Mental health of adolescents: variations by disability and borderline intellectual functioning

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Abstract

Adolescence is a period of elevated stress for many young people, and it is possible that the challenges of adolescence are different for vulnerable groups. We aimed to document the mental health, emotional and behavioral difficulties and suicidal/self-harming behaviors among adolescents with borderline intellectual functioning (BIF) or a disability, compared to those with neither disability nor BIF. Data was drawn from the Longitudinal Study of Australian Children, a nationally representative Australian study. Participants were 2950 adolescents with complete data for Waves 3-6 (years 2008-2014), aged 14-15 years in 2014. Mental health items and self-harming/suicidal thought/behaviors were self-reported. Emotional-behavioral difficulties items came from the Strengths and Difficulties Questionnaire, and were parent-, and adolescent-reported. Results of logistic regression analyses indicate that the emotional-behavioral difficulties of adolescents with either a disability or BIF, was worse than for those with neither disability nor BIF. Additionally, adolescents with a disability reported more symptoms of anxiety and depression, and were more likely to report self-harming/suicidal thoughts and behaviors. Adolescents with BIF or a disability are at higher risk of emotional-behavioral difficulties than those with neither disability nor BIF. There is some evidence that adolescents with a disability are at higher risk of anxiety, self-harming/suicidal thoughts and behaviors than adolescents without a disability.

Keywords

adolescence; emotional and behavioral difficulties; mental health; suicide; self-harm; borderline intellectual functioning; disability

Introduction

The period of adolescence is critical in laying the foundations for adult health and wellbeing[1]. Mental health symptoms often first emerge in adolescence[2], with unipolar depression the largest single contributor to the global burden of disease for adolescents[3, 4]. Furthermore, it is known that poor mental health in adolescence is a risk factor for adult mental health conditions[5]. The period of adolescence therefore, represents a vital opportunity to intervene to prevent the detrimental effects of poor mental health[4, 6].

For many reasons, including stigmatization, exclusion and discrimination,[4] the challenges of adolescence may be different for those with a disability, including those with a developmental disability.

While prevalence estimates of disability are difficult to ascertain due to variations in definitions and a dearth of quality data[7], the World Health Organization estimates that internationally, about 15% of adolescents have a mild to severe disability or chronic condition[8]. In Australia, it is estimated that 9% of young people aged 15-24 years are living with a physical, intellectual, psychological, or sensory/speech disability, or a disability related to a head injury, stroke or brain damage[9].

A greater (and largely under-researched) proportion of the population can be classified as having 'borderline intellectual functioning' (BIF). BIF is typically classified according to standardized IQ tests, and is defined as being between 1 and 2 standard deviations below the mean (typically an IQ of 71-85)[10].

While it is known that the incidence of mental health problems increases during adolescence[4], there is also evidence of an increased risk of emotional distress and poorer mental health for adolescents with a chronic illness or disability[7], or an intellectual disability[11]. It has been observed that children aged 6-7 years with BIF have poorer mental health than those without BIF[12], however little is known about the mental health of adolescents with BIF.

Self-harm is described as the deliberate act of self-injury, irrespective of suicidal intent or motive[13]. It is estimated that about 10% of adolescents have intentionally harmed themselves[13, 14], and self-harm represents one of the most significant contributors to the burden of disease among adolescents[14]. The onset of suicidal and self-harming behaviors often occurs in adolescence, with rates of self-harm consistently found to be higher among

adolescents than among adults[15]. Depression is known to be an important risk factor for suicide[16], and it is also known that the onset of major depressive disorder in adolescents is associated with more suicidality than adult onset depression[17].

There is some evidence that adolescents with chronic physical conditions have slightly higher odds of self-harm, suicidal thinking and suicide attempts[18], but little is known about self-harming behaviors among adolescents with BIF.

Given the paucity of knowledge about the mental health and self-harming and suicidal behavior of adolescents with either a disability or BIF, there is a patent need to examine and understand whether the developmental period of adolescence presents increased risks of psychopathology for adolescents with either a disability or BIF.

Using data from the Longitudinal Study of Australian Children (LSAC), this study aimed to document the prevalence of anxiety, depression, emotional and behavioral difficulties (EBD) and self-harming and suicidal behaviors among adolescents with BIF or a disability, compared to adolescents with neither disability nor BIF.

We hypothesized that poorer EBD, and higher levels of anxiety, depression and self-harming and suicidal behaviors would be observed among adolescents with a disability compared to adolescents without a disability, and among adolescents with BIF, compared to adolescents with no BIF.

Methods

Participants and study design

Data was drawn from LSAC, a nationally representative longitudinal study of Australian children conducted biennially since 2003-2004[19] [20]. Data from Cohort K, Waves 3-6 were used (years 2008-2014, ages 8/9years-14/15 years).

We examined two disability exposure variables. The first exposure variable 'disability status' was collected in Wave 5, based on parent-report of a disability or medical condition that lasted six months or more. The second exposure variable, 'borderline intellectual functioning' (BIF) is an objective measure based on test scores obtained from each participant at 8/9 years of age (Wave 3). Covariates included in models as confounding variables were measured in Wave 4, and outcomes were measured in Wave 6. The outcome

variables (suicidal/self-harming thoughts and behaviors, anxiety, depression, EBD) were collected in Wave 6, when adolescents were 14/15 years of age.

Measures

Primary household informants (94% were the adolescent's mother) responded to the following 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 a range of conditions were presented (see Supplementary material). If respondents answered 'yes' to any of these conditions, the adolescent was categorized as having a disability. To minimize measurement error due to conflation of the exposure and outcome, we used the LSAC measure of disability that did not include mental illness. There were 149 participants (4.5% of the eligible sample) with a disability, and of these, 119 (3.9%) participants were retained in the analytic sample (see Supplementary Figure S1).

To define BIF we used an approach adopted in other studies of LSAC[12]. Wave 3 LSAC included the Learning Outcomes Index (LOI) – a composite of direct measures of children and teacher rated assessments. Language and literacy skills were assessed directly with Peabody Picture Vocabulary Test (PPVT) [21] and the Academic Rating Scale (ARS) Language and Literacy subscale [22]. The Numeracy and Cognition domain of the LOI was assessed directly using the Matrix Reasoning test, a subtest of the Wechsler Intelligence Scale for Children IV (WISC-IV) [23, 24], and the ARS Mathematical Thinking subscale (completed by teachers) [25].

The results of these four subscales produce a continuous LOI score with a mean of 100, and a standard deviation of 10. BIF was defined as being between one and two standard deviations below the mean LOI score – anyone more than two standard deviations below the mean of the within cohort LOI was classified as having an intellectual disability, and was excluded from the analysis. Just over 10% of participants were classified as having BIF.

While analysis for BIF and disability were conducted separately, of those in the analytic sample classified as having a disability, 25.0% were also classified as having BIF.

In Wave 6, two sets of questions asked respondents about suicidal and self-harming thoughts and behaviors over the past 12 months. We created two variables to distinguish between thoughts and behaviors. The self-harming/suicidal thoughts variable was derived from three

questions that asked respondents whether, in the past 12 months, they had: 1) considered harming themselves; 2) seriously considered suicide; 3) made a plan about how they would attempt suicide. A binary variable was created: 'yes' if the answer to any of these three questions was affirmative; 'no', if answered 'no' to all three questions.

The self-harming/suicidal behaviors variable was created based on respondent answers to two questions about behaviors in the past 12 months: 1) whether they had self-harmed; 2) how many times they had attempted suicide. As above, a binary variable was created: 'no' (no self-harming/suicide attempt) or 'yes' (a self-harming/suicide attempt).

The Strengths and Difficulties Questionnaire (SDQ) was used to measure EBD. The SDQ, a commonly applied tool that is used for screening behavioral and emotional problems in children and adolescents, has been shown to have good validity and strong correlations with other measures of psychopathology[26]. Furthermore, there is evidence that it is a robust measure of mental health among adolescents with intellectual disabilities[27].

SDQ ratings came from two sources: adolescent; and primary household informant. From the SDQ items, we created two measures of EBD for each informant (parent, and adolescent): a 'Total Difficulties' score (range 0-40); and an 'Emotional Symptoms' score (range 0-10), with higher scores indicating more EBD problems[28]. SDQ scores were dichotomized according to Australian norms[29]: 'borderline/abnormal'; 'abnormality unlikely'.

Depressive symptoms were assessed with the Short Mood and Feelings Questionnaire (SMFQ) for children, a shortened version of the 34-item Mood and Feelings Questionnaire[30]. The SMFQ has demonstrated strong concordance with depressive diagnoses derived from other inventories such as the Diagnostic Interview Schedule for Children (DISC) and shows high internal consistency[30]. Scores were summed to produce a total score ranging from 0-26, with higher scores indicating more depressive symptoms. Following the precedent of other work using this variable[31], a binary variable was created by dichotomizing scores at the 75^{th} percentile.

The Children's Anxiety Scale: 8-item (CAS-8) was used to measure symptoms of anxiety. The CAS-8 is a shortened version of the Spence Children's Anxiety Scale (SCAS)[32]. Scores were summed to yield a total score ranging from 0-24, with higher scores indicating higher levels of anxiety. Responses were highly positively skewed, thus justifying

transformation. As this is not a standardized scale, there was no precedent for transforming scores. We therefore created a binary variable, dichotomizing at the 75thpercentile.

Other variables from Wave 4 included in our models were: household composition (single parent household; two parents), parental education (at least one parent completed secondary school; no parent completed secondary school), gender, and area-level socio-economic disadvantage (categorized into quintiles based on the Index of Relative Socio-Economic Disadvantage[33]). We also adjusted for ethnicity, following the precedent of previous research[34]: Australian born parents; at least one Anglo/European (Caucasian/White) born parent; Visible minority (a parent of non-Caucasian/non-White and not Indigenous); Indigenous (self- or parent-reported Aboriginal or Torres Strait Islander).

Dropout and non-response

Our eligible sample was defined as those attending Waves 3-6, of which there were 3349 respondents (see Supplementary Table S1 for summary of missingness). Respondents were excluded if they were: missing data on exposures confounding variables, outcomes; classified as having an intellectual disability; missing longitudinal weights. Our resultant analytic sample was 2950 participants (88% of eligible sample). See Supplementary Figure S1.

<INSERT link to Supplementary Table 1 and Figure S1>

The outcomes of interest for this analysis were measured at Wave 6, which is where the majority of missing data arose for this analysis. Multiple imputation is one of the methods available to handle missing data, however it has been found that imputing dependent (outcome) variables does little to improve the efficiency of the analysis[35, 36]. Since the majority of our missing data was due to missing outcomes, we chose not to use multiple imputation to handle the missing data. However, we did incorporate survey weights into our models, which account for non-response bias[36].

Comparing the analytic sample with the eligible sample, those omitted from the analysis due to missing data did not differ in terms of the outcomes nor sex. Those omitted were, however, slightly more likely to have a disability or BIF, come from a single parent household, and not have a parent who had finished secondary school.

Survey weights

Longitudinal survey weights for LSAC were included to reduce non-response bias, and to accommodate sample design characteristics including stratification. The following variables were used to create the survey weights: parent 1 age, mothers highest level of high school completed, parent 2 self-completed questionnaire returned, teacher reported reading ability, parent 1 renting home indicator, number of days each week that someone in the household helps study child with homework [37].

Statistical analysis

All analyses were conducted in Stata/SE version 13.1[38] using the 'svy' commands (see survey weights described above).

We first describe the prevalence of the outcomes according to disability and BIF status. We used logistic regression to obtain odds ratios (OR) for all outcome variables. Results of the logistic regression analyses are presented, both excluding and including the potential confounding variables described above.

To examine selection bias and measurement error, we conducted different sets of sensitivity analyses. Firstly, we conducted sensitivity analyses in which we treated the outcomes of anxiety symptoms, depressive symptoms and EBD as continuous outcomes and fitted linear regression models.

Secondly, as the BIF measure was obtained in Wave 3, (prior to collection of Wave 4 covariates) we conducted sensitivity analyses in which we fitted the regression models described above with the exposure BIF, and adjusted for the confounding variables measured at Wave 2 (i.e. prior to collection of BIF information) instead of Wave 4.

Results

The prevalence of BIF and disability by demographic and socio-economic characteristics is presented in Table 1. There was a higher prevalence of both disability and BIF among adolescents living in one-parent households, and among those whose parents had not completed secondary education. There was a higher prevalence of BIF among boys, Indigenous adolescents and those adolescents living in more disadvantaged areas.

< INSERT Table 1>

Self-harming/suicidal thoughts and behaviors were marginally higher among adolescents with a disability and there was weak statistical evidence that adolescents with a disability were more likely to report symptoms of anxiety (30.6% vs 23.6% adjusted OR 1.69, 95%CI 1.02-2.81) and depression (32.2% vs 26.4% adjusted OR 1.32, 95%CI 0.85-2.06).

<INSERT Table 2>

The EBD of adolescents differed significantly between adolescents with and without a disability as rated by parents and adolescents, for both Total Difficulties and Emotional Symptoms, (with the exception of adolescent-reported Emotional Symptoms where associations were not significant). Greatest differences were found for Total Difficulties, where compared to adolescents without a disability, adolescents with a disability had five times greater odds of being classified as being borderline/abnormal according to parent-report (26.0% vs. 6.0% adjusted OR 5.04, 95%CI 2.81-9.05). Associations between Total Difficulties and disability were also strong for adolescent-report (25.7% vs 16.5% adjusted OR 2.06, 95%CI 1.20-3.53).

Looking at Emotional Symptoms, adolescents with a disability had almost three times greater odds of being outside the normal range according to parent-report (26.5% vs. 11.0% adjusted OR 2.96, 95%CI 1.76-4.98). No substantial differences were observed on the Emotional Symptoms scale according to adolescent self-reported measures.

Adolescents with BIF and without BIF did not differ on reported self-harming/suicidal thoughts or behaviors (see Table 3). While adolescents with and without BIF did not differ on the anxiety symptoms measure, those with BIF reported more depressive symptoms (30.5% vs. 26.2% adjusted OR 1.29 95%CI 0.94-1.76).

<INSERT Table 3>

There were significant differences between those with and without BIF on all EBD measures except for adolescent-reported Emotional Symptoms. As for adolescents with a disability, strongest effects were observed for BIF when examining Total Difficulties, where compared to adolescents without BIF, adolescents with BIF had over four times greater odds of being classified as having borderline/abnormal according to parent-reports (19.4% vs. 5.2% adjusted OR 4.33, 95%CI 2.84-6.62). Weaker associations were observed for adolescent-reported Total Difficulties: compared to adolescents without BIF, adolescents with BIF had

almost one and a half times greater odds of being classified as borderline/abnormal (19.3% vs. 16.6% adjusted OR 1.35, 95%CI 0.94-1.93).

According to parent-report, adolescents with BIF had over two times greater odds of being outside the normal range for Emotional Symptoms: 20.0% vs. 10.7% adjusted OR 2.19, 95%CI 1.51-3.18.

Sensitivity analyses were conducted using continuous outcomes for mental health and EBD. The results of these logistic models are presented in Supplementary Table S2, and show that associations were broadly consistent with those of the main findings.

Other sensitivity analysis conducted using Wave 2 covariates for the BIF models (collected prior to the measurement of BIF in Wave 3) produced negligible change in the estimates (see Supplementary Table S3).

Discussion

The results of the study presented here indicate that EBD were significantly worse for adolescents with either a disability or BIF, compared to those with neither disability nor BIF. These effects were consistent across both measures of EBD (Total Difficulties and Emotional Symptoms), and for parent- and adolescent-reported measures of Total Difficulties.

Emotional Symptoms, as rated by adolescents, were not significantly different for adolescents with and without a disability, nor for adolescents with and without BIF. This may reflect differential misclassification: adolescents who have a disability or BIF may be less likely to report difficulties even when they have them.

Adolescents with a disability had greater odds of reporting symptoms of both anxiety and depression. There were no apparent differences in anxiety symptoms according to whether or not an adolescent had BIF, however adolescents with BIF reported more depressive symptoms than adolescents without BIF (although not statistically significant). Furthermore, while there was no consistent relationship between BIF status and self-harming/suicidal thoughts, adolescents with a disability reported more self-harming/suicidal thoughts and behaviors. While these associations were not significant (potentially due to a lack of statistical power), the estimates suggest that these associations are worthy of further investigation.

These EBD results are consistent with other studies that have shown poorer EBD (as measured by higher SDQ scores), among children with an intellectual disability[12, 39], BIF[12] or a chronic illness or disability[40].

These results are important for several reasons. Firstly, they suggest that adolescents with BIF or a disability are at higher risk of abnormal EBD. Given that the SDQ is known to be a useful instrument in the detection of child psychopathology[41], it is possible that our results flag early signs of psychopathology that are not yet detectable on other measures of psychiatric distress such as the anxiety and depression measures used here.

Furthermore, as it is known that children and adolescents with low intellectual functioning contribute to a disproportionate amount of overall child and adolescent psychiatric morbidity[12], the detection of early signs of abnormal EBD among adolescents with a disability and BIF is of acute importance to policy makers and mental health practitioners, as it highlights opportunity for early intervention. Further to this point, the attenuated differences in EBD when based on self-report highlight the importance of obtaining information from multiple informants, as there is a risk that reliance on self-report may lead to vulnerable adolescents being missed.

Secondly, and relatedly, given that there is some evidence that adolescent mental health problems predict adult mental health problems[5], it is critically important that early signs of abnormal EBD in these vulnerable groups of adolescents are recognized, as early intervention is known to improve the mental health outcomes of adolescents at risk of poor mental health[42].

Thirdly, the results presented here contribute to the modest, but growing literature on the mental health and wellbeing of adolescents with BIF, and adolescents with a disability.

The fact that we observed strong and significant associations for EBD, but less clear associations for anxiety and depression is intriguing. While it is possible that the SDQ, is more sensitive to the early signs of psychopathology than other mental health assessment tools, it is also possible that the instruments used to measure anxiety and depression lack sensitivity and specificity - we note that neither measure is used as a diagnostic test.

There are several strengths and limitations of this research. A key strength is the use of two different reports of two measures of EBD (using the SDQ); as well as adolescent self-report, parent-reported EBD was used to provide external validation. The high overall concordance

between both informants (both showing greater odds of abnormal EBD in adolescents with a disability, and adolescents with BIF), strengthens our findings.

Further supporting our findings, sensitivity analysis conducted with Total Difficulties and Emotional Symptoms analyzed as continuous variables resulted in findings consistent with the main analyses (see Supplementary Table S2). Other sensitivity analysis conducted with anxiety and depressive symptoms analyzed as continuous variables also produced results consistent with those of the principal analyses, providing support for the use of dichotomous variables for this analysis (see Supplementary Table S2). Finally, we also note that we minimized bias arising from conflation of exposure and outcome by using a measure of disability that did not include mental illness.

In terms of limitations, it is firstly important to acknowledge that Wave 6 of LSAC did not collect exhaustive information on all types of psychopathology.

Secondly, the measure of disability used in LSAC is focused on functional limitations or impairment, and may not have adequately captured disability as a construct: it combines a number of different conditions and does not distinguish between levels of severity. It is likely that experiences vary significantly depending on type of disability and level of severity. The measure BIF on the other hand, is an objective measure based on performance on the Learning Outcomes Index in Wave 3.

Our results may also have been limited by sample size: while the proportion of adolescents who reported suicidal and self-harming ideation and behaviors was alarming, it was nonetheless relatively small in terms of absolute numbers among adolescents with a disability, and our ability to detect significant differences between those with and without a disability may have been compromised by lack of statistical power.

There is potential that our study was affected by selection bias due to missing data. There were slight differences in the characteristics of those included in the analysis and those excluded due to missing data. Those with missing data were slightly more likely to have a disability or BIF and experience socio-economic disadvantage. However, the proportion of the eligible sample with missing data was less than 12%, therefore it is unlikely that selection bias would have substantially affected the results.

Finally, it is also important to recognize that adolescents with BIF may have had difficulties understanding and completing the questionnaires, potentially biasing results towards the null.

However, the general consistency of the EBD findings between different informants suggests that this is unlikely to have substantially biased the EBD results. While there is some evidence that those with intellectual difficulties may report at the extremes of scales, there is scant evidence of this reporting pattern among those with BIF[43] and indeed there was no evidence of this reporting pattern in this study.

Conclusions

In conclusion, this study presents evidence that adolescents with either BIF or a disability are at higher risk of poorer mental health. In particular, there is evidence that adolescents with either BIF or a disability are at higher risk of abnormal EBD than those with neither disability nor BIF. Further, there is some evidence that adolescents with a disability are at higher risk of anxiety, and self-harming/suicidal thoughts and behaviors than adolescents without a disability.

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Conflict of interest

None to declare

Ethical standards

The LSAC study has ethics approval from the Australian Institute of Family Studies Ethics Committee. The Ethics Committee is registered with the Australian Health Ethics Committee, a subcommittee of the National Health and Medical Research Council (NHMRC). Written informed consent was obtained from the caregiver on behalf of each of the study children.

Availability of Data and Materials

Data used in this study are not available for sharing due to ethical and data management requirements. The researchers welcome potential collaborations.

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Table 1: Prevalence of disability and BIF by covariate variables among adolescents aged 14-15 years

		Disability %(95%CI)	Borderline %(95%CI)
Sex	Male	5.1 (3.9, 6.6)	13.1 (10.9, 15.8)
	Female	3.2 (2.3, 4.4)	8.6 (6.9, 10.6)
Parents in household	Two parents	3.6 (3.0, 4.4)	10.5 (9.1, 12.0)
	Single parent	6.6 (4.3,10.0)	12.6 (9.3, 16.9)
Education of parents in home	1+ parent completed secondary schooling	3.4 (2.7, 4.3)	8.0 (6.7, 9.4)
	No parent completed secondary schooling	5.5 (3.9, 7.6)	16.0 (13.0, 19.5)
Ethnicity	Australia	4.7 (3.7, 6.0)	11.3 (9.5, 13.4)
	Anglo/Europe	4.6 (2.9, 7.4)	9.1 (6.8, 12.2)
	Visible other	1.7 (0.1, 4.1)	9.3 (6.2, 13.7)
	Indigenous	3.3 (0.1, 12.5)	22.3 (12.5, 36.4)
Area disadvantage	1 – most disadvantaged	3.8 (2.4, 5.8)	14.4 (11.5, 18.0)
	2	4.4 (2.9, 6.7)	11.6 (9.0, 15.6)
	3	4.8 (3.0, 7.7)	12.1 (8.5, 16.7)
	4	2.7 (1.6, 4.5)	10.2 (7.7, 13.5)
	5 – least disadvantaged	5.6 (4.0, 8.3)	4.9 (3.3, 7.1)

Table 2: Prevalence and logistic regression of odds of abnormal emotional and behavioural difficulties[¶], poor mental health, and suicidal and self-harming thoughts and behaviours by disability status, OR (95%% CI)

	Prevalence (%)		Crude OR (95% CI)	Adjusted OR (95% CI) [§]
	No Disability	Disability		
Suicidal and self-harming thoughts and behaviours				
Thoughts	19.1	22.5	1.23 (0.76, 1.99)	1.33 (0.80, 2.20)
Behaviours	11.1	13.2	1.22 (0.66,2.26)	1.22 (0.64, 2.32)
Mental health				
Anxiety symptoms	23.6	30.6	1.42 (0.88, 2.31)	1.69 (1.02, 2.81)
Depressive symptoms	26.4	32.2	1.32 (0.84, 2.07)	1.32 (0.85, 2.06)
Emotional and behavioural difficulties				
Total Difficulties: Adolescent[a]	16.5	25.7	1.74 (1.05, 2.90)	2.06 (1.20, 3.53)
Total Difficulties: Parent[b]	6.0	26.0	5.59 (3.28, 9.53)	5.04 (2.81, 9.05)
Emotional Symptoms: Adolescent [a]	18.7	21.2	1.17 (0.68, 2.00)	1.23 (0.71, 2.12)
Emotional Symptoms: Parent[b]	11.0	26.5	2.91 (1.80, 4.71)	2.96 (1.76, 4.98)

§ Models adjusted for: gender, household type, parental education, ethnicity, area SEP

[¶] Higher scores denotes worse EBD

[a] Outcome was self-reported by the adolescent

[b] Outcome reported by parent

Table 3: Prevalence and logistic regression of odds of abnormal emotional and behavioural difficulties[¶], poor mental health, and suicidal and self-harming thoughts and behaviours by BIF status, OR (95%% CI)

	Prevalence (%)		Crude OR (95% CI)	Adjusted OR (95% CI) [§]
	No BIF	BIF		
Suicidal and self-harming thoughts and behaviours				
Thoughts	19.5	16.9	0.84 (0.58, 1.22)	0.91 (0.61, 1.35)
Behaviours	11.4	10.0	0.82 (0.52, 1.30)	0.83 (0.50, 1.36)
Mental health				
Anxiety symptoms	24.2	21.5	0.86 (0.61, 1.20)	0.98 (0.70, 1.38)
Depressive symptoms	26.2	30.5	1.24 (0.91,1.68)	1.29 (0.94, 1.76)
Emotional and behavioural difficulties				
Total Difficulties: Adolescent[a]	16.6	19.3	1.20 (0.85, 1.70)	1.35 (0.94, 1.93)
Total Difficulties: Parent[b]	5.2	19.4	4.41 (2.87, 6.76)	4.33 (2.84, 6.62)
Emotional Symptoms: Adolescent [a]	18.8	19.0	1.01 (0.70, 1.45)	1.08 (0.75, 1.56)
Emotional Symptoms: Parent[b]	10.7	20.0	2.10 (1.46, 3.02)	2.19 (1.51, 3.18)

§ Models adjusted for: gender, household type, parental education, ethnicity, area SEP

[¶] Higher scores denotes worse EBD

[a] Outcome was self-reported by the adolescent

[b] Outcome reported by parent

Table S1: Summary of missing data as a proportion of eligible sample

Variable	% missing from eligible sample (n=3349)
Confounding variables (measured at Wave 4)	
Sex	0.0
Parental education	0.5
Ethnicity	0.6
Household type	0.1
Area disadvantage	0.0
Exposure variables	
BIF (measured at wave 3)	2.2
Disability (measured at wave 5)	0.5
Outcome variables (measured at Wave 6)	
Anxiety symptoms	5.0
Depressive symptoms	5.0
Thoughts: Self harm or suicide	5.7
Behaviours: Self-harm or suicide	5.6
Emotional Symptoms: Adolescent[a]	5.0
Emotional Symptoms: Parent[b]	4.2
Total Difficulties: Adolescent[a]	5.0
Total Difficulties: Parent[b]	4.2

Table S2: Mean and linear regression of association between disability/BIF status and mental health and emotional and behavioural difficulties (95%% CI)

	Mean (SD)		Crude β coefficient (95% CI)	Adjusted β coefficient (95%CI) [§]
	No Disability	Disability		
Mental health				
Anxiety symptoms	6.0 (4.7)	6.4 (5.0)	0.44 (-0.67, 1.55)	0.77 (-0.30, 1.83)
Depressive symptoms	5.5 (6.7)	6.2 (6.8)	0.66 (-0.90, 2.23)	0.65 (-0.85, 2.15)
Emotional and behavioural difficulties				
Total Difficulties: Adolescent[a]	9.9 (6.0)	12.2 (6.0)	2.28 (1.00, 3.55)	2.16 (0.93, 3.40)
Total Difficulties: Parent[b]	7.1 (5.3)	11.7 (7.5)	4.60 (2.86, 6.33)	4.27 (2.53, 6.02)
Emotional Symptoms: Adolescent[a]	2.9 (2.4)	3.2 (2.2)	0.29 (-0.22, 0.81)	0.43 (-0.08, 0.93)
Emotional Symptoms: Parent[b]	1.9 (1.9)	2.8 (2.3)	0.89 (0.42, 1.36)	0.88 (0.41, 1.36)
	Mean (SD)		**Crude β coefficient (95% CI)**	**Adjusted β coefficient (95%CI) [§]**
	No BIF	**BIF**		
Mental health				
Anxiety symptoms	6.0 (4.8)	5.6 (4.2)	-0.40 (-0.99, 0.19)	-0.07 (-0.61, 0.47)
Depressive symptoms	5.5 (6.8)	5.6 (5.4)	0.12 (-0.78, 1.01)	0.14 (-0.72, 1.01)
Emotional and behavioural difficulties				
Total Difficulties: Adolescent[a]	9.8 (6.0)	11.7 (5.1)	1.86 (1.09, 2.63)	1.77 (1.01, 2.54)
Total Difficulties: Parent[b]	6.9 (5.2)	10.7 (6.3)	3.77 (2.66, 4.87)	3.36 (2.30, 4.43)
Emotional Symptoms: Adolescent[a]	2.9 (2.4)	3.0 (2.0)	0.11 (-0.13, 0.42)	0.25 (-0.3, 0.53)
Emotional Symptoms: Parent[b]	1.9 (1.9)	2.6 (2.0)	0.71 (0.39, 1.03)	0.71 (0.40, 1.01)

[§] Models adjusted for: gender, household type, parental education, ethnicity, area SEP

[¶] Higher scores denote worse EBD

[a] Outcome was self-reported by the adolescent

[b] Outcome reported by parent

Table S3: Prevalence and logistic regression of odds of abnormal emotional and behavioural difficulties[¶], poor mental health, and suicidal and self-harming thoughts and behaviours by BIF status, adjusted for Wave 2 covariates, OR (95%% CI)

	Prevalence (%)			
	No BIF	BIF	Crude OR (95% CI)	Adjusted OR (95%CI) [§]
Suicidal and self-harming thoughts and behaviours				
Thoughts	19.5	16.9	0.84 (0.58, 1.22)	0.91 (0.61, 1.36)
Behaviours	11.4	10.0	0.82 (0.52, 1.30)	0.85 (0.52, 1.40)
Mental health				
Anxiety symptoms	24.2	21.5	0.86 (0.61,1.20)	0.97 (0.70, 1.37)
Depressive symptoms	26.2	30.5	1.24 (0.91,1.68)	1.27 (0.93, 1.74)
Emotional and behavioural difficulties				
Total Difficulties: Adolescent[a]	16.6	19.3	1.20 (0.85, 1.70)	1.34 (0.94, 1.90)
Total Difficulties: Parent[b]	5.2	19.4	4.41 (2.87, 6.76)	4.27 (2.76, 6.56)
Emotional Symptoms: Adolescent[a]	18.8	19.0	1.01 (0.70, 1.45)	1.08 (0.75, 1.56)
Emotional Symptoms: Parent[b]	10.7	20.0	2.10 (1.46, 3.02)	2.19 (1.50, 3.19)

[§] Models adjusted for: gender, household type, parental education, ethnicity, area SEP
[¶] Higher scores denote worse EBD
[a] Outcome was self-reported by the adolescent
[b] Outcome reported by parent

Supplementary material

Disability status

Primary household informants (94% were the adolescent's mother) responded to the following 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

If respondents answered 'yes' to any of these conditions, the child was categorized as having a disability.