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Hearing impairment in otitis media with effusion: A cross-sectional study based in Pokhara, Nepal

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ABSTRACT

Objective: Otitis media with effusion (OME) is a major cause of childhood hearing impairment (HI) in the developing world, but its prevalence has never been quantified in Nepal. This study therefore set out to determine the proportion of cases of OME complicated by HI and to identify associated factors.
Methods: This was a cross-sectional prevalence survey carried out in rural, urban and Tibetan schools in and around Pokhara, Nepal. HI was the primary outcome, and was defined as a middle-frequency pure tone average >25 dB on audiological testing. The study population was defined as children aged four years and older, attending primary school and with a diagnosis of OME.
Results: One hundred and eleven schoolchildren with a combined total of 172 ears affected by OME underwent audiometric assessment. HI was most prevalent in the rural Nepali population; 27% (95%CIs 18–38%) had HI, with a mean hearing loss of 22 dB (15–25 dB). In the Tibetan population, 16% (8–29%) had HI, with a mean loss of 17 dB (12–22 dB). The urban Nepali population had the least HI; 4% (1–13%) were affected, with a mean loss of 16 dB (15–19 dB). The difference in prevalence between the urban and rural Nepali populations was statistically significant ($p > 0.05$). Logistic regression analysis did not identify any associated factors.
Conclusions: HI is a common complication of OME in Nepal. There is hitherto-unreported variation between populations in the number of cases of OME complicated by HI. This study identified higher rates of morbidity amongst rural populations but was unable to identify associated factors.

1. Introduction

Globally, an estimated 278 million people live with disabling hearing impairment (HI), of whom 80% live in low- and middle-income countries, and a quarter develop HI during childhood [1]. Childhood HI, even if transient, can have long-term adverse effects on behaviour, speech and language development, academic performance and future employment [2–4]. Early identification and treatment of children with HI is therefore imperative. This is particularly true in low-income countries, where the overall prevalence of HI in infants is twice that of high-income countries [5].

Otitis media is the single most common cause of childhood hearing impairment in low-income countries, where middle ear disorders tend to be more prevalent than in high-income countries [5,6]. Of these, otitis media with effusion (OME) is amongst the most prevalent, as it is linked to poverty and malnutrition [7,8]. Whilst the clinical course of OME is often benign and self-limiting [9,10], it can cause a persistent, fluctuant, conductive hearing loss in a minority of cases [11] lasting for months or years [12]. Even this minority of cases of OME constitute a major cause of HI in low-income countries [12–15].

The literature on hearing loss in OME is small and fragmented, with existing papers employing various methodologies [5]. Consensus exists, however, that hearing loss in OME is typically mild. Low-frequency pure-tone average (LPTA) thresholds were reported in one study as averaging 24 dB (decibels), with the greatest loss in the lowest frequencies [16]. Another study describes 26.3% of ears with OME failing to hear a 25 dB screening tone in at least one of four 0.5–4 kHz frequencies [17]. A further paper reports hearing loss as ranging from 15 to 40 dB [4]. The mild (>25 dB) HI caused by OME is less disabling but more insidious than severe HI, often going unnoticed by children and their parents but still adversely impacting development [18].

Clinically significant hearing loss has been defined in several clinical guidelines as bilateral hearing loss of >25–30 dB, averaged

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across 0.5, 1, 2 and 4 kHz [19–21]. So far as we are aware, there are no published estimates of the proportion of people with bilateral OME who also suffer significant hearing loss. Treatment of OME is by the insertion of ventilation tubes into the tympanic membrane [19]. Weighing the risks of this procedure against the adverse developmental effects of HI has led to recommendations that surgical treatment of OME should be reserved for cases complicated by HI for three months or longer [19–21].

Given OME's association with poverty and Nepal's status as one of the poorest and least-developed countries in the world [22], it is unsurprising that the prevalence of OME in Nepal is reported to be high; one study of schoolchildren aged 5–15 reports a prevalence of 24.5% [23]. However, as the majority of cases of OME do not require treatment, and the reported degree of HI is quite variable [16,17,24], the scale of the public health problem in Nepal can only be estimated when both prevalence and rates of HI are known.

We identified only one published study of good methodological quality on hearing loss and middle ear disease in Nepal [25]. Whilst Schmitz et al. report that abnormal tympanometry increases the risk of HI compared to that of the general population (OR = 18), they do not quantify the hearing loss, or report the proportion of ears with both abnormal tympanometry and HI. Additionally, this study examined only a rural population, and only participants aged 15–23. Our study therefore set out to examine the proportion of cases of childhood OME complicated by HI, to establish the range and median level of hearing loss seen in cases of OME, and to identify environmental and demographic factors associated with HI.

2. Methodology

This was a cross-sectional point prevalence survey nested within a survey of the prevalence of OME. The primary outcome measure was the presence of hearing impairment (HI). In line with World Health Organisation [26] and UK National Institute for Health and Clinical Excellence [19] definitions, HI was defined in this study as a middle-frequency pure-tone average (MPTA) threshold of >25 dB in the frequencies 500 Hz, 1 kHz, 2 kHz and 4 kHz. Data on other relevant audiological outcomes are also provided.

The study took place in primary schools in Pokhara District, Kaski, Western Region Nepal. Data was collected from the pupils of four schools in the rural area around Pokhara, one urban school within Pokhara, and two schools in Tibetan migrant settlements. Despite being located in rural areas, the Tibetan compounds had a population density and infrastructure comparable to urban Pokhara. The study population was defined as children attending primary school, aged over four years and with a diagnosis of unilateral or bilateral OME.

2.1. Inclusion criteria

- Only children present at school on the day of data collection were included in the study.
- Children were included if a diagnosis of OME was made, based on clinical, otoscopic and tympanometric findings. The latter two tests were chosen as they are recommended by clinical guidelines [20] as the best tests for OME which can be carried out by non-specialist staff. Based on existing clinical definitions of OME [7], we defined OME as:
  - The presence of a Type B tympanogram, indicative of a middle ear effusion.
  - The absence of ear pain and an inflamed tympanic membrane, indicative of acute otitis media.
- Participants with OME and excess but unimpacted cerumen (diagnosed by the presence of view-obstructing cerumen, a low auditory canal volume and a low compliance peak in the tympanogram) were not excluded, as previous studies have demonstrated that the prevalence of HI is not significantly greater in this group than in the general population [5,25].

2.2. Exclusion criteria

- Children younger than four were excluded, as standard audiological testing in this age range does not produce reliable results [27].
- Children with impacted cerumen were excluded, as this condition causes a conductive hearing loss [5]. Impacted cerumen was defined as view-obstructing cerumen and a flat tympanometry trace.
- Participants with incidental sensorineural hearing loss (indicated by an absent bone–air gap) were excluded, as their hearing loss was not attributable to OME.

Participants were recruited from the prevalence survey of OME within which this study was nested. The prevalence survey used a convenience sample drawn from local schools. Audiological data on air- and bone-conduction thresholds for 500 Hz, 1 kHz, 2 kHz and 4 kHz tones were collected. Audiology was conducted in a quiet room, by a trained audiometrician using a recently calibrated Amplivox 260 portable audiometer and ambient noise-attenuating TDH-39 audiocups [28]. Data on age, gender and environmental risk factors were collected from participants in a structured interview by an interviewer fluent in Nepali. Environmental risk factors were proposed on the basis of their association with OME; known risk factors include exposure to other children, low socio-economic status, and environmental pollutants such as cigarette smoke [29–32]. Data were collected on population of origin (rural Nepali, urban Nepali or Tibetan), parental smoking status, number of rooms at home (intended as a proxy for family income), number of siblings and fuel burnt at home (wood or gas). Clinical findings were also used to characterise OME by laterality (unilateral or bilateral) and side affected (left or right).

Statistical analysis was carried out using SPSS Version 17. As per protocol, the population as a whole was analysed and – owing to unforeseen heterogeneity between subpopulations – rural Nepali, urban Nepali and Tibetan populations were analysed separately. Analysis was performed by case (i.e. ears affected by OME, meaning children with bilateral OME were analysed as two separate cases). Tests of normality were carried out on continuous data. Medians, inter-quartile ranges (IQR) and ranges were calculated for non-normal data and presented as summary statistics. The proportion of cases with mild (MTPA >25 dB) and moderate (MTPA >40 dB) HI was calculated, with 95%CIs, for each population and for the whole sample. A binary logistic regression was performed to demonstrate the association between HI and demographic, environmental and pathological variables.

Prior to the start of data collection, institutional ethical approval for this study was gained from the BMedSci Internal Ethics Review Committee at the University of Birmingham, UK [Reference: BMedSc/IERC/010220100]. Verbal consent was sought from participants according to their competency. However, due to the age of our study population many children lacked the competency to provide full informed consent. Written consent was gained instead from the headteacher of the school, who acts as the guardian for the children during the daytime. Parental acquiescence was assumed but parents were free to request that their children 'opt out' of the study. Written parental consent was felt to be not appropriate, as fewer than two thirds of adults in Nepal are literate [22] and written forms are not the Nepali cultural norm.