; Landstedt and Gadin 2011; Landstedt and Persson 2014), delinquent behavior, and substance use (Mitchell et al. 2007). However, as noted by Kowalski et al. (2014), studies to date have not controlled for traditional bullying perpetration and victimization in their analyses or for other relevant risk factors known to predict problem behavior and mental health problems.

Risk factors for problem behavior and mental health problems

A range of risk factors within the young person, their family, and peer group have been identified in the research literature for problem behavior (e.g., violence, antisocial behavior, substance use) and mental health problems (e.g., depression, self-harm). Analyses conducted here will control for these established risk factors (described below) when examining longitudinal associations between cyber-bullying perpetration and victimization and problem behavior and mental health problems.

Young person (individual) factors Traditional bullying perpetration is associated with later antisocial behavior, violence, and substance use, while being a victim of traditional bullying increases the risk of later depression and self-harm (Hemphill et al. 2011b; Ttofi et al. 2011). Students' low achievement at school has been associated with more antisocial behavior, violence, substance use, depression, and self-harm (Evans et al. 2004; Hemphill et al. 2006, 2011a; Windle and Windle 1996). In addition, early concentration problems and hyperactivity have been linked

to more subsequent violent behavior (Hawkins et al. 2000; Hemphill et al. 2009).

Peer group factors Strong longitudinal associations have been found between having antisocial friends and greater risk of violence, antisocial behavior, and substance use (Hawkins et al. 2000; Hemphill et al. 2009). There can be social contagion effects in relation to self-harm and suicide, again underlining the important influence of friends and peers (Hawton et al. 2012).

Family factors Family conflict is an established risk factor for higher levels of later youth violence, antisocial behavior, and substance use, as well as depression and self-harm (Evans et al. 2004; Valios et al. 2002). Poor family management (reflected by lack of clear rules and monitoring of students) is also a risk factor for subsequent violent and antisocial behaviors (Hawkins et al. 2000) and substance use (Hemphill et al. 2011a). This risk factor may be important in the context of cyber-bullying since it can occur anytime, anywhere, including in the family home—and therefore, parent monitoring and rule-setting may exert a strong influence.

Limitations of previous research

Many of the studies reviewed here are limited by cross-sectional designs. Longitudinal studies are required to establish the temporal ordering of the effects of cyber-bullying on later outcomes. In addition, studies to date have not controlled for traditional bullying perpetration and/or victimization in the analyses (Kowalski et al. 2014) to shed light on the independent role of cyber- versus traditional bullying in affecting subsequent problem behavior and mental health problems. There are also few longitudinal studies with comprehensive measures of the risk factors that have been shown to predict problem behavior and mental health problems; the current study will control for a number of these factors in the analyses.

The present study

This paper investigated the extent to which self-reported cyber-bullying perpetration and victimization alone or in combination in Grade 9 and 10 were associated with problem behavior and mental health problems in Grade 11, after controlling for risk factors known to predict these outcomes. It is expected that Grade 9 and 10 cyber-bullying perpetration will predict more Grade 11 problem behavior, Grade 9 and 10 cyber-bullying victimization will predict more Grade 11 mental health problems, and that Grade 9 and 10 cyber-bullying perpetration and victimization will predict both Grade 11 problem behavior and mental health problems, even after controlling for established risk factors.

Methods

The analyses reported in the current paper draw on data from the International Youth Development Study (IYDS), a longitudinal study exploring the development of healthy and problem behaviors in 5,769 students from Victoria, Australia and Washington State, United States (US). Students were recruited through schools in Grades 5, 7, and 9 in 2002. To obtain state-representative samples from the two states, a two-stage cluster sampling approach was utilized. In the first stage, within each state and Grade level, public and private schools containing Grades 5, 7, or 9 were randomly selected using a probability proportionate to Grade-level size sampling procedure (Kish 1965). A target classroom within each school was randomly selected in the second stage. Classes in Washington State yielded a total of 3,856 eligible students, of whom 2,885 (74.8 %) consented to and participated in the survey. In Victoria, 3,926 students were eligible for consent and survey administration, of whom 2,884 (73.5 %) consented and participated. In both states, higher participation rates characterized the older cohorts (range = 76–78 %), while parents of the youngest cohort members (in Grade 5) were equally less likely to consent for their fifth graders to take part in both states (69 % participation). Further details about recruitment and participation rates are described in McMorris et al. (2007).

Participants and procedure

Data for the current results were taken from students recruited in Grade 5 in Victoria because these students have the most complete longitudinal data available. Included in the analyses were participants with complete data from the fourth (2006, Grade 9), fifth (2007, Grade 10) and sixth (2008, Grade 11) surveys. The original sample consisted of 46 % males, aged between 14.1 and 16.5 years (M = 15.1 years; SD = 0.4) in Grade 9, 15 and 17.3 years (M = 16.0 years; SD = 0.4) in Grade 10, and 16.1 and 18.5 years (M = 17.0 years; SD = 0.4) in Grade 11.

Permission to conduct the research in Victorian schools was obtained from the Royal Children's Hospital Ethics in Human Research Committee, the Human Research Ethics Committee at The University of Melbourne, the Department of Education and Training (now the Department of Education and Early Childhood Development) for government-operated (public) schools and from the Catholic Education Office for some privately operated schools. Permission to conduct the survey in each school was sought from the principal. Project staff group administered surveys in classrooms in each year of the study between May and November during a 50- to 60-min period. The pen and paper survey was voluntary and included instructions

on how to answer the questions and further assurances of confidentiality that were presented prior to administration by study staff. Students absent from school were administered surveys later under the supervision of trained school personnel, or in a small percentage of cases, over the telephone by study staff. Students who were no longer attending school were interviewed over the telephone. The student survey was completed by 87 % of students in 2006 ($n = 805$; Grade 9), 89 % in 2007 ($n = 825$; Grade 10), and 85 % in 2008 ($n = 791$; Grade 11).

Measures

The self-reported measures of traditional and cyber-bullying perpetration and victimization, problem behavior and self-harm, and the risk factors included in this study were obtained from a modified version of the Communities that Care Survey which has been found to have acceptable psychometric properties in the US (Glaser et al. 2005) and has been used previously in Victoria (Hemphill et al. 2011a). Depressive symptoms were measured using the self-report Short Mood and Feelings Questionnaire (SMFQ; Angold et al. 1995) designed for the quick assessment and screening of core depressive symptomatology or for use in epidemiological research of adolescents. Traditional and cyber-bullying perpetration and victimization were measured using examples of behaviors (see Table 1). This more general framing of bullying dynamics was similar to that used elsewhere (Hamburger et al. 2011). Traditional bullying victimization was based on questions asked in the Gatehouse Bullying Scale (Bond et al. 2000, 2007). This item was immediately followed by a similar question asking about traditional bullying perpetration. Cyber-bullying victimization and perpetration were each assessed for the first time in Grade 9 using an item developed by the authors to be similar to the traditional bullying victimization and perpetration questions and to be consistent with the wording of other behavioral items in the survey. A dichotomous measure was created separately for both cyber- and traditional bullying perpetration and victimization. Students reporting no involvement in bullying victimization were given a score of 0 and students reporting any bullying victimization (less than once a week or more) were given a score of 1. Responses were similarly recoded for bullying perpetration. Students who were both perpetrators and victims of cyber-bullying were identified as a separate category. Hence, there were three categories of cyber-bullying in this study: cyber-bullies only, cyber-victims only, and both cyber-bullies and cyber-victims.

Measures of problem behavior and mental health problems were reported at the sixth survey (Grade 11). These included suspension from school, theft, violent behavior, marijuana use, binge drinking, depressive symptoms, and self-harm. Due to the positively skewed distribution of scores, all outcomes were dichotomized for the analyses. For all outcomes except depressive symptoms, students were classified as reporting no involvement in these behaviors in the past 12 months (score of 0) or having engaged in these behaviors at least 1 or more times in the past 12 months (score of 1). For depressive symptoms, as established in validation studies (Angold et al. 1995), respondents with a score of $\geq$11 were coded 1 (displaying depressive symptoms) and all other respondents were coded 0 (not showing depressive symptoms).

The six risk factors included in this paper cover individual (impulsivity, concentration problems), peer group (interaction with antisocial friends), family (poor family management, family conflict), and school (academic failure) domains in Grade 9 (2006) and Grade 10 (2007).

Analysis

Data analysis was performed with the Stata/IC 11.0 for Windows program (StataCorp 2009) on cases with complete data in 2006–2008. First, descriptive statistics were calculated for measures of traditional and cyber-bullying, risk factors, and problem behaviors and mental health problems. The means, standard deviations, number of items, item responses, example items, and Cronbach's alphas are listed in Table 1. Second, unadjusted logistic regression analyses were conducted to examine prospective associations between cyber-bullying others, being cyber-bullied, and both cyber-perpetration and cyber-victimization in Grade 9 and Grade 10 with a range of problem behavior and mental health problems measured in Grade 11 (Column 1, Table 2). Next, fully adjusted logistic regression models investigated prospective associations between the three categories of cyber-bullying and the seven outcomes including the risk factors and traditional bullying (Column 2, Table 2). Finally, the statistically significant results for traditional bullying perpetration and victimization in the fully adjusted were reported separately (Table 3). All analyses in this study controlled for gender and the clustering of students in schools.

Results

Descriptive statistics for cyber-bullying perpetration and victimization, risk factors, and outcome variables

One in twenty Grade 9 and 10 students had engaged in cyber-bullying perpetration and almost one in thirteen Grade 9 students and one in seventeen Grade 10 students had been the victims of cyber-bullying (see Table 1).

Table 1 Descriptive statistics for over 600 participants in the Australian arm of the International Youth Development Study for cyber-bullying perpetration and victimization, risk factors in Grade 9 and 10 (2006) and problem behavior and mental health problems in Grade 11 (2008)

	% (*n*)	No. scale items	Item range	Cronbach's alpha
Grade 9 cyber-bullying (dichotomous)				
Cyber-bullying perpetration only[a] (e.g., "…bullied another student using technology such as mobile telephones, the internet, computers, answering machines, or cameras?")	5.33 (33)	1	1–4	N/A
Cyber-bullying victimization only[a] (e.g., "…been bullied by another student who has used technology such as mobile phones, the Internet, computers, answering machines, or cameras?")[a]	7.92 (49)	1	1–4	N/A
Both cyber-bullying perpetration and victimization	8.56 (53)	2	1–4	N/A
Grade 9 risk factors (dichotomous)				
Individual risk factors				
Traditional bullying victimization[a] (e.g., "…been bullied recently (teased or called names, had rumors spread about you, been deliberately left out of things, threatened physically or hurt)?")	33.12 (205)	1	1–4	N/A
Traditional bullying perpetration[d] (e.g., "Have you taken part in bullying another student at school recently?")	18.58 (115)	1	1–4	N/A
	Mean (SD)	No. scale items	Item range	Cronbach's alpha
Grade 9 risk factors (continuous)				
Individual risk factors				
Impulsivity[b] (e.g., "I rush into things, starting before I know what to do")	2.08 (0.52)	3	1–3.67	0.55
Concentration problems[b] (e.g., "I find it hard to keep concentrating on tasks")	2.57 (0.76)	2	1–4	0.74
Peer risk factor				
Interaction with antisocial friends[c] (e.g., "In the past 12 months, how many of your best friends have sold illegal drugs?")	0.28 (0.54)	8	0–4	0.87
Family risk factors				
Poor family management[b] (e.g., "Would your parents know if you did not come home on time?")	1.85 (0.54)	9	1–4	0.83
Family conflict[b] (e.g., "People in my family have serious arguments.")	2.19 (0.77)	3	1–4	0.82
School risk factors				
Academic failure[e] (e.g., "What were your grades like last Grade?")	1.98 (0.66)	2	1–4	0.74
	% (*n*)	No. scale items	Item range	Cronbach's alpha
Grade 10 cyber-bullying (dichotomous)				
Cyber-bullying perpetration only[a] (e.g., "…bullied another student using technology such as mobile telephones, the internet, computers, answering machines, or cameras?")	5.44	1	1–4	N/A
Cyber-bullying victimization only[a](e.g., "…been bullied by another student who has used technology such as mobile phones, the Internet, computers, answering machines, or cameras?")[a]	6.18	1	1–4	N/A
Both cyber-bullying perpetration and victimization	7.79	2	1–4	N/A
Grade 10 risk factors (dichotomous)				
Individual risk factors				
Traditional bullying victimization[a](e.g., "…been bullied recently (teased or called names, had rumors spread about you, been deliberately left out of things, threatened physically or hurt)?")	30.37 (188)	1	1–4	N/A
Traditional bullying perpetration[d] (e.g., "Have you taken part in bullying another student at school recently?")	20.84 (129)	1	1–4	N/A

Table 1 continued

	% (*n*)	No. scale items	Item range	Cronbach's alpha
Grade 10 risk factors (continuous)				
Individual risk factors				
Impulsivity[b] (e.g., "I rush into things, starting before I know what to do")	2.11 (0.57)	3	1–4	0.64
Concentration problems[b] (e.g., "I find it hard to keep concentrating on tasks")	2.64 (0.80)	2	1–4	0.80
Peer risk factor				
Interaction with antisocial friends[c] (e.g., "In the past 12 months, how many of your best friends have sold illegal drugs?")	0.33 (0.61)	8	0–4	0.88
Family risk factors				
Family factor-poor family management[b] (e.g., "Would your parents know if you did not come home on time?")	1.89 (0.54)	9	1–4	0.84
Family conflict[b] (e.g., "People in my family have serious arguments.")	1.89 (0.53)	3	1–4	0.83
School risk factors				
Academic failure[e] (e.g., "what were your grades like last Grade?")	2.09 (0.68)	2	1–4	0.76
	% (*n*)	No. scale items	Item range	Cronbach's alpha
Grade 11 outcomes				
Suspension from school[f] ("In the past 12 months have you been suspended from school?")	7.11 (44)	1	1–5	N/A
Theft- stealing more than $10[f] ("Have you stolen something more than $10 in the past 12 months?")	11.79 (73)	1	1–4	N/A
Violent behavior[f] (e.g., "How many times in the past year have you got into physical fights with other people?")	17.80 (104)	3	1–8	0.79
Marijuana use[g] ("In the past 30 days on how many occasions have you used marijuana?")	9.53 (59)	1	0–1	N/A
Binge drinking[g] ("In the last 2 weeks, how many times have you had five or more drinks in a row?")	48.47 (300)	1	1–6	N/A
Depressive symptoms[h] (e.g., "I felt miserable and unhappy")	28.11 (174)	13	1–3	0.94
Self-harm[i] ("In the past year, have you deliberately hurt yourself or done anything that you knew might have harmed you or even killed you?)	8.89 (55)	1	0–1	N/A

Note The item measuring traditional bullying victimization appeared first on the survey with examples of bullying. The traditional bullying perpetration item and the cyber-bullying items immediately followed the traditional bullying victimization item and did not repeat these examples, as indicated by the text in the table

[a] Response options, 4 (no; yes, less than once a week; yes, about once a week; and yes, most days)

[b] Response options, 4 (definitely no to definitely yes)

[c] Response options, 5 (no friends to 4 of my friends)

[d] Response options, 4 (no to yes once a week)

[e] Response options, 4 (very poor to very good)

[f] Response options, 8 (Never to 40 or more times)

[g] Response options, 2 (never to one or more times)

[h] Response options, 2 (not true to true)

[i] Response options, 2 (no or yes)

Approximately, one in eleven students in Grade 9 was both perpetrators and victims, with one in thirteen in this category in Grade 10.

The mean scores on the risk factors included in this study were generally around two on a 4-point scale. The rates of problem behavior and mental health problems in Grade 11 varied from 7 % for suspension from school to 49 % for binge drinking. Other outcomes with rates above 10 % were theft, violent behavior, and depressive symptoms (see Table 1).

Table 2 Results of unadjusted and adjusted logistic regression analyses of associations between cyber-bullying in Grade 9 ($n = 651$) and 10 ($n = 680$) (2006) and Grade 11 (2008) problem behavior and mental health problems for participants in the Australian arm of the International Youth Development Study

Grade 11 outcomes	Unadjusted OR (95 % CI)	Fully adjusted OR (95 % CI)
Grade 9 cyber-bully		
Suspension from school	1.58 (0.60, 4.20)	1.31 (0.46, 3.68)
Theft (>$10 item)	2.73 (1.36, 5.47)**	2.11 (0.98, 4.53)
Violent behavior	1.16 (0.52, 2.58)	0.83 (0.35, 1.98)
Marijuana use	2.19 (0.96, 5.01)	1.81 (0.64, 5.14)
Binge drinking	2.21 (1.03, 4.75)*	1.71 (0.77, 3.81)
Depressive symptoms	1.44 (0.73, 2.85)	1.30 (0.63, 2.69)
Self-harm	1.68 (0.67, 4.18)	1.49 (0.50, 4.49)
Grade 9 cyber-victim		
Suspension from school	1.03 (0.33, 2.34)	1.28 (0.38, 4.34)
Theft (>$10 item)	0.79 (0.34, 1.85)	0.73 (0.25, 2.13)
Violent behavior	0.86 (0.44, 1.66)	1.01 (0.42, 2.45)
Marijuana use	0.16 (0.03, 0.70)*	0.14 (0.01, 1.55)
Binge drinking	0.76 (0.44, 1.32)	0.74 (0.36, 1.53)
Depressive symptoms	2.12 (1.18, 3.81)*	1.29 (0.71, 2.36)
Self-harm	1.64 (0.76, 3.50)	0.87 (0.36, 2.11)
Grade 9 cyber-bully and victim		
Suspension from school	2.66 (1.12, 6.32)*	1.94 (0.74, 5.09)
Theft (>$10 item)	1.99 (1.03, 3.87)*	1.04 (0.47, 2.31)
Violent behavior	1.50 (0.74, 3.01)	0.97 (0.40, 2.33)
Marijuana use	2.63 (1.39, 4.97)**	1.72 (0.85, 3.46)
Binge drinking	2.89 (1.55, 5.38)**	1.83 (0.88, 3.83)
Depressive symptoms	2.35 (1.38, 4.03)**	1.20 (0.64, 2.26)
Self-harm	2.42 (1.27, 4.61)**	0.99 (0.46, 2.13)
Grade 10 cyber-bully		
Suspension from school	2.77 (1.21, 6.33)*	1.16 (0.46, 2.96)
Theft (>$10 item)	5.60 (2.74, 11.45)***	2.57 (1.05, 6.26)*
Violent behavior	5.02 (2.54, 9.94)***	2.34 (0.98, 5.58)
Marijuana use	2.78 (1.30, 5.97)**	1.10 (0.40, 3.00)
Binge drinking	2.29 (1.12, 4.68)*	0.97 (0.41, 2.31)
Depressive symptoms	1.59 (0.81, 3.11)	1.12 (0.46, 2.75)
Self-harm	2.15 (0.89, 5.21)	2.10 (0.72, 6.16)
Grade 10 cyber-victim		
Suspension from school	0.64 (0.15, 2.80)	0.76 (0.12, 4.71)
Theft (>$10 item)	0.59 (0.18, 1.90)	0.59 (0.14, 2.46)
Violent behavior	0.93 (0.40, 2.14)	1.18 (0.44, 3.20)
Marijuana use	0.70 (0.21, 2.39)	0.91 (0.25, 3.32)
Binge drinking	0.96 (0.49, 1.85)	1.15 (0.50, 2.63)
Depressive symptoms	4.62 (2.23, 9.55)***	4.06 (1.91, 8.65)***
Self-harm	3.21 (1.51, 6.81)**	2.01 (0.82, 4.92)
Grade 10 cyber-bully and victim		
Suspension from school	4.18 (2.05, 8.52)***	3.36 (1.19, 9.50)*
Theft (>$10 item)	2.53 (1.33, 4.80)**	1.20 (0.52, 2.73)
Violent behavior	1.96 (1.19, 3.23)**	1.00 (0.50, 2.03)
Marijuana use	2.37 (1.18, 4.76)*	1.23 (0.48, 3.15)
Binge drinking	3.97 (2.22, 7.11)***	3.59 (1.60, 8.04)**
Depressive symptoms	2.46 (1.35, 4.47)**	1.38 (0.61, 3.13)
Self-harm	2.74 (1.43, 5.25)**	1.26 (0.59, 2.71)

OR odds ratio, *CI* confidence interval

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Correlations between risk factors

The inter-correlations between the risk factors were all .60 or less and, thus, were not at a level at which multi-collinearity is assumed to influence results (Tabachnick and Fidell 2013).

Unadjusted logistic regression analyses

The results of the unadjusted logistic regression analyses showed that cyber-bullying perpetration in Grade 9 was associated with over a twofold increase in the odds for theft and binge drinking in Grade 11 (see Colum 1, Table 2). All problem behaviors were associated with Grade 10 cyber-bullying perpetration. Cyber-bullying victimization in Grade 9 predicted a twofold increase in the odds of depressive symptoms and reduced odds of marijuana use in Grade 11. Cyber-bullying victimization in Grade 10 was linked with more than a threefold increase in Grade 11 self-harm and a fourfold increase in depressive symptoms. Students who were both cyber-bullies and cyber-victims in Grade 9 and Grade 10 showed strong associations with all outcomes in Grade 11, except for violent behavior for cyber-bullies and victims in Grade 9.

Fully adjusted logistic regression analyses

Fully adjusted logistic regression analyses revealed that there were no associations between cyber-bullying perpetration, cyber-bullying victimization, and cyber-bullying perpetration and victimization in Grade 9 and Grade 11 problem behavior and mental health problems (Column 2, Table 2). Grade 10 cyber-bullying perpetration doubled the odds of Grade 11 theft. Grade 10 cyber-bullying victimization was associated with a fourfold increase in the odds for depressive symptoms and combined cyber-bullying perpetration and victimization in Grade 10 was linked with school suspension and binge drinking.

Statistically significant associations for traditional bullying in fully adjusted analyses

Traditional bullying perpetration and victimization were associated with a number of the problem behaviors and mental health problems in Grade 9 and Grade 10 (see Table 3). In Grade 9, these associations were for traditional bullying victimization and depressive symptoms and self-harm. The associations between Grade 10 traditional bullying perpetration and victimization and problem behavior and mental health problems were more varied. In general, the associations between traditional bullying perpetration and victimization and the Grade 11 outcomes measured here resulted in the associations between cyber-bullying perpetration and victimization not maintaining statistical significance in the fully adjusted analyses.

Discussion

To the author's knowledge, this is one of the first longitudinal studies to examine the behavioral and mental health outcomes of cyber-bullying at 24-month follow-up. The main findings of this study were that once the analyses controlled for traditional bullying and risk factors, associations between cyber-bullying and the outcomes no longer remained in Grade 9 and only four associations (out of twenty-one) remained in Grade 10. Cyber-bullying perpetration in Grade 10 was associated with theft in Grade 11, cyber-victimization in Grade 10 was linked with Grade 11 depressive symptoms, and Grade 10 cyber-bullying perpetration and victimization combined predicted Grade 11 school suspension and binge drinking. Traditional bullying perpetration and victimization were related to problem behavior and mental health problems, particularly for the Grade 10 measures.

The results of the present study differ somewhat from previous studies and meta-analyses on associations between cyber-bullying and behavioral and mental health outcomes—in that the current study found associations for unadjusted but not adjusted analyses. In contrast for problem behavior, Ybarra et al. (2007) previously found that students harassed online had more detentions and suspensions, and a higher incidence of truancy. Ybarra and Mitchell (2004) also reported associations between cyber-bullying perpetration and/or victimization and tobacco, alcohol, and drug use, as well as symptoms of anxiety and depression. Cyber-bullying victimization in previous research has been linked to suicide (Hinduja and Patchin 2010), increased self-injury (Schneider et al. 2012), and self-harm (Hay and Meldrum 2010). Recent meta-analyses have also reported associations between cyber-bullying victimization and suicidal ideation (Kowalski et al. 2014; van Geel et al. 2014), anxiety, depression, and small associations with conduct and emotional problems, and drug and alcohol use (Kowalski et al. 2014). For cyber-bullying perpetration, relationships with drug and alcohol use and anxiety and depression were found (Kowalski et al. 2014). The most likely explanation for the difference between the current study's findings and those of other researchers is that this study controlled for a number of risk factors, and also for traditional bullying (as recommended by Kowalski et al. 2014).

The overarching finding of the present study is that exposure to cyber-bullying is yet another potential risk factor for problem behavior and mental health problems; it is, therefore, crucial to find ways to reduce cyber-bullying

Table 3 ORs and 95 % CIs in fully adjusted analyses for statistically significant results for traditional bullying perpetration and victimization in Grade 9 and 10 predicting Grade 11 problem behavior and mental health problems in the Australian arm of the International Youth Development Study (2006–2008)

	Traditional bullying risk factor	OR (95 % CI)
Grade 9 to Grade 11		
Grade 9 cyber-bully		
Grade 11 depressive symptoms	Grade 9 traditional victim	1.96 (1.36, 2.80)**
Grade 11 self-harm	Grade 9 traditional victim	2.45 (1.34, 4.46)**
Grade 9 cyber-victim		
Grade 11 depressive symptoms	Grade 9 traditional victim	1.86 (1.27, 2.72)**
Grade 9 cyber-bully and victim		
Grade 11 depressive symptoms	Grade 9 traditional victim	1.88 (1.31, 2.71)**
Grade 11 self-harm	Grade 9 traditional victim	2.40 (1.34, 4.29)**
Grade 10 to Grade 11		
Grade 10 cyber-bully		
Grade 11 violent behavior	Grade 10 traditional perpetration	1.81 (1.09, 3.00)*
Grade 11 binge drinking	Grade 10 traditional perpetration	1.72 (1.13, 2.62)*
Grade 11 depressive symptoms	Grade 10 traditional victim	1.85 (1.28, 2.66)**
Grade 11 self-harm	Grade 10 traditional victim	2.45 (1.38, 4.33)**
Grade 10 cyber-victim		
Grade 11 theft	Grade 10 traditional perpetration	2.04 (1.15, 3.63)*
Grade 11 violent behavior	Grade 10 traditional perpetration	2.07 (1.28, 3.36)**
Grade 11 binge drinking	Grade 10 traditional perpetration	1.73 (1.14, 2.61)*
Grade 11 self-harm	Grade 10 traditional victim	1.91 (1.02, 3.58)*
Grade 10 cyber-bully and victim		
Grade 11 theft	Grade 10 traditional perpetration	2.07 (1.17, 3.64)*
Grade 11 violent behavior	Grade 10 traditional perpetration	2.06 (1.29, 3.29)**
Grade 11 binge drinking	Grade 10 traditional perpetration	1.61 (1.05, 2.47)*
Grade 11 depressive symptoms	Grade 10 traditional victim	1.69 (1.08, 2.65)*
Grade 11 self-harm	Grade 10 traditional victim	2.16 (1.16, 4.03)*

Note For fully adjusted analyses including variables examining associations between Grade 9 and Grade 11, traditional bullying perpetration and victimization were not statistically significant risk factors for school suspension, theft of an item valued at more than $10, violent behavior, marijuana use, and binge drinking. For the fully adjusted analyses including variables examining associations between Grade 10 and Grade 11, traditional bullying perpetration and victimization were not statistically significant risk factors for school suspension, theft, marijuana use, and depressive symptoms, with the exception of the results presented in Table 3

OR odds ratio, *CI* confidence interval, *Trad* traditional

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

and other established risk factors to also reduce problem behavior and mental health problems.

Implications of the findings of the present study

Prevention programs that are multi-faceted are clearly needed that target both traditional and cyber-bullying perpetration and victimization in combination with other known risk factors for increased problem behavior and mental health problems. Multi-faceted programs target not only the student but also their families, peers, schools and local communities. Although such programs may be more challenging and costly to implement initially, they are likely to have wide-reaching and cost-saving impacts on multiple problem behaviors and mental health problems, since the risk factors for these behaviors and problems are similar.

The main research implication of the present study is that further studies on the longitudinal associations between cyber-bullying perpetration and victimization and problem behavior and mental health problems are needed, particularly studies that control for traditional bullying perpetration and victimization and established risk factors. The current study controlled for risk factors spanning the individual, peer, and family. However, an important question in relation to cyber-bullying perpetration and victimization is the role of school-related factors given the role such factors play in relation to traditional bullying

perpetration and victimization. Further research is warranted in this area. In addition, increased understanding is needed of defining features of power imbalance (e.g., gender, age, socio-economic status, ethnicity) in relation to cyber-bullying perpetration and victimization.

Strengths and limitations of the study

The present study has a number of strengths. It draws on data collected as part of an ongoing longitudinal study of adolescents with rich data on risk factors and a range of behavioral and mental health outcomes. It, therefore, provides a unique opportunity to examine the long-term effects of cyber-bullying perpetration and victimization on these outcomes after controlling for known risk factors. At the time of recruitment in 2002, the sample was state representative with males and females equally represented.

The current study has several limitations. First, a generic, single item was used to measure each of cyber-bullying perpetration and victimization and traditional bullying perpetration and victimization. It is important that studies like this one are replicated in the future using more sophisticated measures of traditional and cyber-bullying. There are access factors that are likely to be particularly relevant to the longitudinal impact of cyber-bullying perpetration and victimization and could have been controlled for in the analyses. These include access to technology, amount of time a student spends using internet and electronic communication technologies, competence in using technology and the behavior of onlookers in the cyber-environment (Hinduja and Patchin 2008; Ybarra and Mitchell 2004). These measures were not available in the current study but are needed in future research. Third, although the correlations found in this study were low to moderate (and all below 0.60), it is possible there may be some problems with multi-collinearity. Fourth, the specific role of school-related factors was not examined in the current study. This is an important area for future research. Fifth, it is possible that relationships between cyber-bullying and problem behaviors and mental health are reciprocal across time. Future longitudinal research can investigate these possible reciprocal relationships between cyber-bullying victimization and problem behaviors and mental health.

Conclusions

The findings of the current paper demonstrated that once the analyses controlled for traditional bullying and risk factors, associations between cyber-bullying and problem behavior and mental health problems no longer remained at 24-month follow-up and very few associations remained at 12-month follow-up. Longitudinal studies from around the world have demonstrated that the risk factors for problem behavior and mental health problems are similar and include characteristics of students, their families, peers, schools, and communities. Multi-faceted prevention programs are needed that target traditional and cyber-bullying and established risk factors within individuals and their social environments to reduce problem behavior and mental health problems. Further research like the present study is needed to examine associations between cyber-bullying and later problem behavior and mental health problems. Such research is likely to provide valuable information for the development of prevention and early intervention approaches.

Acknowledgments The authors are grateful for the financial support of the National Institute on Drug Abuse (R01-DA012140-05) for the International Youth Development Study, the National Institute on Alcoholism and Alcohol Abuse (R01AA017188-01) for analysis of the alcohol data, the Australian National Health and Medical Research Council (NHMRC; project number, 491241) for analysis of the tobacco and cannabis data and the Australian Research Council for follow-up of the Victorian participants from 2006-2008 (DP0663371, DP0887350). The authors also acknowledge the receipt of infrastructure funding from the Victorian State Government through the Operational Infrastructure Support (OIS) Program by Murdoch Childrens Research Institute. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institute on Drug Abuse, National Institute on Alcoholism and Alcohol Abuse, the National Institutes of Health, or the other funding bodies. The authors wish to express their appreciation and thanks to project staff and participants for their valuable contribution to the project.

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