International Journal of Pediatric Otorhinolaryngology 115 (2018) 181–187

Contents lists available at ScienceDirect

International Journal of Pediatric Otorhinolaryngology

journal homepage: www.elsevier.com/locate/ijporl

The prevalence of otitis media in 2–3 year old Cameroonian children estimated by tympanometry

John Njuma Libwea[a,b,d,*], Marie Kobela[b,e], Paul Koki Ndombo[c,e], Ritva K. Syrjänen[d], Heini Huhtala[a], Ninying Fointama[e], Sinata Koulla-Shiro[e,f], Hanna Nohynek[d], J. Pekka Nuorti[a,d], Arto A. Palmu[a,d]

[a] Epidemiology/Health Sciences, Faculty of Social Sciences, University of Tampere, Finland
[b] Expanded Programme on Immunization, Cameroon
[c] Mother & Child Center (MCH), Chantal Biya Foundation, Yaoundé, Cameroon
[d] National Institute for Health and Welfare (THL), Finland
[e] Faculty of Medicine and Biomedical Sciences, University of Yaoundé 1, Cameroon
[f] Ministry of Public Health, Yaoundé, Cameroon

ARTICLE INFO

Keywords:
Otitis media burden
Tympanometry
Low-resource countries
Cameroonian children
PCV13

ABSTRACT

Background: Acute otitis media is a common illness in children under-five years of age and associated with major health care resources in high-income countries. However, there is paucity of data on its epidemiology and clinical presentation in low-income countries. We estimated the prevalence of otitis media and assessed risk factors among children in Cameroon.

Methods: A community-based cross-sectional prevalence study of otitis media (OM) was performed on randomly selected children aged 2–3 years in Yaoundé, Cameroon from March to June 2013. OM was assessed by clinical inspection for chronic suppurative otitis media (CSOM) and tympanometry for otitis media with effusion (OME). CSOM was defined as draining of the middle ear with duration of more than two weeks and OME was defined as a flat 'type B' tympanogram.

Results: Out of 529 children enrolled in the study, 433 (56% males) subjects with available tympanograms were evaluated. Altogether, 9.7% (42/433) of children met the case definition of CSOM, OME or its complications. This consisted of 3 (0.7%) children identified with unilateral CSOM; 7 (1.6%) children with bilateral OME; 31 (7.2%) with unilateral OME and 1 (0.2%) subject with unilateral dry tympanic membrane perforation.

Logistic regression analyses showed statistically significant association between OM and parental reporting of "current symptoms of upper respiratory tract infections", Prevalence Odds Ratio (POR) = 3.71; 95% CI = 1.69–8.14).

Conclusion: As many as two out of a hundred children between the ages of 2–3 years were affected by significant middle ear disease i.e. CSOM or bilateral OME. These data could be useful as a baseline for estimating the impact of pneumococcal conjugate vaccines (PCV13) introduced in July 2011 for infants in Cameroon.

1. Introduction

Otitis media is reported as one of the most common respiratory illnesses affecting children under five years old worldwide [1–3]. The disease and its complications are diagnosed and treated more actively in developed countries than in resource-poor settings like Cameroon [3]. In most developing countries, acute otitis media goes usually undiagnosed and consequently, affected children are not timely identified to be treated. Otitis media may also occur as chronic otitis media with effusion or chronic suppurative otitis media, and it may remain persistent in early childhood [4]. Prolonged hearing loss and delayed development are potential long-term complications of otitis media. These long-term complications in children may amount to considerable socio-economic costs both to the children, parents and the public health system [5], especially in most communities in Cameroon where 24% of the population lived under the poverty line i.e. < $US2 daily [6].

Thus, access to care is not easy to everybody due to financial constraints. Although drugs are prescribed in the hospitals and available in pharmacies, it is a very common practice to buy antimicrobials over-the-counter at local markets. More so, the doctor-patient ratio is low

* Corresponding author. Faculty of Social Sciences, University of Tampere, FI-33014, Finland.
E-mail addresses: Libwea_j@yahoo.com, john.njuma.libwea@staff.uta.fi (J.N. Libwea).

https://doi.org/10.1016/j.ijporl.2018.10.007
Received 7 June 2018; Accepted 3 October 2018
Available online 06 October 2018

and it was reported the country is experiencing a crisis in human health resources with an estimated ratio of 1 clinician and 8 nurses/midwives per 10000 people reported in 2010 [7]. However, there are many health institutions (both public and private) in the country staffed with nurses and general practitioners. A few specialists are available usually in major cities.

Epidemiologic studies on the burden of otitis media in Cameroonian children are lacking. However, the disease incidence is expected to be high considering data from other low-resource settings [8–11].

The 13-valent pneumococcal conjugate vaccine (PCV13) was introduced in Cameroon's Expanded Immunization Programme in July 2011. The primary aim of this study was to measure the prevalence of OM occurring in PCV-unvaccinated children 2–3 years old, as a baseline for estimating the PCV13 impact on OM disease burden and sequelae.

2. Methodology

2.1. Study description

PCV-unvaccinated children aged 2–3 years were enrolled from March to June 2013 in a community-based cross-sectional study to evaluate the prevalence of OM in children. Ethical approval was obtained from the Cameroon National Ethics Committee and from the Institutional Review Board of the Yaoundé Gynaeco-obstetrics and Paediatric Hospital (YGOPH). Further, informed consent was obtained from parents/caretakers in addition to permission from the local administrative authorities.

2.2. Sites selection and inclusion criteria

The study sites were situated within 80 km radius from Yaoundé, Cameroon's capital city. Yaoundé and the surroundings harbour a population of over 3.5 million out of which 18% are children aged from 2 to 3 years, based on 2010 National Population Census. The sites were chosen as they constitute a group of health institutions described as the pneumococcal disease sentinel surveillance sites. These include the Cite Verte Health District (urban) with the Mother & Child Reference Hospital (MCH) and four other health districts. Sites were partitioned into 40 blocks (clusters) using the health map with each cluster hosting at least one health centre/clinic either, public or private. Children were eligible if aged from 24 to 36 months, and residing in the area for at least six months. Enrolment was restricted to those who had not received any doses of pneumococcal conjugate vaccine, as was confirmed from child's vaccination card or registers. The starting household within the cluster was selected after spinning a pen, usually at a central location in the community. Selection of participants was done randomly after every 10th home within a cluster. One participant was selected per home even if two or more were eligible (in such an event, selection was with respect to birth order); and twenty-five children were enrolled per "cluster".

2.3. Study team and participants

Training of the study team members in the practical aspects of the study (recruitment of subjects, questionnaires administration, clinical examination and tympanometry) was done prior to the start of the study by the principal investigator. Two mobile study clinic teams, each with three trained study nurses and a study physician were established to enrol children. Families were informed about the study by community "social mobilisers" (in addition to radio announcements and fliers) a week prior to visiting a specific area and within the actual planned visit days. The study clinics were established at a central location (e.g. chief's or local leader's compound or at a health centre).

2.4. Data collection

In order to enhance compliance of the children, inspection to detect draining ears was done first, followed by tympanometry. Clinical and visual examination involved a thorough inspection of the external ear structure for signs of drainage or cerumen accumulation in the outer third of the ear canal as recommended [12]. Pneumatic otoscopy was performed, but since most subjects had considerable cerumen accumulation and we lacked appropriate equipment to clean-up the wax in the field conditions, the otoscopic data were sparse and not used for this analysis. Tympanometry was performed using the Middle Ear Analyser Grason Stadler tympanometer (GSI-38 Autotymp, Grason-Stadler Inc., Milford, NH, USA). Tympanograms were recorded with a 226 Hz probe tone with a pressure varying from +200 daPa (daPa) to −400 daPa in a time of 7 s. Tympanometry was not performed on draining ears. Tympanometry was followed by parental questionnaire. It consisted of questions on potential risk factors, i.e. demographic characteristics, family socio-economic status, number of children under 18 years living in household, the number of children sleeping in the same bedroom, parental smoking status, source of household cooking, duration of breastfeeding and antibiotic use. In addition, the parents were asked about current symptoms of any respiratory tract infections.

2.5. Interpretation and classification of tympanograms

Tympanograms were independently interpreted by two researchers in retrospect. In an event of discordance in the interpretation, a third researcher interpreted for a final decision. The tympanograms (Table 1) were classified based on a modified version of Liden/Jerger's classification [13]. In this categorisation, flat, 'type B' tympanograms indicated the presence of middle ear fluid (MEF). Tympanograms with curve types A, As, C, or Cs suggested absence of MEF. High external ear canal volume (ECV > 1.0 cm^3) and with a 'flat curve' was interpreted as perforation of the tympanic membrane (TMP) i.e. type P

Table 1
Classification criteria used for reporting tympanograms in this study [13].

Curve Type	Criteria	Clinical Presentation
A	TPP ≥ −100 daPa, SAA ≥ 0.2 cm^3	Normal middle ear pressure (MEP), normal static admittance and no MEF
B	Flat curve; ECV = 0.3 to 1.0; no values for TPP	Consistent with Middle ear pathology (MEF)
C	TPP < −100 daPa, SAA ≥ 0.2 cm^3	Significant negative MEP, normal static admittance, no MEF
As	TPP ≥ −100 daPa, SAA ≤ 0.2 cm^3	Reduced admittance, Normal MEP, no MEF
Cs	TPP < −100 daPa, SAA ≤ 0.2 cm^3	Reduced admittance, decreased MEP, no MEF
F	Erroneous peaks (no distinct curves) or ECV < 0.3 in the absence of a distinct curve	Failed tympanogram, child unstable in process or probe in contact with ear canal or ear wax
P	No Peak (or flat curve); ECV > 1.0	Tympanic Membrane perforated

SAA = Static acoustic admittance; TPP = Tympanometry peak pressure; daPa = deca-pascals; MEF = Middle ear fluid; **ECV** = Ear can volume. The difference between A and As (and C & Cs) at SAA = 0.2cm3 was dependent on the graphical display of the curve. When the curve exceeded the lower limit of the graphic normal box, it was described as A (or C, depending on the TPP); A, As, C, Cs = Healthy ears; B = Diseased ear, F = Failed tympanogram; P = Perforation. Curves type B, P and F all have undetermined acoustic reflexes but could not be distinguished from each other based on the measure of the ear canal volume.

tympanogram. Curves with erroneous peaks due to artefacts or movements of the child and curves with ECV below 0.3 cm^3 without any recording of a normal curve were interpreted as failed (type F tympanogram).

2.6. Case definitions

In this study, ears observed by clinical inspection with draining and parental reporting to have lasted more than two weeks were considered as CSOM based on the World Health Organization's criteria [14]. We defined OME as flat, 'type B' tympanogram and a dry TMP was distinguishable from a 'type B' flat curve when the ECV was above 1.0 cm^3. For each subject, one of the following mutually exclusive categories was assigned: CSOM, dry perforation, bilateral OME, unilateral OME and healthy ears.The first four categories were considered to have OM or its complications.

2.7. Statistical analyses

Estimations were made to sample at least 250 participants from each of the five health districts. In determining otitis media prevalence, we first included subjects with CSOM (n_1) in the analysis (Fig. 1). Of the remaining subjects, those with no tympanometry data (n_2) were excluded. Subjects with CSOM (n_1) and subjects with available tympanogram data (n_3, n_4, n_5, and n_6) were included in the analyses. Multivariable logistic regression analysis was performed to assess risk factors for OM. The presence of OM was the primary outcome. In the multivariate analyses, inclusion of covariates (see Table 2) was restricted using a statistically significance level of alpha < 0.05. Statistical analyses were conducted using the statistical software programme, SPSS 24.0 version.

3. Results

3.1. Enrolment and baseline characteristics of subjects

Of the 529 enrolled in the study, ninety six subjects with no tympanogram measurement were excluded and 433 (56% males) were evaluated. The main reason for missing tympanometry data was electrical power cuts. The baseline characteristics of the participants are shown in Table 2. Forty percent of subjects were sleeping alone and the remainder shared their bedrooms with at least one other sibling. Also, majority of subjects were living in same household with at least one sibling who was ≤18 years old. Day care amenities are uncommon in this setting for this age group so all children were enrolled during home visits.

3.2. Preliminary analysis

We noticed in otoscopy that many children had ear wax accumulation, which could block the ear canal and therefore, give a flat 'false type B' tympanogram curve. Thus, we first addressed this question by examining the distributions of the ECV measurements by tympanogram type. In total, there were seventy six flat tympanograms distributed across all the ECV categories. However, we observed that many flat tympanogram curves initially interpreted as 'type B' had low ECV values i.e. 0.3 cm^3 and 0.4 cm^3 in comparison to other tympanogram types (Fig. 2) and, there was a statistically significant difference in the mean ECV values of flat and 'Other type' tympanograms. We interpreted this difference to be probably due to ear wax accumulation resulting in flat tympanograms in many children. Based on the distribution of the ECV values in 'Other type' tympanograms with discernible curves (A, As, C and Cs), we noticed that 90% of these were in the ECV categories of between 0.5 cm^3 to 1.2 cm^3, and 10% were distributed between 0.3 cm^3 and 0.4 cm^3 ECV categories. With respect to this, we therefore adjusted the number of original 'type B' tympanograms with low ECV values of 0.3 cm^3 and 0.4 cm^3 (n = 42, including 12 bilateral i.e. from 6 subjects) to follow the same ECV distribution for the selected categories of 0.3 cm^3 and 0.4 cm^3. Thus, the estimated number of initial flat tympanograms with low ECVs dropped from 42 to 4 i.e. 38/42 flat tympanograms with low ECVs were considered false positive 'type B' i.e. failed tympanograms, and only 4/42 were considered true positives. Therefore, the final number of true 'type B' tympanograms fell from 76 to 38.

3.3. Point estimates for otitis media prevalence

Among the subjects included in the analysis, 42/433 (9.7%) were diagnosed with at least one form of otitis media or its complications. This consisted of 3 (0.7%) children identified with unilateral CSOM, 7 (1.6%) children with bilateral OME and 31 (7.2%) with unilateral OME and 1 (0.2) subject with unilateral dry tympanic membrane perforation (ECV > 1.0 cm^3). In the stratified logistic regression analyses, no statistically significant association was observed between OM and any of the predictors evaluated (Table 2). However, there was a statistically significant association observed between OM and parental reporting of "notice of any current symptoms of upper respiratory tract infections", Prevalence Odds Ratio (POR) = 3.71; 95% CI = 1.69–8.14; p = 0.001.

4. Discussion

In the present study, we enrolled 2 to 3 year-old PCV-unvaccinated children and, estimated the prevalence of otitis media and associated risk factors in a low-resource setting. The results indicate a 9.7% overall prevalence of otitis media or its complications in the study population. Presence of current symptoms of upper respiratory tract infections was statistically significantly associated with OM.

The 9.7% prevalence of OM (including 2.3% of significant middle ear disease) obtained in our study is within the range of findings reported in previous studies. OM prevalence ranging between 2.5% and 41% has been reported from studies in the USA, Turkey, Italy, Nigeria, Kenya, India and Saudi Arabia using varying methodologies [1,15–18]. Earlier studies, which depended on hospital-data rather than community–based data have either focused on OM prevalence and associated risk factors in the first two-years of life or early infancy to the early teens [19–21]. Although studies on otitis media in low-resource settings are limited, age discrepancies may also limit comparisons with the present results. The current study targeted children aged from 2 to 3 years; whereas, previous studies have covered children aged from 0 to 20 years [1,11,15–17,22]. As such, few studies like the present one have focused on screening of otitis media in the general population. Fifteen percent prevalence for otitis media was reported in one Nigerian study on the epidemiology of otitis media in a community of children aged 0–12 years old. In that study, those between the ages of 1–4 years showed the highest prevalence (22.5%) of the disease [11]. Another study in Nigeria reported a prevalence of 37.7% and 43.7% among day-care and non-day-care attendees aged between 6 and 24 months, respectively [23]. Moreover, Minja & Machemba carried out a study among rural and urban school children aged from 5 to 20 years in Dar es Salaam, Tanzania and reported a prevalence of 9.4% and 1.3%, respectively [22]. Further, a Turkish study to determine the prevalence of OME in primary school children reported 10% prevalence [24]. A similar study conducted in the Qassim Region of Saudi Arabia reported 7.5% prevalence [25]. Additionally, an Australian study reported a 15% prevalence of CSOM in 709 Aboriginal children aged 6–30 months in remote communities [26]. Therefore, it appears that the OM prevalence is high in resource-low settings, especially in early childhood.

The relationship between OM and the lone factor observed in this study, i.e. current symptoms of upper respiratory tract infections (URTI) was expected. Children with prevailing symptoms of URTI are known to have a higher risk of developing otitis media than others [27,28]. In addition, the clinical symptoms of acute otitis media are generally

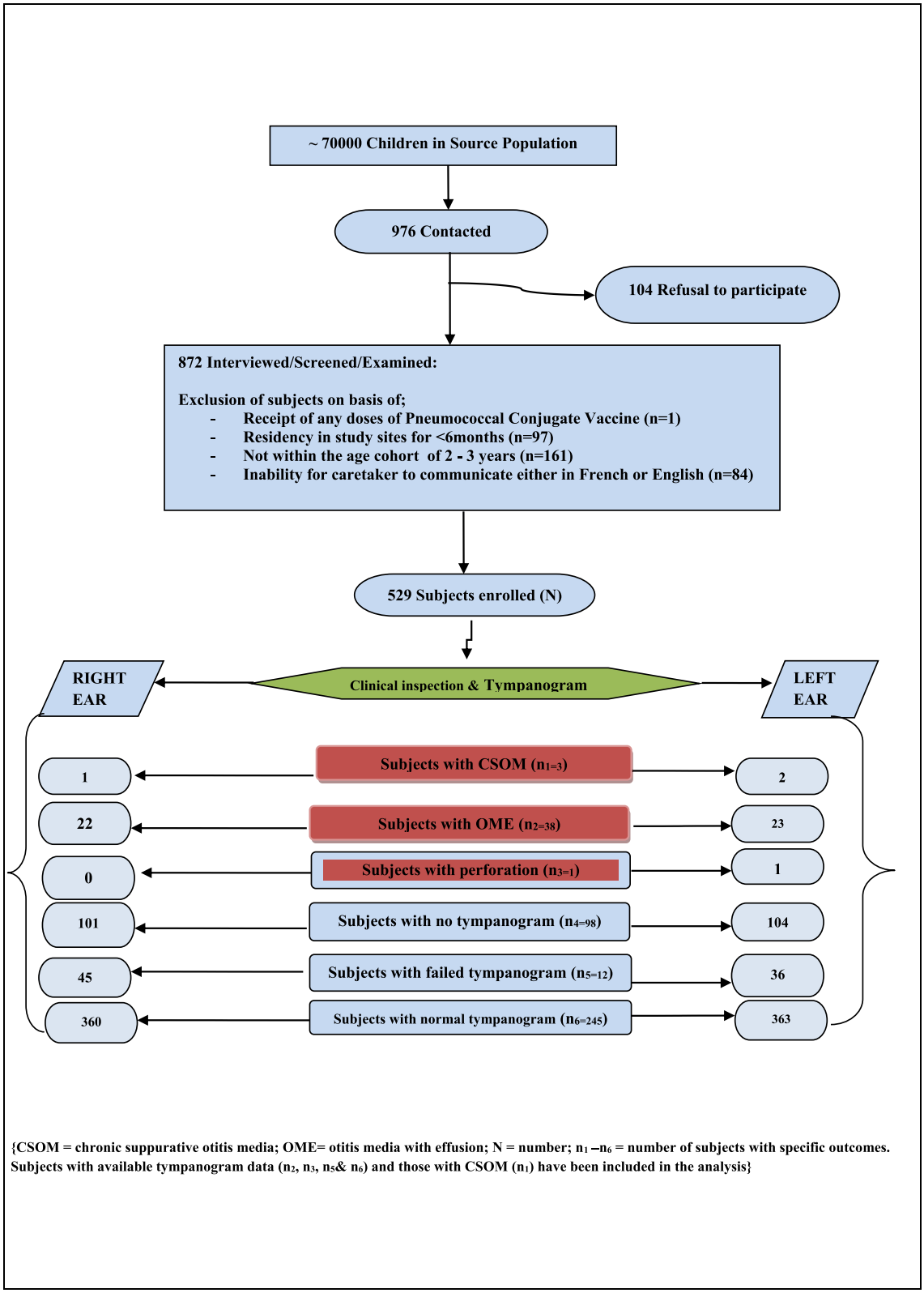

Fig. 1. Flow chart of data collection process and results by ears. {CSOM = chronic suppurative otitis media; OME = otitis media with effusion; N = number; n_1 –n_6 = number of subjects with specific outcomes. Subjects with available tympanogram data (n_2, n_3, n_5& n_6) and those with CSOM (n_1) have been included in the analysis}.

similar to those of URTI [29,30,33]. Although we did not find any risk factor associated with OM in our study apart from the URTI, several other factors have been reported in earlier studies [1,30,31]. No statistically significant association was observed between number of siblings and OM in the present study. This was surprising because families were largely extended with about 60% of the children having at least 3 other siblings living in the same home. Thus, the result is not in line with the finding that increase in the number of persons in homes or

Table 2
Baseline characteristics and their association with Otitis Media (OM) in 2–3 years old children in Cameroon, *N = 429*.

Characteristics	N (%)	Prevalence of OM (%)	Multivariable logistic regression (Modelling for OM)		
			POR	95% CI	p-value
Gender of child					
Male	240 (55.9)	21/240 (8.8)	1.0		
Female	189 (44.1)	17/189 (9.0)	1.03	0.53–2.01	0.929
Age (group) of child in months					
24 to 29	154 (35.9)	12/154 (7.8)	1.0		
30 to 35	109 (25.4)	9/109 (8.3)	1.07	0.43–2.62	0.891
36	166 (38.7)	17/166 (10.2)	1.35	0.55–2.53	0.447
No. of siblings sleeping in same bedroom ≤18years					
Alone	170 (39.6)	14/170 (8.2)	1.0		
One	141 (32.9)	11/141 (7.8)	0.94	0.41–2.15	0.889
Two	84 (19.6)	9/84 (9.6)	1.34	0.55–3.23	0.518
≥ Three	34 (07.9)	4/34 (10.7)	1.49	0.46–4.83	0.510
No. of siblings living in same home ≤18years					
One	76 (17.7)	10/76 (13.2)	1.0		
Two	98 (22.8)	9/98 (9.2)	0.67	0.25–1.74	0.407
≥ Three	255 (59.4)	19/255 (7.5)	0.53	0.24–1.20	0.127
History of previous otitis media					
No	344 (80.2)	27/344 (7.8)	1.0		
Yes	85 (19.8)	11/85 (12.9)	1.75	0.83–3.68	0.143
Breastfeeding period					
≤ 6months or not breastfed	37 (8.6)	2/37(5.4)	1.0		
≤12 months	182 (42.4)	15/182 (8.2)	1.57	0.34–7.19	0.560
> 12 months	210 (49.2)	21/210 (10)	1.94	0.44–8.67	0.383
Antibiotic use when child is sick					
No	147 (34.3)	10/149 (8.1)	1.0		
Yes: with/ without medical report	282 (65.7)	28/280 (9.2)	1.51	0.71–3.20	0.282
Noticed any current URT symptoms					
No	342 (79.7)	26/342 (7.6)	1.0		
Yes	47 (11.0)	13/47 (23)	3.71	1.69–8.14	0.001
Unknown	40 (9.3)	1/40 (2.5)	0.31	0.41–2.36	0.259
Parental educational level (SES1)					
≤ Primary school	146 (34.0)	12/146 (8.2)	1.0		
≥ Secondary school	212 (49.4)	23/212 (10.8)	1.36	0.65–2.83	0.412
≥ University Education	71 (16.6)	3/71 (4.2)	0.49	0.13–1.80	0.285
Parental occupational/income level (SES2)					
No Education	210 (49.0)	15/210 (7.1)	1.0		
No Education, some income	92 (21.4)	7/92 (7.6)	1.07	0.42–2.72	0.886
Some Education	11 (2.6)	1/11 (9.1)	1.30	0.16–10.85	0.808
Higher Education	57(13.3)	5/57 (8.8)	1.25	0.43–3.60	0.679
Student and others	59 (13.8)	10/59 (16.9)	2.65	1.12–6.27	0.026
Parental smoking status					
Non-smokers	370 (86.2)	32/370 (8.6)	1.0		
Smokers	59 (13.8)	6/59 (10.2)	0.95	0.48–2.99	0.703
Using wood/cool as household cooking fuel					
No	127 (29.6)	9/127 (7.1)	1.0		
Yes	302 (70.4)	29/302 (9.6)	1.39	0.64–3.03	0.404

POR = Prevalence Odds Ratio; 95%CI = Ninety-five percent confidence interval; N = Number; % = percentage; OME = Otitis Media with Effusion; URT = upper respiratory tract.

groups facilitates the transmission of URTI and thus development of OM [11,32]. Hence, we expected a positive association as Amusa et al. reported in a Nigerian study [11]. In the current study we did not observe any statistically significant association between exposure to passive smoke and OM, but the number of parents who were smokers was small. A strong correlation between household cooking fuel and OM has been reported in previous studies [1,11,31]. Considering that most of the households depended on wood/coal as cooking fuel, we observed that children were generally more exposed to pollutant smoke from firesides. Similarly, a study conducted in Egypt did not either find any significant association between OM and passive smoke through parental smoking [34]. Some investigators have reported an association between seasonal changes and OM disease prevalence [35], but our study was not designed to measure variations in prevalence in different seasons.

With challenges of data paucity on otitis media in developing countries, this is to our knowledge the first community-based study of otitis media in Cameroon. Moreover, the methodology we have used is not biased by diseases leading to health care attendance or health-care seeking habits. Thus, the findings could be useful as a baseline for evaluating the effectiveness of the pneumococcal conjugate vaccines introduced in 2011 against otitis media disease and sequalae.

Otitis media can be diagnosed using different methods. Although pneumatic otoscopy is the standard tool [36], interpretation of tympanic membrane findings is dependent on a straight visual access, prone to errors and subject to inter-observer variation [37]. Tympanometry, an application of impedance audiometry is a more objective measurement suitable for the diagnosis of middle ear effusion, assessment of tympanic membrane perforations and for the estimation of middle ear pressure [13,38].

In interpreting this result, caution is needed since 96 of the 529 children did not have tympanograms available because of power cuts, and the outcomes for these children remained unknown. Further, the possibility of selection bias should also be carefully considered since 447 of the 976 children contacted could not be enrolled in the study as most of their parents declined [39] (Fig. 1). Additionally, data on otoscopy would have provided more detailed information e.g. of the presence of acute otitis media were not available. This was because we lacked sufficient equipment at field conditions to clean occluded ears.

Tympanometry needs an airtight seal between the probe and the external auditory canal which may pose problems in uncooperative children [13]. Hence, this may result in misclassification as another potential source of bias in this study, i.e. the challenges of distinguishing 'type B' tympanograms from 'type F' or 'type P' tympanograms as they all generate graphically 'flat curves'. The observed differences in the ECV values suggest that we initially misinterpreted many occluded ears as 'type B'. We corrected this by adjusting the majority of these to 'type F' curves based on the ECV distribution in normal tympanograms. Despite of the challenges, our findings provide accurate estimates obtained by tympanometry as it is objective and reliable to detect middle ear effusion in this age group [13,26,37].

The results of OM prevalence from our study population concords with those previously reported elsewhere. The presence of current symptoms of URTI was strongly associated with OM in this population. Lack of adequate materials at field conditions for ear wax removal was one of the main obstacles encountered in the study. However, with limited data on OM in Cameroon and most of Sub-Saharan Africa, our results add to the knowledge on OM from remote settings and could serve as a useful baseline for future vaccine impact studies in Cameroon.

Funding

This work was supported in part by a grant from the International Society of Infectious Diseases (ISID). All research materials were provided by the Finnish National Institute for Health and Welfare (THL). ISID was not involved in the study design, collection, analysis and

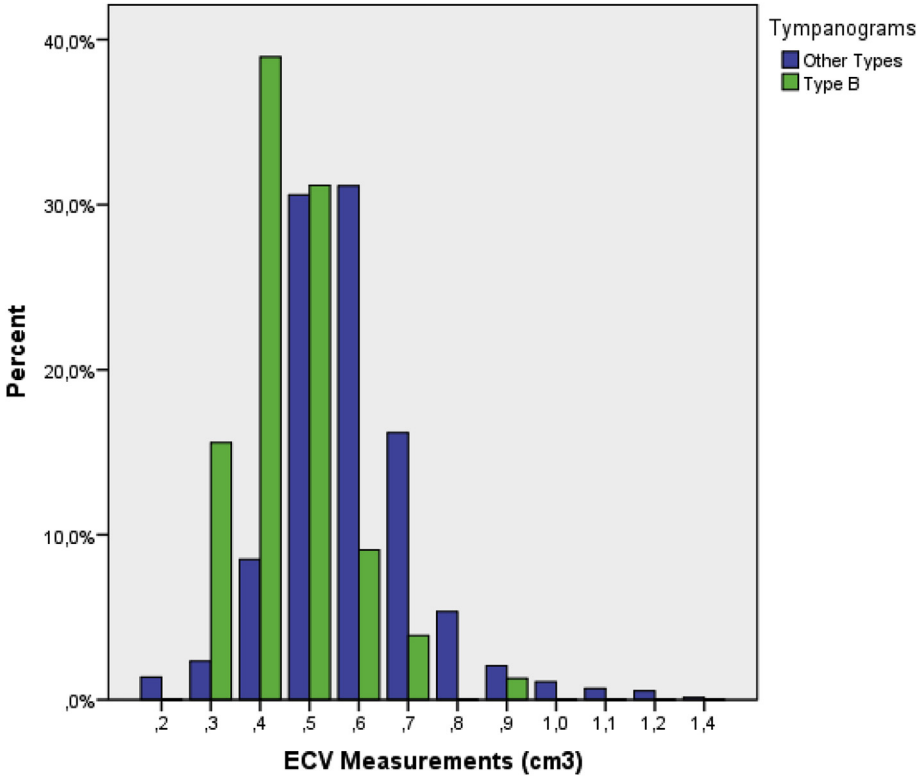

Fig. 2. Distribution of ear canal volume (ECV) measurements on tympanograms types.

interpretation of the data, the writing of the report, and the decision to submit the article for publication.

Declaration of interest

Conflict of interest: none.

Acknowledgements

We sincerely extend our gratitude to all the study participants, study personnel and other collaborators for the immense assistance we received during the conduct of this study. We are particularly indebted to Ms. Päivi Siren (THL, Finland) and Ms. Sandrine Bebey (MCH, Cameroon) for coordinating the logistics and transportation of research materials to and from Cameroon, respectively. Further, our sincere appreciations to the International Society of Infectious Diseases (ISID) for the partial financial support to this study.

References

[1] K. a. Daly, H.J. Hoffman, K.J. Kvaerner, et al., Epidemiology, natural history, and risk factors: panel report from the ninth international research conference on otitis media, Int. J. Pediatr. Otorhinolaryngol. 74 (3) (2010) 231–240, https://doi.org/10.1016/j.ijporl.2009.09.006.
[2] M.M. Rovers, The burden of otitis media, Vaccine 26 (2008) 10–12, https://doi.org/10.1016/j.vaccine.2008.11.005.
[3] M. Verhoeff, E.L. Van Der Veen, M.M. Rovers, E. a M. Sanders, A.G.M. Schilder, Chronic suppurative otitis media: a review, Int. J. Pediatr. Otorhinolaryngol. 70 (2006) 1–12, https://doi.org/10.1016/j.ijporl.2005.08.021.
[4] Adeyi Adoga, O.S. Tonga Nimkur, Chronic suppurative otitis media: socio-economic implications in a tertiary hospital in Northern Nigeria, BMC Publ. Health 2 (2010) 1–8.
[5] A.M. Capra, T.A. Liew, S.B. Black, H.R. Shinefied, K.E.K.J. Martin, Costs of otitis media in managed care population, Pediatr. Infect. Dis. J. 19 (4) (2000).
[6] http://povertydata.worldbank.org/poverty/country/CMR.
[7] http://www.who.int/workforcealliance/countries/cmr/en/.
[8] E.A.F. Simões, F. Kiio, P.J. Carosone-Link, S.N. Ndegwa, J. Ayugi, I.M. Macharia, Otitis media and its sequelae in Kenyan schoolchildren, J Pediatric Infect Dis Soc (2015), https://doi.org/10.1093/jpids/piv038.
[9] R. Anggraeni, W.W. Hartanto, B. Djelantik, et al., Otitis media in Indonesian urban and rural school children, Pediatr. Infect. Dis. J. 33 (10) (2014) 1010–1015, https://doi.org/10.1097/INF.0000000000000366.
[10] A. Vergison, R. Dagan, A. Arguedas, et al., Otitis media and its consequences: beyond the earache, Lancet Infect. Dis. 10 (2010) 195–203, https://doi.org/10.1016/S1473-3099(10)70012-8.
[11] Y.B. Amusa, I.K.T. Ijadunola, O.O. Onayade, Epidemiology of otitis media in a local tropical African population, W. Afr. J. Med. 24 (3) (2005) 227–230 http://www.ncbi.nlm.nih.gov/pubmed/16276700 , Accessed date: 28 December 2015.
[12] P. Morris, A. Leach, P. Shah, N. Sandi, A. Anand, J. Duby, R. Allnut, D. Bainbridge, E.P.H. KeithDarwin Otitis Guidelines Group & Office for Aboriginal and Torres Strait Islander Health Otitis Media Technical Advisory Group, Recommendations for Clinical Care Guidelines on the Management of Otitis Media, Aboriginal & Torres Strait Islander., 2010.
[13] A. Palmu, H. Puhakka, T. Rahko, A. Takala, T. Kilpi, Predicting the development and outcome of otitis media by tympanometry, Int. J. Pediatr. Otorhinolaryngol. 62 (2002) 135–142, https://doi.org/10.1016/S0165-5876(01)00608-5.
[14] World Health Organization, Chronic Suppurative Otitis Media: Burden of Illness and Management Options. Geneva, Switzerland, (2004).
[15] S.K. Chadha, K. Gulati, S. Garg, A.K. Agarwal, Comparative prevalence of otitis media in children living in urban slums, non-slum urban and rural areas of Delhi, Int. J. Pediatr. Otorhinolaryngol. 78 (2014) 2271–2274, https://doi.org/10.1016/j.ijporl.2014.10.032.
[16] E. Gultekin, Ö.N. Develioğlu, M. Yener, I. Ozdemir, M. Külekçi, Prevalence and risk factors for persistent otitis media with effusion in primary school children in Istanbul, Turkey, Auris Nasus Larynx 37 (2010) 145–149, https://doi.org/10.1016/j.anl.2009.05.002.
[17] F. Martines, D. Bentivegna, F. Di Piazza, G. Martinciglio, V. Sciacca, E. Martines, The point prevalence of otitis media with effusion among primary school children in Western Sicily, Eur. Arch. Oto-Rhino-Laryngol. 267 (2010) 709–714, https://doi.org/10.1007/s00405-009-1131-4.
[18] Y. El-Sayed, S. Zakzouk, Point prevalence of type B tympanogram in Riyadh, Int. J. Pediatr. Otorhinolaryngol. 31 (1995) 53–61, https://doi.org/10.1016/0165-5876(94)01075-9.
[19] A. Mark, V. Matharu, G. Dowswell, M. Smith, The point prevalence of otitis media with effusion in secondary school children in Pokhara, Nepal: a cross-sectional study, Int. J. Pediatr. Otorhinolaryngol. 77 (9) (2013) 1523–1529, https://doi.org/10.1016/j.ijporl.2013.06.024.
[20] J. Engel, L. Anteunis, a Volovics, J. Hendriks, E. Marres, Risk factors of otitis media with effusion during infancy, Int. J. Pediatr. Otorhinolaryngol. 48 (1999) 239–249.
[21] J.L. Paradise, H.E. Rockette, D.K. Colborn, et al., Otitis media in 2253 Pittsburgh-area infants: prevalence and risk factors during the first two years of life, Pediatrics 99 (1997) 318–333, https://doi.org/10.1542/peds.99.3.318.
[22] B.M. Minja, A. Machemba, Prevalence of otitis media, hearing impairment and cerumen impaction among school children in rural and urban Dar es Salaam, Tanzania, Int. J. Pediatr. Otorhinolaryngol. 37 (1) (1996) 29–34 http://www.ncbi.nlm.nih.gov/pubmed/8884404 , Accessed date: 28 December 2015.

[23] C.N. Asoegwu, C.C. Nwawolo, A.O. Somefun, Prospective evaluation of the impact of daycare attendance on the prevalence of otitis media with effusion in 6 to 24 months old children in urban Nigeria, Niger. Q. J. Hosp. Med. 23 (1) (2013) 7–11 http://www.ncbi.nlm.nih.gov/pubmed/24579486 , Accessed date: 28 December 2015.
[24] C.E. Ozlem, O.C. Zerin, C.K.M.D. Kadir, Prevalence of otitis media with effusion among primary school children in Eastern Black Sea in Turkey and the effect of smoking in the development of otitis media with effusion, Indian J. Otolaryngol. Head Neck Surg. 64 (1) (2012) 17–21.
[25] A.-H.I. Humaid, A.S. Ashraf, K.A. Masood, A.-H.S. Nuha, A.A. Saleh ADA, Prevalence and risk factors of otitis media with effusion in school children in Qassim Region of Saudi Arabia, Int. J. Health Sci. 8 (4) (2014) 325–334.
[26] P.S. Morris, A.J. Leach, P. Silberberg, et al., Otitis media in young Aboriginal children from remote communities in Northern and Central Australia: a cross-sectional survey, BMC Pediatr. 5 (2005) 27, https://doi.org/10.1186/1471-2431-5-27.
[27] C. Kucur, E. Simsek, O. Kuduban, I. Ozbay, Prevalence of and risk factors for otitis media with effusion in primary school children: case control study in Erzurum, Turkey, Turk. J. Pediatr. 57 (3) (2015) 230–235.
[28] P.S. Morris, A.J. Leach, Acute and chronic otitis media, Pediatr. Clin. 56 (6) (2009) 1383–1399, https://doi.org/10.1016/j.pcl.2009.09.007.
[29] O.C. Erdivanli, Z.O. Coskun, K.C. Kazikdas, M. Demirci, Prevalence of otitis media with effusion among primary school children in eastern black sea, in Turkey and the effect of smoking in the development of otitis media with effusion, Indian J. Otolaryngol. Head Neck Surg. 64 (March) (2012) 17–21, https://doi.org/10.1007/s12070-011-0131-z.
[30] E.A. Macintyre, C.J. Karr, M. Koehoorn, et al., Otitis media incidence and risk factors in a population-based birth cohort, Paediatr. Child Health 15 (7) (2010) 437–442.
[31] Y. Zhang, M. Xu, J. Zhang, L. Zeng, Y. Wang, Q.Y. Zheng, Risk factors for chronic and recurrent otitis media-A meta-analysis, PloS One 9 (1) (2014), https://doi.org/10.1371/journal.pone.0086397.
[32] M. Kiris, T. Muderris, T. Kara, S. Bercin, H.S.E. Cankaya, Prevalence and risk factors of otitis media with effusion in school children in Eastern Anatolia, Int. J. Pediatr. Otorhinolaryngol. 76 (2012) 1030–1035.
[33] M. Uhari, K. Mäntysaari, M. Niemelä, A meta-analytic review of the risk factors for acute otitis media, Clin. Infect. Dis. 22 (January) (1996) 1079–1083.
[34] M. Salah, M. Abdel-Aziz, A. Al-Farok, A. Jebrini, Recurrent acute otitis media in infants: analysis of risk factors, Int. J. Pediatr. Otorhinolaryngol. 77 (10) (2013) 1665–1669, https://doi.org/10.1016/j.ijporl.2013.07.022.
[35] M. a. Gordon, E. Grunstein, W.B. Burton, The effect of the season on otitis media with effusion resolution rates in the New York Metropolitan area, Int. J. Pediatr. Otorhinolaryngol. 68 (2004) 191–195, https://doi.org/10.1016/j.ijporl.2003.10.011.
[36] G.S. Takata, L.S. Chan, T. Morphew, R. Mangione-Smith, S.C. Morton, P. Shekelle, Evidence assessment of the accuracy of methods of diagnosing middle ear effusion in children with otitis media with effusion, Pediatrics 112 (6) (2003) 1379–1387, https://doi.org/10.1542/peds.112.6.1379.
[37] T. Puhakka, J. Pulkkinen, H. Silvennoinen, T. Heikkinen, Comparison of spectral gradient acoustic reflectometry and tympanometry for detection of middle-ear effusion in children, Pediatr. Infect. Dis. J. 33 (8) (2014) e183–e186, https://doi.org/10.1097/INF.0000000000000273.
[38] A.S. Lieberthal, A.E. Carroll, T. Chonmaitree, et al., The diagnosis and management of acute otitis media, Pediatrics 131 (2013) e964–e999, https://doi.org/10.1542/peds.2012-3488.
[39] P. Edwards, I. Roberts, M. Clarke, C. Di Guiseppi, S. Pratap, R.K.I. Wentz, Increasing response rates to postal questionnaires: systematic review, BMJ (2002), https://doi.org/10.1136/bmj.325.7361.444.