# SCHOOL HEARING SCREENING IN THE CITY OF PORTO ALEGRE: RESULTS OF THE PILOT STUDY

## *Triagem auditiva escolar no município de Porto Alegre: resultados do estudo piloto*

**Yandra Mesquita Pereira Cardoso[1], Vera Regina Puerari[2], Christiane Nunes de Freitas[3], Daniela Zimmer[4], Andrea Wander Bonamigo[5], Roberta Alvarenga Reis[2], Maria Inês Dornelles da Costa-Ferreira[1]**

**ABSTRACT**

**Purpose:** to describe the results of the pilot study to guide the process of implementation of school auditory screening in the city of Porto Alegre. **Methods:** 134 protocols of children among six and eight years old, attending classes in an Elementary City School of Porto Alegre. The results were: screening audiometric frequencies of 1000 Hz, 2000 Hz and 4000 Hz in both ears; measurement of sound pressure levels in the environment during the audiometric screening; response to audiometric screening at 20 dB at 1000 Hz, 2000 Hz and 4000 Hz in both ears; acoustic immitance, containing tympanometric curve and ipsilateral phonics repercussion in the frequencies of 500Hz, 1000Hz, 2000Hzand 4000Hz, in left and right ears. **Results:** in respect to gender, 50.75% were boys and 49,25% were girls. The average age of children was 6,86 years (± 0.46). Most children did well in audiometric screening. The most common tympanometric curve was Type A (51.72%), followed by Type C (24.14%) in the right ear. In the left ear, 55.68% was Type A and 21.59%, Type C. Environmental noise remained below 50dBNA (90.53%). At the conclusion of the screening we could notice that there was a difference statistically significant among 7-8year-old children, who did well. **Conclusion:** most children who failed the school auditory screening was six years old. The tympanogram was the most prevalent type A. No statistically significant differences were observed when comparing the tested ears and gender.

**KEYWORDS:** Hearing Loss; Hearing; Triage;Schools; Primary Prevention

## INTRODUCTION

The existent relationship between the auditory integrity and the acquisition of oral language is a consensus among speech pathologists and researchers, since a child needs to have access to the minimum acoustic clues which will help him/her in speech discrimination and in access to the meaning. This occurs when the auditory system is intact both in the peripheral level and in the Central Nervous System (CNS). It is by means of the hearing pathways that it is possible to locate, recognize, understand and distinguish the multiple meanings of sounds in order to form a communication system and elaborate the spoken language structure [1].

Intercurrences in the auditory pathways may lead individuals to reversible Hearing Losses (HL) which are the Conductive Hearing Losses (CHL) and the Mixed Hearing Losses (MHL), and/or to irreversible HL, namely the Sensorineural Hearing Losses (SHL). These HL may result from several factors- pre, peri and/or post natal. The pre and the perinatal risk factors are related to the period during which the newborn infant remains in the

(1) Centro Universitário Metodista do Instituto Porto Alegre, Porto Alegre, RS, Brasil.

(2) Universidade Federal do Rio Grande do Sul – UFRGS, Porto Alegre, RS, Brasil.

(3) Serviços Especializados Ambulatoriais e Substitutivos da Secretaria Municipal de Porto Alegre, RS, Brasil.

(4) Centro Integrado de Desenvolvimento Infantil, Porto alegre, RS, Brasil.

(5) Universidade Federal de Ciências da Saúde de Porto Alegre, RS, Brasil.

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Intensive-Care Unit (more than 48 hours), to the intake of ototoxic medication, to the mechanical ventilation, to periintraventricular bleeding, to craniofacial malformations, to the low Apgar Score, to some syndromes, to neonatal infections, to family history, to hyperbilirubinemia[2]. The postnatal risk indicators are connected to family history of HL, to congenital infections, to traumatic brain injuries and to repetitive otites[3]. The major cause of late HL is the otitis media which is characterized by an increase in secretion in the middle ear[4]. In this case, the pure tone audiometry will show air conduction thresholds above 15 dB and bone conduction thresholds within the standards of normality. The tests of Speech Reception Threshold (SRT) and Speech Perception and Recognition Rate will be within the patterns of normality, the tympanometry will present curve type B and the acoustic reflexes will be absent by efferent pathways, Other dysfunctions of the Eustachian tube such as rhinitis and adenoid hypertrophy can also affect school-age children, causing a mild conductive hearing loss, like otitis media [1,5] .

The later the diagnosis of HL in children is made, the greater their linguistic difficulties will be[6]. The moderate HL will cause significant delays in tests that evaluate the language, and, due to this, the difficulties in discriminating the minimum distinctive traits of speech will be more obvious.

The phonemes /s/ and /z/ have lower contrast, like monosyllabic words, because they present fewer acoustic clues in comparison with the words with greater number of syllables[7]. The screening process is defined as a method of applying quick and simple measures, in a large number of individuals, with the aim of identifying the likelihood of diseases that are being tested. With this, it is considered that examining large populations of asymptomatic individuals is a way to identify those with the possibility of presenting a disease and, consequently, that will require more elaborated diagnostic procedures[8].

The School Hearing Screening (SHS) should analyze precise and efficiently those students with hearing disorders caused either by a conductive or by a sensorineural pathology, because such pathologies may be acquired during childhood. Thus, the AHS aims at early detection of HL in children of school age, contributing to an appropriate referral and better prognosis for the treatment of the deficits caused by HL[9-12].

The sooner the child is forwarded to appropriate treatment, the slighter will be the linguistic, emotional, behavioral and learning difficulties. The protocols commonly used in the SHS process are: otoscopy, audiometry, immittance audiometry (tympanometric curve and acoustic reflexes) and otoacoustic emissions[12-14]. From the pre-established criteria, it is possible to define if the child has passed or failed. The occurrence of tympanometric curve type A, proposed by Jerger[15], the acoustic reflexes triggered in all frequencies and the responses obtained in audiometric screening at 15 or 20dBHL have been the most frequent criteria.

When using the transient evoked otoacoustic emissions or the otoacoustic emissions by distortion product, the criterion is the presence of emissions, mainly the transient ones[16]. During the school hearing screening completion, the Sound Pressure Level (SPL) needs to be considered because, if too loud, may impair the response of the child. Studies show that the noise level measured in the school environment is above the recommended and these noises are generated by handling or falling objects and equipment, moving furniture, screams and isolated conversations between students and teachers, and/or sounds from adjacent rooms. Such noises can cause damages to school activities, since it may interrupt the concentration of teachers and estudantes[17]. These factors may interfere with the procedures performed during the school audiometric screening what justifies the need to prioritize silent rooms and consider the SPL in acceptable standards for completion of the examination.

In Brazil, the School Hearing Screening is not yet part of the routine of the majority of schools, unlike other countries that already carry out the early detection and the rehabilitation of the child, after applying the universal neonatal hearing screening. As a continuity of this process, they include the school hearing screening which, when a failure is detected, determines appropriate referrals aiming at diagnosis and rehabilitation[18].

In accordance with the aspects presented, the objective of this study is to describe the results of the pilot study carried out to guide the process of implementation of the SHS (School Hearing Screening), in the City of Porto Alegre.

## METHODS

The present study was approved by the Research Ethics Committees of Centro Universitário Metodista do IPA, under number 108/2011, and of Secretaria Municipal de Saúde de Porto Alegre, under number 108/2011, and of Secretaria Municipal de Saúde de Porto Alegre, under the 00.024262.11.0 protocol. The Term of Institutional Knowledge was signed by the District Manager of the Eastern/Northeastern Health District. Only the data contained in the protocols of the SHS were used. The consent of parents or guardians preceded the data collection carried out by the SHS team.

It consists of an observational, transversal and contemporary descriptive study. The instrument of study is an SHS protocol that had been elaborated by the authors in order to be used as pilot protocol in this research, having not yet been validated. It contains the child identification data, the records of the otoscopy, the acoustic immittance measures, the audiometric screening and the adopted conduct.

The pilot project took place in a school affiliated to the Health Program in School (PSE), located in the Eastern/Northeastern Sanitary District of the municipality of Porto Alegre, in partnership with the Municipal Secretary of Education, under the coordination of the Municipal Secretary of Health.

A total of 134 SHS protocols of children aged between six and eight, who attended the A10 classes regularly and that had been previously authorized by their parents or guardians to take exams, were analyzed. In accordance with the nomenclature adopted by the Municipal Secretary of Education, the A10 classes correspond to the first year of elementary school. In total, six classes underwent the hearing screening. The SHS began in April 2011, and was performed by municipal speech therapists, by the Speech Pathology Regional Council representatives and by teachers and academics of the Speech Pathology Undergraduate Courses situated in Porto Alegre, namely: Centro Universitário Metodista do IPA, Universidade Federal de Ciências da Saúde de Porto Alegre and Universidade Federal do Rio Grande do Sul.

The SHS team had in its composition a general practitioner, speech therapists and students of Speech Pathology Courses and a nurse auxiliary. The procedures of otoscopy in both ears, were performed by a doctor who analyzed whether the child had any impediment to attend the screening, such as the presence of hard earwax (cerumen) impacted In such cases, doctor prescribed the child the use of topical emollients and, after the treatment, he/she returned to new otological evaluation. For other detected otological problems, the children were sent to the Health Units in which they were registered. In case of a normal EAM inspection, the child performed the audiometric screening and the Acoustic Immittance Measures (AIM).

The audiometric screening was performed with the AD226 audiometer (Interacoustics), primarily testing the right ear and then the left ear, at the frequencies of 1000Hz, 2000Hz and 4000Hz. In the first stimulation, a tone modulated at high intensity (50dBHL), at a frequency of 1000Hz was presented to the child, aiming to provide its recognition and, immediately, it was progressively reduced, down to 20dBHL. Then, the testing proceeded at the intensity of 20dBHL, for all other frequencies. The failure occurred when there was no response to the tone presented at 20dBHL, in any of the tested frequencies. During this examination, the room environmental noise level, which should be less than 60dBHL, avoiding erroneous responses on the part of the child under test, was measured by means of the sound pressure level gauge, model DEC-460.

If the NPS remained above the permitted, the examination was not performed at that moment. The AIM were carried out with the MT10 equipment (Interacoustics), and. the tympanometric curves, which may be of Type A, Type B, Type C, Type Ad or Type Ar[15], were analyzed. Children, to pass the exam, should present tympanometric curve Type A in both ears. The research of ipsilateral acoustic reflexes was performed at the frequencies of 500Hz, 1000Hz, 2000Hz and 4000Hz, at a fixed intensity of 100dBHL, because it is a screening in which the child is expected to have normal hearing thresholds (up to 15 dBHL), and the acoustic reflex, triggered between 70 and 90 dB above threshold. In addition, high intensities can be harmful to the hearing.

For this reason and, considering the ipsilateral acoustic reflexes variability, even in normal hearing individuals, they were not included as a criterion pass-fail. All the equipment used was duly calibrated. At the conclusion of the SHS, the following results were presented: if the child passed, if he/she failed in the right ear, in the left ear, or in both ears. It was also considered keep a record of the need for referral to an ENT doctor, in the event of the impossibility of performing the SHS, as well as a record of relevant observations to other referrals.

The variables in this study were: result of external acoustic meatus inspection (in condition to perform the test, out of condition to perform the test); result of SPL during the realization of the audiometric screening (below 50dB SPL, between 50dBSPL and 60 dB SPL, or above 60dBSPL); result of the audiometric screening (children who passed the audiometric screening and children who failed the audiometric screening; result of Immittance Acoustic Measure (children who passed and children who failed the tympanometric curve), ipsilateral acoustic reflexes and general conclusion of the SHS per ear tested, children that passed and children that failed the SHS; sex, and age in years. The statistical analysis was performed by means of the software The SAS System for Windows (StatisticalAnalysis System) version 8.02.

To describe the sample profile, according to the variables under study, frequency tables of categorical variables (sex, sound pressure level, tympanometric curve, acoustic reflex) were built, with values of absolute frequency (n) and percentage (%), and descriptive statistics of the continuous variable

(age), with average values, standard deviation, minimum and maximum values and median. For the comparison of categorical variables between genders and ages, the Chi-square tests or Fisher's Exact test (for expected values less than five) were used. To compare the numeric variable between genders, the Mann-Whitney test was used, due to the absence of normal distribution of the variable. The level of significance for all statistical tests was 5% being $p < 0.05$.

## RESULTS

The present study consisted of 134 SHS protocols, applied in a Municipal Elementary School, with the participation of six level A10 classes, equivalent to the first year of elementary school. From the A11 class, 19 students participated, totaling 14.89% when considering the total number of children. Twenty-three students (17.16 %) were from the A12 class; 25 (18.66 %), from the A13; 26 (19.40 %), from the A14; 25 (18.66 %) from the A15 and 19 (11.94 %) studied in class A16.

In relation to the school time, 61 students (45.52 %) attended the morning classes and 73 (54.48 % ), the afternoon classes. In addition, 68 students (50.75 %) were boys and 66 (49.25 %), girls.

The average age of the students who took the SHS was 6.86 (± 0.46), with a minimum of 6 years and 10 months old and a maximum of 8 years and 3 months old. Moreover, 73 (55.30%) children were 6 years old; 54 (40.91%) were 7 years old, and 5 (3.79%), 8 years of age; 2 did not present such information in the protocols.

The application of all tests was possible to 85 children (63.43%), while the remaining, 49 (36,57%) children did not do all the SHS tests.

In the inspection of the external acoustic meatus of the right ear, it was observed that 97 (78.86%) children were in condition to carry out the remaining procedures, while 26 (21.14%), were not, and 11 children did not attend the otoscopy. In the left ear, it was noticed that 92 (74.80%) children were normal, but 31 (25.20%) were not, and 11 children did not attend the inspection of the external acoustic meatus. In relation to the medical referral and/ or washing of the meatus, 19 (14.18%) children needed to be sent to their region Health Unit.

The results regarding the audiometric screening can be seen in Table 1 and indicate that the great majority of the children passed the screening, despite the fact that a considerable number of children did not perform the exams.

In relation to the SPL, at the time of the audiometric screening, it was observed that in 86 children (90.53%) the SPL measurement was below 50dBHL; in 4 children (4.21%), between 50dBHL and 60dBHL, and in 5 children (5.26%) it was above 60dBHL.

Table 2 shows the results regarding the tympanometric curve found for both ears, and it is possible to observe the highest frequency of type A curve, followed by C, Ar and B.

**Table 1 – Audiometric Screening Performance of both ears by frequency**

| | Right Ear | | | Left Ear | | |
|---|---|---|---|---|---|---|
| | 1khz | 2khz | 4khz | 1khz | 2khz | 4khz |
| Passed | | | | | | |
| Frequency | 84 | 87 | 85 | 87 | 91 | 87 |
| % | 88.42 | 91.58 | 89.47 | 90.63 | 94.79 | 91.58 |
| Failed | | | | | | |
| Frequency | 11 | 8 | 10 | 9 | 5 | 8 |
| % | 11.58 | 8.42 | 10.53 | 9.38 | 5.21 | 8.42 |
| Missed | | | | | | |
| % | 39 | 39 | 39 | 38 | 38 | 39 |

**Table 2 – Performance of both ears in relation to the tympanometric curve type**

| | Right Ear | | | | Left Ear | | | |
|---|---|---|---|---|---|---|---|---|
| **Type** | **A** | **B** | **C** | **Ar** | **A** | **B** | **C** | **Ar** |
| Frequency | 45 | 6 | 21 | 15 | 49 | 4 | 19 | 16 |
| % | 51.72 | 6.90 | 24.14 | 17.24 | 55.68 | 4.55 | 21.59 | 18.18 |
| Missed | | | | | | | | |
| % | 47 | | | | 46 | | | |

Also in relation to the performance in Acoustic Immittance Measure, Table 3 shows the results of ipsilateral acoustic reflexes for both ears, at the frequencies researched. When considering the number of children who underwent screening, the vast majority passed, but, when considering the total number of children, it was found that a considerable number of children did not perform the AIM.

**Table 3 – Performance in relation to the ipsilateral acoustic reflex for both ears, by researched frequency**

| | Right Ear | | | | Left Ear | | | |
|---|---|---|---|---|---|---|---|---|
| | **5KHz** | **1KHz** | **2KHz** | **4KHz** | **5KHz** | **1KHz** | **2KHz** | **4KHz** |
| **Passed** | | | | | | | | |
| **Frequency** | 66 | 66 | 68 | 67 | 70 | 70 | 69 | 69 |
| **%** | 76.74 | 76.74 | 79.07 | 77.91 | 80.46 | 80.46 | 79.31 | 79.31 |
| **Failed** | | | | | | | | |
| **Frequency** | 20 | 20 | 18 | 19 | 17 | 17 | 18 | 18 |
| **%** | 23.26 | 23.26 | 20.93 | 22.09 | 19.54 | 19.54 | 20.69 | 20.69 |
| **Missed** | | | | | | | | |
| **%** | 48 | | | | 47 | | | |

Table 4 shows the results of the completion of the SHS, comparing the genders in relation to the audiometric screening and to the AIMs. This comparison showed no statistically significant relationship (p= 0.140).

Table 5 makes a comparison between the six-year old and the seven to eight-year old children who participated in the SHS, considering the audiometric screening and the AIM results.

From the results it was possible to verify statistically significant relationship for children from seven to eight years old who presented higher frequency of completion of all tests, and tympanometric curve type A.

Figure 1 shows the general result of SHS, comparing the age ranges.

**Table 4 – Comparative Analysis between the audiometric screening results and the acoustic immittance measures, regarding genders**

| | | Right Ear | | | | | | | Left Ear | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Audiometric Screening | | | Immittance Screening | | | | Audiometric Screening | | | Immittance Screening | | | |
| | | 1 KHz | 2 KHz | 4 KHz | 0.5 KHz | 1 KHz | 2 KHz | 4 KHz | 1 KHz | 2 KHz | 4 KHz | 0.5 KHz | 1 KHz | 2 KHz | 4 KHz |
| Boys | Passed Freq. | 44 | 45 | 45 | 39 | 38 | 39 | 39 | 47 | 50 | 46 | 37 | 39 | 39 | 37 |
| | % | 86.27 | 88.24 | 88.24 | 81.25 | 79. 17 | 81. 25 | 81. 25 | 90.38 | 96.15 | 90.20 | 77.08 | 81. 25 | 81. 25 | 77. 08 |
| | Failed Freq. | 7 | 6 | 6 | 9 | 28 | 9 | 9 | 5 | 2 | 5 | 11 | 9 | 9 | 11 |
| | % | 13.73 | 11.76 | 11.76 | 18.75 | 73. 68 | 18. 75 | 18. 75 | 9.62 | 3.85 | 9.80 | 22.92 | 18. 75 | 18. 75 | 22. 92 |
| Girls | Passed Freq. | 40 | 42 | 40 | 27 | 10 | 29 | 28 | 40 | 41 | 41 | 33 | 31 | 30 | 32 |
| | % | 90.91 | 95.45 | 90.91 | 71.05 | 20. 83 | 76. 32 | 73. 68 | 90.91 | 93.18 | 93.18 | 84.62 | 79. 49 | 76. 92 | 82. 05 |
| | Failed Freq. | 4 | 2 | 4 | 11 | 10 | 9 | 10 | 4 | 3 | 3 | 6 | 8 | 9 | 7 |
| | % | 9.09 | 4.55 | 9.09 | 28.95 | 26. 32 | 23. 68 | 26. 32 | 9.09 | 6.82 | 6.82 | 15.38 | 20. 51 | 23. 08 | 17. 95 |
| Value p | | 0.482 | 0.279 | 0.748 | 0.266 | 0.550 | 0.576 | 0.401 | 1.000 | 0.658 | 0.721 | 0.378 | 0.837 | 0.620 | 0.569 |

| | | Tympanometric Curve | | | | Tympanometric Curve | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | A | B | C | Ar | A | B | C | Ar |
| Boys | Freq. | 23 | 3 | 13 | 9 | 27 | 2 | 11 | 8 |
| | % | 47.92 | 6.25 | 27.08 | 18.75 | 56.25 | 4.17 | 22.92 | 16.67 |
| Girls | Freq. | 22 | 3 | 8 | 6 | 22 | 2 | 8 | 8 |
| | % | 56.41 | 7.69 | 20.51 | 15.38 | 55.00 | 5.00 | 20.00 | 20.00 |
| Value p | | 0.843 | | | | 0.966 | | | |

Square-Qui Test or Fisher's Exact
Legend: Freq. = Frequency

**Table 5 – Comparative Analysis between the audiometric screening results and the acoustic immittance measures, regarding the age ranges**

| | | Right Ear | | | | | | | Left Year | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Audiometric Screening | | | Immittance Screening | | | | Audiometric Screening | | | Immittance Screening | | | |
| | | 1 KHz | 2 KHz | 4 KHz | 5 KHz | 1 KHz | 2 KHz | 4 KHz | 1 KHz | 2 KHz | 4 KHz | 5 KHz | 1 KHz | 2 KHz | 4 KHz |
| 6 years old | Passed Freq. | 40 | 42 | 40 | 29 | 29 | 29 | 28 | 42 | 44 | 41 | 33 | 34 | 33 | 32 |
| | % | 86.96 | 91.30 | 86.96 | 72.50 | 72.50 | 72.50 | 70.00 | 89.36 | 93.62 | 89.13 | 80.49 | 82.93 | 80.49 | 78.05 |
| | Failed Freq. | 6 | 4 | 6 | 11 | 11 | 11 | 12 | 5 | 3 | 5 | 8 | 7 | 8 | 9 |
| | % | 13.04 | 8.70 | 13.04 | 27.50 | 27.50 | 27.50 | 30.00 | 10.64 | 6.38 | 10.87 | 19.51 | 17.07 | 19.51 | 21.95 |
| 7-8 years old | Passed Freq. | 44 | 45 | 45 | 37 | 37 | 39 | 39 | 45 | 47 | 46 | 37 | 36 | 36 | 37 |
| | % | 89.80 | 91.84 | 91.84 | 80.43 | 80.43 | 84.78 | 84.78 | 91.84 | 95.92 | 93.88 | 80.43 | 78.26 | 78.26 | 80.43 |
| | Failed Freq. | 5 | 4 | 4 | 9 | 9 | 7 | 7 | 4 | 2 | 3 | 9 | 10 | 10 | 9 |
| | % | 10.20 | 8.16 | 8.16 | 19.57 | 19.57 | 15.22 | 15.22 | 8.16 | 4.08 | 6.12 | 19.57 | 21.74 | 21.74 | 19.57 |
| Value p | | 0.666 | 1.000 | 0.516 | 0.385 | 0.385 | 0.163 | 0.099 | 0.738 | 0.674 | 0.477 | 0.995 | 0.584 | 0.798 | 0.784 |

| | | Tympanometric Curve | | | | Tympanometric Curve | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | A | B | C | Ar | A | B | C | Ar |
| 6 years old | Freq. | 19 | 5 | 7 | 10 | 16 | 3 | 13 | 10 |
| | % | 46.34 | 12.20 | 17.07 | 24.39 | 38.10 | 7.14 | 30.95 | 23.81 |
| 7-8 years old | Freq. | 26 | 1 | 14 | 5 | 33 | 1 | 6 | 6 |
| | % | 56.52 | 2.17 | 30.43 | 10.87 | 71.74 | 2.17 | 13.04 | 13.04 |
| Value p | | 0.061 | | | | 0.012 | | | |

Square- Qui-Test or Fisher's Exact
Legend: Freq. = Frequency

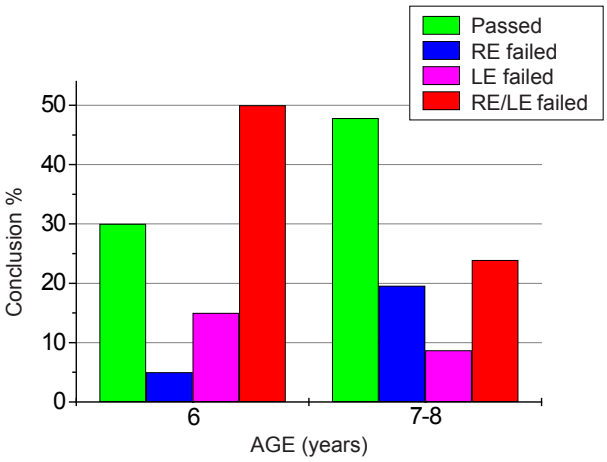


**Figure 1 – Final Result of the School Hearing Screening comparing age ranges**

## DISCUSSION

The present study characterizes the results of the pilot study for the implementation of the SHS in the city of Porto Alegre. From that it will be possible to assess the adequacy of the procedures, protocols, and other relevant aspects to carry out the SHS.

This research was carried out in a municipal school, located in the Eastern/Northeastern Sanitary District of Porto Alegre, with a low socioeconomic level, differing, in part, from other researches carried out in private schools [18,19].

The goal of the SHS is to detect possible auditory disorders that children may present, in a quick and effective way [8,19]. The sooner auditory disorders are detected, the sooner the prognosis will be established, minimizing the likely negative implications for language, speech and learning.

The SHS was performed by children between 7 and 8 years old, newcomers to primary school, similar to other studies that use screening with this age range[8,20]. In the presence of earwax/cerumen or of any other impediment to the conduct of the tests, the prescription of specific drug and/or referral to the Health Unit of specific region was provided, fact that occurred in 25.20% of children. After medication, new inspection was performed by the physician who allowed or not the realization of other SHS procedures. In other studies, inspection of the EAM and its cleaning were performed by an ENT doctor, and the presence of cerumen was equivalent to the findings of the present research, occurring in 26.7%[21].

Thus, it is possible to infer that this procedure can be performed by medical professionals, not requiring the inclusion of a specialist in otolaryngology in the team. The audiometric screening in this school was held in an acoustically treated room, in which the environmental SPL remained, in the majority of the audiometric screenings, below 50dBHL. The need for a room with low noise level for the SHS application is essential, because the level of environmental noise within the schools is extremely high, causing erroneous responses on the part of the children during the audiometric screening[17].

The audiometric screening protocol contained the frequencies of 1000Hz, 2000Hz and 4000Hz to be tested, in both ears, with the Warble modulated tone, at initial intensity of 40 dBHL, followed by a sweeping/scanning at 20dBHL. In other studies, the tone for audiometric screening test is the pure tone and includes the frequency of 500Hz in the protocols, however, the screening occurred in acoustic booth, which provides a reduced level of noise [19,21,22]. Another study reports that the frequency of 500Hz is used as one of the criteria to pass the hearing screening. However, the failure rate in the cited research is greater than when this frequency is not inserted in the screening protocol[23].

A great number of children that did not attend the audiometric screening had not passed inspection of the EAM, or had missed school on the day of data collection. In Tables 1, 2 and 3, it is possible to analyze the high rate of children who missed the SHS, which suggests the necessity for an increased awareness, among parents and teachers, about the importance of the early diagnosis of hearing loss. Such activities could involve clarification on the SHS for the population by means of lectures and/or workshops, besides reinforcement regarding the dates the screening will take place[12].

The present research found that the majority of children had tympanometric curve Type A (Table 2), which indicates middle ear in normal condition. Following Type A curve was Type C that is compatible with altered condition of the Eustachian tube. Following this curve comes the curve Type Ar, suggesting rigidity of the tympano-ossicular chain, and after that,Type B curve, indicating the presence of fluid in the middle ear. These curves were also observed in other studies[12,14]. The commonly used screening protocols cite the tympanometric curve Type A as a criterion for passing the AIM, but the rate of occurrence of curve Type C is relatively large, which suggests the need to review the criteria of pass-fail for the SHS, since many times children pass the audiometric screening, but fail at the conclusion of the SHS for presenting curve Type C, as has occurred in some cases in this research[15,21].

The immittance screening in school-age children has the objective to identify possible disorders in the middle ear, which is very common in this population[4,12,14,24]. The SHS was performed, most

of the time, during the winter, when the weather in southern Brazil was wet and rainy. Such climatic variations favor the increase of failures in the SHS due to episodes of infection and/or flu among infant population[25].

The research of the ipsilateral acoustic reflex was performed at the frequencies of 500Hz, 1000Hz, 2000Hz and 4000Hz, at one single intensity[26]. However, the results of the reflex research were not included as criteria of pass/fail for the SHS, unlike other studies in which one of the criteria for passing the SHS was the presence of at least one out of the four ipsilateral acoustic reflexes investigated[21]. In the Program for the Promotion of Health and Prevention of Hearing Loss in Schoolchildren (PPPAE), the screening of ipsilateral acoustic reflexes is performed only at the frequencies of 1000Hz and 2000Hz, at a fixed intensity of 100dBHL, and the criterion for passing the screening is the presence of two tested reflexes[25].

In the present research, when the results of the audiometric screening and AIM were compared, considering the genders (Table 4), no statistically significant difference was observed[21]. However, there are studies that indicate a minimum difference between the genders when comparing the SHS final result, as it is shown in a study that found the number of failures among boys higher than among girls[23].

Verifying the results of the audiometric screening and of the AIM, considering the age ranges (Table 5), it was observed that the passing rate is higher among children from seven to eight years old; so, the younger the child is, the higher the number of failures in the SHS. When the results of AIM were compared, considering the children's age, it was realized that younger children who failed presented more tympanometric curves Type C, and that this incidence of failure decrease among children from 7 to 10 years old, fact that was also verified in this study[12].

At the conclusion of the hearing screening, it was observed that the number of failures was quite high, mainly among the six-year-old children, which corroborates the results of another study, noticing that 28.42% of the tested children had mild hearing loss in the right ear, and 31.58% in the left ear, and 47.32% had tympanometric curve Type B, C or Ar[25].

## CONCLUSION

It was evident in the research that the highest percentage of children who failed the SHS was six years old, and that the tympanometric curve Type A was more observed, followed by the Type C. There were no statistically significant differences when comparing both tested ears and genders.

Considering that this study is a pilot project, there should be a reinforcement, through lectures and/or workshops aiming at parents and teachers, on the importance of the hearing screening, which could help reduce absences of children on the screening days.

The team composed by doctors and speech therapists proved to be variable according to the time of implementation, which may have interfered with the data collection. The adequacy of the SHS protocol would favor a lower number of failures, and consequently modifying the criteria for passing. Following this way, it is suggested that the isolated occurrence of Type C tympanometric curve does not represent a significant disorder in the middle ear, to the point of interfering with the hearing.

Other studies should be carried out with a greater number of children and in other schools, allowing the correlation between the results and the variables, namely: the conditions of the external acoustic meatus (EAM); the children who passed or failed the audiometric screening and the AIM; the SPL of the environment at the time of the audiometric screening; conclusion of SHS per ear tested, as well as the sex and age of those who passed and those who failed the SHS.

**RESUMO**

**Objetivo:** descrever os resultados do estudo piloto realizado para orientar o processo de implementação da triagem auditiva escolar, no Município de Porto Alegre. **Métodos:** foram aplicados 134 protocolos em crianças de seis a oito anos de idade de uma Escola Municipal de Ensino Fundamental de Porto Alegre. Os resultados apresentados no protocolo de triagem eram: medida do Nível de Pressão Sonora no ambiente, durante a realização da triagem audiométrica; resposta à triagem audiométrica em 20 dB nas frequências de 1000Hz, 2000Hz e 4000Hz, em ambas as orelhas; Medidas de Imitância Acústica: curva timpanométrica e reflexos acústicos ipsilaterais nas frequências de 500Hz, 1000Hz, 2000Hz e 4000Hz, em 100 dB nas duas orelhas, utilizando o critério passa-falha. **Resultados:** em relação ao sexo, 50,75% eram meninos. A idade média foi 6,86 anos (± 0.46). Na triagem audiométrica a grande maioria das crianças passou e a curva timpanométrica mais encontrada foi a Tipo A (51,7%), seguida da Tipo C (24,1%) na orelha direita, e na orelha esquerda 55,7% eram Tipo A e 21,6% Tipo C. O ruído ambiental manteve-se abaixo de 50 dBNA em 90,5%. **Conclusão:** a maioria das crianças que falharam na TAE tinha seis anos de idade. A curva timpanométrica mais prevalente foi do Tipo A, seguida do Tipo C. Não se observou diferenças estatisticamente significantes ao comparar as orelhas testadas e os sexos.

**DESCRITORES:** Perda Auditiva; Audição; Triagem; Instituições Acadêmicas; Prevenção Primária

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Mailing address:
Maria Inês Dornelles da Costa Ferreira
Rua Luiz Afonso 158 Apto 702 Bairro Cidade Baixa
Porto Alegre, RS
CEP: 90050-310
E-mail: costa.ferreira@terra.com.br