Middle ear disease in Aboriginal children in Perth: analysis of hearing screening data, 1998–2004

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ABSTRACT

Objective: To describe diagnoses and correlates of middle ear disease in Aboriginal primary school children in a targeted school-testing program in Perth, Western Australia.

Design and setting: Analysis of records of ear testing carried out over a 6-year period in three primary schools in Perth.

Participants: Aboriginal children of primary school age (4–12 years) who attended the schools on the day of testing. Data on middle ear disease and hearing impairment were available for 119 and 94 children, respectively, from their first test.

Main outcome measures: Proportions of children with middle ear disease and hearing loss.

Results: Middle ear disease was diagnosed in 50 children (42.0%; 95% CI, 33.0%–51.4%). Rates were lower in older children ($P = 0.002$) but did not differ according to season of testing. Hearing loss (mild or moderate) was detected in 18 children (19.1%; 95% CI, 11.8%–28.6%). Hearing impairment was also less prevalent in older children ($P = 0.007$) and had no association with season of testing.

Conclusions: Middle ear disease is a significant problem for Aboriginal children in Perth, and is associated with mild–moderate hearing loss. Health authorities must continue to focus on appropriate identification and management of the disease in this population.

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Around 80% of children experience at least one episode of otitis media before 4 years of age.[1] Australian Aboriginal children are more likely than their non-Aboriginal peers to suffer otitis media, to experience the first episode earlier in life, to continue to experience episodes over a longer period of time, and to suffer permanent auricular damage and hearing loss.[2-6] It has been reported that up to 40% of children in some Aboriginal communities present with chronic suppurative otitis media (CSOM).[2] In the Pilbara region of Western Australia, otitis media was found to be present in 25.6% of Aboriginal children up to the age of 10, but in only 3.2% of non-Aboriginal children in the same age range.[3] Another study found that 91% of children in remote communities in northern and central Australia were affected.[4] The disease is common in preschool and early school-aged Aboriginal children[5] and is likely to persist into adolescence.[6]

High rates of otitis media are associated with high rates of hearing loss in the Aboriginal population. Estimates of prevalence vary but are consistently reported to be higher than in the non-Aboriginal population.[7] Otitis media and its accompanying hearing loss are thought to have an impact on the developmental outcomes of Aboriginal children, with particular effects on the development of language and social skills, and ultimately on educational outcomes.[8]

Most of the research into otitis media in Aboriginal populations has reported the situation in rural or remote areas, but some 30% of the Australian Aboriginal population live in major cities.[9] There have been few studies of otitis media in this population.[10]

Here, we present a retrospective report of results of ear testing carried out in Aboriginal children from three primary schools in metropolitan Perth, WA. Both middle ear disease and hearing loss are considered.

METHODS

Ethical considerations

Parent or caregiver permission was obtained before testing. Approval to access patient files and to publish de-identified data was granted by the Princess Margaret Hospital for Children (PMH) Ethics Committee and the Western Australian Aboriginal Health Information and Ethics Committee.

Data collection

Data were collected in three urban primary schools with high Aboriginal enrolments during the period November 1998 – November 2004. The schools were located in areas with high numbers of Aboriginal residents, and had established, positive relationships with Derbarl Yerrigan Aboriginal Medical Service.

At the start of each year, a letter explaining the project and offering hearing screening was sent home with all children whose parents had identified the family as Aboriginal. Only children for whom parent or caregiver permission was obtained were included. Screening visits took place a number of times each year, and most children were tested on more than one occasion. The number of visits to each school in a particular year varied, as did the timing of the visit.

Testing was carried out on the school premises by trained Aboriginal health workers and nurses under an outreach program of PMH and Derbarl Yerrigan Aboriginal Medical Service. Ear health of participating children was screened using otoscopic examination, pure tone audiometry at 1000 and 4000 Hz, tympanometry and acoustic reflectometry. Treatment was prescribed by one of us (HLC), and children who showed evidence of middle ear disease were prioritised for follow-up at subsequent visits to the school. Data were recorded and stored in patient files at PMH.

The records of testing held at PMH were accessed by one of us (CJW) and recorded in a single database. Results for the left and right ears were recorded separately. Middle ear disease was determined separately for each ear using the diagnostic categories defined in Box 1. Hearing impairment was determined using World Health Organization criteria (Box 2).[11]

Statistical analysis

Data from each child's first assessment visit were used to determine the percentage of children with middle ear disease and hearing impairment. Exact binomial confidence limits (95%) were calculated for all percentages. Variation in percentages by age and season was assessed using univariate exact logistic regression models. Results are reported as percentages and 95% confidence intervals. All statistical analyses were performed using Stata, version 10.0 (StataCorp, College Station, Tex, USA).

RESULTS

Sample characteristics

An estimated 80% of Aboriginal children at the three schools participated. The informa-

1 Diagnostic categories of middle ear disease

Label	Description	Diagnostic details
WNL	Within normal limits	Type A tympanogram, average threshold 25 dB or less
ETD	Appearance suggestive of eustachian tube dysfunction	Type C, As, Ac or Ad tympanogram. On examination, the ear drum appears retracted or dull or shows increased or decreased mobility
OME	Otitis media with effusion	Type B tympanogram (low volume)
CSOM	Chronic suppurative otitis media	Type B tympanogram, perforation of the tympanic membrane (high volume)

2 Hearing impairment criteria[11]

Label	Two-frequency average
Pass (hearing within normal range)	25 dB or less
Mild hearing loss	26–40 dB
Moderate hearing loss	41–60 dB
Severe hearing loss	61–80 dB
Profound hearing loss	81 dB or greater

tion needed to diagnose unilateral and bilateral middle ear disease was available from the first visit for 119 children, and 94 children could be classified in terms of unilateral, bilateral or no hearing impairment.

Median age for the 119 children with data relevant to the analysis of middle ear disease at first visit was 8.5 years (interquartile range [IQR], 6.4–10.5 years). For the 94 children who contributed hearing loss data, median age at first visit was 8.5 years (IQR, 6.8–10.6 years).

Middle ear disease

Middle ear disease (defined as appearance suggestive of eustachian tube dysfunction [ETD], otitis media with effusion [OME], or CSOM, in one or both ears) was diagnosed in 50/119 children (42.0%; 95% CI, 33.0%–51.4%). Bilateral middle ear disease was evident in 29 children (24.4%; 95% CI, 17.0%–33.1%) and unilateral disease in 21 (17.6%; 95% CI, 11.3%–25.7%). Excluding ETD from the definition reduced the number of children with middle ear disease to 23 (19.3%; 95% CI, 12.7%–27.6%), of whom 14 had bilateral disease (11.8%; 95% CI, 6.6%–19.0%) and nine had unilateral disease (7.6%; 95% CI, 3.5%–13.9%).

Results for middle ear disease (including ETD) by age and season of testing are given in Box 3. The proportion of children with middle ear disease decreased with increasing age ($P = 0.002$), but there was little evidence to suggest an association with season ($P = 0.52$).

CSOM and OME were also examined separately. Overall, CSOM was diagnosed in 2/119 children (1.7%; 95% CI, 0.2%–5.9%). Both cases of CSOM were instances of unilateral disease. OME was diagnosed in 22/119 children (18.5%; 95% CI, 12.0%–26.6%), 13 of whom had bilateral OME (10.9%; 95% CI, 5.9%–18.0%) and nine had unilateral OME (7.6%; 95% CI, 3.5%–13.9%). There was no evidence of an association between the diagnosis of OME and age ($P = 0.22$) or season ($P = 0.56$) (Box 3).

Hearing impairment

Of the 94 children with hearing data at first visit, 18 (19.1%; 95% CI, 11.8%–28.6%) had some form (unilateral or bilateral) of mild or moderate hearing loss. Mild hearing impairment was detected in 13 children (13.8%; 95% CI, 7.6%–22.5%), with four cases of mild bilateral loss and nine cases of mild unilateral loss. Moderate hearing impairment was detected in five children (5.3%; 95% CI, 1.7%–12.0%), all of whom had unilateral moderate hearing loss, with either mild loss (two) or normal hearing (three) in the other ear.

Results for hearing impairment by age and season of testing are shown in Box 3. The proportion of children with impaired hearing decreased with age ($P = 0.007$), but there was no evidence of an association with season of testing ($P = 0.44$).

DISCUSSION

This study indicates alarming rates of occurrence of middle ear disease in an urban Aboriginal population over a 6-year period. Middle ear disease was evident in just over 40% of children at first screening visit. Although this rate is lower than those reported in many studies in rural and remote areas, where rates of more than 90% have been recorded,[7] it is considerably higher than those reported for non-Aboriginal populations. For example, a study of ear disease in New South Wales indicates the prevalence of acute otitis media in children aged 0–14 years is 7.17%. The same study showed prevalence rates of serous otitis media to be 0.56%.[12]

Our rate is also higher than rates of recurrent ear problems found in the Western Australian Aboriginal Child Health Survey,[10] which used parent report to investigate a range of health conditions in children aged 0–17 years. The study found that recurrent ear infections were more common in areas classified as extremely isolated (22.8%), as were recurrent ear infections with at least one episode of discharge (18.4%). Areas classified as no isolation (Perth metropolitan area) and low isolation had the lowest reported prevalence of both recurrent otitis media (16.9% and

3 Children with middle ear disease and hearing impairment, by age and season of testing

	Middle ear disease ($n = 119$)			Hearing impairment ($n = 94$)	
	Any*		OME		
Predictor variable	No.†	Per cent (95% CI)	Per cent (95% CI)	No.†	Per cent (95% CI)
Age (years)					
4 to < 7	33	66.7 (48.2–82.0)	27.3 (13.3–45.5)	22	40.9 (20.7–63.6)
7 to < 10	47	36.2 (22.7–51.5)	14.9 (6.2–28.3)	37	16.2 (6.2–32.0)
⩾ 10	35	25.7 (12.5–43.3)	11.4 (3.2–26.7)	31	6.4 (0.8–21.4)
Season					
Autumn	37	46.0 (29.5–63.1)	21.6 (9.8–38.2)	19	15.8 (3.4–39.6)
Winter	42	47.6 (32.0–63.6)	19.1 (8.6–34.1)	37	18.9 (8.0–35.2)
Spring	37	32.4 (18.0–49.8)	13.5 (4.5–28.8)	34	17.6 (6.8–34.5)
Summer	3	33.3 (0.8–90.6)	33.3 (0.8–90.6)	4	50.0 (6.8–93.2)

OME = otitis media with effusion. * Appearance suggestive of eustachian tube dysfunction, OME, or chronic suppurative otitis media, in one or both ears. † Numbers of children may not sum to totals because date of birth was not recorded for four children. ◆

17.6%, respectively) and recurrent infections with at least one episode of discharge (11.2% and 11.6%).

Eustachian tube dysfunction is associated with otitis media[13] and was therefore included in our analysis, contributing to the high rate. However, the rate remained unacceptably high (19.3%) when it was removed from calculations. The proportion of children with CSOM (1.7%) was lower than rates reported for remote communities, but exceeded the 1% seen to constitute an avoidable disease burden.[14]

Hearing loss was recorded in over 19% of the children at first testing. As is typical with otitis media,[15] all recorded hearing loss fell into the categories of mild or moderate loss. The highest percentage was recorded for unilateral mild loss.

The data analysed in this study demonstrate the continuing occurrence of middle ear disease and hearing loss in Aboriginal children across the age range sampled. Consistent with findings reported elsewhere, there was a significant reduction in OME with increasing age. However, the proportion of children in the ⩾10-years age group with OME (11.4%) is higher than the 3%–8% reported for non-Aboriginal children after the age of 7 years.[16] We also found a significant difference in the occurrence of hearing loss according to age, with older children less likely than younger children to suffer mild or moderate hearing loss. In the ⩾10-years age group, 6.4% of children were affected, while hearing loss was evident in 40.9% of children in the 4 to <7-years age range — the time at which formal education begins. This finding has significant implications for the educational progress of affected children. Episodes of middle ear disease and associated hearing loss can be expected to have an adverse impact on learning.

In contrast to previous reports,[17,18] we found no significant difference in rates of middle ear disease according to season, indicating a need for year-round vigilance in monitoring its occurrence.

The results of this study may have been influenced by selection bias if parents were more likely to provide screening permission for children known to have middle ear problems. However, we estimate that 80% of Aboriginal children in the schools participated in the study, suggesting that selection bias was not an issue.

This study highlights the problem presented by otitis media in Aboriginal children. Middle ear disease and mild to moderate hearing loss have been shown to affect large numbers of Aboriginal children attending schools in metropolitan Perth. The effects of these factors on the children's learning remain to be demonstrated, but associated adverse outcomes can be predicted. The findings present challenges for health authorities — to reduce the occurrence and expedite the treatment of OME and CSOM — and for educational authorities — to address the learning needs of the affected children.

COMPETING INTERESTS

None identified.

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