Middle Ear Disease and Hearing Loss Among Urban Children and Orphans in Bauru, Brazil. A Study of Prevalence and Practical Screening Priorities

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Introduction

It is a well-known fact that the prevalence of middle ear disease is high among certain populations, like Inuits and North American Indians [1-3]. Racial factors as well as socio-economic conditions may both contribute to the differences found [4-7]. However, investigations of middle ear disease and hearing loss in developing countries are few. In a study of school children in Angola [8], it was found that chronic otitis media (COM) was more common among *children* in a socioeconomically underprivileged district than among those with better living conditions. Other studies by Bastos *et al* [9-10] have shown that COM constitutes a health probiem among school children in developing countries of Africa. On the other hand, secretory otitis media (SOM), was not as common as in, e.g., Scandinavia [11], where SOM is e main cause of hearing impairment among school children.

The aims of the present study were:

a) to determine the prevalence of COM among children in two socio-economically different populations.

b) to determine the prevalence of SOM in the above mentioned populations.

c) to evaluate the usefulness of otoscopy and tympanometry as screening methods for middle ear dísease in the above mentioned populations.

Material

The investigation was carried in Bauru a town of about 350,0000 inhabitants situated around 300 km west of São Paulo, Brazil. At the time of the investigation there were 17 Otorhinolaryngologists in Bauru, three of them engaged in public governmental service and fourteen in private practice.

Altogether 403 children were examined: the first group comprised 259 children from randomly chosen schools and pre-schools in the urban poor districts. The second group consisted of 144 children living in an orphanage.

The children living in urban poor districts were defined as group I, and the orphanage children as group II. Their age and sex distribution are demonstrated in **Figure 1**.

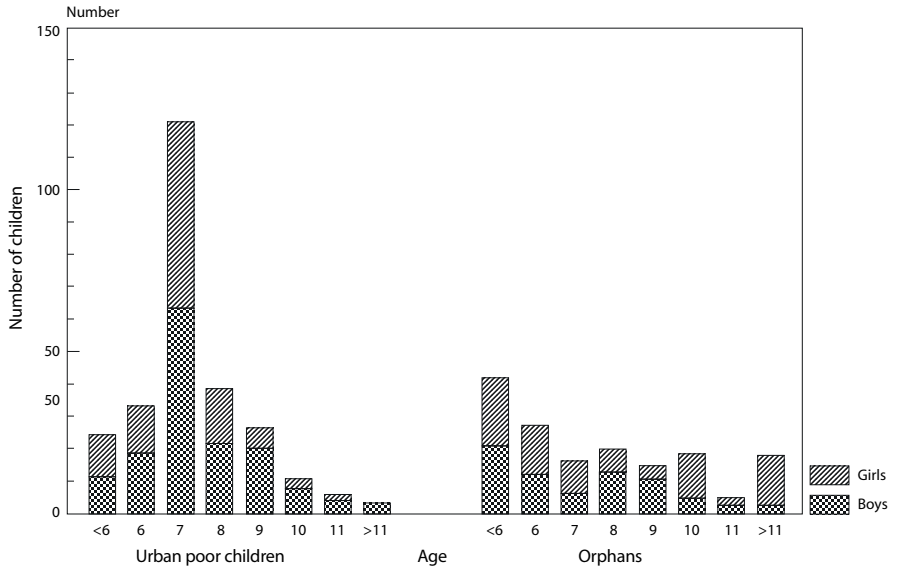

Figure 1. Urban/Orphans childrens (sex and number)

All the children were examined with otoscopy. The distribution of age in these different groups is shown in **Table 1**. For practical reasons, hearing could not be tested in all the children, as some of them ran away and others refused. In all, 299/403 children had their hearing tested, and tympanometry was performed in 361/403 children for the above reasons. These missing children did not affect the distribution of age. The study was carried out in February 1989 and February 1990.

Table 1. Age distribution

	Otoscopy	Tympanometry	Screening Audiometry
Age (year)	n = 403	n = 361	n = 299
	%	%	%
< 6	14.6	13.9	13.7
6 - 7	48.4	49.0	52.2
8 - 9	23.8	23.3	21.7
10 - 11	8.7	9.4	7.7
≥ 12	4.5	4.4	4.7
Total	100%	100%	100%

Examination of ear and hearing

Otoscopy

A team consisting of one or two otolaryngologists and 2-4 hearing technicians performed the examination. All the children were first examined with otoscopy. Tympanometry, as well as screening audiometry, were carried out independently of otoscopy findings. Otoscopy was performed with an otoscope. The presence or absence of otorrhea, perforations of the tympanic membranes, scarred or sclerotic

tympanic membranes, and foreign bodies were determined, A visible perforation of >25 % of the tympanic membrane (TM) surface with or without otorrhea (intermittent or lasting for ≥3 months) was used as the criterion for chronic otitis media (COM). Scarring or calcification of the TM, signs of middle ear effusion or retraction, were defined as minor pathology (MP).

Hearing test

The hearing screening was performed with a conventional audiometer and TDH 39 head were unacceptable. The frequencies 500, 1000, 2000, 4000, and 6000 Hz were tested, The screening threshold value was 20 dB HL. For children failing the screening test, an exact pure tone threshold was set at the affected frequencies, by means of presenting signals with intensities increasing in 10 dB steps and decreasing in 5 dB steps.

Results of the hearing tests were calculated as the mean values of the intensity above the screening threshold for the frequencies 500, 1000 and 2000 Hz. Hearing impairment thus means that the child did not pass the screening level at one or more of these frequencies.

Tympanometry

Using the Madsen impedance bridge ZO 70 (probe tone 220 Hz) the pressure in the external ear canal was varied between -300 and +200 mm water pressure. The results were classified into four types:

A, ±l00 mm water pressure; Cl , -101 to -200 mm water pressure; C2, < -200 mm water pressure. and B, flat curve.

Test for contralateral acoustic reflex was performed at 90-110 dB HL for white noise stimulus. The presence of secretory otitis media or otitis media with effusion (SOM) was identified according to the diagnostic algorithm suggested by Bluestone *et al*, 1979.

Statistical analysis

All information was recorded in a specially designed form and later subjected to data processing. Statistical distributions were compared with Chi-squared analysis and z-test for two proportions.

Results

Otoscopy

The otoscopy findings among the children in Group I (urban poor) and Group II (orphans) are demonstrated in **Table 2**.

Table 2. Otoscopy findings

Otoscopy finding	Group I.			Group II.		Total	
	Unilat	Bilat		Unilat	Bilat	n	%
Bilat NTM	-	185		-	88	273	67.7
Cerurnen	25	20		6	6	57	14.1
Minor pathology	15	8	$p<0.001$	14	21	58	14.4
Acute otitis media	2	1		-	-	3	0.7
Chronic otitis media	2	1	$p<0.001$	3	6	12	3.0
Total		259			144	403	

Otoscopy findings among 403 children in Bauru, Brazil.
NTM = normal tympanic membrane.

The prevalence of MP in the two groups was 10 % and 24 %, respectively. After standardization for age, the prevalence was 12 % and 24 %, respectively, the difference being significant (z=3.134; $p<0.001$). Secretory otitis media was more common among the children below 6 years of age (14/59) than among those aged 6 and above (27/344), the difference being significant ($X^2=13.897$; df= 1; $p<0.001$).

Minor pathology included 13 cases (20 ears) of secretory otitis media in Group I, and 28 cases (48 ears) in Group II.

COM was found in 3 children (1.2 %), and 4 ears, in Group I, and in 9 children (6.3 %), 15 ears, in Group 11. After standardization for age, the prevalence was 2.7 % and 5.8 %, respectively. The difference is significant (z=4.290; $p<0.001$). Three children with unilateral COM had signs of SOM in the contralateral ear.

Otoscopy and tympanometry

Of 361 children subject lo both otoscopy and tympanometry, 26 children had SOM according lo the algorithm used. SOM was identified in 9/236 children in Group I, and 17/125 children in Group II, the difference being significant (X2=11.710; df=1; $p<000l$). Tympanometry was performed in 642 ears, otoscopically identified either as being normal or as having SOM (**Table 3**). By otoscopy, 572/642 ears were identified as normal, while 70 ears were identified as having SOM. Tympanometry revealed 46 ears with SOM, 7 of them being otoscopically normal. The probability of identifying SOM by otoscopy alone was 85 %.

Table 3. Otoscopy findings

Otoscopy	SOM present	SOM absent	Total
Signs of SOM	39	31	70
Normal TM	7	565	572
Total	46	596	642

Comparison between otoscopy findings and the presence or absence of SOM according to the adopted algorithm for SOM. 642 ears.

Screening audiometry

A total of 299 children were hearing tested (**Table 4**). Normal hearing (≤20 dB HL) was found in 179 children; 120 children (40 %) showed hearing impairment. Normal tympanic membranes were found in two thirds (76/120) of the children with hearing impairment ≤30 dB HL. Five children showed unilateral hearing impairment ≥31 dB HL, one of them with impacted cerumen, one with SOM. one with acute otitis media, and two with COM. Three children, two of them otoscopical1y c1assified as having MP(SOM) and one with COM, had a bilateral hearing impairment of ≥31 dB HL in the better ear.

Table 4. Hearing levels according otoscopy findings

	Hearing level dB HL				Total
Otoscopy finding	≤20	21-25	26-30	≥30	
Normal TM	152	52 (18)	24 (7)	-	228
Cerumen	16	9 (3)	3 (1)	1 (-)	29
Minor pathology					
SOM	7	2 (-)	9 (4)	3 (2)	21
Scar/sclerosis	4	6 (4)	2 (2)	-	12
Acute OM	-	-	1 (-)	1 (-)	2
Chronic OM	-	-	4 (1)	3 (1)	7
Total	179	69	43	8	299

Relationschip between otoscopy findings and screening audiometry among 299 children. Numbers within brackets ( ) are cases with bilateral hearing impairment.

Screening audiometry and SOM

Screening audiometry and tympanometry were performed in 511 ears, identified by otoscopy and tympanometry either as normal or as having SOM (**Table 5, Table 6**). A comparison between two different screening levels, 20 dB HL and 25 dB HL, showed that the sensitivity did not increase by using the lower screening level and that the specificity decreased. The predictive value of screening audiometry decreased from 27 % to 10.3 %, as a substantial amount of otoscopically and tympanometrically normal ears were classified as hearing impaired.

Table 5. Hearing screening

Hearing	SOM	Normal	Total
Hearing impairment	14	122	136
Normal hearing	13	362	375
Total	27	484	511

Results of screening audiometry (level 20 dB HL) in 511 ears.
Hearing impairment = mean value for 500, 1000 and 2000 KHz >20 dB HL.
SOM = secretory otitis media diagnosed by otoscopy and tympanometry.
Normal tympanic membrane and normal tympanometry.

Sensitivity: 52%, Specificity: 75%, Predictive value: 10.3%

Table 6. Hearing screening

Hearing	SOM	Normal	Total
Hearing impairment	14	38	52
Normal hearing	13	446	459
Total	27	484	511

Results of screening audiometry (level 25 dB HL) in 511 ears.
Hearing impairment = mean value for 500, 1000 and 2000 KHz >25 dB HL.
SOM = secretory otitis media diagnosed by otoscopy and tympanometry.
Normal tympanic membrane and normal tympanometry.

Sensitivity: 52%, Specificity: 92%, Predictive value: 27%

High frequency loss

Nine children, aged 7 to 10 years, had a hearing loss ≥35 dB HL in the frequencies 4000 and 6000 Hz with normal hearing within the speech frequency range. Tympanometry was normal in ali lhe ears with high frequency loss.

Discussion

Methods of screening for middle ear disease and hearing loss

The main reasons for screening for hearing impairment and middle ear disease in developing countries should be

1. to detect middle ear disease, which left untreated may have serious complications, but for which simple treatment at primary health care level exists.
2. to detect hearing loss of such a degree that it interferes with the child's language development at performance at school.

The detection of SOM by otoscopy alone was compared with the combination of otoscopy, tympanometry and middle ear reflex measurements, using the same criteria for pathology at otoscopy as in our previous studies. Otoscopy alone as a tool for diagnosing SOM was reasonably good. There were few false negative findings. As expected, the majority of normal ears were identified. although an over diagnosis of SOM by otoscopy was noted.

Whether tympanometry should be added to otoscopy and screening audiometry is a question of local resources, the prevalence of SOM in the population studied, and locally existing possibilities for the treatment of SOM.

A majority of cases with SOM will recover spontaneously [12]. The existing treatment of selected cases of chronic SOM with tympanostomy tubes is performed by specialists, and cannot be recommended as a simple treatment that should be carried out at primary hea1th care level in developing countries. In the present study. only two out of 21 children with SOM had bilateral hearing impairment of such a degree that the insertion of tympanostomy tubes might have been indicated.

Chronic otitis media among children in developing societies is characterized by an early onset [1,13,14]. Early and adequate treatment of acute otitis media and discharging ears would prevent many children from contracting COM. COM is a serious middle ear disease with potential complications. "Safe ears" are not always safe [15]. Simple conservative treatment of chronically discharging ears may be given at primary.

In our earlier studies, we could not detect all ears with COM by using screening audiometry. Otoscopy must be added to discover all cases of COM. In cases of COM with discharge, tympanometry is not possible, as it can be difficult to obtain a good seal between the ear canal and the measuring probe [16]. Tympanometry alone might lead to missed cases of COM with a swollen middle ear mucosa, giving a curve identical to the one found in ears with SOM (Bylander A, personal communication, 1994). Thus, when screening for COM, otoscopy is poreferable to tympanometry.

In the present study, a change of the screening level from 25 to 20 dB HL more than doubled the number of hearing impaired (by definition) children, most of whom (75%) had normal TMs and middle ears. Hearing impairment above 30

dB HL was found only in children with a pathological findings at otoscopy. The sensitivity for screening audiometry in the detection of SOM was low at either screening level (**Table 4, 5** and **6)**. It therefore seems reasonable to set the screening level to at least 25 dB HL.

Prevalence of middle ear disease

In earlier studies of African school children, SOM has not been a common finding. [8-10] In the present study, the prevalence of SOM, diagnosed by otoscopy, using the same criteria as in our earlier studies, was higher (7.8% in the school age children) as compared with 0.5% in Tanzanian school children. This difference might due to the *mixed* population with children of African, European or Amerindian origin. This agrees with the results of several other studies which indicate a higher prevalence of middle ear pathology in children of Indian and Caucasian origin as compared to children of African origin [17,5,18,,19]. There is a close link between low education / low socio-economic status and the utilization of health care services and compliance, respectively [20-22]. In the present study, otoscopical signs of past or present middle aear disease were found in 18% of all children investigated. Both SOM and COM were significantly more common among the underprivileged children in the orphanage as compared to the urban poor children.

A low socio-economic status and failure to identify ear problems, due to lack of information or illiteracy, are the main reasons for keeping the parents from calling on medical attendance. In earlier studies among African school children by Bastos et al [8,9,10,14], COM has shown a prevalence of 1.6% to 4.2%, the highest prevalence being found among urban underpriviledged children. Our findings in the present investigation correlate very well with our findings in Africa, stressing an association between low socio-economic status and the presence of COM and SOM.

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