

## To What Extent is the Association between Disability and Mental Health in Adolescents Mediated by Bullying? A Causal Mediation Analysis

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## **Abstract**

### **Background**

Disability among adolescents is associated with both poorer mental health (MH) and higher levels of bullying-victimisation. Bullying, therefore, conceivably mediates the association between disability and mental health. Quantifying this pathway is challenging as the exposure (disability), mediator (bullying) and outcome (MH) are subjective, and subject to dependent measurement error if the same respondent reports on two or more variables.

### **Methods**

Utilising the counterfactual and potential outcomes approaches to causal mediation, we decomposed the total effect of disability on MH into natural indirect effects (through bullying) and natural direct effects (not through bullying) using a sample of 3409 adolescents. As the study included data from multiple informants (teacher, parent, adolescent) on the outcome (MH, as measured on the Strengths and Difficulties Questionnaire), and two informants (adolescent, parent) on the mediator (bullying), we assessed the influence of dependent measurement error.

### **Results**

For preferred analysis (using parent-reported bullying and adolescent-reported MH), the total effect was a 2.18 (95%CI: 0.66, 3.40) lower MH score for adolescents with a disability, compared to those with no disability (strength of association equivalent to 37% of the standard deviation for MH). Bullying explained 46% of the total effect. Use of adolescent-reported bullying with adolescent-reported MH produced similar results (37% mediation, 95%CI: 12%, 74%).

### **Conclusion**

Disability exerts a detrimental effect on adolescent MH, and a large proportion of this appears to operate through bullying. This finding does not appear to be spurious due to dependent measurement error.

**Medical Subject Headings:** disabled persons, adolescent development, mental health, bullying, epidemiologic methods

**Keywords:** disability, bullying-victimisation, adolescence, causal mediation, dependent measurement error, mental health

**Key messages:**

- Having a disability exerts a harmful effect on adolescent mental health.
- Using the counterfactual, and potential outcomes approach, we showed that a large proportion of the effect of disability on mental health operates through experiences of bullying-victimisation.
- Much epidemiological research using subjective measures elicited from the same individual may generate bias due to dependent measurement error. This paper demonstrates the use of multiple respondents in sensitivity analyses, and finds dependent measurement is an unlikely source of bias.
- Interventions targeting bullying could reduce inequalities in mental health between adolescents with and without disability.

## Introduction

The World Health Organization estimates that about 15% of adolescents have a mild to severe disability or chronic condition<sup>1</sup>. In Australia in 2015, 9% of young people aged 15-24 years were living with a physical, intellectual, psychological, or sensory/speech disability, or a disability related to a head injury, stroke or brain damage<sup>2</sup>. There is substantial evidence that adolescents with a health condition or disability experience poorer mental health than adolescents without a disability<sup>3-6</sup>.

Bullying is a common and deleterious experience of childhood and adolescence. There is extensive evidence that bullying-victimisation in adolescence is associated with adverse mental health outcomes<sup>7-10</sup>. Internationally it is estimated that about one third of children and adolescents report experiencing bullying-victimisation, and 10-14% report bullying-victimisation lasting six months or more<sup>11,12</sup>. There is international evidence from population-based studies that the prevalence of bullying-victimisation experiences is one to two times higher among adolescents with a disability compared to those without a disability<sup>13-15</sup>.

It is feasible that exposure to bullying-victimisation in adolescence contributes to the poorer mental health (MH) of adolescents with disability, however there has been a lack of research in this area. Identifying any mediation of the disability to mental health association by bullying can: a) help explain why adolescents with a disability have worse MH on average; and b) identify policy intervention points.

Variations in classification produce differences in estimates of the prevalence of disability<sup>16</sup>, particularly among adolescents who are the least researched and understood groups of all persons with a disability<sup>17</sup>. Some definitions of disability also include MH conditions such as

anxiety or depression: it is therefore important when examining associations between disability and MH, to minimize potential conflation of exposures and outcomes by carefully defining these measures.

Mediation analysis offers a way of disentangling the relationship between disability, MH and bullying-victimisation. Using the Baron and Kenny approach, a study among 11<sup>th</sup>-graders in the USA found that bullying-victimisation mediated 16-21% of the association between disability and MH<sup>18</sup>. The inclusion of emotional conditions in the disability classification however, may have conflated the exposure and outcome. It is also possible that the critical period when bullying is most prevalent was missed: there is some evidence that bullying peaks in mid-adolescence, and then wanes<sup>19</sup>. Importantly too, traditional Baron and Kenny approaches do not take into account exposure-mediator interactions (such as that which might occur if having a disability increased vulnerability to the negative effects of bullying-victimisation)<sup>20</sup>. Causal mediation analysis premised on the counterfactual and potential outcomes approaches overcomes some of the limitations of previous methods<sup>21</sup>. It allows decomposition of the total effect into direct and indirect effects through the mediator, even in models with interactions and non-linearities<sup>20</sup>. Further, by explicitly delineating assumptions, the counterfactual and potential outcomes approaches provides a stronger theoretical basis for causal inference<sup>22</sup>. We are unaware of any study that has examined the mediating effect of bullying on the relationship between disability and MH utilizing such methods.

We applied a causal mediation approach to examine the extent to which bullying-victimisation mediates the relationship between disability and MH, using data collected from 3409 adolescents, and their parents and teachers, in the Longitudinal Study of Australian Children (LSAC). Our primary aim was to examine mediation of the disability to MH

relationship by bullying-victimisation, however a major challenge to the validity of mediation analyses – and epidemiological analyses more generally – is dependent measurement error. This may arise when variables are based on self-reported subjective responses (such as disability, bullying or MH) from the same respondent<sup>23</sup>. If errors in the measurement of these two variables are correlated, then bias will drive the natural indirect effect (NIE) upwards (as the elicited mediator values will be correlated with either or both the exposure and outcome due to correlated measurement error). We also note that co-existing components of non-differential and independent measurement error would probably bias NIEs downwards<sup>24</sup>; the net effect of such measurement error is therefore challenging to quantify. Most studies are unable to assess the likely impact of dependent measurement error bias. The use of different or multiple informants to examine causal mediation pathways in this dataset offers a way of probing dependent measurement error and assessing its impact. To our knowledge, this is the first time that such testing of dependent measurement error has been applied using multiple independent measures of the mediator and outcome variables. A secondary aim therefore, was to examine the impact of dependent measurement error on estimates of total effects (TE), natural direct effects (NDE) and NIE. We used different combinations of informant (adolescent, parent, teacher) reports of the mediator and outcome to assess changes in estimates.

## **Methods**

### **Study setting and design**

Data was drawn from LSAC, a nationally representative longitudinal study of Australian children and families<sup>25,26</sup> that aims to examine the determinants of children's wellbeing over the life course. LSAC has been conducted biennially since 2003-2004, among two cohorts, who, at Wave 1 were families with children aged: 4–5 years (Cohort K); 0–1 years (Cohort B). The sampling frame was the Medicare Australia database which has near complete

coverage of Australian residents<sup>25</sup>. In this analysis, Cohort K, was used (years 2010-2014, Waves 4 to 6, ages 10/11 years to 14/15 years, n=2836 with complete data (Figure 1; 83% of eligible sample)).

Disability was obtained from Waves 5, bullying-victimisation and MH from Wave 6, and covariates from Wave 4.

Disability was elicited from primary household informants (94% were the adolescent's mother) in Wave 5, when adolescents were 12/13 years of age. The question, derived from other health questionnaires<sup>27,28</sup>, and prompt cards with a range of conditions were presented (see Appendix A). If respondents answered yes to any of these conditions, the adolescent was categorised as having a disability. To minimize potential conflation between the exposure (disability) and outcome (MH), we used the LSAC measure of disability that did not include mental illness.

MH was measured with the Strengths and Difficulties Questionnaire (SDQ)<sup>29</sup>, a tool with good validity and strong correlations with other measures of psychopathology<sup>29,30</sup>. We used the Total Difficulties score (range 0-40), and in sensitivity analysis we also examined the Emotional Symptoms subscale (range 0-10). The SDQ is a robust measure of MH among adolescents, including those with intellectual disabilities<sup>31</sup>.

SDQ ratings in this study came from three sources: the primary household informant (principally the mother), each adolescent's main teacher; and each adolescent. Agreement on SDQ between different informants is variable, and typically low to modest<sup>32-34</sup>.

Adolescents' experiences of bullying-victimisation were reported in Wave 6 by both the adolescent, and the primary household informant (see Appendix B). Parent-report responses were dichotomised, with 'don't know' responses classified as missing (3.6%).

Adolescents were asked 11 questions about bullying-victimisation (see Appendix B). As in previous research<sup>35</sup>, we derived a single dichotomous variable for bullying-victimisation with 'any' for one or more experiences of bullying-victimisation versus 'none'.

Covariates were measured in Wave 4, and included: household composition (single parent, two parents); parental education (household contains 1+ parent who completed secondary school vs none); gender; parental depression (using Kessler-6<sup>36</sup>), and household income centred on the mean (with imputation for missing values using 'Nearest Neighbour method'<sup>37</sup>), small area socioeconomic position (categorised into quintiles based on the Index of Relative Socio-Economic Disadvantage<sup>38</sup>). We also adjusted for adolescent ethnicity, categorised following the approach used in previous research<sup>35</sup>: (Australian born parents; at least one parent born in Anglo/European country (Caucasian or White); Visible minority (a parent of non-Caucasian or non-White and not Indigenous background); Indigenous (self- or parent-reported Aboriginal or Torres Strait Islander). While typically considered to vary over time, we found that household type, parental depression and income changed negligibly across the three waves of data examined (and were unlikely to cause exposure-mediator-outcome confounding); these variables were thus included in models as time invariant confounders.

### **Missing Data**

Figure 1 shows the eligible and analytic samples. Some variables required for our preferred model had a small proportion of missing data (<5.0% for individual variables except for



parent-reported bullying (6.3%)), with a total of 16.8% missing from the eligible sample, so complete-case analysis was deemed satisfactory. (Teacher-reported MH measures, used in our sensitivity analyses, were missing for 24.6%).

[insert Figure 1]

### **Statistical analysis**

All analyses were conducted in Stata/SE 13<sup>39</sup> using the ‘svy’ commands to accommodate stratification and sampling weights. The directed acyclic graph in Figure 2 guided variable selection.

[insert Figure 2]

We used a parametric regression approach to estimate the natural direct effect (of disability on MH not through bullying-victimisation) and the natural indirect effect (of disability on MH through bullying-victimisation)<sup>20</sup>, allowing for an interaction between the exposure and mediator in the outcome model<sup>40,41</sup>. We used bootstrapping to obtain standard errors (500 iterations).

For the primary analysis, we used *parent-reported disability* at Wave 5, *parent-reported bullying-victimisation* at Wave 6, and *adolescent-reported MH* at Wave 6. Regarding the MH outcome, we judged adolescent-reported as ‘best’ for two reasons: bullying-victimisation typically exerts effects on internalising symptoms of mental distress such as depression and anxiety<sup>42</sup> – symptoms that adolescents may be adept at concealing (and parents less adept at detecting and reporting)<sup>29</sup>; there is also some evidence that adolescent self-reported SDQ is a more valid and reliable assessment of MH than adult informant<sup>43</sup>.

Regarding the bullying mediator, we judged parent-report to be the preferred measure in this analysis; there is some evidence that the ability of self-reported bullying measures to identify victims is relatively poor<sup>44,45</sup>.

### **Sensitivity analyses**

We conducted the following sensitivity analyses:

1. While the parental measure of bullying-victimisation was preferred (see above), we also used the adolescent bullying-victimisation measure. We could both dichotomize adolescent-reported bullying (any versus none based on 11 question), and also treat it as continuous using the number of bullying items reported, a comparison that may inform understanding of misclassification arising from dichotomizing what is essentially a continuum of intensity.
2. Trialing different combinations of who reported the mediator and outcome, to explore possible impacts of dependent measurement error. For example, replacing adolescent-reported MH with parent-reported MH (meaning the same informant reports exposure, mediator and outcome), we hypothesized, may lead to greater estimated total effects and NIE (because of increased dependent measurement error between the exposure and outcome).
3. Replacing the MH outcome ‘total difficulties’ with ‘emotional symptoms’. If bullying-victimisation exerts a stronger effect on internalizing dimensions of MH, then we would expect greater mediation using the ‘Emotional Symptoms’ subscale of MH.

## **Results**

### **Descriptive statistics**

Table 1 shows the distribution of the MH outcome, bullying mediator and covariates, by disability. Among those with a disability (n=109, compared to n=2727 without), MH measures were higher (worse), as were reported experiences of bullying. Notable other differences for those with a disability were a higher proportion of: males; single parent households; and households with no parent educated beyond secondary school, and a lower mean income (Table 1).

[insert Table 1]

Table 2 shows the means of the MH outcomes and prevalence (or means, where appropriate) of covariates, by level of (binary) bullying-victimisation within the disability exposure.

Among those with and without a disability, the bullying mediator was consistently associated with worse MH. Regarding other covariates, for those with and without a disability, bullying-victimisation was also associated with more disadvantaged living circumstances (single parent households, living in the most disadvantaged areas, and having no parent educated beyond secondary school); thus, these variables are potential confounders and were included in causal mediation analysis.

[insert Table 2]

Table 3 presents total effects, NDE and NIE (mediated through bullying-victimisation) of the association between disability and MH (Total Difficulties) (see Figure 3). In the preferred model (Model 1: adolescent-reported MH, parent-reported bullying-victimisation), results show the total effect of having a disability on MH was detrimental (2.18, 95%CI: 0.66-3.40).

This effect size was equivalent to over a third of a standard deviation difference in MH (Total difficulties) (Figure 3).

[insert Table 3]

[insert Figure 3]

There was strong evidence of mediation by bullying-victimisation for the relationship between disability and MH (natural indirect effect of 1.01, 95%CI: 0.30- 1.80), indicating that almost half (46%, 95%CI: 15%-117%) of the excess in adolescent-reported ‘Total difficulties’ due to disability was mediated through bullying-victimisation.

### **Sensitivity analyses**

Replacing the parent-reported bullying-victimisation mediator with adolescent-reported bullying-victimisation resulted in a similar total effect (2.23, 95%CI: 0.72-3.55), but slightly less mediation through bullying, with a NIE of 0.83 (95%CI: 0.23-1.53), corresponding to 37% mediation (95%CI: 12%, 74%). Replacing the adolescent-reported outcome with parent- or teacher-reported MH produced similar levels of mediation to that of the principal analyses (44% and 42% respectively) and NIEs of 1.66 (95%CI: 0.74-2.68) and 1.32 (95%CI: 0.34-2.44), respectively (see Table 3).

Replacing both the mediator and outcome measures (adolescent-reported bullying and either parent- or teacher-reported MH as outcomes) resulted in less mediation; NIEs (0.52, 95%CI: 0.11-1.11) and 0.39 (-0.04-1.11) respectively, and 14% and 12% mediation respectively (see Table 3).

Modelling adolescent bullying-victimisation as a continuous variable increased the NIE by 0.2-0.6 units in the three instances of adolescent measurement of bullying-victimisation, as expected of a mediator with more nuanced measurement of bullying intensity (Table 3).

Figure 4 shows analyses for the Emotional Symptoms subscale of the SDQ. The pattern of results was broadly consistent with results for Total Difficulties, however substantially more mediation was observed in most models (e.g. for the preferred model, two thirds (67%) of the effect of disability on the Emotional Symptoms measure of MH was mediated through bullying). Effect sizes for total effect estimates were also lower for Emotional Symptoms (0.19 SD of the overall sample mean for the preferred model (adolescent-reported MH and parent-reported bullying) compared to 0.37 SD of the overall sample mean for the preferred model with Total Difficulties).

[insert Figure 4]

## Discussion

These results indicate that having a disability has a strong, detrimental effect on the MH of adolescents. Bullying appears to mediate almost half (46%) of the total effect of disability. For our preferred analysis, parent-reported bullying-victimisation was dichotomous - sensitivity analyses using a continuous variant of bullying (adolescent-reported) resulted in greater NIEs than a dichotomous bullying variable, suggesting that better measurement of bullying-victimisation in our preferred model may result in more than half of the association being explained. The use of different respondents' measures of bullying-victimisation and MH suggested the findings were both robust and that if dependent measurement error was biasing findings, it was not easily discernible. Specifically, when the adolescent's or the parent's responses to both the mediator and outcome were used (models 2 and 3 in Table 3), the percentage mediated was similar to that in the preferred model. These findings are important from a policy perspective as they suggest that much of the poorer MH of adolescents with a disability might be attributable to their treatment at the hands of others.

Based on evidence that bullying-victimisation exerts a stronger effect on internalising dimensions of MH such as depression and anxiety<sup>42</sup>, we hypothesized that more mediation would be observed using the Emotional Symptoms subscale of the SDQ. Indeed, more mediation was observed for all models except for those with adolescent-reported bullying-victimisation and parent- or teacher-reported MH (Table 3).

Our findings are congruent with other studies that have shown that disability is associated with poorer MH<sup>9</sup>, and that bullying-victimisation has a detrimental impact on MH<sup>3</sup>. While the mediating role of bullying in the disability-MH relationship has been previously demonstrated<sup>18</sup>, we advance the literature in this area by using the counterfactual and

potential outcomes approaches, which can account for non-linearity, and also interactions between the exposure and mediator: this represents the substantive and unique contribution of this work.

Social and epidemiological research is particularly prone to bias: the application of innovative methods to address and accommodate these biases represents a key strength of these analyses. While quantification of these relationships is the key contribution of our study, the examination of the effect of dependent measurement error on estimates, a key problem with subjective measures such as bullying-victimisation and MH<sup>23</sup>, represents another significant methodological contribution. The use of multiple measures of bullying-victimisation and MH enabled us to examine the potential for this source of bias. While overall patterns, especially the proportion mediated, did not appear to be substantially changed by using alternative reports of the mediator and outcome, we observed some nuance in associations, with small variations in total effects, NDE and NIE. As an example of this, models in which parent-reported MH was used yielded greatest total effects, possibly indicating exposure-outcome dependent error. We also observed an attenuation of NIE estimates in some models that removed mediator-outcome dependent measurement error (such as those models in which parent or teacher-reported outcomes were used with the adolescent-reported mediator).

There are several limitations of our study. Firstly, we make necessary assumptions about the temporal sequencing of the exposure, mediator and outcome. We assume that: disability precedes experiences of bullying-victimisation and; bullying-victimisation precedes MH outcomes. While there is evidence that bullying-victimisation in adolescence is associated with poorer MH<sup>7-9</sup>, the direction of this association remains unclear. There is some evidence

that children with internalising problems or symptoms are more likely to be bullied<sup>46</sup>, however other studies have shown that bullying-victimisation is predictive of the onset of MH difficulties<sup>47,48</sup>. Nevertheless, our measures were staggered over time consistent with the directed acyclic graph.

Secondly, we assume no unmeasured confounding of the mediator-outcome relationship. That stated, we were unable to identify any strong potential confounders of this relationship. Third, it is possible that our measures of bullying-victimisation did not sufficiently capture bullying experiences. Bullying as a construct is difficult to measure and is operationalised in many different ways<sup>49,50</sup>; prevalence estimates differ depending on the measure used<sup>50</sup>. Additionally, while it is known that bullying prevalence estimates differ between parent and adolescent-report<sup>51,52</sup>, it is not known which is most accurate. It is also possible that parent-reported bullying may have differed for those with and without a disability. Better measurement of bullying would likely see bullying explaining a greater proportion mediated<sup>24</sup>, as indicated when we compared the dichotomous and continuous measures reported by adolescents.

The LSAC definition of disability is focussed on impairment, and may not have sufficiently captured disability. For children and adolescents, disability is commonly reported by parents, and is typically conceptualised in terms of functional limitations or impairment. Applying this conceptualisation, those categorised as having a disability can vary considerably<sup>17</sup>. Reliable measurement of disability in children and adolescents is affected by the way that disability is operationalised<sup>53</sup>, and the willingness of parents to identify their child as having a disability, and disclose that information<sup>53</sup>. Misclassification would likely produce underestimation of total effects; but unless this misclassification was differential by either



bullying or MH, it would be unlikely to alter the estimates of the proportion mediated. Relatedly, we also note the relatively small number of respondents with a disability as a limitation.

## **Conclusion**

We demonstrate that bullying-victimisation is an important mediator of the association between disability and MH among adolescents: indeed, a large proportion of the effect of disability on MH operates through experiences of bullying. This indicates that interventions targeting bullying-victimisation could reduce inequalities in MH between adolescents with and without disability.

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## **Conflict of interest**

We declare no conflicts of interest.

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**Table 1: Distribution of Outcome (Mental Health Wave 6), Mediator (Bullying Victimization, Wave 6), and Covariates (Wave 4) by Exposure, (Disability, Wave 5)**

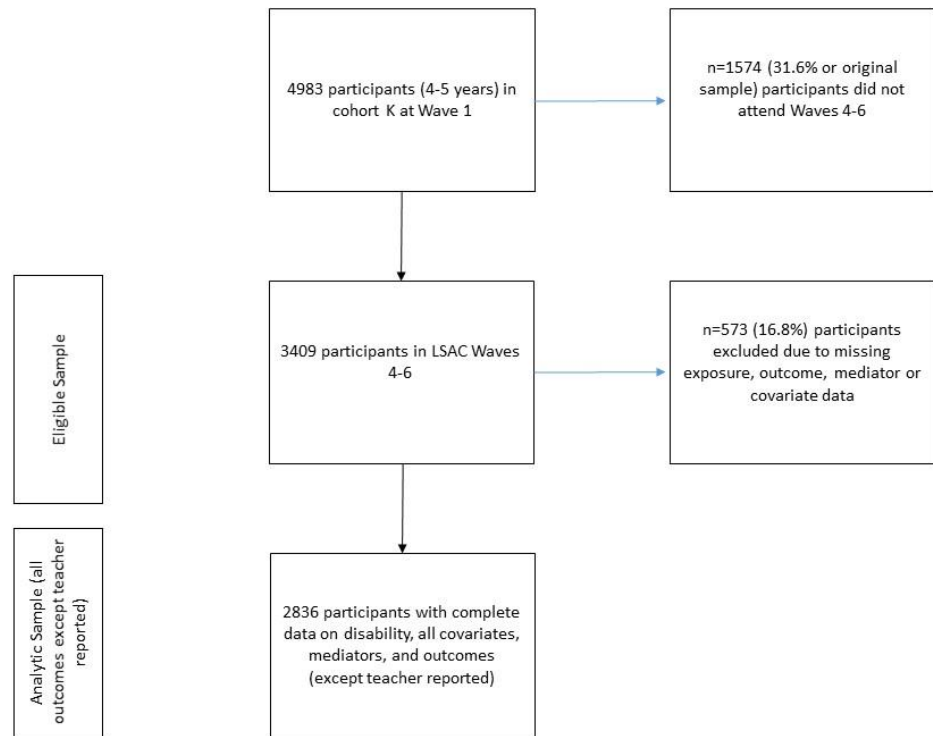
		No disability (n=2727)		Disability (n=109)	
<b>Outcome</b>		<b>Mean</b>	<b>SD</b>	<b>Mean</b>	<b>SD</b>
Total Difficulties	Parent reported	7.1	5.3	11.5	7.2
Total Difficulties	Teacher reported	5.5	5.2	9.5	7.1
Total Difficulties	Adolescent reported	9.8	5.9	12.1	6.1
Emotional Symptoms	Parent reported	1.9	2.0	2.8	2.2
Emotional Symptoms	Teacher reported	1.2	1.6	2.1	2.1
Emotional Symptoms	Adolescent reported	2.9	2.4	3.2	2.4
<b>Mediator</b>		<b>n(%)</b>	<b>95%CI</b>	<b>n(%)</b>	<b>95%CI</b>
Bullying in past 12 months (W6): Adolescent reported	Yes	60.7	58.6, 62.8	76.3	67.2, 83.4
Bullying in last 12 months(W6): Parent reported	Yes	17.7	16.2, 19.3	44.4	34.1, 55.2
Bullying in past month (W5): Adolescent reported	Yes	54.1	51.9, 56.2	62.0	51.5, 71.5
<b>Covariates</b>					
Gender	Male	51.2	49.1, 53.3	65.5	55.5, 74.3
Parents in household (W4)	Single parent	17.2	15.5, 19	29.7	20.0, 41.7
Education of parents in home (W4)	No parent completed secondary schooling	34.7	32.1, 37.3	49.3	39.2, 59.6
	Australia	66.8	64.5, 69	77.4	67.3, 85.1
	Anglo/euro	17.1	15.5, 18.9	16.8	10.4, 26
	Visible other	14.2	12.4, 16.2	5.8	2.3,13.7
Ethnicity: biological parents (W4)	Indigenous	1.9	1.4, 2.6	0.0	0.0, 0.0
	1 – most disadvantaged	27.3	23.4, 31.5	22.4	14.5, 33
	2	18.6	15.6, 22.2	18.6	12.0, 27.7
	3	14.3	11.5, 17.7	18.9	11.8, 28.8
	4	19.9	16.2, 24.1	12.6	7.0, 21.6
Area disadvantage (W4)	5 – least disadvantaged	19.9	16.3, 24	27.5	19.1, 37.8
Parental depression (W4)	Yes	2.7	2.1, 3.5	5.9	2.2, 14.6
Household income (mean \$/week; SD)		2117.4	1897.4	1705.7	1038.9

**Table 2: Distribution of Outcome (Mental Health, Wave 6) and Covariates (Wave 4) by Mediator (Parent-Reported Bullying Victimization, Wave 6), Within Strata of Exposure (Disability, Wave 5)<sup>1</sup>**

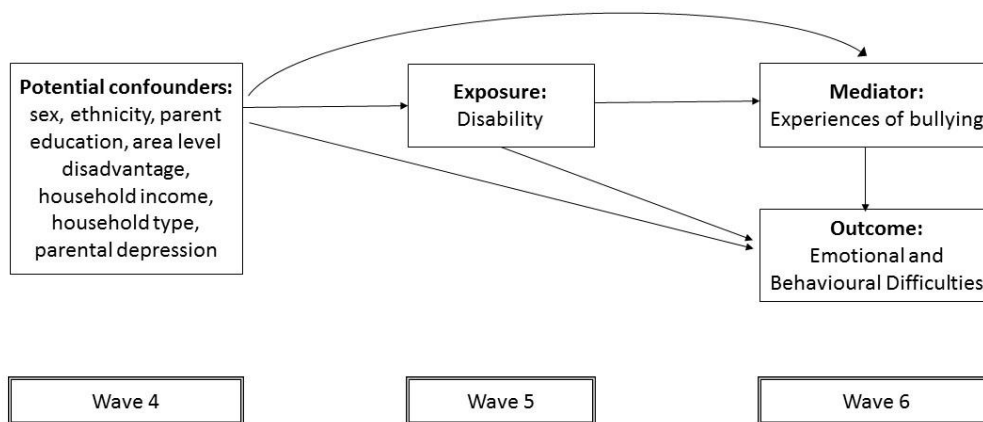
		No Disability (n=2727)				Disability (n=109)			
		Not bullied (n=2260)		Bullied (n=467)		Not bullied (n=65)		Bullied (n=44)	
Outcome		Mean	SD	Mean	SD	Mean	SD	Mean	SD
Total Difficulties	Parent reported	5.9	4.4	10.9	6.2	8.1	5.2	14.9	7.9
Total Difficulties	Teacher reported	4.7	4.6	7.9	6.5	6.7	5.0	11.5	8.5
Total Difficulties	Adolescent reported	8.8	5.4	13.3	6.5	9.9	5.4	14.8	6.7
Emotional Symptoms	Parent reported	1.6	1.7	2.9	2.4	2.0	2.0	3.9	2.6
Emotional Symptoms	Teacher reported	1.0	1.5	1.8	2.1	1.3	1.4	3.0	2.7
Emotional Symptoms	Adolescent reported	2.6	2.3	4.0	2.7	2.6	2.2	4.2	2.8
<b>Covariates</b>		<b>n(%)</b>	<b>95%CI</b>	<b>n(%)</b>	<b>95%CI</b>	<b>n(%)</b>	<b>95%CI</b>	<b>n(%)</b>	<b>95%CI</b>
Gender	Male	51.6	49.6, 53.7	45.0	40.5, 49.5	69.2	56.8, 79.4	54.5	39.5, 68.8
Parents in household (W4)	Single parent	86.8	85.4, 88.1	79.0	75.1, 82.5	18.5	10.7, 30.0	25.0	14.2, 40.1
Education of parents in home (W4)	No parent completed secondary schooling	22.9	21.2, 24.7	33.2	29.1, 37.6	24.6	15.5, 36.7	5.00	35.3, 64.7
	Australia	66.3	64.4, 68.2	77.1	73.0, 80.7	72.3	60.0, 82.0	81.8	67.3, 90.8
	Anglo/euro	18.8	17.2, 20.4	13.9	11.1, 17.4	18.5	10.7, 30.0	18.2	9.2, 32.7
	Visible other	13.4	12.1, 14.9	6.0	4.2, 8.6	9.2	4.1, 19.3	0.0	0.0, 0.0
Ethnicity: biological parents (W4)	Indigenous	1.5	1.1, 2.1	3.0	1.8, 5.0	0.0	0.0, 0.0	0.0	0.0, 0.0
	1 – most disadvantaged	22.9	21.2, 24.7	32.5	28.4, 36.9	12.3	6.2, 23.0	31.8	19.6, 47.2
	2	18.5	16.9, 20.2	19.1	15.7, 22.9	13.8	7.3, 24.8	25.0	14.2, 40.1
	3	14.6	13.2, 16.1	15.0	12.0, 18.5	26.2	16.8, 38.4	13.6	6.1, 27.6
	4	20.6	19.0, 22.3	17.3	14.2, 21.1	15.4	8.4, 26.5	6.8	2.2, 19.5
Area disadvantage (W4)	5 – least disadvantaged	23.4	21.7, 25.2	16.1	13.0, 19.7	32.3	21.9, 44.8	22.7	12.5, 37.7
Parental depression (W4)	Depressive symptoms	1.9	1.5, 2.6	3.9	2.4, 6	1.5	0.2, 10.5	9.1	3.4, 22.3
Income (\$)		2316.6	2172.8	1912.3	1136.3	2014.4	1170.2	1552.6	860.6

<sup>1</sup> These estimates are not weighted due to small numbers in some cells

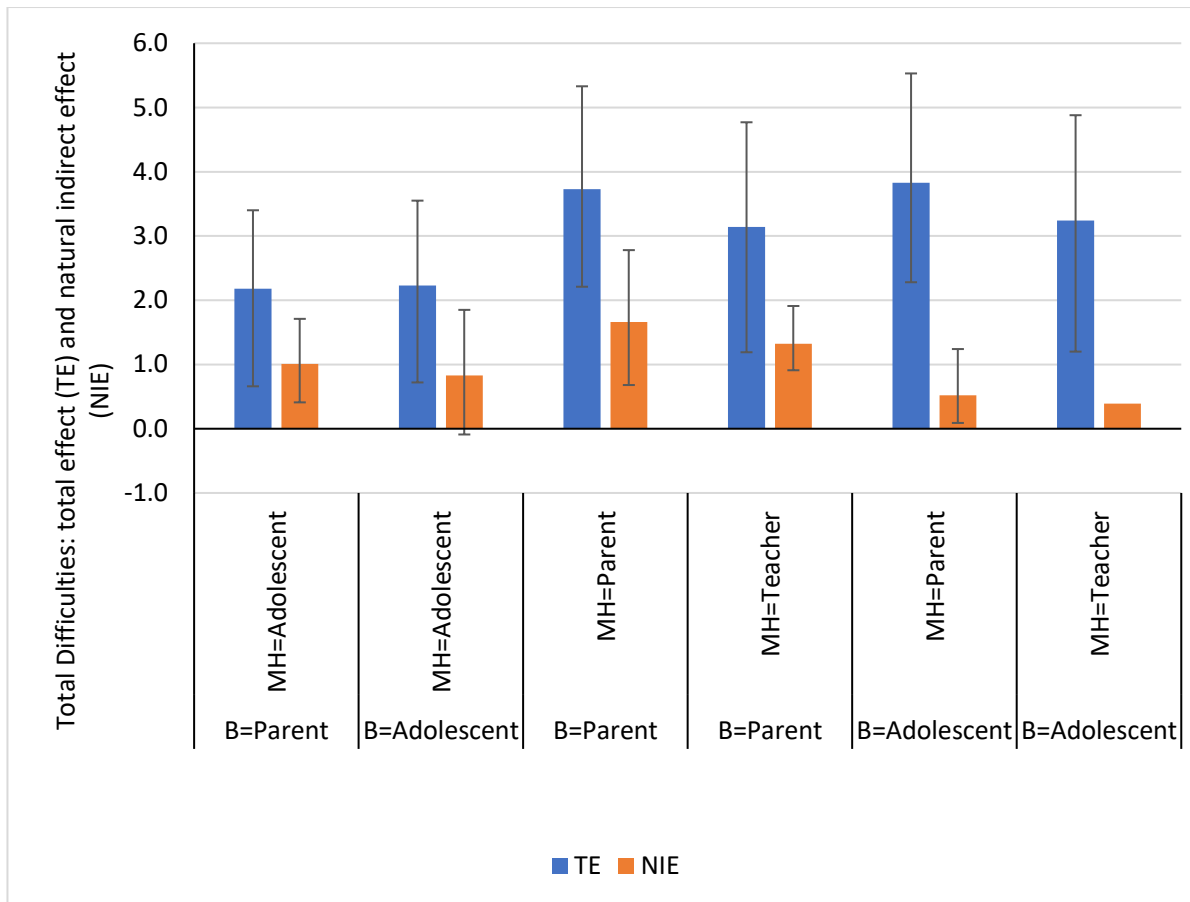




**Figure 1: Analytic sample**

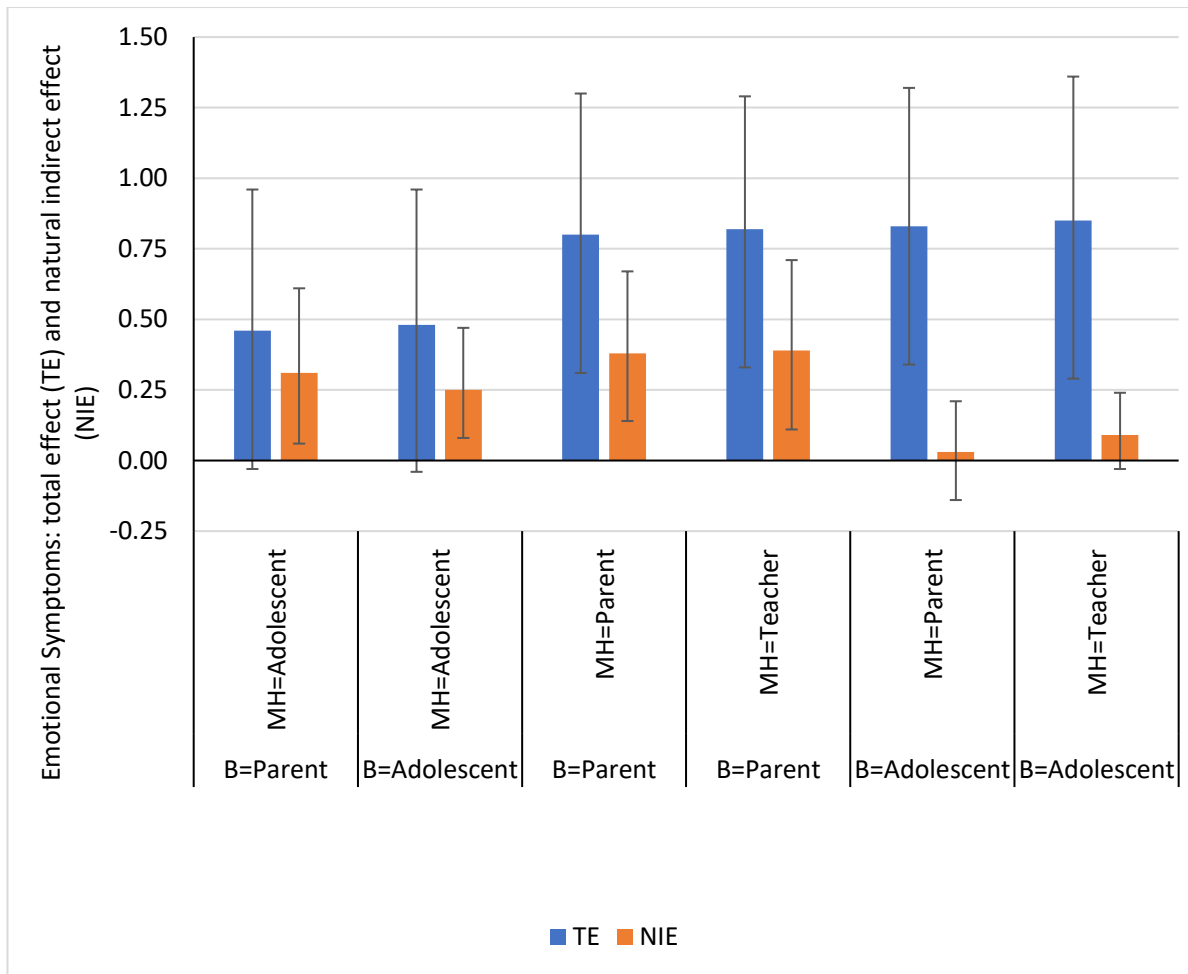


**Figure 2: Directed Acyclic Graph**



**Figure 3. Estimates of Direct and Indirect Effects (Mediated Through Bullying) of Association Between Disability and Total Difficulties for 14-15 Year old Adolescents<sup>¥</sup>**

<sup>¥</sup> The x-axis shows various combinations of who reported mental health (MH) and bullying (B)



**Figure 4: Estimates of Direct and Indirect Effects (Mediated Through Bullying) of Association Between Disability and Emotional Symptoms for 14/15 Year old Adolescents<sup>¥</sup>**

<sup>¥</sup> The x-axis shows various combinations of who reported mental health (MH) and bullying (B)

## **Appendix A**

### **Disability question**

*“Does [the study child] have any medical conditions or disabilities that have lasted, or are likely to last, for six months or more?”* Prompt cards with the following conditions were presented:

- a. Sight problems (not corrected by glasses or contact lenses)*
- b. Hearing problems (where communication is restricted, or an aid to assist with or substitute for hearing is used)*
- c. Speech problems*
- d. Blackouts, fits or loss of consciousness*
- e. Difficulty learning or understanding things*
- f. Limited use of arms or fingers*
- g. Difficulty gripping things*
- h. Limited use of legs or feet*
- i. Any condition that restricts physical activity or physical work*
- j. Any disfigurement or deformity*

## **Appendix B**

### **Bullying question: Parent**

*“In the last 12 months, has the study child been bullied at school? (At school includes travel to and from school)”*

The response options were: “yes”, “no”, “don’t know”.

### **Bullying question: Adolescent**

*“For the next questions, please think about things that might have happened to you at school, or out of school. Include texts, Facebook etc. as well as face-to-face contact. Do not include things that happened with your close family members (such as brothers and sisters).”*

The stem question then asked:

*“During the last 12 months, since [month at time of interview] last year...”,*

- a) Someone hit or kicked me on purpose;*
- b) Someone grabbed or shoved me on purpose;*
- c) Someone threatened to hurt me;*
- d) Someone threatened to take my things;*
- e) Someone said mean things to me or called me names;*
- f) Someone tried to keep others from being my friend;*
- g) Someone did not let me join in what they were doing;*
- h) Someone used force to steal something from me;*
- i) Someone hurt me or tried to hurt me with a weapon;*
- j) Someone stole me things to be mean to me;*
- k) Someone forced me to do something I didn’t want to do.*

The response options were: “yes”, “no”, “don’t know”.