

Effect of mental disorders on the association between bullying, suicidality and self-harm among Australian adolescents: A mediation analysis using data from a nationwide survey

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Abstract

Background

Recent research has depicted that both traditional and cyber bullying victimization report serious mental health issues, particularly suicidal and non-suicidal self-harm in adolescents. However, the little is known about the mechanism underlying the correlation between bullying and risk behaviours – suicidality and self-harm. This study aimed to examine the effect of bullying victimization on suicidal and non-suicidal self-harm, and the mediating effect of mental disorders (major depressive disorder, ADHD, conduct disorder and anxiety disorder) on the relationship between bullying victimization, suicidality and self-harm among adolescents.

Methods

Data for this study came from the Young Minds Matter: the second Australian Child and Adolescent Survey of Mental Health and Wellbeing and Youth dataset, which is a cross-sectional nationwide survey. A total of 2166 adolescents aged 12–17 years ($M = 14.83$; $SD = 1.61$; 52.2% boys) were analyzed. Baron and Kenny's approach with regression analysis was employed to test the mediation effect of each mental disorder on the association between traditional and cyber bullying victimization, suicidality and self-harm. Further, the Sobel test was used to statistically assess whether the indirect effects of bullying victimization on suicidality and self-harm were significant via mental disorder.

Results

Overall, 622 (28.7%) and 255 (11.8%) of adolescents reported traditional and cyberbullying victimization, respectively. The analysis showed that victims of both bullying incurred a significantly higher risk of suicidality and self-harm among adolescents. The effect of both bullying victimization on suicidality and self-harm was mediated by major depressive disorder after adjusting for the effect of potential sociodemographic characteristics, substance use, sedentary activities. While anxiety disorder only mediated the relationship between traditional bullying, and suicidality and self-harm. ADHD and conduct disorder had no mediating effect.

Conclusions

Depression and anxiety disorder plays a mediating role in the association between bullying victimization, suicidal and self-harming behaviour. Thus, addressing such mental disorders among bullying victims is worthwhile to prevent suicidality and non-suicidal self-harm, and ultimately suicide.

Background

Suicidality and non-suicidal self-harm in adolescents are considered to be a serious public health concern and has contributed heavily to the burden of disease globally and in Australia (1–3). For instance, recent estimates showed that suicide rates among 10–24 year-olds risen 56% in 2017 from 2007, and suicide is the second leading cause of death among this age group in the US (4). While in Australia it is the topmost cause of death among 15–24 year-olds age group (2, 5). In Australia, the prevalence of suicidality (ideation, plan and attempt) and non-suicidal self-harm among 12–17 year-olds was most recently estimated to be 7.9% and 7.8%, respectively (6, 7). Since the rates of suicide and self-harm have not changed significantly in the 5-year period between 2014 and 2018 in Australia (8), these troubling statistics add to the urgent need to provide research evidence to determine the determinants of suicidality and self-harm among the population. Studies reported that one of many potential predictors of suicidality and self-harm is bullying victimization (6, 9).

Bullying may be traditional (e.g. physical, verbal, relational) and cyber; is a repetitive and deliberately harmful act of aggression involving a power imbalance between perpetrator and victim (9–11). Childhood bullying victimization is recognized as a major public health issue in developed worlds including Australia because of its high prevalence and its enduring contribution to mental health problems (1, 12, 13). Studies in Canada and the Netherlands found that approximately 10%-30 percent of adolescents are frequently abused as victims, perpetrators or both (14, 15). Throughout Australia, latest figures indicate that in the past 12 months at least one in four adolescents experienced bullying (1). A recent study reported that 28.7% of adolescents experienced traditional bullying and about 11% of adolescents were a victim of cyberbullying (6). Given the increasing number of bullying victims, the harmful effects of bullying on victims needs to be investigated (16).

There is evidence that bullying precedes more adverse impacts on children with mental health issues, which may lead to extremely negative effects on mental wellbeing at adulthood (17, 18). Evidence has also shown that bullying victims were often associated with low self-esteem, depression, anxiety and violent behaviour (1, 17). Several studies have also reported the association between traditional bullying and suicidality and self-harm in children and adolescents (12, 19). In addition, studies found depression to be a mediator in the relationship between traditional bullying victimization and suicidality (11). However, research on the effect of cyberbullying on psychological outcomes has just begun (16, 20). Some researchers suggest that cyberbullying tends to have similar consequences as traditional bullying; others believe cyberbullying can be more stressful than traditional one (18, 21). Recently, an emerging research body has begun to relate cyberbullying with its psychopathology and negative outcomes such as suicidality and self-harm in children and adolescents to solve this debate (16, 21). For example, Islam et al. (6) and Extremera et al. (21) reported that cyberbullying is significantly associated with depression, anxiety, substance use, suicidal and self-harming behaviour among adolescents.

However, the psychological mechanisms underlying the causal link between bullying victimization and suicidality and non-suicidal self-harming behaviour are not clear. According to Agnew's theory of deviance in social psychology, social ties and incidents cause an individual to commit acts of deviation such as suicidality and self-harm (22). Bullying is one of the sources of strain, which can anger and upset

the victim and thus make them more likely to be unearthed (23, 24). It means that the victims of bullying are more vulnerable to suicide and to self-harm than dealing with their bullying. Since depression and mental illnesses are well-known risk factors for suicidality and self-harm (25–27), the victims of bullying may first undergo episodes of mental health problems before moving into suicidal and self-harming behaviour (Fig. 1).

Evidences mostly from the international literatures, has documented the mediating role of depression only on the relationship between traditional bullying victimization and suicidality (27, 28). However, none of them have included both types of bullying (traditional and cyber), non-suicidal self-harm and other mental health disorders such as attention-deficit-hyperactivity-disorder (ADHD), conduct disorder and anxiety disorders as a mediator in their analysis. In Australia, studies mostly were state-wide focusing on individual types of bullying, risk factors or mental health issues (1, 29, 30). Moreover, only Ford et al. (1) and Islam et al. (6) presented population-based estimates regarding the association of bullying with mental disorders, suicidality and self-harm health among Australian and adolescents. However, none investigated whether the association is mediated by mental disorders or not. Thus, the effects of different types of bullying (traditional and cyber) on suicidality and self-harm concerning mental disorders are not clear. This research gap shows an urgent need for understanding the interplay of bullying, mental disorder, and suicidality and self-harm from policy perspective to prevent the risk of child suicidality and self-harm.

This paper therefore aimed to examine the association between bullying victimization (traditional and cyber) with suicidality (ideation, plans or attempts) and non-suicidal self-harm among and adolescents aged 12–17 years, and to test separately whether each mental disorders (major depressive disorder, ADHD, conduct disorder and anxiety disorder) is one of the mechanisms via which bullying affects suicidality and self-harm in and adolescents. In the current study, we tested a hypothesized mediation model (Fig. 1) and predicted that there will be higher probability of suicidality and self-harm among bullying victims, and that mental disorders would mediate these relationships, while adjusting for potential sociodemographic covariates.

Methods

Data source

This study analyzed a nationwide cross-sectional data from Young Minds Matter (YMM): the second Australian Child and Adolescent Survey of Mental Health and Wellbeing that follow a random probability based sample of 5500 Australian children and adolescents aged 4–17 years. The survey was conducted in 2013-14 in collaboration between The University of Western Australia (UWA), Roy Morgan Research and the Australian Government Department of Health (AGDH). YMM was ethically approved respectively from the Human Research Ethics Committees of AGDH and UWA (31, 32).

A multi-staged, area-based sampling technique was used in the survey to ensure the proportional distribution of geographic areas and representativeness of the households across the Australia. The study participants were selected from households that consented to willingly participate in the survey; where if more than one qualifying child resided in the household, a single child was randomly sampled. Overall, 6310 parents of 4–17 years-aged (55% of qualifying households) and 2967 adolescents of 11–17 years were participated in the study. Data were collected through face-to-face interviews by trained interviewers from parents using a structured questionnaire; while adolescents completed a computer-based self-reported questionnaire privately at home to provide information related to health-risk behaviours (e.g. bullying, mental disorders, suicidality, self-harm, substance use, service use). However, few samples were excluded from the survey of most remote regions, homeless children and adolescents, institutions and any household where English-language interviews were not conducted. A more detailed of the methods have been described elsewhere (31).

Measures

Suicidality and self-harm (Outcome variables)

In the YMM survey, the Standard High School questionnaires of the Youth Risk Behavior Survey (33) were utilized to assess suicidality (ideation/plan/attempt) and self-harm only among 12–17 years aged adolescents (self-reported data), where all answers were kept confidential (25). Suicidality was assessed with the question: *'During the past 12 months, did you ever seriously consider attempting suicide?'* While, regarding self-harm, the following question was asked: *'Have you ever deliberately done something to yourself to cause harm or injury, without intending to end your own life?'* (25, 26). All response options were coded 1 for 'Yes' and 0 for 'No'.

Bullying (Independent variable)

Items measuring bullying were collected from the Olweus Bully–Victim Questionnaire and from the Cyber Friendly Schools Project at Edith Cowan University, and were modified according to the YMM survey objectives (34, 35). Traditional bullying was considered *'when people tease, threaten, spread rumours about, hit, shove, or hurt other people over and over again'* and cyberbullying was measured *'when people use mobile phones or the internet to send nasty or threatening emails or messages, post mean or nasty comments or pictures on websites like Facebook, or have someone pretend to be them online to hurt other people over and over again'*. It was not considered bullying when two individuals of equal intensity or power discuss or battle each other amicably (35).

Adolescents were directly asked about traditional bullying and cyberbullying victimization using the following question: *'In the past 12 months, have you ever been bullied or cyberbullied?'* with the listed bullying types: *'Hit, kicked, or pushed around'*, *'Made fun of or teased in a mean and hurtful way'*, *'Lies, rumours or nasty stories were spread'*, *'Threatened or made afraid'*, *'Deliberately ignored, left out on purpose or not allowed to join in'*, *'Other young people stole things or from me, or broke or damaged my things deliberately'*, *'Teased about my race, the colour of my skin or my religion'*, *'Sent nasty messages by*

email, mobile phone, or on the internet, *'Nasty messages or pictures were sent about me to other young people via mobile phone, internet or email*', and *'Nasty comments or pictures were sent or posted about me on websites (e.g. Facebook or Twitter)'* (35). For traditional bullying and cyberbullying victimization responses included 'Yes' (coded as 1) or 'No' (coded as 0).

Sociodemographic characteristics (Covariates)

The following sociodemographic covariates were included in the study: age (as continuous variable), gender (Boys/Girls), country of birth (Australia/Overseas), and location (major cities/regional and remote), school grade (Grade 7-Grade 12), family type (children from original biological parents/children from other parents like step or blended), family income (<\$52000 as low/\$52000-\$129999 as medium/>\$130000 as high). For substance use a dichotomous variable (Yes/No) was created and were measured using the questions: *'Have you ever tried cigarette smoking, even one or two puffs?'*; *'Have you ever had at least one drink of alcohol, other than a few sips?'*; *'Have you ever tried cannabis/marijuana'* and *'Have you ever used illegal drugs, or sniffed petrol, glue, aerosol, paints, solvents or nitrous?'* (32).

Also, sedentary activities were measured by two items: *'In a typical day, how much time do you usually spend (I) using internet on the computer, mobile or tablet, including accessing social media such as Facebook or Twitter, emailing, looking at websites or chatting online, (II) playing electronic games, such as Xbox or similar console, online, on a handheld device, computer, or mobile phone'*. For each question, children and adolescents were asked to provide an average number of hours spent in a day (36). In this study, two categories 'internet use' and 'electronic game-play' were generated and coded as 0 (≤ 2 hours/day) and 1 (> 2 hours/day).

Mental disorders (Mediator)

The Diagnostic Interview Schedule for Children IV (DISC-IV) were selected for the inclusion of mental disorders in the survey (37, 38). Mental disorders in the 12-months prior the survey included: major depressive disorders, attention-deficit hyperactivity disorder (ADHD), conduct disorder and anxiety disorder (i.e. covers modules for social phobia, separation anxiety disorder, generalized anxiety disorder and obsessive-compulsive disorder) (31, 32). Response options for each category included 'Yes' (coded as 1) or 'No' (coded as 0).

Statistical analysis

In this study, the analysis was restricted to adolescents aged 12–17 years due to paucity of information on outcome variable. Also, the 'Don't know' and 'Prefer not to say' responses were omitted. Finally, a total of 2166 adolescents were included in the analysis after combining self-reported child data and parent data to achieve study objectives.

Data were analyzed using Stata/SE 14.1 (SataCorp, College Station, TX, USA). Descriptive statistics were reported and the significance of difference was calculated using the Pearson Chi-square test, which signified the strength of the bivariate relationships between these characteristics and reports of bullying victimization. Then, a series of multivariate logistic models were used to investigate the role of mediator

(each mental disorder) on the associations of independent variable (traditional bullying and cyberbullying victimization) with the outcome variables (suicidality and self-harm). Potential confounders included in the analysis were age, gender, location, school grade, family type, household income, time spent on internet use and electronic game-play and substance use by the child.

Test for mediation

The mediating role of mental disorders on the associations of bullying victimization (traditional and cyber) with suicidality and self-harm was examined using Barron and Kenny's four step approach (39), in which a series of regression analyses were conducted and significance of the odds was examined at each step. Figure 1 shows the hypothesized mediation model for the study of the relationship between bullying (traditional and cyber) and suicidality and self-harm. The conditions necessary to investigate such a mediating relationship require: (i) a significant association between independent variables (traditional and cyberbullying) and dependent variables (suicidality and self-harm) (Step 1 - Path C, Fig. 1); (ii) a significant relationship between independent variables and assumed mediator (each mental disorder) (Step 2 - Path A, Fig. 1); and (iii) a significant association between assumed mediator and dependent variables (Step 3 - Path B, Fig. 1), adjusting the potential covariates except specific mental disorder for the model. Based on the significant findings from Steps 1–3, the final regression model was carried out. In Step 4 (Path C'), inclusion of a mediator (specific mental disorder) as control, resulting in reduction of the significance or magnitude of the relationship between independent variables (bullying victimization) and dependent variables (suicidality and self harm) indicates that it is the mental disorder that actually triggers suicidality (rather than direct effects of bullying). That is, bullying affects suicidality and self harm via a mental disorder.

However, due to the fact that the Baron and Kenny's approach tends to miss some true mediation effect such as Type II errors (40), it is suggested to calculate the indirect effect and test it for significance. In this study, the Sobel test (41) was used to estimate the indirect effect of bullying victimization on suicidality and self-harm through a mental disorder and for its significance. In this study, according to the Sobel approach, a product is formed by multiplying two coefficients together, the partial regression effect for assumed mediator (mental disorder) predicting dependent variable (suicidality and self-harm), and the simple coefficient for independent variable (bullying victimization) predicting assumed mediator (mental disorder). The strength of the associations between the bullying victimization and suicidality and self-harm was estimated by means of odds ratios (OR) and 95% confidence intervals.

Results

General information

Of the 2166 participants, 28.7% were victims of traditional bullying and 11.8% were cyberbullying victims (Table 1). Girls (65.5%) were clearly more prone to be cyberbullying victims than boys (34.5%). Almost similar proportions of boys and girls were traditional bullying victims (47.9% of boys and 52.1% of girls).

There was a clear difference between genders in involvement in bullying victimization ($p < .05$). Adolescents in higher school grades and from low to medium-income backgrounds were more likely to be the victim of traditional and cyberbullying. Table 1 also shows that adolescents who spent more time (> 2 hours/day) on using internet were more likely to report traditional bullying (63.7%, $p = 0.005$) and cyberbullying (71.4%, $p < 0.001$) than those who spent ≤ 2 hours/day. While adolescents spent less than 2 hours a day in electronic gaming were more likely to be bullying victims (73.3% traditional bullying, 74.1% cyberbullying) compared to those who spent more the 2 hours. Among the cyberbullying victims, 57.7% ($p < 0.001$) of adolescents had a history of substance use; while, the percentage is lower (43.6%, $p = 0.033$) among the traditional bullying victims.

Table 1
Sample distribution (i.e. Adolescents aged 12-17-years old)

Characteristics	Total	Traditional bullying*		Cyberbullying^	
	n (%)	n (%)	p-value	n (%)	p-value
Total	2166 (100.0)	622 (28.7)		255 (11.8)	
Age ^a	14.83	14.55	< 0.001	14.91	0.006
Gender			0.011		< 0.001
Boys	1131 (52.2)	298 (47.9)		88 (34.5)	
Girls	1035 (47.8)	324 (52.1)		167 (65.5)	
Country of Birth			0.053		0.209
Australia	1855 (85.6)	547 (87.9)		225 (88.2)	
Overseas	311 (14.4)	75 (12.1)		30 (11.8)	
Location			0.005		0.259
Cities	1394 (64.4)	372 (59.8)		156 (61.2)	
Regional/Remote	772 (35.6)	250 (40.2)		99 (38.8)	
Grade			< 0.001		0.002
Grade 7	265 (12.2)	97 (15.6)		26 (10.2)	
Grade 8	283 (13.1)	100 (16.1)		33 (12.9)	
Grade 9	286 (13.2)	80 (12.9)		33 (12.9)	
Grade 10	359 (16.5)	110 (17.7)		57 (22.4)	
Grade 11	467 (21.6)	126 (20.3)		68 (26.7)	
Grade 12	506 (23.4)	109 (17.5)		38 (14.9)	
Family type ^b			< 0.001		< 0.001
Original	1324 (61.1)	342 (55.0)		126 (49.4)	
Step/Blended/Others	842 (38.9)	280 (45.0)		129 (50.6)	
Household income ^c			0.033		0.235
Low	503 (23.2)	167 (26.9)		69 (27.1)	
Medium	1014 (46.8)	283 (45.5)		118 (46.3)	
High	649 (30.0)	172 (27.6)		68 (26.6)	

Characteristics	Total	Traditional bullying*	Cyberbullying^
Internet Use ^d		0.005	< 0.001
≤2 hours/day	889 (41.0)	226 (36.3)	73 (28.6)
> 2 hours/day	1277 (59.0)	396 (63.7)	182 (71.4)
Electronic games ^e		< 0.001	0.025
≤2 hours/day	1721 (79.5)	456 (73.3)	189 (74.1)
> 2 hours/day	445 (20.5)	166 (26.7)	66 (25.9)
Substance use by the child ^f		0.033	< 0.001
Yes	867 (40.0)	271 (43.6)	147 (57.7)
No	1299 (60.0)	351 (56.4)	108 (42.3)
Notes:			
- ^a Continuous variable. Mean has been inserted in the cells;			
- ^b Family type: original families means children are natural, adopted, or foster child of both parents, and no step child; other families include step, blended and children from families who are not natural, adopted, foster or step of either parent;			
- ^c Household income: Low (<\$52,000), Medium (\$52,000-\$129,999) and High (>\$130,000);			
- ^d Time usually spent on the computer, mobile or tablet, including accessing social media such as Facebook or Twitter, emailing, looking at websites or chatting online on a typical weekday;			
- ^e Playing an Xbox or similar console, online, on a handheld device, computer, or mobile phone on a typical weekday;			
- ^f Ever seriously try cigarette smoking, drink alcohol, cannabis or any other illegal drugs;			
- *Traditional bullying: Following questions were considered to code as 1 (Yes) and 0 (No), "Hit, kicked, or pushed around; Made fun of or teased in a mean and hurtful way; Lies, rumours or nasty stories were spread; Threatened or made afraid; Deliberately ignored, left out on purpose or not allowed to join in; Other young people stole things or from me, or broke or damaged my things deliberately; Teased about my race, the colour of my skin or my religion.";			
- ^Cyberbullying: Following questions were considered to code as 1 (Yes) and 0 (No), "Sent nasty messages by email, mobile phone, or on the internet; Nasty messages or pictures were sent about me to other young people via mobile phone, internet or email; Nasty comments or pictures were sent or posted about me on websites (e.g. Facebook or Twitter)".			

Mental disorder, Suicidality and Self-harm

The prevalence of mental disorders was as follows - major depressive disorder (11.5%), ADHD (6.5%), conduct disorder (1.9%) and anxiety disorder (7.1%); while the prevalence of suicidality and self harm were 8% and 7.8%, respectively (Table 2). Most of the adolescents who had mental disorders, suicidal and

self-harming behaviour were victims of traditional bullying. About 48%, 62%, 49% and 60% of the adolescents who respectively reported major depressive disorder, ADHD, conduct disorder and anxiety disorder were traditional bullying victims. More than one-third adolescents was a victim of traditional bullying among those who reported suicidality and self-harm (35.6% and 42.3%, respectively). The percentage of being cyberbullied was also high among the adolescents who reported with mental disorder, suicidality and self-harm. Table 2 illustrates that around 68%, 85%, 75% and 82% of those who had a mental disorder (major depressive disorder, ADHD, conduct disorder and anxiety disorder, respectively) were a victim of cyberbullying. In addition, 51.1% and 61.3% of those who respectively reported suicidality and self-harm were cyberbullied.

Table 2
Prevalence of mental disorders, suicidality and self-harm by bullying victimization (traditional and cyberbullying)

	Mental Disorders [#]				Suicidality* (%)	Self-harm [^] (%)
	Major Depressive Disorder (%)	ADHD (%)	Conduct Disorder (%)	Anxiety Disorder (%)		
Total	248 (11.5)	141 (6.5)	41 (1.9)	154 (7.1)	174 (8.0)	168 (7.8)
Traditional bullying						
Yes	120 (52.0)	53 (37.6)	21 (51.2)	61 (39.6)	112 (64.4)	97 (57.7)
No	119 (48.0)	88 (62.4)	20 (48.8)	93 (60.4)	62 (35.6)	71 (42.3)
<i>p</i> -value	< 0.001	0.016	0.001	0.002	< 0.001	< 0.001
Cyberbullying						
Yes	80 (32.3)	20 (14.2)	10 (24.4)	28 (18.2)	85 (48.9)	65 (38.7)
No	168 (67.7)	121 (85.8)	31 (75.6)	126 (81.8)	89 (51.1)	103 (61.3)
<i>p</i> -value	< 0.001	0.358	0.011	0.010	< 0.001	< 0.001
Notes:						
- [#] No. of children having any of the following mental disorders - Major depressive disorder or ADHD or Anxiety disorder or Conduct disorder;						
- [*] Suicidality: Number (%) of children seriously considered attempting suicide in the past 12 months;						
- [^] Self-harm: Number (%) of children deliberately done something to themselves to cause harm or injury, without intending to end their own life						

Association between bullying victimization (traditional and cyber) and suicidality and self-harm

Table 3 depicts crude associations between traditional bullying and cyberbullying with suicidality and self-harm. Victims of traditional bullying and cyberbullying incurred a significantly higher risk of suicidality (traditional bullying: COR 5.17, 95% CI: 3.62–7.37); cyberbullying: COR 11.02, 95% CI: 7.62–15.93), and self-harm (traditional bullying: COR 4.13, 95% CI: 2.89–5.90; cyberbullying: COR 6.60, 95% CI: 4.60–9.46) compared to those adolescents who had not reported such threats.

Table 3
Crude associations of bullying victimization (traditional and cyberbullying) with suicidality and self-harm

	COR (95% CI)	<i>p</i> -value
Traditional bullying		
Suicidality	5.17 (3.62, 7.37)	< 0.001
Self-harm	4.13 (2.89, 5.90)	< 0.001
Cyberbullying		
Suicidality	11.02 (7.62, 15.93)	< 0.001
Self-harm	6.60 (4.60, 9.46)	< 0.001
COR = Crude odds ratio; CI = confidence interval		

Mediation analysis

A series of multivariate logistic regression analyses were performed, controlling potential covariates (age, gender, location, school grade, family income, family type, substance use by the child, the time spent on internet use and playing electronic games) and the findings are summarized in Table 4. The regression odd ratio of the Path C between the independent variables (bullying victimization), and each of the dependent variables (suicidality and self-harm) was significant ($p < 0.05$) except for those who reported ADHD and traditional bullying (Table 4b). In Path B (Table 4a), the associations between the major depressive disorder (mediator) and dependent variables (suicidality and self-harm) for both traditional bullying and cyberbullying victims was found to be significant. In addition, only anxiety disorder found to be significantly associated with suicidality (AOR 2.06, 95% CI 1.02–4.16) and self-harm (AOR 2.92, 95% CI 1.35–6.31) among traditional bullying victims (Path B, Table 4d). In Path A in Table 4 shows that adolescents who experienced traditional bullying and cyberbullying victimization were respectively 3.07 (95% CI, 2.16–4.35) and 3.57 (95% CI, 2.45–5.20) times more likely to develop major depressive disorder compared to those who had not reported any bullying victimization. It is also found in Path A that conduct disorder in Table 4c (AOR 2.48, 95% CI 1.16–5.28) and anxiety disorder in Table 4d (AOR 1.48, 95% CI 1.02–2.14) were more likely to be developed among traditional bullying victims. However, the main effect of traditional bullying and cyberbullying victimization on suicidality and self-harm was decreased in most of the cases but still remained significant after controlling for specific mental health disorders (Path C', Table 4). Hence, according to the criteria of Baron and Kenny's approach we can conclude from the Table 4 that major depressive disorder have the mediating effect on the relationship of bullying victimization (both traditional and cyber) with suicidal and self-harming behaviour. Further, anxiety disorder found to be a significant mediator of the association between traditional bullying, suicidality and self-harm. While, ADHD and conduct disorder have no mediating effect on the association between bullying, suicidality and self-harm.

Table 4
Mediation analyses using Baron and Kenny's approach

	Path A (BV → MD)	Path B (MD → Suicidality & SH)	Path C (BV → Suicidality & SH)	Path C' (BV → Suicidality & SH)	Sobel Test [†]
	AOR (95% CI)	AOR (95% CI)	AOR _{M-} (95% CI)	AOR _{M+} (95% CI)	p- value
4a. Bullying Victimization → Major depressive disorder → Suicidality & Self-harm					
Traditional bullying					
Major depressive disorder	3.07*** (2.16, 4.35)				
Suicidality		9.41*** (5.39, 16.42)	2.59** (1.29, 5.18)	2.41** (1.30, 4.45)	< 0.001
Self-harm		10.18*** (5.91, 17.51)	2.67** (1.42, 5.05)	2.63*** (1.73, 3.99)	< 0.001
Cyberbullying					
Major depressive disorder	3.57*** (2.45, 5.20)				
Suicidality		10.42*** (4.70, 23.09)	4.98*** (2.72, 9.12)	4.80** (2.50, 9.20)	< 0.001
Self-harm		13.17*** (5.82, 29.80)	2.92** (1.49, 5.70)	2.78** (1.49, 5.17)	< 0.001
4b. Bullying Victimization → ADHD → Suicidality & Self-harm					
Traditional bullying					
ADHD	1.38 (0.91, 2.10)				
Suicidality		0.91 (0.35, 2.40)	2.99 (0.92, 9.69)	2.84** (1.55, 5.18)	-
Self-harm		0.69 (0.22, 2.09)	3.46 (0.64, 18.55)	3.19*** (1.76, 5.78)	-
Cyberbullying					
ADHD	1.51 (0.84, 2.71)				
Suicidality		1.19 (0.38, 3.73)	13.01** (3.12, 54.12)	4.94*** (2.68, 9.11)	-

	Path A (BV → MD)	Path B (MD → Suicidality & SH)	Path C (BV → Suicidality & SH)	Path C' (BV → Suicidality & SH)	Sobel Test [†]
Self-harm		0.98 (0.25, 3.81)	13.38** (2.47, 72.46)	2.99** (1.61, 5.56)	-
4c. Bullying Victimization → Conduct disorder → Suicidality & Self-harm					
Traditional bullying					
Conduct disorder	2.48* (1.16, 5.28)				
Suicidality		1.10 (0.30, 3.99)	2.35** (1.26, 4.38)	3.00*** (1.67, 5.38)	-
Self-harm		1.14 (0.37, 3.54)	2.66** (1.46, 4.85)	3.44*** (1.92, 6.14)	-
Cyberbullying					
Conduct disorder	2.53 (0.98, 6.51)				
Suicidality		0.68 (0.13, 3.45)	4.67*** (2.39, 9.10)	4.99*** (2.72, 9.14)	-
Self-harm		0.84 (0.15, 4.55)	2.75** (1.45, 5.22)	3.12*** (1.70, 5.71)	-
4d. Bullying Victimization → Anxiety disorder → Suicidality & Self-harm					
Traditional bullying					
Anxiety disorder	1.48* (1.02, 2.14)				
Suicidality		2.06* (1.02, 4.16)	9.98** (2.61, 38.11)	2.79** (1.53, 5.09)	0.015
Self-harm		2.92** (1.35, 6.31)	9.89*** (3.65, 26.74)	3.25*** (1.80, 5.89)	0.008
Cyberbullying					
Anxiety disorder	1.52 (0.98, 2.37)				
Suicidality		1.16 (0.39, 3.42)	11.99*** (3.55, 40.45)	4.73*** (2.55, 8.80)	-

	Path A (BV → MD)	Path B (MD → Suicidality & SH)	Path C (BV → Suicidality & SH)	Path C' (BV → Suicidality & SH)	Sobel Test [†]
Self-harm		1.81 (0.56, 5.81)	4.47* (1.10, 18.07)	2.99*** (1.62, 5.52)	-
<p>Notes:</p> <ul style="list-style-type: none"> - BV = Bullying Victimization; MD = Mental disorder (Major depressive disorder/ADHD/Conduct disorder/Anxiety disorder); SH = Self-harm; AOR = Adjusted odds ratio; CI = confidence interval - All Model adjusted for age, gender, location, school grade, family income, family type, substance use by the child, the time spent on internet use and playing electronic games - 4a. Estimating the mediating effect of major depressive disorder on the relationship between BV and Suicidality/SH - 4b. Estimating the mediating effect of ADHD on the relationship between BV and Suicidality/SH - 4c. Estimating the mediating effect of conduct disorder on the relationship between BV and Suicidality/SH - 4d. Estimating the mediating effect of anxiety disorder on the relationship between BV and Suicidality/SH - Path A: BV is the independent variable and specific MD (Major depressive disorder/ADHD/Conduct disorder/Anxiety disorder) is the outcome variable - Path B: MD (Major depressive disorder/ADHD/Conduct disorder/Anxiety disorder) is the independent variable and Suicidality/SH is the outcome variable - Path C: BV is the independent variable and Suicidality/SH is the outcome variable; OR_{M-}: Odds ratio from regression model unadjusted for specific MD (Major depressive disorder/ADHD/Conduct disorder/Anxiety disorder) - Path C': BV is the independent variable and Suicidality/SH is the outcome variable; OR_{M+}: Odds ratio from regression model adjusted for the specific MD (Major depressive disorder/ADHD/Conduct disorder/Anxiety disorder) - [†]Sobel test: Indirect effect of mediation and its significance was estimated by multiplying two regression coefficients together, the partial regression effect for MD (Major depressive disorder/ADHD/Conduct disorder/Anxiety disorder) predicting Suicidality/SH, and the simple coefficient for BV predicting MDs. Note that Sobel test was performed only for those variables who fulfilled all the criteria of Baron and Kenny's approach. - Survey weight adjusted - ***p < 0.001, **p < 0.01, *p < 0.05 considered significant 					

Finally, the Sobel test was performed only for those variables who fulfilled all the criteria of Baron and Kenny's approach to test the indirect effect of mediation, and found significant mediatory role of major depressive disorder and anxiety disorder in the association of traditional bullying with suicidality and self-harm among the 12–17 year-aged adolescents ($p < 0.001$). The mediation analysis also revealed that cyberbullying victimization affects suicidality and self-harm via anxiety disorder ($p < 0.05$).

Discussion

This research validated and expanded findings found in previous US and Canadian studies (9, 42, 43) and indicated that bullying victims (traditional or cyber) are at risk of certain mental disorders such as major depressive disorder and anxiety disorder, which in turn initiates suicidal and self-harming behaviour among adolescents.

In Australia, the prevalence of traditional bullying and cyberbullying was respectively around 29% and 12% in adolescents aged 12–17 years; which corroborated the previous studies in conducted Australia (6, 30, 35) and in other developed countries (20, 44). In consistent with past researches, the study found that girls were more likely to be cyber bullied compared to boys; as cyberbullying is web-based and girls may communicate with each other more frequently than boys through text, social media and email (11, 16, 20). As expected, more time on internet use is found to be common among the cyberbullying victims; may be due to high popularity of hi-tech devices in the modern world among adolescents (45). Like other studies, substance use among bullying victims found to be congruent (44, 46).

The present study also estimated that the prevalence of major depressive disorder (11.5%), ADHD (6.5%), anxiety disorder (7.1%), conduct disorder (1.9%), suicidality (8%) and non-suicidal self-harm (7.8%) in adolescents and found that the figures are not very different from previous studies (1, 47, 48), which is alarming. The types of bullying (traditional or cyber) experienced among those who diagnosed with a mental disorder was also consistent with prior research (14, 47). For example, being cyber bullied was found to be less frequent among the children with mental disorders than traditionally bullied (49). Interestingly, traditionally bullying victims were found to be more involved in suicidal and self-harming behaviour compared to cyberbullying victims, where several studies reported that cyber victimization may have more chances to be involved in suicidality and self-harm than traditional bullying victimization (14, 15).

In accordance with existing research, the results showed that being bullied is significantly associated with the higher risk of developing suicidality and non-suicidal self-harm among adolescents (50, 51). This can be due to the fact that being bullied is stressful, which can cause multiple psychopathological changes, including extreme depression, consequently suicidality and/or self-harm (1, 52).

In the current study, the mediating role of major depressive disorder on the association of traditional bullying and cyberbullying victimization with suicidality and self-harm is found to be congruent with previous studies (16, 28, 53). This may be because depressive symptoms may affect moods, interpersonal relationships and performance in school or among peers, which triggers the risk of suicide and /or self-harm (50, 54). However, Espelage and Holt (55) found minimal effect of depression on the association between bullying victimization and suicidality and/or self-harm among the US children. Another study involving 10-countries in Europe reported those depressive disorder alone does not have any mediating effect on the association between bullying victimization and suicidality and/or self-harm (11).

Although only a few studies consider other mental disorders such as anxiety disorder, ADHD and conduct disorder as a mediator (11, 56); this study found that the effect of traditional bullying victimization on suicidality and non-suicidal self-harm was mediated by anxiety disorder, which was consistent with previous research findings (50). This is may be due to the fact that the causal associations between bullying, anxiety, suicidality and self harm remain elusive and bullying victims are vulnerable to anxiety which can lead to suicidal and self-harming behaviour (50). Interestingly, the study did not find any mediating effect of ADHD or conduct disorder on the relationship between bullying, suicidal and self-harming behaviour, although previous studies claimed that ADHD and conduct disorder alone can be a potential risk factor for suicidality/self-harm and conduct disorder (57).

The finding that the effect of bullying victimization on suicidality and non-suicidal self-harm is partially mediated by depressive symptoms and anxiety has important implications for clinicians, psychologists, social workers, mental health practitioners and policy makers for preventing suicide globally and in Australia. Assessment of adolescents with mental disorders can include a brief evaluation to determine any history of bullying; as it is acknowledged that the better integration of preventive measures in reliable measures is important if preventive strategies are to be effective (34, 35).

The current study has some shortcomings. First, the cross-sectional study design limits to establish the temporal and causal relationship of bullying victimization with suicidality and self-harm. Second, although self-reported data are strong indicators for risk behaviours such as bullying, suicidality and self-harm; measurement error and social desirability bias are likely (58). The survey covered a variety of subjects related to mental health and kept the response burden to a minimum, as much as possible. However, global bullying issues have enough psychometric properties and are often popular in population studies (59).

Conclusion

The study has demonstrated that being bullied (both traditional and cyber) among adolescents was associated with increased risk of suicidality and self-harm. Most notably, the association of being traditionally bullied with suicidality and self-harm mediated by major depressive disorder and anxiety disorder. Also, major depressive disorder is found to be a mediator in the association of cyberbullying victimization with suicidality and self-harm. Understanding this relationships are important for parents, teachers and practitioners who work with adolescents and others who plan to combat bullying and its related harm at the policy level. The results also emphasize the need to address mental disorders among bullying victims to help prevent the risk of suicidality and self-harm in adolescents worldwide.

Declarations

Ethical approval and consent to participate

All participants were informed about the study. Both verbal and written informed consent was obtained from the study participants. (For children under-17 years, parents/guardians completed the written consent form). The Research Ethics Committee of the Australian Government Department of Health (Project 17/2012) and the Research Ethics Committee of the University of Western Australia ethically approved the YMM study.

Consent for publication

Not applicable

Availability of data and material

The datasets of Young Minds Matter (YMM) survey data is an open sources data-set, available at the Australian Data Archive (ADA) Dataverse on request (DOI: <http://dx.doi.org/10.4225/87/LCVEU3>).

Competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Author contributions

Md. Irteja Islam: Conceptualization, Methodology, Software, Data curation, Formal Analysis, Validation, Visualization, Investigation, Writing- Original draft preparation, Writing- Reviewing and Editing; Rasheda Khanam: Supervision, Project administration, Writing- Reviewing and Editing; Enamul Kabir: Supervision, Writing- Reviewing and Editing

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Figures

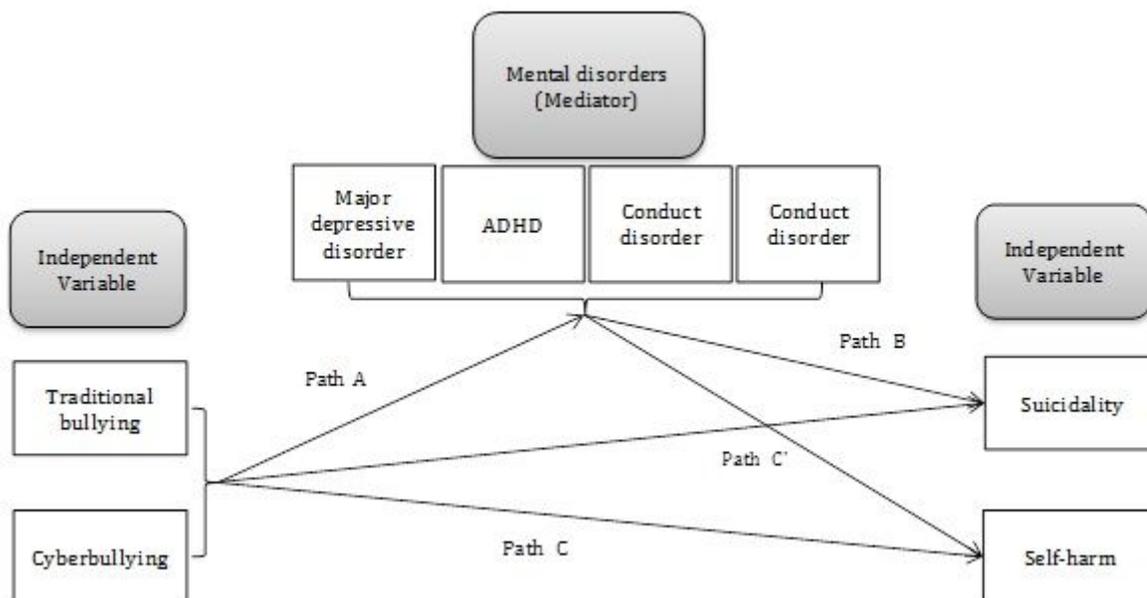


Figure 1

Hypothesized mediational model to study the effect of mental disorders in the relationship between bullying victimization, suicidality and self-harm