TYMPANOMETRIC FINDINGS IN A GROUP OF STUDENTS

Achados timpanométricos em um grupo de escolares

Tâmara de Andrade Lindau [1], Camila Ribas Delecrode [2], Ana Claúdia Vieira Cardoso [3]

ABSTRACT

Purpose: to characterize and compare the tympanometric findings in a group of preschoolers. **Method**: 112 preschoolers were evaluated, both genders, aged from four years old to five years and eleven months old who attended a Municipal School of Early Childhood Education in the suburbs of Marilia city– SP. Tympanometry was used as triage procedure. It was considered that the child PASSED in the triage when it presented an A type tympanometric curve, bilaterally, being reevaluated in case of failure. **Results:** it was observed a high failure index (63.4%) in the studied population. The older female preschoolers presented a higher index of A type tympanograms, in both ears. There was a higher incidence of failure in male preschoolers aged from four years to four years and eleven months. **Conclusion:** in this sample, there was a high index of tympanometric alteration. There was a tendency among younger male students to present a higher index of tympanometric alteration when compared to older female preschoolers, this difference was not statistically significant.

KEYWORDS: Hearing; Preschool; Triage; Middle Ear; Acoustic Impedance Tests

INTRODUCTION

Hearing is a pre-requisite for language acquisition and development. Any sensorial hearing deprivation may result on problems in communication processes, interfering in the global cognitive development, learning and interpersonal relationships, and may also impair the school and therefore the professional performance of the affected population[1-3].

Recurrent otitis media is one of the most frequent causes of hearing loss[3,4]. Most often, approximately 70% of the cases, it would be a complication of any upper airway infection[4-6].

Some studies report that in addition to any upper airway infection, there are other risk factors related to otitis media, such as: care in day care centers, seasonal variation, the presence of siblings (family size), exposure to passive smoking, breastfeeding, socioeconomic level, health care and pacifier use[7]. These factors are not directly related to the physiopathology of the disease, but if present, represent an increased risk of disease, probably it influences one or more of the causal mechanisms[3,8].

There are some behaviors that are suggestive of auditory deprivation caused by otitis media which are: turn the head toward the sound source, frequent requests for repetition, high or low vocal intensity, focus on the teacher´s lip, lack of attention, social isolation, learning disabilities, among others[2]. These manifestations may be missed by parents and educators, and may interfere on language development and school performance[2,9].

When one considers the risk factors related to changes of the middle ear and the impact caused by deprivation, it becomes essential to conduct the screening aimed at the early detection of such changes in order to minimize the losses. The findings of such changes was reported by a study conducted with 287 students from five to ten years of age, it found a prevalence of 39,4% of immitance screening failure, it showed that students between the ages of nine and ten years have failed less than the younger ones and this difference was statistically significant[9].

(1) Philosophy and Science College of São Paulo State University – UNESP, Marília, SP, Brasil.

(2) Studies Centre for Education and Health of the Philosophy and Science College of São Paulo State University – UNESP, Marília, SP, Brasil.

(3) Department of Speech Therapy of the Philosophy and Science College of São Paulo State University – UNESP, Marília, SP, Brasil.

Conflict of interest: non-existent

The American Speech and Hearing Association (ASHA) screening guidelines include the following procedures to screen for outer and middle ear disorders in children: case history obtained from the child´s parents or guardian; otoscopic inspection for obvious structural anomalies or obstructions of the ear canal and tympanic membrane; and low frequency (220 or 226 Hz) tympanometry. Pure-tone screening is not employed by contemporary protocols for identifying outer and middle ear disorders[10].

Similar to the ASHA guidelines, the American Academy of Audiology (AAA) recommends immediate medical referrals if any of the following conditions are identified: otalgia, otorrhea, external ear disease, and flat tympanogram with ear volume > 1.0 cm^3 (suggesting eardrum perforation) unless there is a tympanostomy tube[10,11].

Thus the hearing screening is an efficient way to determine the appropriate approach to be adopted with students regarding peripherical hearing loss and/or hearing abilities. If necessary, it should be adopted medical and speech therapy approaches associated with hearing screening to minimize the resulting consequences, especially the learning process of reading and writing.

So the present study aimed to characterize and to compare the tympanometric findings in a group of preschoolers.

METHOD

This study was conducted in a Municipal Pre-School of Education located in a suburban area of Marilia, whose population has a low socioeconomic level.

At the school we develop an Extension Project aiming to perform hearing screening, tympanometry and auditory processing screening in preschoolers. In this study, especially, the focus was the tympanometric findings.

It was evaluated 112 preschoolers, from both genders, aged from four to five years and eleven months. The preschoolers were divided according to gender and age as in Table 1.

It was considered as inclusion criteria: the parents or guardian sign the informed consent term and the child remaining at school in integral period.

Table 1 – Preschoolers' distribution according to the variables age group and gender

AGE GROUP	GENDER		TOTAL
	Female	Male	
4y to 4y11m	29	32	61
	25,90%	28,60%	54,50%
5y to 5y11m	23	28	51
	20,50%	25,00%	45,50%
Total	52	60	112
	46,40%	53,60%	100,00%

It is important to emphasize that in this sample there were no children with signs or symptoms which were suggestive of syndrome or craniofacial malformations.

Initially was carried out the otoscopic inspection to identify changes that would prevent the tympanometry or compromise the reliability of the results. The changes observed during the inspection were considered as exclusion criteria, on these cases the family was advised and referred to medical care.

The immitanciometry was performed using a middle ear analyzer Grasson-Standler GSI-38, low frequency (226 Hz), with insert earphones and probe system. It was inserted the probe tip into the ear canal to seal.

To analyze the tympanometric findings were used the tympanogram classification system proposed by Jerger (1970)[12]. It was considered the PASS/FAIL criterion; the preschooler PASSED when presented Type A tympanogram on both ears, and FAILED when presented other tympanogram type. The preschooler who FAILED was rescreened after six weeks[11].

This research project was approved on the Ethics Committee of the College of Philosophy and Science – UNESP- Marília, protocol number 132/2010.

To describe the results was used the descriptive and inferential analysis. At inferential statistical analysis was applied the Likelihood Ratio Test in

order to verify the possible differences between genders and age groups for the variables of interest (tympanogram type and PASS/FAIL criterion). When analyzing the results of the association between the gender and age variables with the screening results (PASS/FAIL criterion) it was noticed a tendency, then it was applied the Likelihood Ratio Test adjusted by Bonferroni correction in order to identify which combinations of gender and age have tended to be different. The significance level adopted for the application of the statistical tests was 5% (0.005) and the analysis was performed using SPSS program (Statistical Package for Social Science) , in 19.0 version.

RESULTS

The analysis of the results showed a high failure rate (63, 4%) in this population (Table 2 and 3).

Table 2 – Tympanogram type distribution according to the age variable on right and left ear

Age	RIGHT EAR				LEFT EAR			
	A	Ad	B	C	A	Ad	B	C
4y to 4y11m	23	0	22	16	23	0	26	12
N=61	37,70%	0,00%	36,10%	26,20%	37,70%	0,00%	42,60%	19,70%
5y to 5y11m	30	2	11	8	26	2	14	9
N=51	58,80%	3,90%	21,60%	15,70%	51,00%	3,90%	27,50%	17,60%
Total	53	2	33	24	49	2	40	21
N=112	47,30%	1,80%	29,50%	21,40%	43,80%	1,80%	35,70%	18,80%
	p = 0,026*				p = 0,105			

Likelihood Ratio Test/ p-value < 0,005 = statistically significant*

Table 3 – Tympanogram type distribution according to the gender variable on right and left ear

Gender	RIGHT EAR				LEFT EAR			
	A	Ad	B	C	A	Ad	B	C
Female	33	0	13	6	25	0	16	11
N=52	63,50%	0,00%	25,00%	11,50%	48,10%	0,00%	30,80%	21,20%
Male	20	2	20	18	24	2	24	10
N=60	33,30%	3,30%	33,30%	30,00%	40,00%	3,30%	40,00%	16,70%
Total	53	2	33	24	49	2	40	21
N=112	47,30%	1,80%	29,50%	21,40%	43,80%	1,80%	35,70%	18,80%
	p = 0,004*				p = 0,275			

Likelihood Ratio Test/ p-value < 0,005 = statistically significant*

Whereas the variables age (Table 2) and gender (Table 3), it was observed that the male preschoolers with lower age presented lower rates of Type A tympanograms in both ears when compared to female preschoolers of higher age, this difference was statistically significant on both variables in the right ear.

As regards the pass/fail criterion for both age groups (Table 4) and genders (Table 5), the results showed a higher fail incidence for males at the age group of four years to four years and eleven months, however, this difference was not statistically significant on any variable.

Table 4 – The occurrence of pass/fail on tympanometry according to the age variable

Age	TYMPANOMETRY		Total
	Pass	Fail	
4y to 4y11m	18	43	61
	29,50%	70,50%	100,00%
5y to 5y11m	23	28	51
	45,10%	54,90%	100,00%
Total	41	71	112
	36,60%	63,40%	100,00%
p = 0,088			

Likelihood Ratio Test/ p-value < 0,005 = statistically significant*

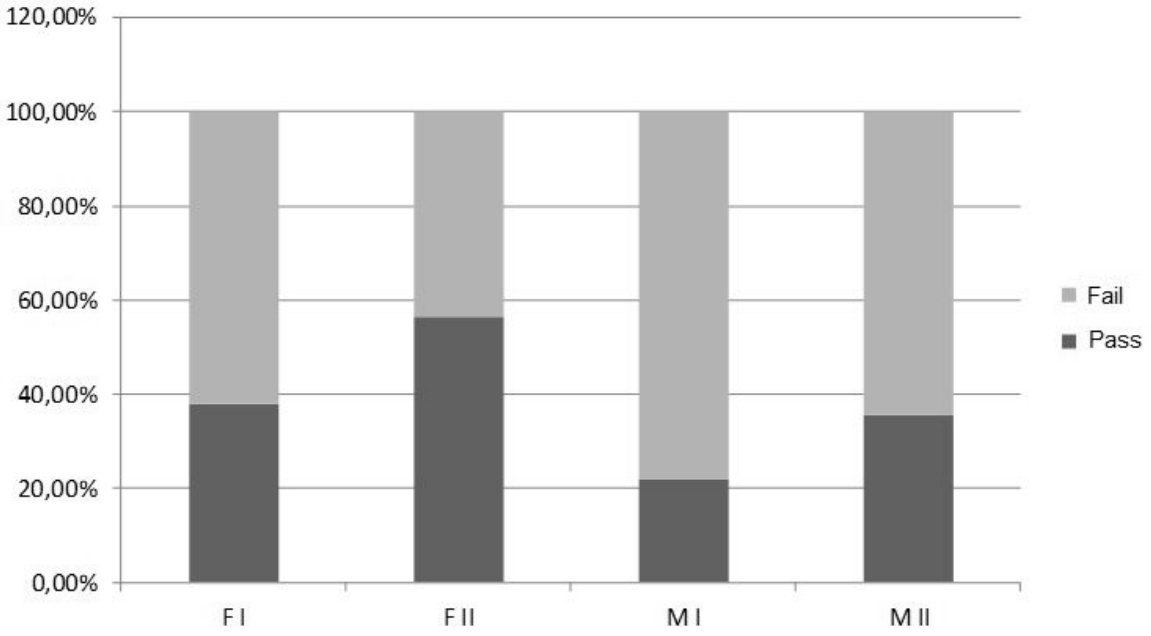
Table 5 – The occurrence of pass/fail on tympanometry according to the gender variable

Gender	TYMPANOMETRY		Total
	Pass	Fail	
Female	24	28	52
	46,20%	53,80%	100,00%
Male	17	43	60
	28,30%	71,70%	100,00%
Total	41	71	112
	36,60%	63,40%	100,00%
p = 0,051			

Likelihood Ratio Test/ p-value < 0,005 = statistically significant*

When you combine the variables gender and age (Figure 1) according to the pass/fail criterion, it was found that preschoolers from both genders among four years and four years and eleven months, and males, among five years and five years and eleven months, had failed more than the female preschoolers in this age group.

This tendency was statistically significant only when was compared the older female preschooler group and the younger male preschooler group (Table 6). So, it can be stated that there is a tendency that more female preschoolers, at five and five years and eleven months, do not exhibit changes in the middle ear when compared to male preschoolers at four and four years and eleven months of age.



Legend: F- female/ M – male/ I – 4 years to 4 years and 11 months / II – 5 years to 5 years and 11 months.

Figure 1 – Scholars distribution according to gender and age and the tympanometry screening pass/ fail criterion

Table 6 – Statistical analysis of the tympanometry screening pass/fail criterion matching to preschoolers' gender and age group

Pair of Categories	Significance (p)
F(4y to 4y11m) x F(5y to 5y11m)	0,181
F(4y to 4y11m) x M(4y to 4y11m)	0,169
F(4y to 4y11m) x M(5y to 5y11m)	0,862
F(5y to 5y11m) x M(4y to 4y11m)	**0,008***
F(5y to 5y11m) x M(5y to 5y11m)	0,136
M(4y to 4y11m) x M(5y to 5y11m)	0,235

Legend: F= female / M = male
Likelihood Ratio Test adjusted by Bonferroni correction/
Bonferroni alpha = 0,008512 – statistically significant*

DISCUSSION

Hearing screening is an efficient way to determine the appropriate approach to be adopted with students regarding peripherical hearing loss and/or hearing abilities. If necessary, it should be adopted medical and speech therapy approaches associated with hearing screening to minimize the resulting consequences, especially the learning process of reading and writing[9].

So, in this study, the preschoolers who failed on the tympanometric rescreening, the parents or guardians were advised and referred to medical care.

Early detection and immediate intervention in children with auditory deprivation increases the probability to optimize the receptive and expressive language potential, literacy (reading and writing), academic performance, emotional and social development[9].

In the literature, over the last decade, were found few studies concerning the hearing screening in students. Regarding the middle ear disorders, most studies focused on the effectiveness of treatment

using antibiotics and the possible causes of these disorders[3-6,13,14].

This study verified a high rate of tympanometric screening abnormalities. This fact can be explained by the presence of several risk factors which this population is exposed, such as: care in daycare centers[7], climatic variations[7], socioeconomic level[3,7,8] and persistent rhinorrhea[15].

The risk factors are not involved in the physiopathology of otitis media, but, when present, can increase the risk of the disease, probably it can influence one or more causal mechanisms[7].

The recurrent otitis media is one of the most frequent causes of hearing loss[3,4] in children at school attendance phase[2]. Most of the time, around 70% of the cases, would be a complication of upper airway infection[4-6].

Some studies have reported that otitis media is a common disease in countries in development [3-15], as occurs in Brazil, and the variability of risk factors among the countries is a reflection of the sociocultural differences on the studied population[16].

In this study the prevalence of abnormal tympanometry was 63,4%, in the literature was found a prevalence ranging from 39,4%[9] to 74,8%[3].

When analyzing qualitatively the tympanometric was found a predominance of type B and C tympanograms, and these findings were similar to the literature[9,17], the first study was conducted with 287 students from five to ten years which showed types As, B and C tympanograms on 20% of the children[9], and the second study evaluated 142 children of similar age, and found 46% of abnormal tympanometries with the prevalence of types B,C and As tympanograms, both studies revealed the occurrence of abnormalities in the middle ear[17].

In relation to gender, there was a higher incidence of abnormal tympanograms on males; this difference was statistically significant only in the right ear. On others authors studies were found no association between the variable gender and a higher prevalence of otitis media in one of these genders[3,9,15].

As regards the variable age, it was observed that the youngest preschoolers failed more than the older ones, however, this difference was not statistically significant. In the literature there is no consensus regarding age as a risk factor for otitis media, some authors have associated age to a higher prevalence of otitis media[3,8] but others have not[9,15].

A study conducted with 555 children stated that children in initial series are more prone to have a positive diagnosis of otitis media than those of higher grades[3]. However, a hearing screening program developed with children from five to ten years had found that age was not a significant risk factor for middle ear disorders[9].

Otitis media is a highly prevalent disease in childhood, with a higher peak of incidence between six and 24 months of age and the second peak of incidence between four and seven years[19].

The parameters race, sex and age influence the structure of the Eusthachian tube or its function, while the age also determines the immunological response of the host, it is evident that some factors are related, since younger children have more upper airways infections[7].

Authors[20] claim that sensory deprivation caused by serous otitis media, aggravated by number and episodes length of disease, can affect the speech perception and comprehension, especially in noise environments, and even affect the child´s language development. The hearing fluctuation caused by middle ear disorders on early childhood can lead to auditory processing disorders, and interferes on learning.

Certain measures could be implemented in order to reduce the incidence of middle ear disorders. Authors suggest as actions: treatment for enlarged adenoids, chronic sinusitis and allergies as some of the necessary measures to reduce the problem of persistent rhinorrhea, considering that regular visits to schools in order to screen children which present persistent rhinorrhea, mouth breathing and otitis media should be part of a national program that emphasizes the hearing health and guidelines regarding the effect of passive smoking on the respiratory and auditory system of children should be emphasized in all anti-smoking campaigns[15].

Considering the findings of this study, it is necessary to implement actions to reduce the incidence of middle ear disorders in this population. Thus, it is suggested that parents and teachers should be oriented and the implementation of immunization programs for this population in order to reduce upper airways infections episodes.

CONCLUSION

In this sample, it was observed a high rate of tympanometric alterations. There was a tendency of younger male preschooler group present a higher rate of tympanometric alterations when compared to the older female preschooler group, this difference was not statistically significant.

RESUMO

Objetivo: caracterizar e comparar os achados timpanométricos de um grupo de escolares. **Método**: foram avaliados 112 escolares, de ambos os gêneros, na faixa etária de quatro anos a cinco anos e onze meses que frequentavam uma Escola Municipal de Educação Infantil, localizada em um bairro periférico da cidade de Marília. Como procedimento de triagem, utilizou-se a timpanometria. Considerou-se que a criança PASSOU na triagem quando apresentou curva timpanométrica do tipo A, bilateralmente, sendo reavaliada em caso de falha. **Resultados:** observou-se um alto índice de falha (63,4%) na população estudada. Os escolares de maior faixa etária e do gênero feminino apresentaram um índice maior de timpanogramas do tipo A, em ambas as orelhas. Houve uma maior incidência de falha nas crianças de faixa etária entre 4 anos e 4 anos e 11 meses, e do gênero masculino. **Conclusão:** nesta amostra obteve-se um alto índice de alterações timpanométricas. Houve uma tendência de escolares do gênero masculino e de menor faixa etária apresentarem um índice maior de alterações timpanométricas quando comparados ao gênero feminino e de maior faixa etária, não sendo esta diferença estatisticamente significante.

DESCRITORES: Audição; Pré-escolar; Triagem; Orelha Média; Testes de Impedância Acústica

REFERENCES

1. Gatto CI, Tochetto TM. Deficiência auditiva infantil: implicações e soluções. Rev CEFAC. 2007;9(1):110-5.

2. Vieira ABC, Macedo LR, Gonçalves DU. O diagnóstico da perda auditiva na infância. Rev. Pediatria. 2007;29(1):43-9.

3. Taha AA, Pratt SR, Farahat TM, Abdel-Rasoul GM, Albtanony MA, Elrashiedyet ALE et al. Prevalence and risk factors of hearing impairment among primary-school children in Shebin El-kom District, Egypt. Am J Audiol. 2010;19:46-60.

4. Spiro DM, King WD, Arnold DH, Johnston C, Baldwin S. A randomized clinical trial to assess the effects of tympanometry on the diagnosis and treatment of acute otitis media. Pediatrics. 2004;114(1):177-81.

5. Winther B, Alper CM, Mandel EM, Doyle WJ, Hendley JO. Temporal relationships between colds, upper respiratory viruses detected by polymerase chain reaction, and otitis media in young children followed through a typical cold season. Pediatrics. 2007;119(6):1069-75.

6. Revai K, Patel JA, Grady JJ, Chonmaitree T. Tympanometric findings in young children during upper respiratory tract infections with and without acute otitis media. Pediatr Infect Dis J. 2008;27:292-5.

7. Lubianca Neto JF, Hemb L, Silva DB. Fatores de risco para otite média aguda recorrente: onde podemos intervir?- uma revisão sistemática da literatura. J Pediatr. 2006;82(2):87-96.

8. Adhikari P. Otite média crônica supurada em crianças de escolas do vale katmandu. Arq. Int. Otorrinolaringol. 2007;11(2):175-8.

9. Colella-Santos MF, Bragato GR, Martins PMF, Dias AB. Triagem auditiva em escolares de 5 a 10 anos. Rev. CEFAC. 2009;11(4):644-53.

10. American Academy of Audiology (AAA) Position Statement: Identification of hearing loss and middle-ear dysfunction in preschool and school-age children. Audiology Today. 1997;9:21-3.

11. American Speech-Language-Hearing Association (ASHA). Guidelines for Audiologic Screening. Rockville Pike.1997.

12. Jerger J. Clinical experience with impedance audiometry. Arch Otorhinolaringol. 1970;92:311-24.

13. Meropol SB, Glick HA, Asch DA. Age Inconsistency in the American Academy of Pediatrics Guidelines for Acute Otitis Media. Pediatrics. 2008;121(4):657-68.

14. Vergison A, Dagan R, Arguedas A, Bonhoeffer J, Cohen R, DHooge I et al. Otitis media and its consequences: beyond the earache. Lancet Infect Dis. 2010; 10(3):195-203

15. Sophia A, Isaac R, Rebekah G, Brahmadathan K, Rupa V. Risk factors for otitis media among preschool, rural Indian children. Int. J. Pediatric Otorhinolaryngol. 2010;74(6):677-83.

16. Rovers MM, Kok IMCM, Schilder AGM. Risk factors for otitis media: an international perspective. Int J Pediatr. Otorhinolaryngol. 2006;70:1251-6.

17. Guida HL, Diniz TH. Perfil audiológico em crianças de 5 a 10 anos de idade. Arq. Int. Otorrinolaringol. 2008;12(2):224-9.

18. Caylan, R, Bektas, D, Atalay, C, Korkmaz, O. Prevalence and risk factors of otits media with effusion in Trabzon, a city in nrtheastern Turkey, with an emphasis on the recommendation of OME screening. Eur. Arch. Otorhinolaryngol. 2006;263: 404-8.
19. Almeida CIR, Almeida RR. Otite media aguda. In: Campos CAH, Costa HOO, editores. Tratado de Otorrinolaringologia. 1ª ed. São Paulo: Roca; 2003. Vol. 2, p. 21-7.
20. Pereira PKS, Azevedo MF, Testa JR. Alterações condutivas em neonatos que falharam na triagem auditiva neonatal. Braz. J. Otorhinolaryngol. 2010;76:347-54.

Received on: January 31, 2012
Accepted on: May 02, 2012

Mailing Address:
Tâmara de Andrade Lindau
Rua José Chieramont, 54
Santa Rosa de Viterbo – SP – Brasil
CEP: 14270-000
E-mail: lindau.fono@gmail.com