Ethnic differences in acute hospitalisations for otitis media and elective hospitalisations for ventilation tubes in New Zealand children aged 0–14 years

Justine McCallum, Liz Craig, Ian Whittaker, Joanne Baxter

ABSTRACT

AIMS: This paper describes ethnic differences in acute hospitalisations for otitis media (OM) and elective hospitalisations for ventilation tube insertion in New Zealand children aged 0–14 years. Ethnic differences in first attendances at Ear Nose and Throat (ENT) outpatient clinics are also described.

METHOD: The analysis included all hospital admissions of children aged 0–14 years during 2002–2008 which met the following criteria: Acute admissions with an ICD–10-AM primary diagnosis code of otitis media; and elective admissions with a primary procedure code of ventilation tube insertion. First attendances at ENT outpatient clinics during 2007–2008 were also reviewed. Explanatory variables included ethnicity, gender, age, and NZ Deprivation Index decile.

RESULTS: Among 0–4 year olds, Māori and Pacific children were more likely to be admitted acutely for otitis media than European children. In contrast, both Māori and Pacific children had lower rates of elective admissions for ventilation tube insertion, with ethnic differences being most marked for children from the most deprived areas. Māori and Pacific children aged 5–14 years also had higher acute otitis media admission rates than European children. In contrast to their younger counterparts however, they also had higher rates of ventilation tube insertion.

Exploration of ENT outpatient data for children 0–4 years revealed similar first appointment rates for European and Māori children, but lower rates for Pacific and Asian children. For the 5–14 age group, first appointment rates were higher for Māori and Pacific children than for European children. However, Māori and Pacific children in both age groups had higher rates of non-attendance at their first ENT appointments than European children.

CONCLUSION: This study highlights ethnic differences in access to ventilation tubes amongst New Zealand's 0–4 year olds, with the greatest inequalities being seen for Māori, Pacific and Asian children living in the most deprived areas. For Māori and Pacific children, such differences cannot be attributed to lower rates of AOM or OME compared to European children. The fact that similar patterns are not seen for children aged 5–14 years potentially suggests that routine Well Child hearing screening may be playing a role in identifying unmet need in this older age group.

Such disparities also suggest that factors over and above OM prevalence may be influencing access to ventilation tubes. Further research is required to determine why Māori and Pacific children (0–4 years) have similar/lower ENT appointment rates than European children, despite a higher burden of middle ear disease, as well as higher non-attendance rates at outpatient clinics.

Given the importance of early detection and treatment of OM for children's ongoing well-being and education, a greater understanding of the reasons for these inequalities is urgently required.

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Introduction

By the age of 3 years the majority of children (~80%) will have had one episode of acute otitis media (AOM).[1] Approximately 10–30 % will have a further episode,[2] and up to 25% will develop persistent otitis media with effusion (OME) following AOM. A common treatment of recurrent AOM and persistent OME is the insertion of ventilation tubes, more commonly referred to as grommets. Ventilation tubes decrease the number of episodes of AOM[3] and can improve hearing at 6 and 12 months after insertion.[4]

In New Zealand the general practitioner (GP) is the main source of referral to specialist services including the Ear, Nose and Throat clinic (ENT) for consideration for ventilation tubes. A child can be referred to the GP and subsequently the ENT clinic through a number of mechanisms. Prior to 2008, Well Child services included a specific hearing screening program which aimed to identify children failing tympanometry at 3 years of age or screening audiometry at school entry (5 years of age).[5] This was replaced by the B4 School Check in 2008, which now comprises audiometry, followed by tympanometry (if necessary) at age 4, as part of the Well Child Tamariki Ora Programme.[6] Children can also be referred to GPs by Well Child Providers who identify hearing concerns during routine checks, with children also presenting to GPs as a result of parental concerns, or more recently, newborn hearing screening.[7,8] Following GP assessment, a child may be referred to an otolaryngologist, with the otolaryngologist then determining whether the insertion of ventilation tubes is necessary.

The New Zealand Hearing and Screening Vision Report 2005–2006,[5] which reports on data from the earlier hearing screening programme described above, found that a higher proportion of Pacific and Māori children failed tympanometry screening for OME at 3 years, than did European/Pākehā children. Pacific and Māori children also had higher audiometry and/or tympanometry failure rates at school entry than European/Pākehā children.

Similarly, the New Zealand Child and Youth Epidemiology Service (NZCYES) found in 2008 that although Māori and Pacific children aged 0–4 years had higher acute hospital admission rates for OM than European children, they paradoxically had lower elective admission rates for the insertion of ventilation tubes.[9] This paradox raises important questions regarding the nature of and mechanisms leading to such disparities. At face value, they suggest that pre-school aged Māori and Pacific children have higher levels of need, yet may receive lower levels of treatment.

This study investigates ethnic differences in acute hospital admissions for OM and elective admissions for ventilation tubes in New Zealand children. It also explores access to first ENT Outpatient appointments by ethnicity, as ENT Outpatient appointments are one of the key steps on the pathway leading to ventilation tube insertion for New Zealand children.

Method

This study has two parts. The first comprises an analysis of acute hospital admissions for otitis media and elective admissions for ventilation tubes in children aged 0–14 years. The second explores first outpatient appointments and attendances at ENT clinics in the same age group.

Hospitalisation data from the National Minimum Dataset (NMDS) was used to calculate acute admission rates for otitis media and elective admission rates for ventilation tubes. The NMDS dataset contains mainly publicly funded hospital admissions, as privately funded private hospital data is incomplete.

The analysis included all hospital admissions of children aged 0–14 years during 2002–2008 which met the following criteria:

1. Acute admissions for otitis media included all unplanned admissions (admitted on the day of presentation) with an ICD10-AM primary diagnosis code of H65, H66 or H67 (Otitis Media).
2. Elective admissions for ventilation tubes included all Arranged (admission less than seven days after a specialist decision) and Waiting List (admission seven or more days after specialist decision) admissions with an Australian Classification of Health Interventions (ACHI)

primary procedure code of 4163200 or 4163201 (unilateral or bilateral myringotomy with insertion of tube).

All children aged under 15 years were included, with children further being subdivided into two age groups (0–4 years and 5–14 years). These age groups were chosen because they best reflected service delivery configurations: infants and preschool children, covered by Well Child hearing surveillance and screening; and school age children, primarily cared for by GPs.

Analysis by other known risk factors for middle ear disease was also undertaken. Variables included age (known higher prevalence in younger children),[10] gender (higher prevalence in males),[11] ethnicity (higher prevalence in Indigenous populations)[12] and NZ Deprivation Index quintile (known higher prevalence in children from areas of high deprivation).[12]

The denominator for the rate calculations was the 2001 and 2006 New Zealand Censuses (estimated resident population), with linear extrapolation being applied between Census years. Ethnic specific rates were calculated by dividing the number of hospital admission or outpatient events for children of each ethnic group, by their relevant ethnic specific census denominators. The rationale for the presentation of crude ethnic specific rates and rate ratios, rather than those which had been adjusted for NZ Deprivation Index decile, was the desire to reflect the actual inequalities experienced by Māori and Pacific children.

Level 1 prioritised ethnicity was used for both admission and outpatient numerators and for the denominator. Prioritised ethnicity means that for those children for whom multiple ethnic affiliations are identified, a single ethnic group is assigned. This uses a Statistics New Zealand algorithm that results in people who report being Māori as one or more of their ethnic groups being assigned Māori ethnicity as a priority. This is followed by prioritisation of Pacific ethnicity.

The child's domicile code (usual area of residence) was mapped to the New Zealand Deprivation Index (NZDep2001), a small area index of deprivation. The NZDep2001 is constructed from nine socio–economic variables from the 2001 census, covering multiple factors.[13] The index is traditionally presented as a decile scale with decile 1 representing the 10% least deprived small areas, and decile 10 representing the 10% most deprived small areas.

The second part of this study examined first appointment and attendance rates at ENT outpatients, using data from the National Non–Admitted Patient Collection (NNPAC). Public outpatient clinic data was analysed for 2007–2008. The dataset contains no diagnostic coding, such as ICD codes, so analysis was by health specialty code only.

All children aged 0–14 years who had a first outpatient appointment with an ENT health specialty code (S25, S26 or S28) were included. Those with follow up appointments were excluded. All children with an Attendance Code of 'ATT' were considered to have attended their appointment, while those with a 'DNA/DNW' code were recorded as either not attending or not waiting to be seen. The attendance rate was calculated by dividing the number attending (ATT) by the total number of first appointments. Ethnic specific first appointment rates were calculated by dividing the number of first appointments by the census denominators for that ethnic group.

Results

Table 1 presents acute admissions for otitis media in New Zealand children during 2002–2008. During this period Māori and Pacific children aged 0–4 years had significantly higher acute admission rates for otitis media than those of European ethnicity. Rates for Māori children were 1.49 (95% CI 1.38–1.60) times higher than for European children, while rates for Pacific children were 1.53 (95% CI 1.38–1.69) times higher. Admission rates were also 1.25 (95% CI 1.17–1.33) times higher for males than for females.

In the 5–14 year old age group, while overall admission rates were much lower, Māori and Pacific children still had significantly higher acute admission rates than did European children. Rates for Māori children were 1.95 (95% CI 1.60–2.37) times higher than for European children, while rates for Pacific children were 1.76 (95% CI 1.32–2.33) times higher. Admissions were also 1.24 (95% CI 1.04–1.48) times higher for males than for females.

Table 1: Acute hospital admissions for otitis media in children in New Zealand for the time period of 2002 to 2008. Rate Ratio (RR) reference categories are NZDep Decile 1–2, European and Female: Note RR are unadjusted.

	Age 0–4 years			Age 5–14 years		
	rate per 1,000	RR	95% CI	rate per 1,000	RR	95% CI
New Zealand Deprivation Index Decile						
1-2	1.07	1.00		0.07	1.00	
3-4	1.46	1.36	1.19–1.55	0.08	1.16	0.81–1.66
5-6	1.55	1.44	1.27–1.64	0.10	1.49	1.06–2.11
7-8	1.96	1.83	1.61–2.06	0.13	1.87	1.35–2.58
9-10	2.80	2.61	2.32–2.92	0.20	2.93	2.17–3.95
Prioritised Ethnicity						
European	1.59	1.00		0.09	1.00	
Māori	2.36	1.49	1.38–1.60	0.18	1.95	1.60–2.37
Pacific	2.43	1.53	1.38–1.69	0.16	1.76	1.32–2.33
Asian/ Indian	1.05	0.66	0.56–0.77	0.07	0.72	0.47–1.48
Gender						
Female	1.65	1.00		0.11	1.00	
Male	2.06	1.25	1.17–1.33	0.13	1.24	0.47–1.10

Table 2: Elective admissions for ventilation tubes in children in New Zealand for the time period of 2002–2008. Rate Ratio (RR) reference categories are NZDep Decile 1–2, European and Female: Note RR are unadjusted.

	Age 0-4 years			Age 5-14 years		
	rate per 1,000	RR	95% CI	rate per 1,000	RR	95% CI
New Zealand Deprivation Index Decile						
1-2	8.61	1.00		1.97	1.00	
3-4	10.28	1.19	1.14–1.25	2.77	1.40	1.31–1.50
5-6	12.47	1.45	1.38–1.52	3.90	1.98	1.86–2.10
7-8	13.62	1.58	1.51–1.65	5.08	2.57	2.43–2.72
9-10	12.59	1.46	1.40–1.53	6.38	3.23	3.06–3.41
Prioritised Ethnicity						
European	13.04	1.00		3.27	1.00	
Māori	11.58	0.89	0.86–0.92	5.69	1.74	1.68–1.80
Pacific	9.71	0.74	0.71–0.78	7.33	2.24	2.15–2.34
Asian/ Indian	3.42	0.26	0.24–0.29	1.32	0.40	0.37–0.44
Gender						
Female	9.57	1.00		3.63	1.00	
Male	13.76	1.44	1.40–1.48	4.62	1.27	1.23–1.31

There were also significant social gradients in acute hospital admissions for otitis media in both age groups. For example children aged 0–4 years living in the most deprived areas (NZDep2001 deciles 9–10) had 2.61 times (95% CI 2.32–2.92) higher admission rates than those living in the least deprived (NZDep2001 deciles 1–2) areas.

Table 2 presents elective admissions for the insertion of ventilation tubes during the same time period. In the 0–4-year-old age group, Māori and Pacific children had significantly lower ventilation tube admission rates than did European children. The rate ratio was 0.89 (95% CI 0.86–0.92) for Māori children and 0.74 (95% CI 0.71–0.78) for Pacific children. Admission rates were 1.44 (CI 1.40–1.48) times higher for males than for females.

In contrast, in the 5–14 year old age group, Māori and Pacific children had significantly higher rates of admission for ventilation tube insertion than did European children. For Māori children, rates were 1.74 (95% CI 1.68–1.80) times higher, while for Pacific children rates were 2.24 (95% CI 2.15–2.34) times higher. Admissions were also 1.27 (95% CI 1.23–1.31) times higher for males than for females.

During 2002–2008, a social gradient in elective admissions for ventilation tubes was observed in both age groups. For example, children aged 0–4 years living in the most deprived areas (NZDep2001 decile 9–10) were 1.46 (95% CI 1.40–1.53) times more likely to be admitted for ventilation tubes than those in the least deprived areas (NZDep2001 decile 1–2).

Figure 1 summarises the relationship between age and ethnicity for both acute hospital admissions for otitis media and elective admissions for ventilation tubes. In this figure, acute admissions for otitis media were higher for Māori and Pacific children than for European children during the first 4 years of life, with the highest rates being seen in children at one year of age. Small numbers after 3 years of age made interpre-

Figure 1: Acute Hospital Admissions for Otitis Media vs. Elective Admissions for Ventilation tubes in Children 0–14 Years by Age and Ethnicity, New Zealand 2002–2008

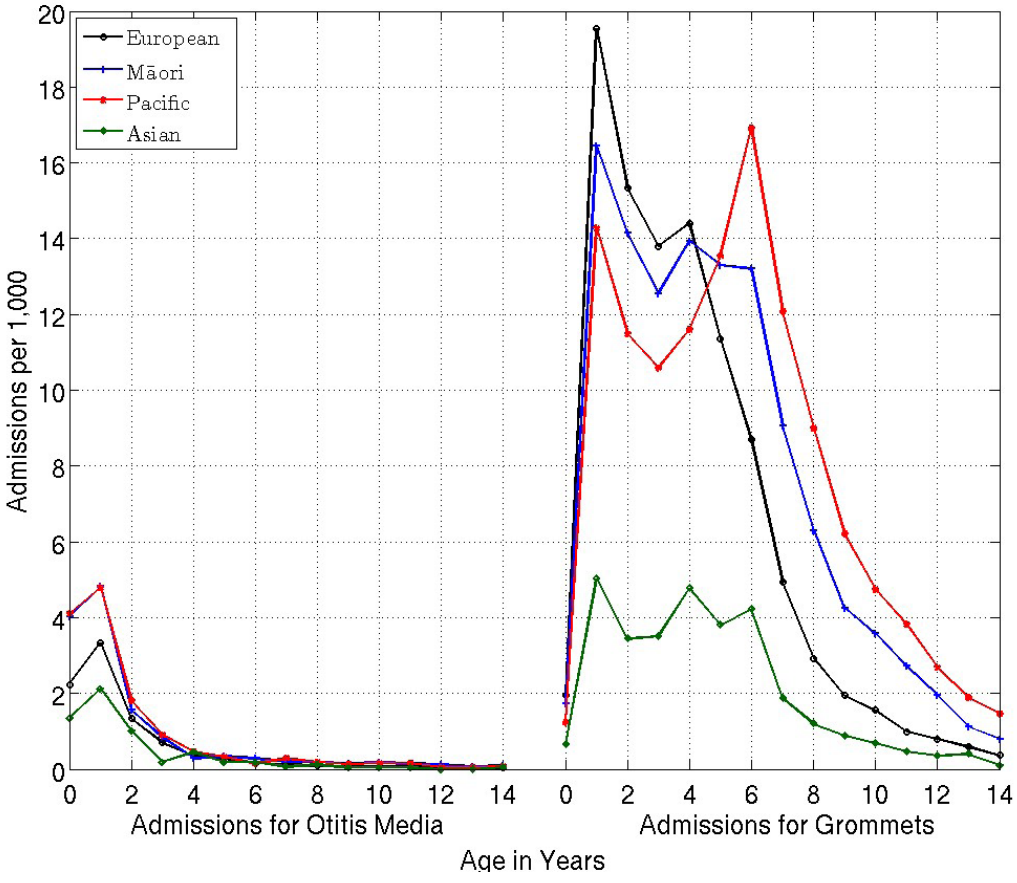
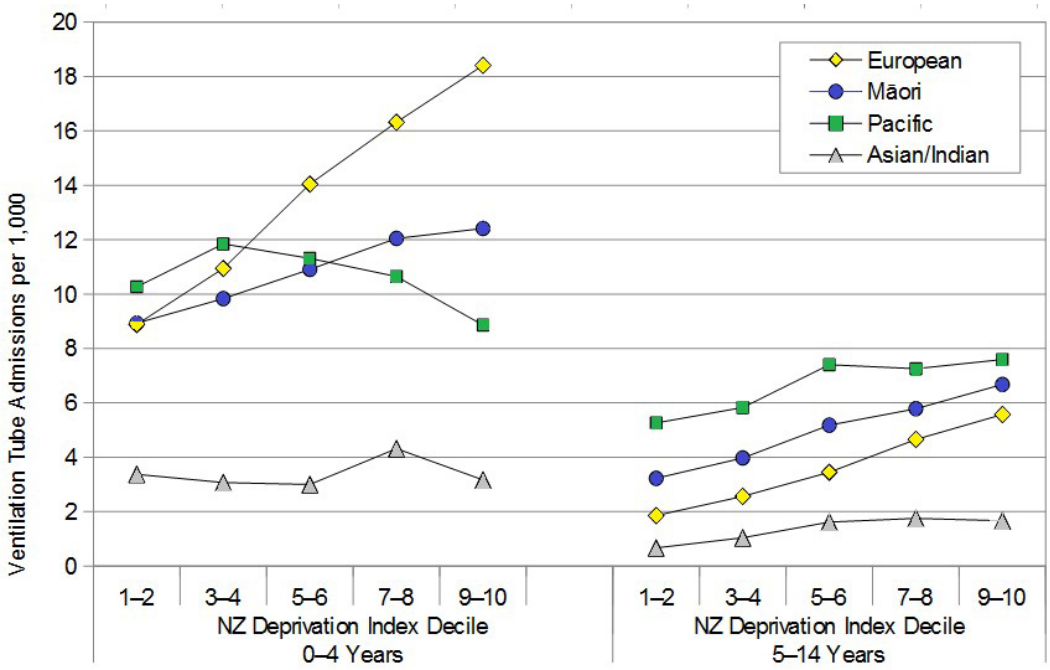


Figure 2: Elective Admissions for Ventilation tubes in 0–14 Year Olds by Age Group, Ethnicity and New Zealand Deprivation Index, New Zealand 2002–2008.



tation of ethnic differences by single year of age less reliable for older children.

In contrast elective admissions for ventilation tubes were higher for European children than for Māori, Pacific and Asian children during the first 5 years of life. At 5 years and older the pattern reversed, with Māori and Pacific children having higher admission rates than European children.

Figure 2 shows elective admissions for ventilation tubes by age group, NZ Deprivation Index quintile and ethnicity. For those aged 0–4 years, social gradients were evident for European and Māori children, with admissions increasing with increasing NZDep2001 deprivation. For Pacific and Asian children however, no such social gradients were evident. Further, in the more deprived areas (NZDep2001 decile 7–10) admissions were much higher for European, then Māori, then Pacific, then Asian/Indian children. For children aged 5–14 years however, social gradients were evident for all ethnic groups, with admissions increasing with increasing NZDep2001 deprivation. At each level of deprivation, admissions were higher for Pacific, then Māori, then European, then Asian/Indian children.

Figure 3 explores first ENT outpatient appointment rates by ethnicity during 2007–2008. During this period, Māori and European children aged 0–4 years had similar first ENT appointment rates, with rates for Pacific and Asian/Indian children being much lower. In contrast, Māori children aged 5–14 years had the highest first appointment rates, followed by Pacific, European and then Asian/Indian children. The 0–4 year age group also had a higher total first appointment rate than the 5–14 year age group.

Table 3: Attendance of children at first Ear Nose and Throat Outpatient Clinics by age, New Zealand during 2007–2008.

Ethnicity	Attended (%)	Did not Attend or Did not Wait (%)
Aged 0–4 years		
European	92.5	7.5
Māori	77.8	22.2
Pacific	84.2	15.8
Asian/Indian	92.0	8.0
Aged 5–14 years		
European	91.7	8.3
Māori	79.2	20.8
Pacific	84.0	16.0
Asian/Indian	93.1	6.9

Figure 3: Rate of referral for first appointment to Ear Nose and Throat Outpatient Clinics by age and ethnicity in New Zealand children during 2007–2008.

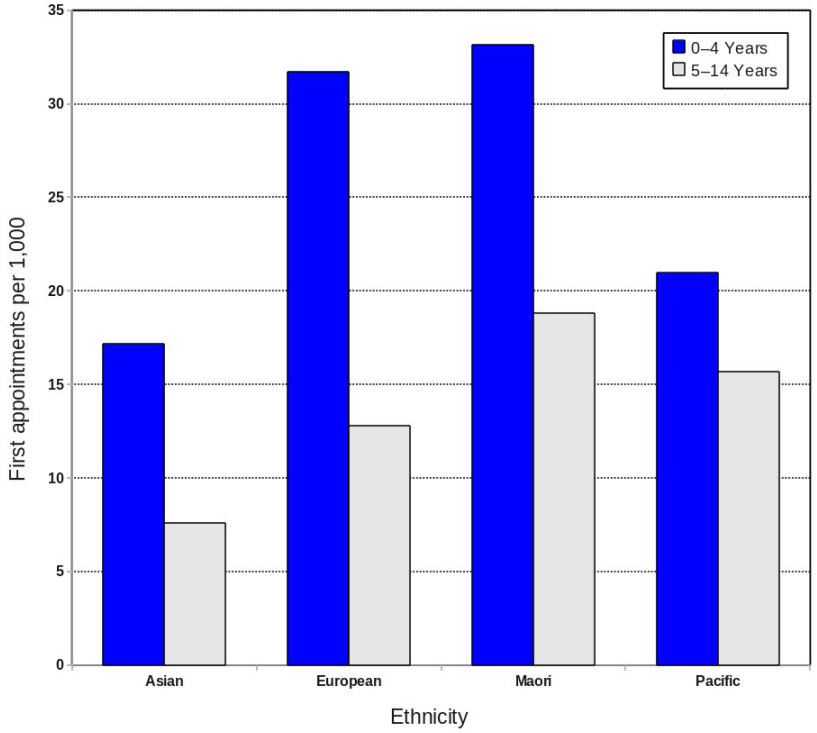


Table 3 reviews the attendance and non-attendance rates of children at their first ENT outpatient appointment during 2007–2008. During this period, Māori children had the highest non-attendance for their first appointment (22.2% at 0–4 years and 20.8% at 5–14 years) followed by Pacific children (15.8% and 16.0% respectively). European and Asian children had the lowest non-attendance rates.

Discussion

Part one of this study examined acute hospital admissions for otitis media and their distribution by gender, ethnicity and socio-economic status. It found that admissions occurred most commonly in 1-year-olds, followed by infants, with rates being lowest in school-age children of all ethnic groups. The predominance of admissions in the younger age groups is similar to international studies, which show that the peak incidence of AOM is approximately 6 months to 1 year of age.[1,10,14]

In this study, acute admissions for otitis media also varied by ethnicity, with Māori and Pacific children having higher admission rates than European children in both age groups. While hospitalisation data is a poor proxy for assessing ethnic differences in AOM incidence, few other reliable data sources are available. Those local studies which have explored the incidence of AOM either do not report ethnic specific rates,[15] or have low numbers of Māori and Pacific children in their samples.[16] The ethnic differences seen in our study are in keeping with the results of a study by Milne and Vander Hoorn,[17] as well as with local hearing screening data.[5] This study found higher tympanometry failure rates at 3 years and audiology and/or tympanometry failure rates at 5 years for Pacific and Māori children than for European/ Pākehā children.[5] While failed tympanometry and audiology are only indirect markers of OM prevalence, they do nevertheless suggest a higher prevalence of middle ear disease in Māori and Pacific children. Similarly a study by Paterson et al, found a high population prevalence of OME in Pacific Island 2-year-olds (25.4%).[18] Higher rates of OM are also present in other indigenous populations such as Australian Aboriginal children, American Indian and Inuit children.[19,20]

By contrast, in our study Asian/Indian children were the least likely group to be admitted acutely with otitis media. It is unclear whether this reflects a lower prevalence of OM or a lower rate of hospital presentation (vs. attending the GP). However, one prospective US cohort study[21] examining risk factors for OM also found that after adjusting for confounders, Asian infants were less likely to be diagnosed with OM than White Infants (OR 0.77 95% CI 0.57-1.00). In this study, the reason for this disparity was unknown.

Research suggests that the prevalence of OME follows that of AOM, with a peak

at 2 years of age and a smaller peak at 5 years.[21,22] Our analysis by single year of age showed that in European, Māori and Asian children, ventilation tubes were most commonly inserted in 1-year-olds, with a second smaller peak at 4 years of age. This is similar to the ages of peak prevalence for OME. For Pacific children however, the peak occurred at 6 years, with a second smaller peak at 1 year of age. While the reasons for this are unclear, it is possible that the peak at 1 year[1,2,10] follows the peak incidence in AOM while the peak at six years reflects delays in access to hearing screening. For example, hearing screening (tympanometry) at 3 years of age during the study period was often undertaken in preschool settings, with Pacific children having known lower rates of prior engagement with early childhood education at school entry.[23]

When aggregated into broader age categories, Māori and Pacific children aged 0–4 years were significantly less likely to be admitted electively for ventilation tubes than European children, despite having a likely greater burden of middle ear disease. The pattern was reversed for 5–14 year olds, with Māori and Pacific children having significantly higher ventilation tube admission rates than European children.

Lower rates of ventilation tube insertion in indigenous children and those from ethnic minority groups have been reported in other countries.[24,25,26] In Western Australia, Spilsbury found that in the 0–4 year old age group, the lowest rates of ventilation tube insertion were in indigenous girls and the highest rates were in non–indigenous boys. They also found that the age of first ventilation tube insertion for indigenous children was on average 20 months older than for non–indigenous children. Spilsbury concluded this indicated reduced access to health care especially given the high rate of OM seen in the Australian indigenous population.[24]

In our study, access to ventilation tubes also varied with neighbourhood deprivation, with admission rates for Māori and European children aged 0–4 years increasing with increasing NZDep2001 deprivation. For Pacific and Asian/Indian children however, no such social gradients were evident. While the reasons for these differential gradients are unclear, what the results do suggest is that European children living in average to more deprived areas (NZDep2001 decile 5–10) are accessing ventilation tubes at much higher rates than Māori or Pacific children, with the lowest access rates being seen in Asian children. Given that a much higher proportion of Māori and Pacific children live in the most deprived NZDep areas,[27] the magnitude of these inequalities in access is particularly concerning.

In contrast, for children aged 5–14 years, social gradients were evident for all ethnic groups. Further, at each level of NZDep2001 deprivation, admissions were higher for Pacific, then Māori, then European, then Asian/Indian children. The finding that access to ventilation tubes better matched need in this older age group potentially suggest that routine Well Child hearing screening may be playing a role in identifying unmet need in older children.

While hospital admission data is useful for identifying inequalities in ventilation tube access, it is unable to shed any light on the pathways leading to the paradoxical access patterns seen in younger children. In particular, it is unclear whether Māori and Pacific children had lower ventilation tube access rates because: they were referred less often from primary care to otolaryngologists; once referred they attended outpatient clinics less often; or once assessed, otolaryngologists admitted Māori and Pacific children less often for ventilation tube insertion. Further, the impact the underreporting of privately funded, private hospital admissions to the NMDS has on the findings is unclear (as many children admitted privately for ventilation tube insertion do not appear in the NMDS).

As the outpatient data in this study was not diagnostically coded (only a health specialty code is available), our analysis of first ENT appointments was only able to provide partial answers to the questions raised above. This is because many children attend ENT clinics for other reasons (eg assessment for tonsillectomy), with the authors being unable to filter their data from the analysis. However, given that ventilation tube insertion is the leading reason for elective ENT admissions in New Zealand children,[28] the contribution such referrals make to ENT first appointments is likely to be significant.

Even given these limitations, the finding that Māori and Pacific children aged 0–4 years had similar or lower first ENT appointment rates than European children, despite having a likely higher burden of middle ear disease is concerning. Such findings potentially suggest that barriers in access may be occurring at the primary care level. Further, once referred, the higher non-attendance rate of Māori and Pacific children at their first appointments also raises questions about barriers to access (eg travel and parking costs, time off work) to outpatient clinics.

Such concerns are supported by the 2004 New Zealand Living Standards survey which found that Māori, when compared to European, were more likely to report a time in the past when they needed to access the GP but did not do so. The main reason for this in the survey was appointment costs.[29] Another study in South Auckland investigating non-attendance at outpatient clinics also highlighted cost, alongside multiple factors such as information and transport.[30] This study found in 1998 the average non-attendance rate of Māori patients to outpatient appointments at South Auckland Health was 23%, which is similar to the figure seen in this study. Paterson et al, in their study, also found similar high non-attendance rates for Pacific children.[18]

Given the limitations of the outpatient datasets however, it is likely that more definitive answers will need to await the diagnostic coding of outpatient data, so that the referral pathways from primary care, through ENT clinics, to surgery can better be assessed.

Conclusions

This study highlights large ethnic differences in access to ventilation tubes amongst New Zealand's 0–4 year olds, with the greatest disparities being seen for Māori, Pacific and Asian/Indian children living in the most deprived areas. For Māori and Pacific children, such differences cannot be attributed to lower rates of AOM or OME when compared to European children. The fact that similar patterns are not seen for older children (5–14 years) potentially suggests that routine Well Child hearing screening may be playing a role in identifying unmet need in this older age group.

The disparities seen also suggest that factors, over and above OM prevalence, may be influencing access to ventilation tubes in younger children. In particular, further research is required to assess why Māori and Pacific children aged 0–4 years have similar or lower first appointment rates at ENT outpatient clinics than European children, despite having a higher burden of middle ear disease. Further research is also warranted into the reasons for higher non-attendance rates of Māori and Pacific children at ENT outpatient clinics. While the specific nature of barriers to access is unknown, issues such as cost, transport and parents needing to take time of work may play a role.

Given the importance of early detection and treatment of OM for children's ongoing well-being and education, a greater understanding of the reasons for these inequalities is urgently required.

Competing interests:
Dr McCallum reports while undertaking this dissertation she was training as a Public Health physician and was receiving a bursary from the NZ College of Public Health. She had non-financial support from the NZCYES during the conduct of the study. Dr Craig reports DHB and Ministry of Health Funding for NZ Child and Youth Epidemiology Service (NZCYES) Reporting: This paper utilises a similar methodology to that used by the NZCYES for its reporting of hospitalisations–but extends it with new material on outpatients data. Some of Dr Craig's salary was funded from NZCYES contracts with the MoH and DHBs, however the MoH and DHBs had no input into the methodology used to report the data. Dr Craig was a political candidate for Labour at the 2014 election–the paper was written prior to this and the paper does not make any recommendations of a political nature.

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Author information:
Justine S McCallum, Paediatric Registrar, Dunedin Hospital, Dunedin; Liz Craig, Senior Research Fellow, NZ Child and Youth Epidemiology Service, University of Otago, Dunedin; Ian Whittaker, Postdoctoral Research Fellow, Space Physics Group, Department of Physics, University of Otago, Dunedin; Jo Baxter, Associate Dean for Māori Health and Director of the Centre for Hauora Māori, Dunedin

Corresponding author:
Justine S McCallum, Paediatric Unit, Dunedin Hospital, Great King Street, Dunedin, Otago, 9016.
justine.mccallum@middlemore.co.nz

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REFERENCES:

1. Teele DW, Klein JO and Rosner B (1989). Epidemiology of Otitis Media during the 1st 7 years of life in children in Greater Boston – A prospective, cohort study. Journal of Infectious Diseases, 160(1), 83–94.
2. Rovers MM, Schilder AGM, Zielhaus GA and Rosenfeld RM (2004). Otitis Media. Lancet, 363(9407), 465–473.
3. Glasziou PP, Del Mar CB, Sanders SL and Hayem M (2004). Antibodies for acute otitis media in children. Cochrane Database Syst. Rev. (CD000219)
4. Lous J, Burton MJ, Felding MJ, et al. (2005). Grommets (ventilation tubes) for hearing loss associated with otitis media with effusion in children. Cochrane Database Syst. Rev. (CD000219)
5. Greville Consulting. (2006). New Zealand Vision and Hearing Screening Report – July 2005 to June 2006. www.grevilleconsulting.co.nz
6. Well Child Tamariki Ora Handbook www.healthed.govt.nz/ resource/ well-child-tamariki-ora-my-health-book
7. Cook L (1998). Screening programmes for the detection of otitis media with effusion and conductive hearing loss in pre–school and new entrant school children – an appraisal of the literature. New Zealand Health Technology Assessment (NZHTA) Report 3.
8. Ministry of Health, N.Z. Universal newborn hearing screening for New Zealand 2005 – A report of the universal newborn hearing screening advisory group to the National Screening Unit, (2006). www.moh.govt.nz
9. Craig E, Anderson P and Jackson C (2008) The Health Status of Children and Young People in Waitemata DHB. New Zealand Child and Youth Epidemiology Service.
10. Casselbrant ML, Mandel EM, Kurs-Lasky M, Rockette HE, and Bluestone CD (1995). Otitis media in a population of black American and white American infants, 0-2 years of age. Int. J. Ped. Otorhinolaryngology. 33 1-16
11. Paradise JL, Rockette HL, Colborn DK, Bernard BS, Smith CJ, Kurs-lasky M, and Janosky JE (1997). Otitis media in 2253 Pittsburgh-area infants: Prevalence and risk factors during the first two years of life. Pediatrics 99(3), 318-333.
12. Mahadevan M, Navarro-Locsin G, Tan H K, Yamanaka N, Sonsuwan N, Wang PC, Dung NT,

Restuti RD, Hashim SS, and Vijayasekaran S (2012). A review of the burden of disease due to otitis media in the Asia-Pacific. Int J Pediatr ORL, 76(5); 623-635

13. Tobias M, and Yeh LC, (2007). How much does health care contribute to health inequality in New Zealand? Aust NZ J Public Health, 2007, Jun;31(3):207–10.

14. Homøe P, Christensen R B and Bretlau P (1999). Acute otitis media and age at onset among children in Greenland. Acta Otolaryngol. 119(1) 65-71

15. Gribben B, Salkeld L J, Hoare S, Jones H F (2012). The incidence of acute otitis media in New Zealand under five years of age in the primary care setting. J. Prim. Health Care, 4(3) 205-212.

16. Chalmers D (1989). Otitis Media with Effusion in children, the Dunedin study. Volume 108 of clinics in developmental medicine. University of Michigan, Mac Keith Press.

17. Milne RJ, and Vander Hoorn S (2010) Burden and Cost of Hospital Admissions for Vaccine–Preventable Paediatric Pneumococcal Disease and Non–Typable Haemophilus influenza Otitis Media in New Zealand. Appl. Health Econ Health Policy, 8(5): 281–300

18. Paterson J E, Carter S, Wallace J, Ahmad Z, Garrett N, and Silva P A (2006). Pacific Island families Study: the prevalence of chronic middle ear disease in 2 yr old Pacific Children living in New Zealand. Int. J. Ped. Otorhinolaryngology. 70, 1771-1778.

19. Morris P S, Leach A J, Silberberg P, Mellon G, Wilson C, Hamilton, et al, (2005). Otitis Media in young Aboriginal children from remote communities in Northern and Central Australia: a cross-sectional survey. BMC Pediatr, 5, 27.

20. Curns A T, Holman R C, Shay D K, Cheek J E, Kaufman S F, Singleton R J, et al. (2002). Outpatient and hospital visits associated with otitis media among American Indian and Alaska native children younger than 5 years. Pediatrics, 109(3), E41-41.

21. Vernacchio L, Lesko SM, Verzina RM, Corwin MJ, Hunt CE, Hoffman HJ, Mitchell AA. (2004) Racial/ethnic disparities in the diagnosis of OM in infancy. International Journal of Pediatric Otorhinolaryngology, 68(6): 795- 804.

22. Midgely EJ, Dewey C, Pryce K and Maw AR (2000). The frequency of otitis media with effusion in British pre–school children: A guide for treatment. Clinical Otolaryngology, vol 25, iss:6. Doi: 10.1046/j.1365–2273.2000.00360.x

23. New Zealand Childcare Survey 2009 (Revised 17 December 2010) Highlights, Statistics New Zealand

24. Spilsbury K, Kadhim A L, Semmens J B and Lannigan F J (2006). Decreasing rates of middle ear surgery in Western Australian children. Archives of Otolaryngology–Head & Neck Surgery. Vol 132, iss:11 doi: 10.1001/archotol.132.11.1216.

25. Kogan MD, Overpeck MD, Hoffman HJ, Casselbrant ML (2000), Factors associated with tympanostomy tube insertion among pre-school aged children in the United States. Am. J. Public Health, 90(2), 245-250.

26. Falster K, Randall D, Banks E, Eades S, Gunasekera H, Reath J, and Jorm L (2013). Inequalities in ventilation tube insertion procedures between Aboriginal and non-Aboriginal children in New South Wales, Australia: a data linkage study. BMJ Open 2013 3(e00307) doi:10.1136/bmjopen-2013-003807

27. Robson B and Harris R (2007) Hauora: Māori Standards of Health IV – A study of the years 2000–2005. Wellington, Ministry of Health.

28. Craig E, Jackson C, Han D, et al. Monitoring the health of New Zealand children and young people. Auckland: Paediatric Society of New Zealand, New Zealand Child and Youth Epidemiology Service, 2007

29. Ministry of Social Development (2004). New Zealand living standards 2004. http://www.msd.govt.nz

30. Coffin TK, Emery B, Zwier G (2000) Report on reasons for Māori non–attendance of outpatient clinic appointments. Counties Manukau District Health Board.