

**Mental health problems among 4–17 year olds with hearing problems: results from a nationally representative study**

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## **Abstract**

**Objective:** This study aimed to characterise the risk of mental health problems among a representative sample of 6,310 4–17 year olds, 147 of whom had parent-reported hearing problems.

**Methods:** The study used data from the Young Minds Matter survey. The Diagnostic Interview Schedule for Children (DISC-IV) assessed prevalence of mood, anxiety and behavioural disorders. The Strengths and Difficulties Questionnaire (SDQ) assessed social and emotional problems. Logistic regression models were used to estimate odds of having mental health problems adjusting for child factors (speech and language problems, global health, age and gender), family factors (family structure, parent income, education, financial strain and psychological distress) and school-related factors (bullying, school liking, school absence).

**Results:** In unadjusted analyses children and young people with hearing problems had substantially higher odds of most mental health problems. Hearing problems were not associated with any mental health problem among 4–11 year olds after adjusting for other child factors. After adjustments for child, family and school-related factors, 12–17 year olds with a hearing problem remained at greater risk of social phobia and generalised anxiety (DISC-IV), and of peer and emotional problems (SDQ).

**Conclusions:** Clinicians caring for children and young people with hearing problems should be alert for heightened risk of specific mental health problems based on age and the nature of hearing problems. Understanding a wider range of correlates associated with the higher prevalence of mental health problems may allow health professionals to be more informed about the nature of mental health problems that are comorbid to hearing problems.

**Keywords:** Hearing loss, mental health, children, adolescents

**Word count:** 6,094

## Introduction

Hearing loss has significant impacts on the development of children's language, communication and socialisation skills [1]. Children with hearing loss can have greater difficulties making friends and are more socially isolated than their peers with typical hearing levels [2-4]. Several studies have shown that hearing loss in children is associated with an increased risk of broad internalising and externalising symptoms and behaviours [5-9].

Although the association between hearing loss and mental health problems is well-established, inconsistencies and limitations across studies have resulted in equivocal findings regarding the nature and extent of the association. For example, Dammeyer [5] noted that the prevalence of psychosocial difficulties reported in previous studies has ranged between 20–50%. This variability likely arises from the different psychosocial measures used to index mental health [10]. A systematic review highlighted the need to address more specific aspects of mental health and behavioural disorders, such as depression, anxiety, and attention-deficit hyperactivity disorder (ADHD), as opposed to broader measures of psychopathology that are typically used [11]. In one of the few studies to use a diagnostic interview to assess ICD-10 disorders, van Gent [12] reported prevalence rates of 27% for internalising disorders and 18% for externalising disorders. More specific data would enable clinicians to monitor mental health disorders and provide details about potential mechanisms to inform future research and intervention.

Previous research has indicated that it is not hearing loss *per se* that contributes to mental health problems, but additional factors such as communication problems, physical health problems, adverse living conditions and other factors increase the risk of mental health problems in the population of children with hearing loss [12]. Several studies have shown that among children and young people with hearing loss, an increased likelihood of mental

health problems have been observed for those with multiple health problems [12], communication problems [2,6,8,10], and intellectual impairments [11–13].

While the literature is well established with respect to the role of comorbid health and communication problems for the mental health of children and young people with hearing problems, few studies have examined in detail the additional factors that may contribute to an increased risk of mental health problems, including family and school factors [14]. Fellingner et al. [6] considered family background and the child's school experiences and found that these did not vary by the degree of hearing loss, however their study did not include a comparison group of children without hearing loss. Others that compared socio-demographic characteristics of children and young people referred to mental health services found that those who were deaf or hard of hearing were more likely to come from single-parent families and from parents with low levels of education. Mental health problems in the general population have been linked with socioeconomic status, parental mental health, family structure, family functioning or stress and other social issues such as bullying at school [15]. Given that research has found that children and young people with hearing loss have are more likely to be bullied or teased than their normally hearing counterparts [16], and parents of children with hearing loss report higher levels of parenting stress than parents of children without hearing loss [17], these family and social factors are notably absent from the literature concerning hearing loss and mental health problems.

A further limitation of previous research has been the focus on children with severe hearing loss, for example those recruited from clinics or special schools [11]. The use of standard decibel cut-off criteria in audiological and epidemiological research is widespread, with the definition of disabling hearing loss in children being  $\geq 30\text{dB}$  according to the World Health Organization [18] and  $\geq 40\text{dB}$  according to many national newborn hearing screening programs [19]. These cut-offs are useful for statistical analyses but are arbitrary in nature and

can be of limited practical or clinical use as they give no indication of the level of impairment experienced by an individual [20]. Moog et al. [21] also highlighted that studies examining the outcomes of children within a specific early intervention program may be subject to selection bias and may not represent the psychosocial characteristics of the entire population of children with severe or profound hearing loss.

Most studies have shown that the extent of psychosocial difficulties are unrelated to the degree of hearing loss [5,6,22], although others have found that children with hearing aids had more symptoms of psychopathology than those with cochlear implants or their normally hearing peers despite children with cochlear implants having more severe hearing loss [23]. Studies that focus on more severe levels of hearing loss may therefore underestimate prevalence of mental health problems among children and young people with milder hearing loss.

The prevalence of hearing loss varies according to age group and the definition of hearing loss. In Australia, the reported prevalence of moderate and more severe hearing loss (three frequency average in the better ear of  $\geq 40$  dB HL) rises from 1.04/1000 live births at 3 years of age to 1.57/1000 live births for children aged between 9 and 16 years [24]. The prevalence of mild degrees of hearing loss (three frequency average in the better ear  $< 40$  dB HL) rises from 0.28 live births at 3 years of age to 1.68/1000 live births at 9 years of age and older [24]. These estimates consider only sensorineural hearing loss. Recurrent otitis media (OM) and its associated fluctuating conductive hearing loss concerns approximately 1 in 4 children in Australia [25]. Although the hearing loss associated with OM typically resolves with or without intervention, approximately 2% of children will suffer a perforated tympanic membrane with chronic discharge in early childhood [26], and 90% of these children will suffer a permanent mild-moderate hearing loss as a result [27]. The current study examines

children and young people with parent-reported hearing problems regardless of whether the cause was conductive or sensorineural.

It is clear from previous research that children and young people with various forms of hearing loss are at greater risk of broad social and emotional wellbeing problems, however there is limited information about the particular mental health problems that these children and young people experience, or the extent to which these risks may be accounted for by other factors. This objective of this study was to use nationally representative survey data to examine the prevalence of specific mental health problems among children and young people with parent-reported hearing problems, as compared to children and young people without hearing problems, and the extent to which child, family and social factors contribute to the relationship between hearing and mental health problems.

## **Methods**

### ***Participants***

This study used Young Minds Matter (YMM) data, a nationally representative survey of 6,310 Australians parent/carers of children and young people aged 4–17 years conducted between May 2013 and April 2014 [15,28]. The survey was designed to estimate national prevalence rates and associated burden of mental health disorders among children and young people. Full details of the survey design and sampling strategy are available elsewhere [29]. In brief, a multi-stage, area-based sample selection procedure was used to select areas for interviewing, within which interviewers approached selected households to determine survey eligibility. If the household included a child or young person aged 4–17 years, the parent/carer was invited to participate in the survey (for brevity, we refer to the parent/carer as the parent throughout this study). Parents were interviewed in their homes about one randomly selected child or adolescent in the family. The overall response rate from invited

households was 55%. Comparisons with Australian Bureau of Statistics (ABS) 2011 census data showed the sample to be broadly representative of Australian households on major demographic characteristics such as area-level socioeconomic indices, population distribution, family structure, parent/carer country of birth, housing tenure, housing income, education status and labour force status of parents/carers [29]. Trained interviewers from Roy Morgan Research conducted the survey using a handheld tablet computer to complete a Computer Assisted Parent Interview (CAPI) with parents.

The YMM survey was approved by the Australian Government Department of Health Human Research Ethics Committee and The University of Western Australia Human Research Ethics Committee. Verbal consent was initially obtained from parents to participate in the survey, and paper consent forms were completed at the completion of the household interview.

### ***Measures***

#### *Hearing problems*

Parents were asked if the child had a chronic health condition within the last 12 months. The response list included ‘hearing problems’, amongst other conditions such as asthma, allergy, diabetes, and chronic pain. In total, 92 (2.8%) children aged 4–11 years and 55 (1.7%) aged 12–17 years were reported to have hearing problems. No information was collected on the severity or duration of the hearing problem. These rates are consistent with other representative surveys of Australian children that report a prevalence rate of 2% for hearing problems among 4–5 year old children [3].

#### *Mental Health*

The Diagnostic Interview Schedule for Children IV (DISC-IV) [30] was used to assess 12-month prevalence of mental disorders. The DISC-IV modules include conduct disorder, major depressive disorder, attention deficit/hyperactivity disorder (ADHD),

oppositional defiance disorder and anxiety disorders (social phobia, separation anxiety disorder, generalised anxiety disorder and obsessive-compulsive disorder). To meet the criteria for full-syndrome disorder, children and young people needed to satisfy symptom criteria and an impairment criterion. The DISC-IV was selected for the survey because the instrument was designed for epidemiological research and can be administered by trained, lay interviewers. The DISC-IV was designed to capture mental disorders among 6-17 year olds, but has been used previously for children as young as 4 years [31–33].

In order to provide comparability to other studies that use broader assessments of social and emotional problems, we also used data from the Strengths and Difficulties Questionnaire (SDQ) [34,35]. The SDQ is a behavioural screening questionnaire consisting of four problem subscales of five items each and a total difficulties score. Problem subscales include emotional, conduct, hyperactivity, and peer problems, with subscale scores ranging from 0 to 10. Subscale and total scores were categorised into normal, borderline or abnormal ranges [36]. In this study, we examined the prevalence of children and young people meeting the abnormal criteria for each scale.

#### *Other child health and development problems*

To account for other conditions that have known comorbidity with hearing loss, this study also included a range of other health and development factors. Parents were asked whether they had ever been told by a doctor or mental health professional that the child has speech and/or language problems, autism spectrum disorder or an intellectual disability. We also included whether the child had glue ear, otitis media or grommets in the previous 12 months, and a global health measure of the child's health, with ranging from excellent, very good, good to fair/poor.

#### *Family information*



A broad range of socio-demographic characteristics that may be associated with hearing problems or mental health problems were examined. These included family structure, equivalised household income, highest level of caregiver education, whether or not the child's household had at least one parent in employment, residential remoteness, financial strain (where the parent indicated they had experienced difficulties such as not being able to pay bills on time), and the smoking status of the primary carer, which can proxy for other poor health-related behaviours [37]. The mental health of the primary carer was indexed on the Kessler Psychological Distress Scale (K10) [38] a measure of non-specific psychological distress in the last four weeks. We used the criteria developed by the ABS [39] to categorise K10 severity as low, moderate, high and very high.

#### *School and social factors*

Three indicators of school and social problems were included to capture additional social contexts. First, the primary carer was asked if their child had been bullied, teased or victimised to the point of distress, including in person, or via mobile phone, text message, internet or email, (yes/no). School attendance was captured by carer-report of the number of days the child or young person had missed since the start of the school year. Days of absence was converted to an absence rate based on the date of the interview. Children and young people with an absence rate greater than 10%, the equivalent of approximately four weeks of school in a year, were classed as being chronically absent (yes/no). Finally, a parent/carer report of how much the child or young person likes school was included ('very much', 'somewhat', 'neither likes nor dislikes', 'somewhat dislikes' or 'very much dislikes school'). The latter three categories were combined to identify children and young people who did not like school.

### *Statistical analyses*

All analyses were stratified by age group to provide estimates for 4–11 year olds and 12–17 year olds. These age groups correspond to educational level, as most Australian and territories students enter secondary school at 12 years of age. We first examined which of the child health and development, family and school variables were associated with hearing problems in children. We then estimated the prevalence of DISC-IV mental health disorders and SDQ problems for children and young people with and without hearing problems, along with unadjusted odds ratios using univariate logistic regression. Multivariate logistic regression models were estimated to determine the odds of children and young people having each disorder. In total, four logistic regression models were estimated for each DISC-IV and SDQ problem, each one building further on the previous model. The first model provided unadjusted odds ratios. The second model then adjusted for the child health and development factors, the third model also included the family socio-demographic factors and the fourth model then adjusted further for the school factors.

All survey data were weighted to represent the full population of 4–17 year olds and to adjust for patterns in non-response. We used the SAS SURVEYLOGISTIC procedure to account for the clustered nature of the sample design (statistical areas) [40]. Throughout all tables, estimates with bold type represent odds ratios that were significant at  $p < .05$ , and 95% confidence intervals of estimates are also provided.

### **Results**

Table 1 provides the proportion of children and young people (aged 4–17 years) with hearing problems, by selected characteristics. All p-values reported refer to Rao-Scott chi-square values. Child health factors were substantially more common among children and young people with hearing problems than those without, including speech and language problems (27.8% vs 6.4%), intellectual disability (9.4% vs 1.4%) and otitis media (25.1% vs

Table 1. Proportion of children and young people with given characteristic, by presence of hearing problem in previous 12 months.

	No hearing problem		Hearing problem		Chi-square test	
	%	95% CI	%	95% CI	$\chi^2$	<i>p</i>
<b>Child Factors</b>						
Speech/language problems	6.4	5.7-7.2	27.8	20.2-35.3	87.3	<.001
Intellectual Disability	1.4	1.0-1.7	9.4	4.4-14.5	822.4	<.001
Otitis Media	2.9	2.4-3.4	25.1	17.4-32.7	182.5	<.001
Autism	3.4	2.9-4.0	9.8	4.7-15.0	14.8	<.001
Child global health						
Excellent	52.2	50.8-53.6	25.3	17.8-32.8	47.2	<.001
Very good	30.8	29.5-32.1	40.7	31.7-49.6		
Good	13.2	12.3-14.2	22.2	14.8-29.6		
Fair or poor	3.8	3.2-4.3	11.9	6.1-17.6		
Male	51.2	49.8-52.5	57.9	49.4-66.4	2.4	.125
Age group						
4–11 years	57.3	55.8-58.7	68.7	60.7-76.8	6.8	.009
12–17 years	42.7	41.3-44.2	31.3	23.2-39.3		
<b>Family Factors</b>						
Sole parent family	19.8	18.4-21.2	24.7	17.1-32.2	1.9	.171
Household Income						
\$130,000 or more	25.6	23.7-27.5	19.0	12.1-25.9	9.4	.024
\$52,000 – \$129,000	43.9	42.3-45.4	39.2	30.5-47.8		
<\$52,000	26.4	24.5-28.3	37.7	28.9-46.5		
Not stated	4.1	3.5-4.7	4.1	1.0-7.2		
Highest Parent Education						
Bachelor degree+	41.2	38.9-43.4	26.3	18.8-33.8	18.4	<.001
Diploma or Cert. III/IV	38.6	36.9-40.3	43.0	34.6-51.4		
Year 11 or 12	12.4	11.4-13.5	22.8	15.5-30.2		
Year 10 or below	7.8	6.8-8.8	7.9	3.1-12.7		
Does not have one parent employed	11.8	10.5-13.2	18.2	11.2-25.3	4.7	.030
Lives in major city	64.3	59.7-68.9	54.7	45.1-64.2	5.4	.020
Primary carer psych. distress						
Low	70.7	69.2-72.1	56.3	47.7-64.8	14.5	<.001
Moderate	18.1	17.0-19.2	24.1	16.9-31.3		
High or very high	11.2	10.2-12.2	19.6	13.0-26.2		
Financial strains	25.4	23.7-27.1	43.2	32.4-52.0	22.1	<.001
Primary carer is current smoker	19.5	18.0-20.9	29.3	21.1-37.4	7.3	.026
<b>School Factors</b>						
Child is bullied	31.4	29.9-32.9	42.5	34.0-51.0	7.4	.007
Child dislikes school	13.9	12.9-14.9	19.6	12.9-26.3	3.5	.061
Child has 10%+ absence rate	10.4	9.5-11.4	17.5	11.2-23.9	7.5	.006

2.9%) all with  $p < .001$ . Only 25.3% of children with hearing problems were reported to have excellent health, compared with 52.2% for those without hearing problems ( $p < .001$ ). A higher proportion of children with hearing loss were in lower income households (37.7% vs 26.4%,  $p < .024$ ), in families experiencing financial strain (43.2% vs 25.4%,  $p < .001$ ), and had a primary carer who was a current smoker (29.3% vs 19.5%,  $p = .026$ ) or who had high or very high psychological distress (19.6% vs 11.2%,  $p < .001$ ) than those without hearing loss. The proportion of children and young people reported as having been bullied was higher for those with hearing problems (42.5% vs 31.4%,  $p = .007$ ), and they also had a higher prevalence of chronic school absence (17.5% vs 10.4%,  $p = .006$ ). Nearly 20% of children and young people with a hearing problem were reported to dislike school, compared to only 13.9% for those without hearing problems ( $p = .061$ ).

Table 2 shows the proportions and unadjusted odds ratios of children aged 4–11 years with and without hearing problems who met the DISC-IV criteria for each mental health problem, and the abnormal criterion of the SDQ. Overall, 30% of 4–11 year olds met criteria for at least one of the DISC-IV mental disorders. In unadjusted models, hearing problems were significantly associated with increased odds for separation anxiety (OR = 3.3, 95% CI = 1.7–6.4), generalised anxiety (OR = 2.9, 95% CI = 1.1–7.9), and ADHD (OR = 2.7, 95% CI = 1.5–4.7). For the SDQ subscales, the odds of peer problems (OR = 2.3, 95% CI = 1.5–4.3), emotional problems (OR = 2.1, 95% CI 1.2–3.6), hyperactivity problems (OR = 2.7, 95% CI = 1.7–4.4) or total problems (OR = 2.5, 95% CI = 2.5–4.3) were over twice as high for children with hearing problems than those without. Conduct problems were not significantly associated with hearing problems.

These odds ratios for children aged 4–11 years were then adjusted for the child health factors. After adjusting for these variables, there were no longer any significant associations between hearing problems and any of the DISC-IV disorders SDQ problems. As none of the

Table 2. Proportion of children aged 4–11 years with DISC-IV disorder or SDQ problem, by hearing problem, along with unadjusted odds ratios (UOR) and adjusted odds ratios (AOR).

	Hearing Problem		Logistic Regression Models			
	No (n=3,242)	Yes (n=92)	Hearing Problem only (unadjusted)		With child health factors	
	% with disorder	% with disorder	UOR	95% CI	AOR	95% CI
<b>DISC-IV Disorder</b>						
Social Phobia	1.5	2.3	1.5	0.4–5.2	0.9	0.2–3.6
Separation Anxiety	4.6	13.9	<b>3.3</b>	1.7–6.4	1.9	0.9–3.8
Generalised Anxiety	1.6	4.4	<b>2.9</b>	1.1–7.9	1.7	0.6–4.9
OCD	0.8	1.7	2.2	0.5–9.6	1.5	0.3–8.3
MDD	1.1	1.4	1.3	0.3–5.8	0.7	0.2–3.3
Any Anxiety	6.6	15.3	<b>2.5</b>	1.4–4.7	1.4	0.7–2.7
ADHD	7.9	18.7	<b>2.7</b>	1.5–4.7	1.6	0.7–3.4
Conduct Disorder	2.0	4.3	2.2	0.7–7.3	1.2	0.3–5.4
ODD	4.9	8.9	1.9	0.9–4.1		
Any Behavioural	8.9	20.5	<b>2.7</b>	1.5–4.6	1.5	0.7–3.3
Any Disorder	13.1	29.9	<b>2.8</b>	1.7–4.6	1.5	0.8–2.9
<b>SDQ Problem</b>						
Total score	9.5	20.9	<b>2.5</b>	1.5–4.3	1.2	0.6–2.4
Peer problems	10.8	21.8	<b>2.3</b>	1.3–4.0	1.5	0.8–2.7
Emotional problems	10.8	20.1	<b>2.1</b>	1.2–3.6	1.1	0.6–2.1
Hyperactivity problems	14.2	31.2	<b>2.7</b>	1.7–4.4	1.3	0.8–2.2
Conduct problems	10.9	16.2	1.6	0.9–2.9	1.0	0.5–2.0

1. Bolded estimates represent odds ratios that are significant at  $p < .05$ .
2. Each line represents estimates from a separate model estimating the odds of each disorder, these estimates are not independent.

Table 3: Proportion of young people aged 12–17 years with DISC-IV disorder or SDQ problem, by hearing problem, along with unadjusted odds ratios (UOR) and adjusted odds ratios (AOR).

	Hearing Problem		Logistic Regression Models							
	No (n=2,921)	Yes (n = 55)	Hearing Problem only (unadjusted)		+ Child factors		+Child, family factors		+ Child, family, social factors	
	% with disorder	% with disorder	UOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI
<b>DISC-IV Disorder</b>										
Social Phobia	3.1	16.3	<b>6.0</b>	2.6–13.8	<b>3.3</b>	1.3–8.5	<b>2.7</b>	1.1–6.8	<b>3.0</b>	1.2–7.6
Separation Anxiety	3.2	18.4	<b>6.9</b>	2.7–17.9	<b>3.3</b>	1.1–9.9	2.9	0.9–8.6	2.1	0.8–5.6
Generalised Anxiety	2.6	16.3	<b>7.2</b>	3.1–16.6	<b>3.8</b>	1.3–10.6	<b>3.2</b>	1.2–8.7	<b>4.0</b>	1.5–10.6
OCD	0.7	8.1	<b>12.5</b>	3.6–43.7	<b>4.8</b>	1.3–18.0	3.8	0.8–18.0	1.5	0.2–9.1
MDD	4.9	12.4	<b>2.7</b>	1.1–6.6	1.9	0.8–4.5	1.5	0.6–3.8	1.6	0.7–4.0
Any Anxiety Disorder	6.7	25.1	<b>4.7</b>	2.1–10.3	<b>2.6</b>	1.1–6.3	<b>2.2</b>	1.0–5.0	1.9	0.9–4.2
ADHD	6.0	21.2	<b>4.2</b>	2.0–8.6	1.5	0.6–3.6	1.2	0.5–3.0	1.2	0.4–3.4
Conduct Disorder	2.0	9.3	<b>5.0</b>	1.6–15.3	2.0	0.6–6.1	1.3	0.5–3.7	1.4	0.4–4.1
Any Behavioural Disorder	7.2	22.5	<b>3.7</b>	1.9–7.5	1.4	0.6–3.3	1.0	0.4–2.4	1.0	0.4–2.7
Any DISC Disorder	14.0	38.8	<b>3.9</b>	2.1–7.3	<b>2.1</b>	1.0–4.3	1.6	0.8–3.3	1.3	0.6–2.9
<b>SDQ Problem</b>										
Total score	9.9	34.0	<b>4.7</b>	2.5–8.7	<b>2.1</b>	1.0–4.3	1.6	0.7–3.4	1.5	0.6–3.7
Peer problems	14.4	45.3	<b>4.9</b>	2.6–9.2	<b>2.9</b>	1.5–5.5	<b>2.6</b>	1.4–4.8	<b>2.3</b>	1.1–4.7
Emotional problems	15.8	50.7	<b>5.5</b>	3.0–9.8	<b>3.6</b>	1.9–6.9	<b>3.2</b>	1.6–6.4	<b>3.2</b>	1.6–6.5
Hyperactivity problems	10.5	26.8	<b>3.1</b>	1.6–5.9	1.5	0.8–2.9	1.2	0.6–2.3	1.2	0.5–2.5
Conduct problems	9.4	29.1	<b>3.9</b>	2.1–7.6	<b>2.2</b>	1.0–4.6	1.8	0.9–3.8	1.8	0.8–4.1

1. Estimates in bold type represent odds ratios that are significant at  $p < .05$ .
2. Child factors include gender, child intellectual disability, child speech/language problems, child ASD, otitis media or glue ear in previous 12 months, and global health rating.
3. Family factors includes highest parent education, equivalised household income, parent employment, parent psychological distress, family financial difficulties, primary carer smoking status.
4. Social factors include if young person has been bullied, absence from school and if the young person dislikes school.

odds ratios were statistically significant, no further adjustments or additional covariates were examined further for the 4–11 year olds.

Table 3 provides the same analysis but for 12–17 year olds. For this age group, the prevalence of all DISC-IV problems and SDQ problems was substantially higher for young people with hearing problems, with 38.5% meeting criteria for a DISC-IV disorder, compared to 14% for young people without a hearing problem. In unadjusted models, the odds of social phobia, separation anxiety or generalised anxiety were six to seven times higher for young people with hearing problems. The odds of OCD were 12.5 times higher (95% CI 3.6-43.7) for young people with hearing problems, the odds of major depressive disorder were 2.7 times higher (95% CI 1.1-6.6), ADHD 4.2 times higher (95% CI 2.0-8.6), and conduct disorder five times higher (95% CI 1.6-15.3). For SDQ problem scales, half of the young people with hearing problems also had emotional problems, and 45% had peer problems, approximately five times higher than young people without hearing problems (see Table 3).

After adjusting for child health factors the magnitude of these odds ratios reduced by approximately one-third to one-half. Major depressive disorder and behavioural disorders were no longer associated with hearing problems, and neither was hyperactivity from the SDQ scale. Further adjustment for family factors saw these odds ratios lower again, and the odds ratios for separation anxiety, OCD, total SDQ problems and SDQ conduct problems were no longer associated with hearing problems. Final adjustments for school factors resulted in minor additional differences. After adjusting for all child, family and school variables, hearing problems remained associated with increased odds of social phobia (OR = 3.0, 95% CI 1.2–7.6) and generalised anxiety disorder (OR = 4.0, 95% CI 1.5–10.6). Hearing problems among 12–17 year olds were still significantly associated with higher odds of peer problems (OR = 2.3, 95% CI 1.1–4.7) and emotional problems (OR = 3.2, 95% CI 1.6–6.5) on the SDQ.

## Discussion

Previous research has consistently shown that children and young people with hearing problems have a higher risk of mental health problems than the general population, with prevalence estimates ranging from 20% to 50% [5]. These estimates have largely been based on clinical samples of children with severe hearing loss, using broad screeners of mental health problems, without full consideration of the range of child, family or school factors that can also contribute to mental health problems. The current study addressed these limitations by using a nationally-representative survey of 4–17 year olds to estimate the prevalence of mental health problems using a validated diagnostic instrument. The study also included a broad range of contextual variables about the child, their family and social circumstances to enable a better understanding of the links between hearing loss and mental health problems.

Among those with parent-reported hearing problems, 30% of 4–11 year olds and 39% of 12–17 year olds had an anxiety or behavioural disorder, compared to 13% and 14% respectively for children and young people without hearing problems. Even with a broadly defined, parent-rated measure of hearing problems, these estimates are comparable to those reported by previous studies [5], though few have provided estimates by age. For 4–11 year olds, those with a hearing problem were 2–3 times as likely to have separation anxiety, generalised anxiety and ADHD as those without a hearing problem, and similarly 2 to 3 times as likely to have peer, emotional or hyperactivity problems as identified by the SDQ. For 12–17 year olds, those with a hearing problem had substantially higher odds of all mental disorders, including the SDQ problem subscales.

When covariates were included in our models, we found no evidence of higher odds of mental health problems in 4–11 year olds once other child development factors were accounted for. For 12–17 year olds, even after adjusting for child development, and family and school factors, we found that the odds of having social phobia or generalised anxiety



disorder were three and four times higher respectively for young people with a hearing problem. For other disorders, inclusion of other factors attenuated the findings, suggesting that much of the association between hearing loss and mental health problems can be attributed to child development and sociodemographic factors. These include communication problems, as has been highlighted in the literature previously [5, 23], but also other factors such as parent psychological distress, financial strain and parent education level. There is limited research pertaining to why the families of children and young people with hearing problems may be more likely to have financial strain and psychological distress. It may be that parents elect to reduce work commitments in order to care for their child or that some parents experience more psychological distress caring for a child with special needs. Alternatively, families with limited financial resources may not seek appropriate help when health related issues like recurrent ear infections arise, leading to longer term hearing loss.

Beyond these results, the use of broad survey data allowed us to identify a number of factors associated with hearing loss that have not been identified in previous research. Of particular note, primary carers of children and young people with a hearing problem were more likely to report experiences of financial strain and elevated psychological distress. If parents have heightened levels of psychological and/or financial stress associated with caring for a young person with special needs, then this may partly explain the heightened risk of mental health problems among their children. This explanation is supported by our finding that the odds of mental health problems were lower in magnitude after adjusting for family social and demographic factors.

This study also demonstrates that risk of mental health problems for children and young people with a hearing problem changes with age. Among 4–11 year olds, the associations between hearing loss and mental health problems were fully accounted for by child health and development factors such as speech and language problems, intellectual

disability and poor health. For this age group, interventions that focus on the child, their ability to communicate and their health profile would be appropriate. While the child health and development factors explained a large part of the association with mental health among 12–17 year olds, family factors also explained a substantial part of these associations, and school factors to a smaller degree. This pattern suggests that mental health interventions targeted towards young people with hearing problems therefore need to consider the role of the family environment, and how to help the young person respond to stressors they may be experiencing at home as well as at school. Further research is required to determine whether and why hearing loss becomes more strongly implicated in mental health problems over development. It may be that an accumulation of experiences linked to hearing loss may contribute to mental health difficulties over time, only expressing by adolescence. Alternately, there may be critical experiences specific to adolescence deriving from hearing loss that impact mental health. A developmental psychopathological perspective on the role of hearing loss in the onset of mental health problems may be required.

Early detection of childhood hearing loss has been reported to be a predictor of better psychosocial functioning among young children with hearing loss [41]. State-wide newborn hearing screening programs in Australia aimed at early detection of childhood hearing loss were introduced from 2001. As many of the 12–17 year olds in the YMM study were born before 2001, they may not have benefitted from the potential psychosocial benefits of the early identification program. This may be a contributing factor to the higher prevalence of mental health problems among the older age group.

### ***Strengths and limitations***

The key strengths of the present study include the nationally representative sampling method, the detailed characterisation of a range of full-syndrome mental disorders and the range of contextual factors that could be addressed using the YMM data. By controlling for a

wider range of covariates – all of which were associated with whether or not the child had a hearing problem – we found that only 12–17 year olds with hearing problems were at greater risk of anxiety disorders. Therefore it is possible that other studies may have overestimated the association between hearing loss and behavioural problems that can be attributed to hearing loss alone and not to other factors.

The most significant limitation of the study is the characterisation of hearing problems, which is by parent report. The use of parent-report measures is not uncommon for identifying ear and hearing disorders in epidemiological research [42]. Age-appropriate audiometric behavioural or electrophysiological testing is required to accurately quantify the extent of hearing loss. However, as the primary purpose of the YMM survey was to examine the population prevalence estimates of mental health problems among children and young people. As such, detailed data regarding the child’s medical or hearing history were not collected as the equipment and expertise required to conduct these assessments were not available. In such cases, parent-report measures are often recommended [43] and continue to be used to identify broad presentations of hearing problems that may include children and young people with a wide range of severity. For the parent, child or young person, it can be argued that the perception of hearing loss is a valid observation, even without objective testing. We note that despite this limitation, the prevalence of mental health problems among children and young people with hearing loss was broadly consistent with the studies using more detailed characterisations of hearing loss.

By relying on parent-report to identify children and young people with hearing problems, we cannot discern a) the cause of the hearing loss (congenital or acquired, sensorineural or conductive), b) the severity of the hearing loss, or c) the duration of the hearing loss, which in turn may have implications for the results. Some parents may not be able to identify a mild or unilateral hearing loss, particularly among younger children. In such

cases, this would result in an under-representation of children with hearing problems, which in turn could suppress differences between children with and without hearing problems. The survey identified 2.3% of children and adolescents with hearing problems. Comparing this proportion to population prevalence rates of less than 1% for mild to severe sensorineural loss [24], or the research suggesting that of the 2% of children who suffer a perforated tympanic membrane, 90% will also suffer a permanent mild-moderate hearing loss [27], we suggest that children and adolescents with mild-moderate hearing loss were more likely to be included than excluded, and that children with sensorineural or conductive hearing loss were both included in our sample. As previous studies have indicated that psychosocial difficulties are unrelated to the degree of hearing loss [5,6,22] it is unclear that any under- or over-representation of mild hearing loss would have substantial bearing on the results. Similarly, to our knowledge there is no literature that examines variation in the prevalence of mental health problems according to the onset, duration or etiology of hearing loss. Therefore, the implications of the limited parent-report measure are unclear in this respect. Future research that examines the impact of congenital versus acquired hearing loss on mental health problems will be of great interest and will help to target interventions for children.

Finally, over one-quarter of the children and young people with parent-reported hearing loss also had speech and language problems. Communication difficulties have been consistently identified as a key mechanism linking hearing loss and mental health problems [2,6,8,10]. We controlled for speech and language problems in our analyses, and this may be a key reason why there was no association between hearing problems and mental health problems among the 4–11 year olds once we controlled for this factor, among others. To this end, this result is consistent with previous literature. However, an association between hearing and mental health problems among 12–17 year olds was still evident after controlling for these and other family and school factors. These results would suggest that

communication issues are not the only mechanisms linking hearing and mental health problems, and that the mental health of young people with hearing loss should be of concern to clinicians even in the absence of communication difficulties. Some further insight into these relationships may have been apparent had we stratified our results according to the presence of speech and language problems, however, the limited sample of children and young people with hearing problems did not support this analytic approach.

### ***Conclusions***

These findings provide important information for clinicians, parents and teachers as to the psychiatric co-morbidities and contextual factors associated with hearing problems. In pre-adolescent patients, paediatricians may attend to separation anxiety and other internalising problems, and ADHD symptoms. With adolescent patients with hearing loss, social phobia and generalised anxiety disorder may be of particular concern. Understanding these specific mental disorder risks may allow clinicians to intervene more effectively and engage in primary prevention of mental health problems co-morbid to hearing problems.

The results from the present study offer significant new insights into the mental health profile of children and young people with hearing problems. Greater efforts should be taken to identify and improve mental health outcomes for these children and young people, and to investigate potential pathways through which hearing problems confer risk for mental disorders.

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## **Disclosure of interest**

The authors report no conflicts of interest.

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