

## Childhood hospitalisation for otitis media in Western Australia: A 10-year retrospective analysis

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### RESEARCH

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### ABSTRACT

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#### Background

The aim of this study was to assess the prevalence of hospitalisation for otitis media across the different risk indicators for Western Australian children (less than 15 years old) over a 10-year period.

#### Method

This retrospective population-based study used the de-identified detailed data of children under the age of 15 years, hospitalised for otitis media (OM), as determined by principal diagnosis (ICD-10AM) and obtained from the Western Australian (WA) Hospital Morbidity Dataset for 10 financial years from 1999–2000 to 2008–2009. Various risk indicators, including age, gender, Indigenous status, insurance status, hospital area, hospital type, and length of stay were also analysed.

#### Results

Out of 26,294 cases of in-hospital care, Indigenous children comprised 4.7 per cent (n=1,226), while the non-Indigenous children comprised 95.3 per cent (n=25,068). The majority of the children, nearly 98.8 per cent, were admitted for

chronic OM. The children were grouped into three age groups, namely, 0–4 years, 5–9 years, and 10–14 years. Nearly two-thirds of all cases were in the 0–4-year age group. Significantly more non-Indigenous (51 per cent) than Indigenous children (2 per cent) had private health insurance. The hospitalisation rates were directly proportional between the number of Indigenous children living in the area and the increasing remoteness of the area along with greater socioeconomic disadvantage. There were 24 per cent more cases from very remote areas compared to highly accessible areas, and there were 60 per cent more cases from the most disadvantaged socioeconomic category, compared with the least disadvantaged category, for Indigenous children.

#### Conclusion

These data depict the variations in prevalence of otitis media hospitalisations within the community, as affected by various risk indicators.

#### Key Words

Jaw fractures, hospitalisation, epidemiology, otitis media

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#### What this study adds:

##### 1. What is known about this subject?

In Australia, there is a clear disparity in the prevalence of otitis media in the population, with the major burden of the disease affecting the poor, and in particular Aboriginal and Torres Strait Islander children.

##### 2. What new information is offered in this study?

The rates of admission for non-Indigenous preschool children were almost five times higher than that of Indigenous children, and for the 10–14 year olds, rates for Indigenous children were almost four times higher than that of non-Indigenous children

##### 3. What are the implications for research, policy, or practice?

This has both narrow and wider implications for policy and practice. Narrowly, it's about where are services provided. Widely, it's about societal advancement.

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## Background

Otitis media (OM), also known as middle ear infection, is defined as any inflammation of the middle ear, regardless of the etiology, onset, or pathogenesis.<sup>1</sup> According to the World Health Organization (WHO), middle ear infection or otitis media, is the most common cause of deafness that can be controlled and prevented. It is also one of the most prevalent diseases in young children, bearing significant health and economic impacts, and is aggravated by poverty.<sup>2</sup> It is of particular importance to children as it can impede education, communication, and language development.<sup>3</sup> The early onset of the disease, coupled with prolonged suffering, results in substantial load on the DALY (disability adjusted life years).<sup>4</sup>

In Australia, otitis media is one of the most common diseases of childhood and affects nearly 80 per cent of children by the time they are three years old.<sup>5</sup> In 2008, the estimated number of cases of otitis media in Australia varied between 992,000 and 2,430,000, with a total associated estimated cost of AUD \$100–\$400 million.<sup>6</sup> In Australia, there is a clear disparity in the prevalence of otitis media in the population, with the major burden of the disease affecting the poor, and in particular the Aboriginal and Torres Strait Islander community.<sup>7</sup> To enunciate this dichotomy clearly, our research investigated the prevalence of hospitalisation for the disease across the different risk indicators for Western Australian children (less than 15 years old) over a decade. Our hypothesis is that cases of hospitalisation for otitis media are higher in poorer and more remote communities, as well as Aboriginal and Torres Strait Islander children, compared to the rest of the WA population.

## Method

Ethics approval for this study was granted by the Ethics Committee of the University of Western Australia, reference number RA/4/1/5502.

### WA Hospital Morbidity Dataset

This study used a de-identified dataset (WA Hospital Morbidity Dataset) spanning 10 financial years, from 1999–2000 to 2008–2009, and obtained from the WA Health Department. All children under the age of 15 who were admitted for otitis media, as diagnosed and classified under the ICD-10AM system, were included in this study. This

included those diagnosed and classified according to the following ICD-10AM numbers: acute (H65.0, H65.1 and H66.0), and chronic (H65.2, H65.3, H65.4, H65.9, H66.1, H66.2, H66.3, H66.4 and H66.9).

### Demographics

The age, gender, Indigenous status, insurance status, hospital geography, hospital type, and length of stay data were collected from the database.

### Residential location

The remoteness was classified using the Accessibility and Remoteness Index of Australia (ARIA), which has five categories (based on access along the road network from populated localities to service centres).<sup>8</sup>

### Socioeconomics

The socioeconomic status was analysed using the Socio-Economic Index of Advantage (SEIFA) classification, which was developed by the Australian Bureau of Statistics.<sup>9</sup> This ranks the areas in Australia in accordance to their relative socioeconomic advantage and disadvantage. The indexes were based on information from the five yearly censuses.

Age-specific and age-standardised rates (ASRs) were calculated using the Health Statistics Calculator, a software package developed by the Health Department of WA. The rate calculations used population data (denominators) as obtained from the Australian Bureau of Statistics Census data.<sup>10</sup> All the data were analysed using the SPSS 20 (SPSS, Chicago, IL USA) for Windows software and Microsoft Excel (Version 2010, Microsoft, Redmond USA).

## Results

A total of 26,294 children were admitted to hospitals for otitis media in Western Australia from 1999 to 2008. The majority were non-Indigenous children (95 per cent, n=25,068), while the remaining 5 per cent were Indigenous children (n=1,226). A significantly higher percentage of male than female children were admitted, 60 per cent and 40 per cent, respectively. The majority of the children were admitted due to chronic otitis media (99 per cent), as compared to acute otitis media (1 per cent).

### Age

All cases were categorised into one of the following age groups: 0–4 years (63 per cent), 5–9 years (32 per cent), and 10–14 years (4 per cent). For Indigenous children (Table 1), the distribution across the age groups 0–4 years and 5–9 years remained fairly stable at nearly 45 per cent and 44 per cent, respectively. This then decreases to 12 per cent

among the 10–14-year age group. In the non-Indigenous children, most were aged 0–4 (64 per cent) with 32 per cent aged 5–9 years, and 4 per cent were 10–14 years old (Table 1).

In the pre-school age group (0–4), the rates of admission for non-Indigenous children were almost five times higher than that of Indigenous children (Table 1). It was similar for ages 5–9, and for the 10–14 year olds, rates for Indigenous children were almost four times higher than that of non-Indigenous children (Table 1).

### Hospital geography and type

There was a significant difference between the Indigenous children versus the non-Indigenous child hospitalisations in terms of geography and type of hospital ( $p < 0.001$ ). In the metropolitan hospitals, 3 per cent of all children admitted were Indigenous children, while in the rural hospitals, 15 per cent of all the children admitted were Indigenous children. (Table 1).

Of all the children admitted to public hospitals, nearly 11 per cent ( $n=1,196$ ) were Indigenous children and 89 per cent ( $n=9,655$ ) were non-Indigenous. On the other hand, the children admitted to private hospitals consisted nearly entirely of non-Indigenous children at 99.8 per cent. Almost all the Indigenous children (hospitalised for otitis media) were admitted to public hospitals (98 per cent), and in the non-Indigenous children, the majority were admitted in private hospitals at 62 per cent.

### Same-day discharge

Indigenous children (15.3 per cent,  $n=188$ ) were significantly less likely to be discharged on the same day as non-Indigenous children (3.7 per cent,  $n=939$ ) ( $p < 0.001$ ).

### Insurance status

About one-half (51 per cent) of all the non-Indigenous children did have private insurance, compared to only 2 per cent among the Indigenous children ( $p < 0.001$ ) (Table 1).

### Location of residency (ARIA)

The proportion of Indigenous children hospitalised, increases as accessibility decreases (as per ARIA classification), with the largest proportion in the most remote areas (Figure 1). The opposite applies to non-Indigenous children, with highest proportions admitted in metropolitan areas (Figure 1).

### Socioeconomics (SEIFA)

There was a significant difference between the Indigenous and non-Indigenous children living in various SEIFA classified areas ( $p < 0.001$ ). In the most disadvantaged group, 16 per cent of all children admitted for otitis media were Indigenous. In the least disadvantaged area, almost the entire group consisted of non-Indigenous children (99.2 per cent) (Figure 2).

### Discussion

A total of 26,294 children were admitted to hospitals for otitis media in Western Australia from 1999 to 2008, with 5 per cent Indigenous children and 95 per cent non-Indigenous children, respectively. This is a slight overrepresentation of the Indigenous children, as the Aboriginal and Torres Strait Islander population of Western Australia (WA) in 2006 was estimated at 3.8 per cent of the total WA population.<sup>10</sup> There were significantly higher numbers of male children admitted than female children, and this corresponds with previous studies which showed increased prevalence among male children.<sup>5,11</sup>

Children were divided into three categories according to age: the 0–4-year age group, where there can be a difference in the practice of breastfeeding and daycare centre use,<sup>12</sup> 5–9 years, where the children are again exposed to a new environment when they start school,<sup>13</sup> and the 10–14-year age group, which shows the lifetime representation up until that point in time.<sup>14</sup>

There were significantly different admission rates between Indigenous and non-Indigenous children across the different age groups. This dissimilarity in the admission rates of Indigenous and non-Indigenous children could be a reflection of inadequate access to medical care of Indigenous children due to rural living and poverty.<sup>7,15,16</sup> Indigenous children are also more likely to be uninsured and may only have access to the public health sector, which can have long wait times.<sup>16</sup> These factors prolong the burden of the disease, and the majority of the Indigenous children are affected up to age 10 or older. The non-Indigenous children, most of which have better access to health services, are admitted and treated.<sup>17</sup> This explains the highest rates in the 0–4-year age group, and as they get treated the rates reduce subsequently in the following age groups. The burden of otitis media on the Indigenous population continues to increase and rise due to the aforementioned factors. It has been documented that Indigenous children have a high prevalence of otitis media until adolescence.<sup>18</sup> A similar pattern was found in our study.

The significant difference in the insurance status between

Indigenous and non-Indigenous children in the study can be explained on the basis of the socioeconomic backgrounds of the respective groups. The healthcare system in Australia comprises a public and private sector.<sup>17</sup> The public sector is financed by the government, whereas the private sector is mainly out-of-pocket payments and private health insurance. It is well documented that greater proportions of the Indigenous population come from lower socioeconomic groups<sup>15</sup> with lower incomes and higher unemployment levels, and thus less access to private health insurance, and subsequent reliance on the public health care system.

Indigenous children in this study were hospitalised, on average, for longer periods than non-Indigenous children. The longer length of stay for the Indigenous children may be due to the increased severity of the disease coupled with remoteness of the residential locations.

Indigenous children were equally admitted to hospitals in the rural and metropolitan areas, but most non-Indigenous children were admitted to metropolitan hospitals. This distribution was expected as more than two-thirds (69 per cent) of the Australian population lives in major cities while only 2.3 per cent live in remote or very remote areas.<sup>19</sup> The easier access to health care, presence of specialists, and the location of major hospitals in the metropolitan area are also responsible for the majority of the participants in this study being admitted in hospitals in the metropolitan area.

Remote and very remote areas are associated with poor accessibility to many services.<sup>20</sup> There was a clear difference in the socioeconomic status between the Indigenous and non-Indigenous children admitted to hospital for otitis media. In 2011 the average disposable income for an Aboriginal and Torres Strait Islander was only 70 per cent of average non-Indigenous Australians.<sup>15</sup>

This study highlighted the difference between Indigenous and non-Indigenous children in the proportions of 10–14-year-olds hospitalised for otitis media. In the non-Indigenous children, the condition is well stabilised and controlled by this age, whereas in Indigenous children, higher numbers of children are exposed to prolonged suffering from the disease. The higher rates of otitis media hospitalisations among the 10–14-year-old Indigenous children can be the result of various factors, including lower socioeconomic status, lack of insurance, overcrowding, and poor accessibility to health services with prolonged wait times, which increases the severity of the disease. The various programs implemented, increased awareness, better accessibility, and purchase of private health

insurance all add up in reducing hospitalisation rates.

## Conclusion

The findings in this study solidifies the effects of various risk indicators. A lack of insurance coverage, poor accessibility, use of public hospitals, low socioeconomic status, and poor living conditions with overcrowded homes, all show the negative effect—namely, most likely increased the prevalence of otitis media—in this study. The findings indicate disparities in treatment access between Indigenous and non-Indigenous children, with Indigenous children clearly having delayed access and treatment at much later ages. Infants with OM and persistent middle ear effusion are at risk for behavioural problems and problems with development of speech, language, and cognitive abilities. Untreated otitis media may lead to persistent perforation of the tympanic membrane and permanent conductive hearing loss.<sup>1–4</sup> These consequences emphasise the importance of timely access to treatment for especially Indigenous, poor and rural-living children to resolve otitis media and reduce its debilitating effects on health, learning, and social interaction.

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## References

1. Alaki SM, Burt BA, Garetz SL. Middle ear and respiratory infections in early childhood and their association with early childhood caries. *Pediatric Dentistry*. 2008;30(2):105–10.
2. Cripps AW, Otczyke DC, Kyd JM. Bacterial otitis media: a vaccine preventable disease. *Vaccine*. 2005;23(17-18):2304–10.
3. Acuin J. Chronic suppurative otitis media—Burden of Illness and Management Options, Geneva: World Health Organization; 2004. 84 p.
4. Monasta L, Ronfani L, Marchetti F, et al. Burden of disease caused by otitis media: systematic review and global estimates. *PloS One*. 2012;7(4):e36226.
5. Teele DW, Klein JO, Rosner B. Epidemiology of otitis media during the first seven years of life in children in greater Boston: a prospective, cohort study. *The Journal of Infectious Diseases*. 1989;160(1):83–94.
6. Kelvin K, Harvey LC, Coates, HL. Natural history, definitions, risk factors and burden of otitis media. *Medical Journal of Australia*. 2009;191(9):S39–43.
7. Coates HL, Morris PS, Leach AJ, et al. Otitis media in Aboriginal children: tackling a major health problem. *Medical Journal of Australia*. 2002;177(4):177–8.
8. Australian Population and Migration Research Centre. “Accessibility/Remoteness Index of Australia (ARIA)”. 2013. [accessed 2015 JUN 15]. Available from: <http://www.adelaide.edu.au/apmrc/research/projects/>

category/about\_aria.html

9. Australian Bureau of Statistics. "2033.0.55.001 -Census of Population and Housing: Socio-Economic Indexes for Areas (SEIFA), Australia, 2011". 2013. [accessed 2016 APR 8]. Available from: <http://www.abs.gov.au/ausstats/abs@.nsf/mf/2033.0.55.001/>
10. Australian Bureau of Statistics. "4705.0 - Population Distribution, Aboriginal and Torres Strait Islander Australians, 2006". 2006. [accessed 2015 JUN 15]. Available from: <http://www.abs.gov.au/ausstats/abs@.nsf/mf/4705.0>
11. MacIntyre EA, Karr CJ, Koehoorn M, et al. Otitis media incidence and risk factors in a population-based birth cohort. *Pediatric Child Health*. 2010;15(7):437–42.
12. Greenberg D, Hoffman S, Leibovitz E, et al. Acute Otitis Media in Children: Association with Day Care Centers -- Antibacterial Resistance, Treatment, and Prevention. *Paediatric Drugs*. 2008;10(2):75–83.
13. Daly KA, Giebink GS. Clinical epidemiology of otitis media, *The Paediatric Infectious Disease Journal*. 2000;19(5 Suppl):S31–36.
14. Cohen S. Social Status and Susceptibility to Respiratory Infections. *Annals of the New York Academy of Sciences*. 1999;896(1):246–53.
15. Biddle N. "CAEPR Indigenous Population Project, 2011 Census Papers". 2011. Paper 11, Income. ANU, Canberra.
16. Turrell G, Mathers CD. Socioeconomic status and health in Australia. *Medical Journal of Australia*. 2000;172(9):434–8.
17. Doorslaer EV, Clarke P, Savage E, et al. Horizontal inequities in Australia's mixed public/private health care system. *Health Policy*. 2008;86(1):97–108.
18. Morris PS, Leach AJ, Silberberg P, et al. Otitis media in young Aboriginal children from remote communities in Northern and Central Australia: a cross-sectional survey. *BMC Paediatrics*. 2005;5(1):27–36.
19. Australian Bureau of Statistics. "Estimated Resident Population statistics are based on 2006 Census data, updated to take account of births, deaths, international and interstate migration". 2010. [accessed 2015 MAY 24]. Available from: <http://tinyurl.com/jboglr7>
20. Australian Institute of Family Studies. "Australian Institute of Family Studies". 2011. [accessed 2015 JUL 22]. Available from: <http://www.aifs.gov.au/institute/pubs/factsheets/2011/fs201103.html#ftn3>

## PEER REVIEW

Not commissioned. Externally peer reviewed.

## CONFLICTS OF INTEREST

The authors declare that they have no competing interests.

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## ETHICS COMMITTEE APPROVAL

The University of Western Australia, Human Ethics Committee. Reference number RA/4/1/5502.

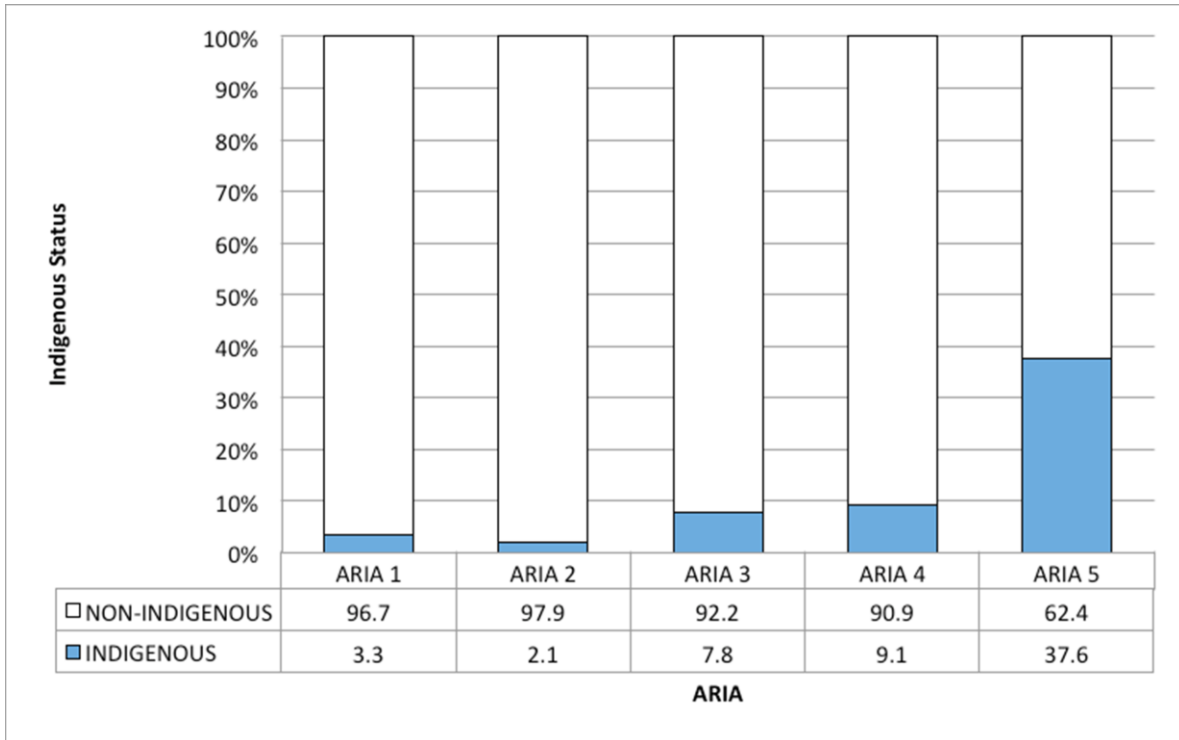
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NIL

**Table 1: Hospitalisation of WA children for otitis media across different variables**

Variables	Otitis Media	
	Indigenous	Non-Indigenous
All children (ASR)	471.3	666.9
0-4 Years	645.9	1328.2
5-9 Years	603.7	637.8
10-14 Years	173.7	69.2
<b>Age % (N)</b>		
0-4 Years	44.8% (549)	64.1% (16,071)
5-9 Years	43.4% (532)	32.2% (8,075)
10-14 Years	11.8% (145)	3.7% (922)
<b>Gender % (N)</b>		
Male	57.3% (703)	60.5% (15,164)
Female	42.7% (523)	39.5% (9,904)
<b>SEIFA* % (N)</b>		
Most disadvantage	64.6% (791)	16.1% (4,032)
Below average disadvantage	16.9% (207)	19.4% (4,871)
Average disadvantage	8.2% (101)	18.5% (4,647)
Above average disadvantage	6.2% (76)	21.2% (5,300)
Least disadvantage	4.1% (50)	24.8% (6,202)
<b>ARIA* % (N)</b>		
1 Highly accessible	14.1% (172)	20.5% (5,112)
2 Accessible	28.8% (351)	65.8% (16,441)
3 Moderately accessible	13.1% (160)	7.6% (1,902)
4 Remote	6.3% (77)	3.1% (768)
5 Very remote	37.6% (458)	3% (761)
<b>Same day separation % (N)</b>		
Yes	84.7% (1,038)	96.3% (24,129)
No	15.3% (188)	3.7% (939)
<b>Insurance status* % (N)</b>		
Insured	1.7% (21)	51.1% (12,823)
Uninsured	98.3% (1,205)	48.9% (12,245)
<b>Hospital geography** % (N)</b>		
Metropolitan	51.8% (635)	87% (21,799)
Rural	48.2% (591)	13% (3,269)
<b>Hospital type* % (N)</b>		
Public	97.6% (1,196)	38.5% (9,965)
Private	2.4% (30)	61.5% (15,413)
ASR (age-standardised rate per 100,000 people).		
* $p < 0.001$ , Pearson chi-square. ** $p < 0.05$ , Pearson chi-square.		

**Figure 1: Percentage of children hospitalised due to otitis media in Western Australia based on ARIA and Indigenous status from 1999–2000 to 2008–2009**



**Figure 2: Percentage of children hospitalised due to Otitis Media in Western Australia based on SEIFA and Indigenous status from 1999–2000 to 2008–2009**

