The point prevalence of otitis media with effusion in secondary school children in Pokhara, Nepal:
A cross-sectional study

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Abstract

Objective:

Otitis media with effusion (OME) is a condition of uncertain aetiology seen in paediatric practice. It has important sequelae that can result in significant morbidity. Worldwide documentation of OME prevalence in older children is poor as OME is traditionally seen in children below the age of 6 years. Available research in Nepal suggests prevalence of OME in children between the ages of 3 and 8 years to be as high as 27%. This study aims to establish a reliable prevalence of OME in children between the ages of 9 and 16 years in order to inform public health policy and target limited resources.

Methods:

This cross-sectional study was undertaken in Pokhara, Nepal. Two different school populations were examined, government and non-government. Children in these schools between 9 and 16 years underwent clinical assessment for OME with otoscopy and tympanometry. Demographic data were also collected to identify potential OME risk factors. For each school population the prevalence of unilateral, bilateral and all case OME was calculated as percentages with 95% confidence intervals.

Results:

A total of 494 children were recruited in this study (government= 187, non-government= 307). 14 were excluded due to impacted cerumen or other ENT pathology making it very difficult to conduct a clinical assessment. In the combined school populations the point prevalence of OME was 12.9%. The peak prevalence of OME was found in children aged 10 years (23.1%). A higher point prevalence of OME was found in the non-government school population than the government school (government= 9.3%, non-government= 15.0%). This difference was not statistically significant ($\chi^2=3.209$, df=1, p=0.073). Age was found to be significant predictor of OME.

Conclusions:

Contrary to its established natural history OME has been found to be widespread in older children in Nepal. Rates did not vary significantly between school types and only age was found to be a significant predictor of OME. Studies need to be conducted in a larger population to investigate this further. To fully assess disease burden of OME amongst children in Nepal, prevalence in children not regularly attending schools also needs investigation.
Introduction

Otitis media with effusion (OME), more commonly referred to as glue ear is characterised by the presence of serous fluid in the middle ear in the absence of acute inflammation or infection.\(^1,2\) Although its aetiology is uncertain low-grade infection, allergy and adenoidal infection or hypertrophy have all been implicated.\(^3\) Generally OME is found in younger children with a prevalence of 20% at 2 years of age and a second peak at 6 years of age.\(^4\) Case control studies have identified a number of risk factors that have been shown to markedly increase the risk of developing OME. These include age below 6 years, a large number of siblings, low socioeconomic status, passive smoking and frequent upper respiratory tract infections.\(^5,6\) Incidence of OME also has seasonal variation with higher rates during winter months.\(^7\)

The resolution of OME is often spontaneous with normal middle ear function returning within 3 months, but approximately 35% of children have recurrent OME and 5-10% of episodes last for a year or more.\(^1,8,9\) Although the reported symptoms of OME are few there are important sequelae of this condition. OME is the most common cause of acquired hearing loss in childhood.\(^10\) The persistent middle ear fluid produced results in decreased mobility of the tympanic membrane creating a barrier to sound conduction.\(^11\) Studies have shown that OME can result in mild to moderately impaired hearing levels with hearing loss of up to 40 decibels reported.\(^12,13\) In addition, OME may have negative effects on development of speech, language and learning.\(^10,14\) OME is also closely related to the condition acute otitis media (AOM) where middle ear infection is present. Persistent OME and AOM can predispose to other ear conditions such as cholesteatoma and chronic suppurative otitis media (CSOM) both of which can result in the fatal complication of brain abscess formation.\(^15\)

The recommended diagnostic technique for OME is pneumatic otoscopy in combination with tympanometry as an adjunct to confirm the diagnosis.\(^16\) In the UK, OME has a largely benign course and can be treated by a simple surgical procedure whereby a ventilation tube is inserted into the tympanic membrane to aerate the middle ear and allow fluid to drain.\(^17\) Indeed, this is one of the most common operations conducted in the UK.\(^18\) However, the public health impact of OME and its resultant hearing loss cannot be underestimated in poorer nations where preventative and routine care is often not affordable for such conditions. Nepal is one of the poorest countries in the world and 31% of its population live below the national poverty line. Therefore it is unsurprising that OME poses a significant public health issue, despite its seemingly straightforward management within Western nations.\(^19\)
The international trends in epidemiology of OME are difficult to ascertain due to poor documentation of its prevalence. Data is particularly scarce regarding prevalence of OME in older age groups as OME is traditionally a disease of younger children. Where studies have been conducted they are limited to a few nations and to children in young age groups for example those attending pre-school or primary school. Available literature demonstrates that worldwide prevalence of OME is highly variable. This is unsurprising due to the variety of risk factors implicated in the development of OME including climate and socioeconomic status. A study by Castagno et al in 2002 in Brazil found an OME prevalence of 72.9% during winter months in children aged 3-4 years belonging to a low socioeconomic group. Contrastingly an OME prevalence of 1.2% was found in children aged 5-6 years by Ogisi et al in Nigeria. Difficulties arise in making comparisons between such data due to the varying quality and design of individual studies.

Research conducted in Nepal suggests that the point prevalence of OME is high when compared to other nations. An unpublished study by Wall et al conducted in 2010 reported a point prevalence of OME of 27% in children aged between 3 and 8 years of age and in 2009 Amin et al reported a point prevalence of 38.2% in the same age group. When these figures are compared to the point prevalence of OME in similar age groups reported by studies in Europe there is a marked difference. A study in 2010 conducted in Western Sicily by Martines et al reported a point prevalence of OME of 6.8%. Similarly in 1998 Apostolopoulos et al reported the point prevalence of OME amongst school children in Greece to be 6.5%.

Although in developed countries the prevalence of OME decreases after the age of 6 years this may not be the case in Nepal due to the higher prevalence of OME that is found in younger children. It is possible that this high prevalence may continue into older age groups. The point prevalence of OME within secondary school children in Nepal has been largely unreported and available evidence from published papers is of poor methodological quality. One study conducted in a secondary school in Nepal by Maharajan et al in 2006 reported a prevalence of 13.2% in children between the ages of 5 and 15 years. However, only half all study participants with suspected OME who failed screening tests were examined further.

This study aimed to establish a reliable prevalence of OME found in older children in Nepal in order to improve existing research and create an accurate picture of individuals with this condition. This would help enable the provision of better public health initiatives by local government and non-government organisations in Nepal to target prevention, early detection and management of OME, with the aim to decrease the socioeconomic burdens of its resulting complications.
Objectives

The primary objective of this study was to measure the point prevalence of otitis media with effusion in children between the ages of 9 to 16 years attending secondary schools in Pokhara, Nepal. There were three secondary objectives; to compare the prevalence of OME according to socioeconomic status gauged by school type attended, evaluate the change in prevalence of OME with age and identify potential predictors for developing OME in adolescence.

Methods

Population and Sample Selection:

This quantitative, cross-sectional study aimed to determine the point-prevalence of OME in secondary school children aged 9-16 years. The data collection for this research took place in both government and non-government run secondary schools in and around Pokhara, Nepal in spring 2011. Children from these schools were screened for presence or absence of OME. Pokhara is the third largest city in Nepal and has a population of approximately 200,000.30

Schools were chosen to recruit participants from as they were easily accessible establishments for the researchers and allowed comparisons to be made between the point prevalence of OME in children attending government versus non-government run schools where school type was a proxy for establishing socioeconomic status.

Government and non-government schools situated in and around Pokhara, Nepal were notified of the project by the International Nepal Fellowship (INF), a prominent non-governmental organisation based in Pokhara. Headmasters of these schools were provided with information regarding the research project and consent was gained from those schools who wished to take part. Convenience sampling was used to select one government and one non-government school. The inclusion and exclusion criteria for the study are listed below:

Inclusion Criteria:
- Children attending secondary school aged 9-16 years
- Children who consented to assessment or from whom consent from a parent or guardian was received
- Children attending the school on the day of data collection
Exclusion Criteria:

- Children with impacted cerumen in making a diagnosis of OME not possible
- Children in whom clinical assessment was not possible due to other ENT pathology

Sample Size:

Sample size calculation for this study was two-fold due as this study laid down the groundwork for a secondary survey to be conducted looking at the prevalence of significant hearing loss amongst participants with OME. Due to the scarcity of reliable, good quality studies in Nepal looking at the prevalence of OME in children aged between 9 and 16 years it was difficult to estimate the percentage of participants who would be diagnosed with OME. Therefore it was necessary to extrapolate OME prevalence from previous studies in Nepal conducted in younger age groups in order to calculate a sample size. In 2009 Wall et al reported the prevalence of OME in primary school children in Nepal to be 27%. From knowledge of the natural history of OME it was anticipated that this figure would be lower in secondary school children. Therefore, based on an extrapolated prevalence of 9% to maintain feasibility of the study a sample size of 126 was calculated to estimate prevalence of OME at a 95% confidence level with a precision of ±5%. To estimate the prevalence of significant hearing loss as a result of OME at a 95% confidence level with a precision of ±5% a sample size of 656 was needed based on a prevalence of 4%.

Data Collection:

The primary outcome measured in this study was presence or absence of OME assessed by clinical examination using an otoscope and tympanometer. These are the recommended diagnostic tools for OME and have been shown to have the greatest sensitivity and specificity. The clinical examinations were carried out by two 4th year medical students from the UK who had undergone training in examination and interpretation of results from these assessments by an ENT specialist registrar in the UK. An otoscope was used to visualise the pinna, ear canal and tympanic membrane. The colour and patency of the tympanic membrane were assessed for features of OME and to identify presence of wax, a perforation or AOM, indicated by redness and bulging of the tympanic membrane. A Welch Allyn GSI 37 automatic tympanometer was used to diagnose OME. OME was indicated by a type B flat line tympanogram in the absence of a raised ear canal volume (ECV) or wax which would indicate a perforation or impacted cerumen respectively. Due to the lack of ENT expertise held as a medical student in the event of uncertainty regarding ear pathology a doctor from the INF was asked for a second opinion.
Data from each ear was collected. Every participant underwent both otoscopy and tympanometry unless it was not possible to conduct these clinical assessments due to ENT pathology. Tympanometry results for each ear were recorded as “type A”, “type B OME”, “type B raised ECV”, “type impacted cerumen” or “type C”. Diagnosis of OME was recorded for each ear as “present”, “absent” or “exclude”. Presence of ear pain, discharge from the ear and redness of tympanic membrane were recorded as “present” or “absent” to be able to diagnose AOM and refer on where necessary. Perforations of the tympanic membrane were also recorded.

In addition to these assessments demographic data was collected from each participant to identify potential risk factors for the development of OME in adolescence. Data about the participants’ age, gender, school type attended, number of siblings and presence of smokers in the household were collected. A positive history of OME was recorded as “present” or “absent” to investigate past history of OME as a potential risk factor for developing OME again. Assistance from an INF translator was organised prior to departure from the UK.

This study allowed for a secondary survey to be conducted of the prevalence of significant hearing loss in those individuals diagnosed with OME. Following clinical assessment for OME and demographic data collection participants diagnosed with OME had audiometric assessment using an Amplivox 260 audiometer. Both air and bone conduction were assessed.

Participants with impacted cerumen, perforations of the tympanic membrane, AOM, significant hearing loss or any other suspected pathology were referred to the INF for further examination and treatment.

**Outcome Measure:**

“OME present”, “OME absent” or “exclude case”

**Ethical Considerations:**

The University of Birmingham BMedSc Population and Health Sciences Internal Ethics Committee, UK granted ethical approval for this study in January 2011. The procedure for ethical approval in Nepal was researched and approvals for the study by the Nepali government were not required.

Since the age of the study population were secondary school children below the age of sixteen years they were not able to consent themselves. However, since some of the children could be deemed Gillick competent, if they refused to have the assessment done they were free to withdraw and not coerced to
participate. In Nepal it is culturally acceptable for consent to be obtained from the headmaster of the school, since the headmaster acts in loco parentis whilst they are in the school environment. A consent form was therefore provided to each headmaster to sign prior to data collection.

Tympanometry and otoscopy are low risk methods for assessing ear pathology and adverse effects have not been reported. To minimise any risk of infection during examination anti-bacterial solution and alcohol gel were used.

**Analysis:**

The statistical software used for data analysis was SPSS Version 16.0. Cases designated as exclusions were not included in the analysis. Participants were excluded from analysis if either one or both ears had impacted wax. Participants were also excluded if data could not be collected from one or both ears due to ENT pathology making it very difficult to carry out clinical assessment with otoscopy and tympanometry. This was done in order to allow the prevalence of unilateral OME or bilateral OME to be accurately calculated. In cases with one ear excluded due to impacted cerumen it was not possible to diagnose whether or not OME was present in the excluded ear. Therefore an accurate diagnosis of unilateral OME or absence of OME could not be made.

Comparisons of demographic variables between school populations were made according to whether the variable was categorical or continuous. Pearson’s Chi-square tests were used to compare categorical demographic variables such as gender, number of siblings and smoking exposure. Mann-Whitney U tests were used to compare continuous demographic variables that did not follow a normal distribution such as age.

The prevalence of OME was calculated for the proportions of children with unilateral OME, bilateral OME and unilateral or bilateral OME i.e. all case OME as percentages with 95% confidence intervals. Prevalence of OME according to socioeconomic status was by comparison of the above proportions found in government versus non-government schools using a Chi-square test. Prevalence of unilateral, bilateral and overall OME change with age was evaluated by comparing these prevalences at different ages and seeing if CI's overlap as well as using a Mann-Whitney U test. Predictors for the development of OME in adolescence were identified by multiple logistic regression using a backward stepwise model.
Results

From a total of 494 participants (government school= 187, non-government school= 307) 14 participants were excluded prior to analysis (government school= 3.2%, non-government school= 2.6%). 13 participants were excluded due to impacted cerumen in one or both ears that made accurate calculation of unilateral and bilateral OME not possible. 1 participant was excluded due to eczema on the external ear bilaterally that made otoscopy and tympanometry difficult to conduct. These details are summarised in table 1.

[Table 1.]

Participant demographics were compared according to school type and can be seen in table 2. There were no statistically significant differences between school groups with regards to age or gender. There were statistically significant differences between schools with regards to smoking exposure and number of siblings. Chi-Square tests showed there to be significantly higher smoking exposure to participants in the government school population compared to the non-government schools ($\chi^2=76.073$, df=1, $p=<0.0001$). Participants in the government school also had a significantly higher number of siblings than participants from the non-government schools ($\chi^2=1.333$, df=3, $p=<0.0001$).

[Table 2.]

A total of 986 ears were clinically assessed for OME. A summary of clinical diagnoses by ear according to tympanometry results can be seen in table 3. A total of 22 participants had to be referred to the INF due to ENT pathology; 9 for perforations in the tympanic membrane, 12 participants for impacted wax and one case for eczema on the external ear bilaterally.

[Table 3.]

The proportions of children with unilateral OME, bilateral OME and either unilateral or bilateral OME i.e. all case OME were calculated as percentages with 95% confidence intervals. These were calculated for the school populations combined and also for government and non-government school populations individually. Results are summarised in figure 1.

[Figure 1.]

In the combined school populations the prevalence of all case OME was 12.9%. Unilateral OME was found to be more prevalent than bilateral OME (unilateral= 8.3%, bilateral= 4.6%). When prevalence of all case OME
in the government school population was compared to that in the non-government school population a higher prevalence was found in the non-government school (government school= 15%, non-government= 9.3%). This difference approached, but did not reach, statistical significance (Chi-Square, $\chi^2=3.209$, df=1, $p=0.07$). Similarly, there were higher prevalences of both unilateral OME and bilateral OME in the non-government school compared to the government school population that were found not to be statistically significant; unilateral OME, $\chi^2=3.00$, df=1, $p=0.08$; bilateral OME, $\chi^2=0.341$, df=1, $p=0.56$).

The proportion of participants with all case OME was calculated by age and is illustrated in figure 2. The trend in prevalence of all case OME by age is illustrated in figure 3. The peak prevalence of OME was found in children aged 10 years (23.1%). Univariate analysis using a Mann Whitney U test showed there to be no significant difference in all case OME prevalence by age ($p=0.06$). There was also no significant difference in diagnosis of unilateral OME by age ($p=0.17$) or bilateral OME by age ($p=0.23$).

[Figures 2 and 3.]

In addition to school type and age, univariate analyses of the change in OME prevalence by gender, smoking exposure and number of siblings were carried out. No statistically significant differences in either unilateral, bilateral or all case OME prevalence were found according to any of these demographic variables. Although data were collected regarding previous diagnosis of OME as a potential risk factor for developing OME again, no study participants had any information regarding a prior diagnosis therefore this variable was not included in the analysis.

Despite a lack of statistical significance in any of the univariate analyses a backward stepwise logistic regression was carried out. This was because demographic data collected in this study have been shown in previous literature to be predictors of OME in younger children.\textsuperscript{5,6} Another reason for carrying out a multivariate analysis was because although not reaching statistical significance all case OME by age ($p=0.06$) and school type ($p=0.07$) approached a statistically significant level of $p=0.05$. The dependent variable in the binary logistic regression was all case OME. Predictor variables were age, gender, school type, smoking exposure and number of siblings. Results showed that in the total study population only age was a significant predictor of all case OME. OME was slightly less common with increasing age [OR=0.86, (95% CIs=0.75-0.9), $p=0.047$]. Age explained only 2.9% of variability in prevalence of all case OME (Nagelkerke $R^2=0.029$). Gender, school type, smoking exposure and number of siblings were all non-significant.
Discussion

The overall prevalence of OME was found to be 12.9% in the combined school populations with a higher prevalence of 15% in the non-government school population compared to 9.3% in the government school population. This difference was not statistically significant. Likewise, there were higher prevalences of both unilateral and bilateral OME in non-government compared to government school populations which were also non-significant. Only age was found to be a significant predictor for developing OME; OME prevalence decreasing with increasing age. Peak OME prevalence was found in children aged 10 (23.1%).

Results of this study are difficult to compare to existing literature due to the heterogeneity of age and diagnostic criteria in studies conducted. Internationally there are some studies in which the age of children examined overlapped with the age of participants in this study. Caylan et al conducted a study in north-eastern Turkey in children aged between 5 and 12 years and reported a prevalence of OME of 11.2%. Apostolopoulos et al reported the point prevalence of OME among school children in Greece aged between 6 and 12 years to be 6.5%, however, both type B and type C tympanogram traces were used to diagnose OME so it is likely that this figure is an overestimate.

Most research conducted in Nepal has been in children aged 3-8 years. In this age group Wall et al reported an OME prevalence of 27% and Amin et al reported it to be 38.2%. Only one study by Maharjan et al of poor methodological quality included children between 5-15 years of age and reported an OME prevalence of 24.5% (95% CI 18.0%-30.9%); significantly higher than the prevalence reported in this study of 12.9% (95% CI 10.0%-16.0%). Variation in these figures is hard to explain especially as OME is seen more commonly in younger children and the largest proportion of children in the study by Maharjan et al were aged between 13-15 years. Also, it is likely that the study by Maharjan et al underestimated the prevalence of OME as only half of those who failed ENT screening tests were examined further. This variation in OME prevalence may due to the low socioeconomic status of the participants in the study who were from the Morang district in Eastern Nepal considered to be poor compared to the city of Pokhara. Despite differences in methodology in the available literature the prevalence of OME established in this study appears to be important. OME is found in older children in Nepal, where worldwide it is usually seen in those of a younger age.

In this study school type was used as a proxy for establishing socioeconomic status. Low socioeconomic status is documented in the literature as a risk factor for developing OME. These results are therefore unexpected as a higher prevalence of OME was found in the non-government, fee paying school population than the government school population where education is free. Other risk factors not accounted for may
have influenced this such as frequency of upper respiratory tract infections (URTIs) and fuel type burnt in the home which is associated with increased frequency of URTIs.\textsuperscript{33,34} A number of unidentified risk factors may also partially explain these varied OME rates. Although no statistically significant differences were found between school type and prevalence of OME the study was not powered to detect this difference. Studies with a larger sample size in each school are needed to investigate this further.

OME by age does not follow the expected trend of decreasing prevalence with age. Peak prevalence of OME was at 10 years rather than 9 years of age. This may be a chance finding or due to unidentified risk factors not accounted for. A potential cause for this finding is transmission of an URTI around the time of this study within this age. Due to their proximity to each other in classrooms this may have made them more susceptible, as a group, to developing OME. Therefore these results may be unique to this study.

Only younger age was found to be significant predictor of developing OME. Evidence from the literature supports this; anatomically young children have an increased chance of Eustachian tube dysfunction and they do not have a fully developed immune system making them more susceptible to development of OME.\textsuperscript{35} In this study number of siblings and smoking exposure were not found to be significantly associated with increased risk of OME, despite previously reported evidence in the literature suggesting them as risk factors.\textsuperscript{5,6} However, this study was not powered to detect these associations. The logistic regression model accounted for only 2.9% of the variability in OME diagnosis.

Compared to previously published studies the design of this study was methodologically sound. Tympanometry is the recommended diagnostic technique for OME by the National Institute for Clinical Excellence (NICE).\textsuperscript{17} It is an acceptable and accurate diagnostic tool and was therefore appropriate to use in this study. Results from a large, well-conducted meta-analysis show use of a type B tympanogram to detect middle ear effusion to have a pooled sensitivity of 84% and specificity of 79%. Although some studies have shown that pneumatic otoscopy can perform as well as tympanometry in diagnosing middle ear effusions this tool has significant practical implications as accuracy depends on the skill of each examiner.\textsuperscript{36} The subjectivity of this test therefore justifies the preferred use of tympanometry in this study.

Limitations of the study fundamentally relate to sample size attained and the logistic challenges of data collection. The sample size from a government school was limited as permission to continue data collection was denied after two days. Contingency links were not in place to collect data from another government school. Although an INF translator had been organised prior to study commencement, no translator was available at the time of the study. The author was able to conduct data collection in Hindi and English, largely understood by the study participants and when translation was difficult assistance was provided by
Nepali speaking teachers. The lack of consistency in translators may have affected the quality of the data. However, due to the high proportion of children understanding either Hindi or English it is likely that this influence is negligible. Lack of central school registers meant that it was not possible to comment on how representative the sample was of each school population as absentees were not accounted for. Although a potential source of bias it would have been unlikely for children to be absent from school as a consequence of symptomatic OME. Rather any absences would have been random in nature.

**Implications and Further Research**

This study has established that in Nepal there is a prevalence of OME in secondary school children aged 9-16 years despite OME generally having been documented in younger children. Unfortunately a lack of international research regarding OME prevalence in children beyond pre-school and primary school age means that it is not possible to directly compare how high this established prevalence is compared to other parts of the world in children of a similar age. However, despite the varying prevalence of OME seen in younger children worldwide the prevalence established in this study is not low.

Further research needs to be conducted in order to establish the persistence of OME in these children through period prevalence surveys and the degree of significant hearing impairment through audiological assessment. Research also needs to be conducted in different populations in Nepal in different parts of the country. Pokhara is a relatively wealthy city; it is likely that areas of poorer socioeconomic status will have a higher prevalence of OME. It is in remote, rural populations where persistent OME is likely to occur and where health coverage and behavioural factors such as the demand for healthcare is poor. Targeting effective interventions in these populations would be most useful to combat the resulting consequences of OME. This study was unable to account for non-school going children due to lack of a central register of children in Pokhara meaning that sampling from this broader population was not feasible. In Nepal 87% of children between the ages of 6 and 10 years attend school and only 47% of all children between the ages of 11 and 15 years attend. Further research needs to include this population in order to be fully representative.

**Conclusion**

This study has established that there is a high prevalence of otitis media with effusion in Pokhara, Nepal in children aged 9-16 years meaning that a large proportion of children in this age group may be at risk of further complications as a result of this disease. Prevalence was found to be higher in the non-government school population than the government school population, a difference that was not significant. Further
research is required in this age group in different communities within Nepal to fully establish the burden of this disease within the country.

Acknowledgements

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Author Contributions

Conception of the study was by MS. EW and RB contributed to study methodology. AM wrote the study protocol and carried out data collection with VM. AM analysed results and wrote up this paper.

Conflicts of Interest

None declared
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The point prevalence of otitis media with effusion in secondary school children in Pokhara, Nepal: A cross sectional study

Table 1. Description of Study Participants

<table>
<thead>
<tr>
<th>Population by School Type</th>
<th>Government(n)</th>
<th>Non-Government(n)</th>
<th>Both Populations</th>
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<td>Location</td>
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<td>Pokhara City</td>
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<td>Total No. of Participants</td>
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<td>Participants Included [n (%)]</td>
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<td>Participants Excluded</td>
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<td>8</td>
<td>14</td>
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<tr>
<td>- Impacted cerumen</td>
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<td>7</td>
<td>12</td>
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<tr>
<td>- Other</td>
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<td>1*</td>
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*One exclusion was made in the non-government school population due to the presence of eczema on the pinna bilaterally making assessment with otoscopy and tympanometry not possible.
Table 2. Participant Demographics

<table>
<thead>
<tr>
<th>Demographic Data</th>
<th>Government (n=178)</th>
<th>Non-Government (n=294)</th>
<th>Both Populations (n=472)</th>
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<td>12 (10-14)</td>
<td>12 (10-13)</td>
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<td>Gender (Male) [n (%)]</td>
<td>89 (50.0)</td>
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<td>Presence of smokers in household [n (%)]</td>
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<td>No. of siblings (median, IQR)</td>
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<td>1 (1-2)</td>
<td>2 (1-3)</td>
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*IQR= Interquartile Range*
Table 3. Clinical diagnosis by ear

<table>
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<tr>
<th>Clinical Diagnosis by Tympanogram Result</th>
<th>Government (n=374)</th>
<th>Non-Government (n=614)</th>
<th>Both Populations (n=986)</th>
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<tr>
<td>Type A*1 Normal [n (%)]</td>
<td>317 (84.8)</td>
<td>500 (81.4)</td>
<td>817 (82.8)</td>
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<td>Type B flatline*2 OME [n (%)]</td>
<td>25 (6.7)</td>
<td>62 (10.1)</td>
<td>87 (8.8)</td>
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<td>Type B Raised ECV*3 Perforation of Tympanic Membrane[n (%)]</td>
<td>4 (1.1)</td>
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<td>11 (1.1)</td>
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<td>Type B Impacted Cerumen [n (%)]</td>
<td>10 (2.6)</td>
<td>8 (1.3)</td>
<td>18 (1.8)</td>
</tr>
<tr>
<td>Type C*4 [n (%)]</td>
<td>18 (4.8)</td>
<td>35 (5.7)</td>
<td>53 (5.4)</td>
</tr>
</tbody>
</table>

*1 Type A tympanogram: Middle Ear Pressure (MEP)= -150 to +100daPa. Compliance peak = 0.2 to 1.4cm³
*2 Type B flatline tympanogram indicative of OME: MEP > -150daPa. Compliance peak <0.2cm³
*3 Type B raised ECV (Ear Canal Volume) greater than 2.0cc suggestive of patent tympanic membrane due to perforation or ventilation tube
*4 Type C tympanogram indicative of negative MEP: MEP< -150daPa. Compliance peak >0.2cm³

Tympanometry classification guidelines from 1996 American Speech-Language-Hearing Association (ASHA) guidelines

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The point prevalence of otitis media with effusion in secondary school children in Pokhara, Nepal: A cross sectional study.

Figure 1. Prevalence of unilateral, bilateral and all case otitis media with effusion by school populations

<table>
<thead>
<tr>
<th>Population by School Type</th>
<th>Government School (n=181)</th>
<th>Non-Government School (n=299)</th>
<th>Both Populations (n=480)</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>%</td>
<td>95% CI</td>
<td>n</td>
</tr>
<tr>
<td>Participants with UOME</td>
<td>10</td>
<td>5.5</td>
<td>2.2-8.8</td>
</tr>
<tr>
<td>Participants with BOME</td>
<td>7</td>
<td>3.9</td>
<td>1.1-6.6</td>
</tr>
<tr>
<td>Participants with UOME or BOME</td>
<td>17</td>
<td>9.3</td>
<td>5.2-13.6</td>
</tr>
</tbody>
</table>
Figure 2. Number of participants with either unilateral or bilateral otitis media with effusion by age with proportions as percentages
Figure 3. Prevalence of all case otitis media with effusion by age with 95% CIs