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Original articles

Hearing and language screening in preschoolers

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ABSTRACT

Purpose: to describe the results of preschooler hearing and language screening and the association between them.

Methods: a study with 75 children enrolled in preschool. The language was screened with the Behavior Observation Guide for 0-to-6-Year-Old Children. The hearing of children up to 1 year and 11 months old was screened with meatoscopy, acoustic immittance, behavioral hearing assessment, and otoacoustic emissions, while those in the age range 2 years or older were screened with meatoscopy, acoustic immittance, and play pure-tone audiometry. The children who failed the screening were referred for diagnosis. The results of the hearing and language assessments were compared with the McNemar test.

Results: of the 75 children screened, 18 (24%) failed the hearing tests and 11 (15%) failed the language test. Hearing impairment was confirmed in 12 (66%) of those referred for diagnosis, and language impairment, in 10 (90%) of them. There was no association between hearing and language impairments ($p = 0.230$).

Conclusion: hearing and language impairments were found in preschoolers. Although they were not associated, they can impact academic performance. This result emphasizes the need for developing strategies to implement preschooler screening programs that include hearing and language.

Keywords: Hearing; Child Language; School Health Services; Mass Screening; Child, Preschool

INTRODUCTION

Preschool children progressively develop their skills and can perform increasingly complex everyday tasks. The auditory and linguistic skills stand out in this period as essential parts of the human communication overall development process[1].

The integrity and full development of the auditory system are essential for the child to acquire oral language and interact with the environment. Hence, these conditions interfere significantly with their cognitive, emotional, and social development[2,3].

Even a slight auditory sensory deprivation can directly impact the acquisition of language, speech, and cognitive skills[1,3]. Such an impact is perceived as school learning difficulties because oral language, verbal comprehension, and reading and writing development are necessary to good academic achievement[4,5].

Language acquisition and development begin at birth, and their critical establishment period extends up to 5 years old. This process depends on cognitive and neuromotor maturation, auditory system integrity, and social interaction[1].

When the neurobiological, auditory, and social relationship is not well established, language delays and/or disorders may appear. Studies demonstrate a high prevalence of language disorders in preschoolers, revealing that it is a common disability in childhood[4,5].

However, some language impairments are not detected in preschool, causing learning difficulties and academic failure[6]. The American Speech-Language-Hearing Association (ASHA) estimates that 10% of children have some type of language impairment[7]. The interrelationship between language acquisition delay and learning difficulties requires that they be timely detected and treated to avoid future academic and social difficulties[6].

Speech-language-hearing therapists are professionals apt to promote and improve hearing and language and prevent their impairments at school, thus helping develop and advance school learning[8]. Moreover, their work at school is regulated by law, which provides for student hearing and language screening programs[8,9].

The work of speech-language-hearing therapists in Brazilian schools has been increasingly documented in the literature. However, few studies have addressed preschooler language and hearing screening. Although health status assessments in preschool should also identify students with possible signs of hearing and/or oral language impairment, the School Health Program (PSE, in Portuguese) considers it optional to have a speech-language-hearing therapist in preschool[10]. On the other hand, the therapists themselves have not yet duly turned their attention to this need[8,9].

Given the recurrence of hearing and language impairments at school, detecting them early in preschoolers enables timely interventions for their psychosocial and cognitive development and learning to read and write[1,3].

Thus, speech-language-hearing therapists must integrate further with the educational environment to carry out screening and follow-up methodologies for auditory and language development and promote better strategies to address communication disorders in preschoolers[4,5].

Hence, the objective of this study was to describe the results of preschooler hearing and language screening and the association between them.

METHODS

Study design and ethical considerations

Observational cross-sectional study approved by the Research Ethics Committee of the *Universidade Federal de Minas Gerais* (Federal University of Minas Gerais – UFMG), Brazil, under evaluation report no. 931.831. It was conducted at a philanthropic institution partnered with the municipal government of Belo Horizonte, Minas Gerais, located in a highly socially vulnerable neighborhood (0.5 to 0.63)[11].

Initially, the project to be developed was discussed with the school principal, approaching aspects related to the importance of hearing and language to child overall development and clarifying the screening procedures to be carried out. Upon the institution's authorization, the parents were informed about the hearing and language screening and signed the informed consent form.

Study participants

The institution can admit up to 95 students and, at the time of the research, 90 were enrolled – 75 of whom were included in the study. The inclusion criterion was to be enrolled in the institution. The exclusion criteria were as follows: not having the informed consent form signed by the parents/guardians (n = 4), being absent from school on the days of the screening (n = 2), or not undergoing all the hearing and language tests (n = 9). At the time of this study, none of the children in the institution had been diagnosed with cognitive, neurological, hearing, and/or language deficits.

Data collection

The data were collected in weekly visits to the institution. Two children were screened per visit, and the tests lasted, on average, 20 minutes for the hearing and 30, for the language screening, per child. Two speech-language-hearing therapists, who had been trained to this end, conducted the assessments.

Hearing screening

Before beginning the hearing screening tests, all the participating children had their external acoustic meatus (EAM) examined with Omni 2000 otoscope to check for any hindrance to the hearing tests. Those with excessive cerumen in the EAM were evaluated by an otorhinolaryngologist at the school. After removing the cerumen (when necessary), the hearing screening tests began. There was an 1-week interval between cerumen removal and the hearing screening.

The instruments used in the hearing screening varied according to the child's age, as follows:

- Children 1 year to 1 year and 11 months old: acoustic immittance (tympanometry and ipsilateral acoustic reflex testing), behavioral hearing assessment, and transient evoked otoacoustic emissions (TEOAE).
- Children 2 years to 5 years and 11 months old: acoustic immittance (tympanometry and ipsilateral acoustic reflex testing) and play pure-tone audiometry.

Acoustic immittance (tympanometry and ipsilateral acoustic reflex testing) with an automatic acoustic-immittance meter (AT235h/Interacoustics) was conducted. The acoustic reflexes were tested ipsilaterally in both ears at 1000 and 2000 Hz. The pass criteria were a tympanometry type A curve and the presence of acoustic reflexes with normal values between 70 dB and 100 dB above the auditory threshold at the frequency researched[12].

The behavioral hearing assessment was made with the following instruments: jingle bells (77 dB), large *agogô* (100 dB), coconut shells (92 dB), and voice and voice detection test, with Ling sounds /a/, /u/, /i/, /s/, and /ʃ/. The expected responses were:

- In those 12 to 15 months old – sound localization: lateral, directly below, and indirectly above;
- In those 16 to 21 months old – sound localization: lateral and directly below and above;
- In those 22 to 24 months old – sound localization: directly, at any angle[13].

The pass criteria were auditory responses expected for their age, the presence of cochlear-palpebral reflex, and voice detection in all directions[13].

The TEOAE test was conducted with a portable device (Elios/ECHODIA), and their recording protocol used nonlinear click stimuli at 80 dBSPL. They were considered present when they had 70% or more reproducibility and 3 dB or more signal-to-noise ratio (SNR)[14].

The portable Elios/ECHODIA for the play pure-tone audiometry was also used, researching pure tones at 1000, 2000, and 4000 Hz with DD45 supra-aural earphones. For this test, a play with the child, who was instructed to do a motor activity (e.g., playing with shape-fitting cubes or placing an object in a container) when they heard the sound[13], was previously arranged. After training the child, the first stimulus was presented at 1000 Hz and 50 dBHL and the descending technique used until responses at 20 dBHL were obtained. Then, the test continued at 20 dBHL for all the other frequencies[13]. The pass criteria were auditory responses at a minimum of 20 dBHL in both ears at all frequencies[12].

All the auditory tests were conducted in a quiet room, without acoustic treatment; environmental noise was controlled with a sound pressure level meter[15]. The maximum noise level allowed in the room while conducting play pure-tone audiometry was 50 dBSPL, in compliance with ANSI-1999 norms for hearing screenings per sweeping without a sound booth[15]. In the case of the otoacoustic emissions, the portable device indicated when the noise level was high, so the examination at that moment was not performed, waiting for silence before doing it. All the equipment used was properly calibrated.

Language screening

Language cognition, reception, and production with the adapted Behavior Observation Guide for 0-to-6-Year-Old Children[16] were assessed. The adaptation consisted of using only the language cognition, reception, and production assessment items. Hence, the motor development assessment items were not used.

The language screening took place individually in a quiet room, and each child underwent stages with fun activities encompassing the aspects proposed in the protocol[16]. The responses were recorded in individual sheets, marking yes or no for each behavior expected for their age. This screening lasted on average 30 minutes per child.

The data from the individual sheets were entered into a database developed specifically to quantitatively analyze the children's behavior. To this end, the performance index (PI) in each aspect assessed in the language observation protocol was used, namely: receptive, productive, and cognitive, besides the overall PI[17].

The PI is established by analyzing the percentage of responses according to the language development milestones, considering the PI of the receptive, productive, and cognitive aspects of language, and the overall PI. The PI was calculated with the following formula[18]:

$$PI = \frac{Nba - Nbno \times 100}{Nba}$$

PI: performance index;
Nba: number of behaviors assessed;
Nbno: Number of behaviors not observed.

The pass criterion in the language test was 60% or more overall PI[17-19].

Diagnostic stage

After the school screening tests, the children with possible hearing or language impairments were referred for diagnosis and procedures at a specialized center. The children were evaluated there by two speech-language-hearing therapists, professors with Ph.D., specialized in hearing and language, and another physician, professor with Ph.D., specialized in otorhinolaryngology. They used the following methods:

Auditory assessment: EAM examination, acoustic immittance (tympanometry and acoustic reflex testing), TEOAE, air- and bone-conduction play pure-tone audiometry in a sound booth, medical evaluation, and procedures, if necessary.

Language assessment: ABFW Child Language Test[20].

There was, on average, a 3-month interval between the hearing and language screening and the diagnosis. The children diagnosed with language or hearing impairments were instructed to seek follow-up and were referred to specialists in the healthcare network.

After data collection, the researchers gave speeches at school to instruct the parents/guardians and teachers regarding auditory and language development.

Data analysis

The data were placed into an Excel database developed specifically for the research. They were statistically analyzed with SPSS statistical software, version 20 (IBM, 2015). The categorical variables (sex and results of the language and hearing tests) were presented as frequency measures. The continuous variables (age and PI) were presented as measures of central tendency and variability. A comparison analysis between the results of the hearing and language tests with the McNemar test was conducted. The significance level was set at 0.05 and the confidence interval, at 95%.

RESULTS

A total of 75 children were included in the study – 39 (52%) males and 36 (48%) females. The youngest one was 1 year and 8 months old, the oldest was 5 years and 11 months old, and the mean age was 3 years and 8 months. Figure 1 presents an overall summary of the results of the preschooler hearing and language assessments.

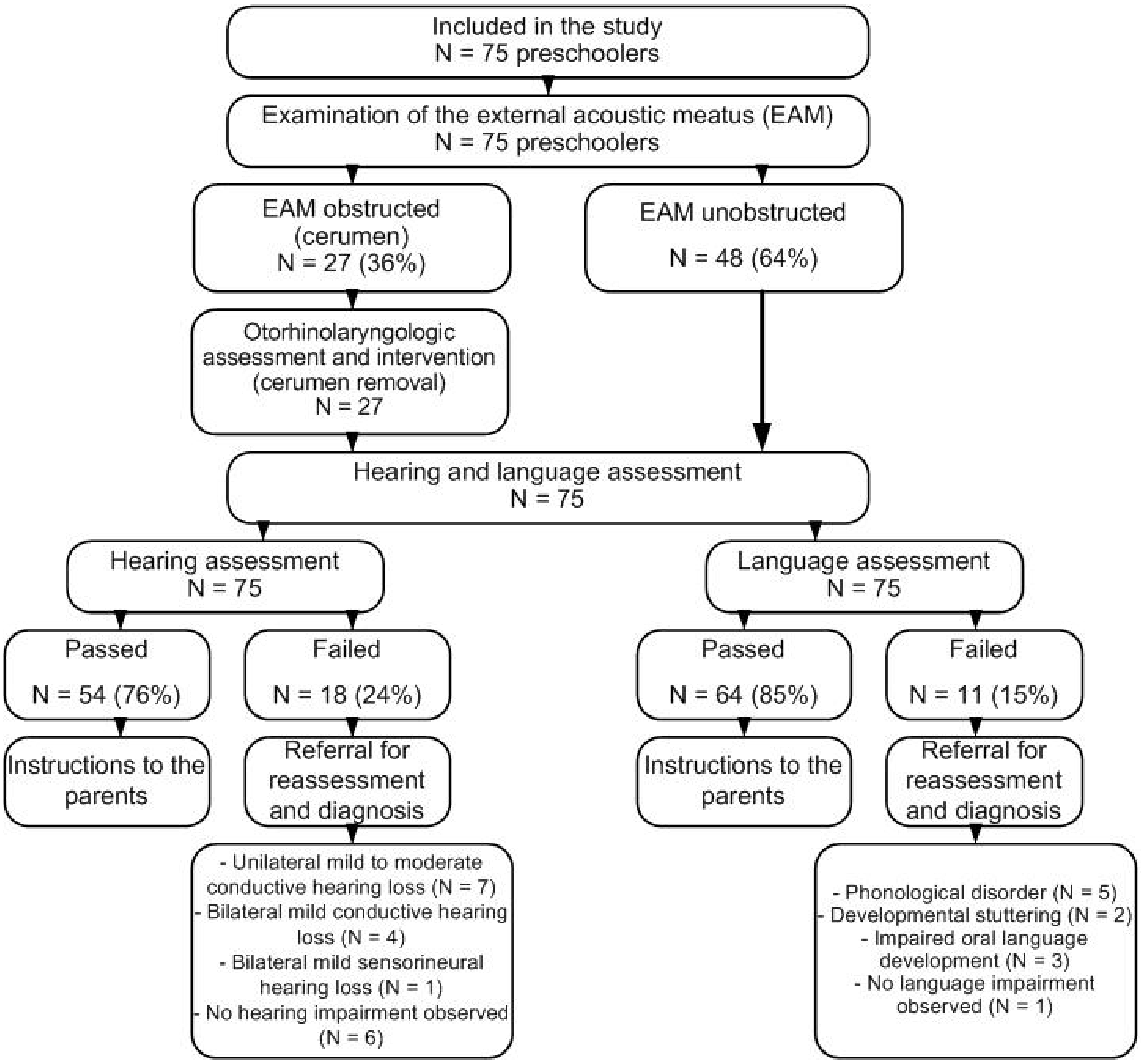

Figure 1. Overall summary of the results of the preschooler hearing and language assessments

All the 75 children had their EAM examined – 27 (36%) of them had excessive cerumen and were submitted to otorhinolaryngologic assessment and intervention at the school before the hearing screening.

The hearing screening results per audiological examination are described in Table 1.

Table 1. Results of the hearing assessment per audiological examination

Audiological examination	Age group	Result	N (%)
Tympanometry	1 year to 5 years and 11 months	Tympanometry bilateral type A curve	61 (81%)
		Tympanometry bilateral type B curve	4 (5%)
		Tympanometry bilateral type C curve	4 (5%)
		Tympanometry type B and type A curves	3 (4%)
		Tympanometry type C and type A curves	1 (2%)
		Tympanometry type B and type C curves	2 (3%)
		Total	75 (100%)
Stapedial acoustic reflex	1 year to 5 years and 11 months	Present bilaterally	57 (76%)
		Present unilaterally	4 (5%)
		Absent bilaterally	14 (19%)
		Total	75 (100%)
Behavioral hearing assessment	1 year to 1 year and 11 months	Adequate for age	6 (75%)
		Inadequate for age	2 (25%)
		Total*	8 (100%)
TEOAE	1 year to 1 year and 11 months	Present bilaterally	4 (50%)
		Present unilaterally	2 (25%)
		Absent bilaterally	2 (25%)
		Total	8 (100%)
Pure-tone audiometry	2 years to 5 years and 11 months	Normal degree bilaterally	56 (83%)
		Normal degree unilaterally	7 (10%)
		Abnormal bilaterally	4 (6%)
		Total	67 (100%)

Caption: TEOAE = Transient evoked otoacoustic emissions

The overall and receptive, productive, and cognitive language PI per age group are presented in Table 2.

Table 2. Preschoolers' performance index in the language assessment per age group

Age group	Category	N	Minimum	Maximum	Mean	Standard deviation
1 year to 1 year and 11 months	Reception PI	8	75.00	100.00	87.50	13.36
	Production PI	8	36.36	100.00	71.59	21.97
	Cognition PI	8	11.11	77.78	66.67	23.00
	Overall PI	8	41.67	91.67	72.40	17.95
2 years to 2 years and 11 months	Reception PI	16	75.00	100.00	94.38	9.01
	Production PI	16	25.00	100.00	67.35	26.50
	Cognition PI	16	41.18	100.00	81.05	15.20
	Overall PI	16	47.06	97.06	78.18	16.03
3 years to 3 years and 11 months	Reception PI	19	37.50	100.00	79.61	16.25
	Production PI	19	25.00	100.00	78.77	22.55
	Cognition PI	19	33.33	100.00	80.51	15.86
	Overall PI	19	44.12	100.00	79.31	14.97
4 years to 4 years and 11 months	Reception PI	13	75.00	100.00	87.18	7.31
	Production PI	13	25.00	100.00	77.18	19.18
	Cognition PI	13	23.53	88.89	60.86	20.15
	Overall PI	13	35.90	89.66	73.18	14.55
5 years to 5 years and 11 months	Reception PI	19	25.00	100.00	89.47	25.43
	Production PI	19	25.00	100.00	75.79	23.59
	Cognition PI	19	15.38	92.31	74.60	22.27
	Overall PI	19	7.41	96.30	74.97	25.29

Caption: PI = performance index

The preschoolers' results regarding hearing and language according to their age groups are shown in Table 3. No statistical association was found in the comparison of the hearing and language examination results of the children who failed both tests.

Table 3. Results of the hearing and language assessments per age group

Age (years)	Hearing screening n (%)	Language screening			p-value*
		Passed n (%)	Failed n (%)	Total n (%)	
1 year to 1 year and 11 months (N = 8)	Passed	2 (25)	2 (25)	4 (50)	0.687
	Failed	4 (50)	0 (0)	4 (50)	
	Total	6 (75)	2 (25)	8 (100)	
2 years to 2 years and 11 months (N = 16)	Passed	12 (75)	0 (0)	12 (75)	0.250
	Failed	3 (19)	1 (6)	4 (25)	
	Total	15 (94)	1 (6)	16 (100)	
3 years to 3 years and 11 months (N = 19)	Passed	14 (74)	3 (16)	17 (90)	1.000
	Failed	2 (10)	0 (0)	2 (10)	
	Total	16 (84)	3 (16)	19 (100)	
4 years to 4 years and 11 months (N = 13)	Passed	8 (62)	2 (15)	10 (77)	1.000
	Failed	3 (23)	0 (0)	3 (23)	
	Total	11 (85)	2 (15)	13 (100)	
5 years to 5 years and 11 months (N = 19)	Passed	12 (63)	2 (11)	14 (74)	0.687
	Failed	4 (21)	1 (5)	5 (26)	
	Total	16 (84)	3 (16)	19 (100)	
Total: 1 year to 5 years and 11 months (N = 75)	Passed	48 (64)	9 (12)	57 (76)	0.230
	Failed	16 (21)	2 (3)	18 (24)	
	Total	64 (85)	11 (15)	75 (100)	

* McNemar testr

The distribution of overall PI obtained in the language assessment per age group is shown in Figure 2, indicating which children failed the hearing and language screening. It is important to highlight that two children failed both the hearing and the language screenings.

The results indicated that 18 (24%) children failed the hearing screening and 11 (15%) failed the language screening. All the children who failed the screening were assessed at a hearing and language specialized center.

Concerning hearing, seven children were diagnosed with unilateral mild to moderate conductive hearing loss, four with bilateral mild conductive hearing loss, and one with bilateral mild sensorineural hearing loss, while six of them did not have hearing impairments (Figure 1).

As for language, five of the 11 children who failed the screening were diagnosed with phonological disorder[21,22], two with developmental stuttering[21], and three with impaired oral language development[21], while in one of the children no language impairments were identified (Figure 1).

Two out of the 12 children diagnosed with hearing impairments also had language impairments. One case is a 5-year-old child diagnosed with a mild steeply sloping sensorineural hearing loss and severely impaired oral language development. This child's previous history includes extreme prematurity, birth weight under 1,500 grams, and prolonged neonatal ICU stay. The other case is a 2-year-old child diagnosed with bilateral mild conductive hearing loss and mildly impaired oral language development. This child's previous history includes recurrent otitis.

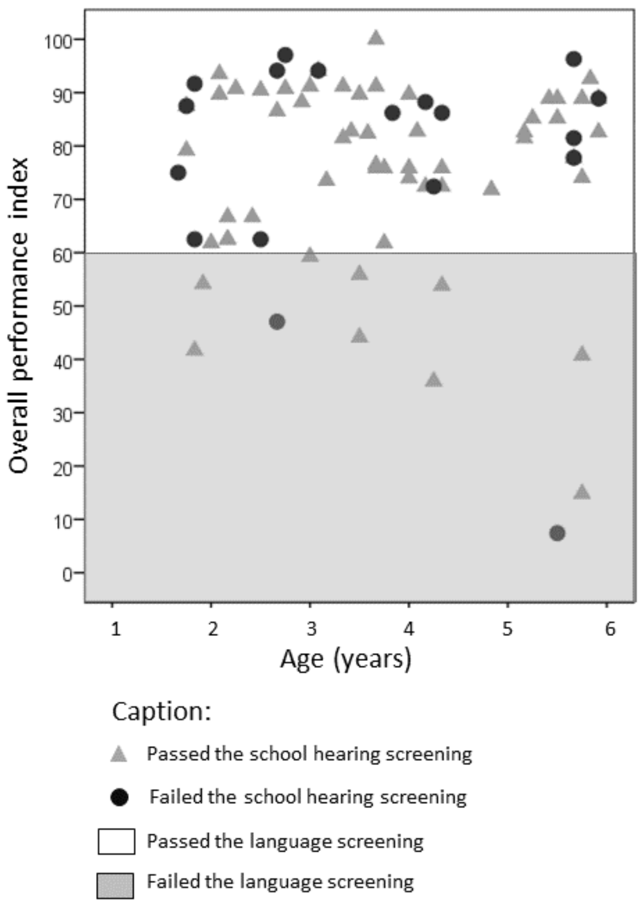

Figure 2. Distribution of overall performance index obtained in the language assessment per age group (n=75)

DISCUSSION

This study described preschooler hearing and language screening, identifying their possible impairments. A total of 75 preschoolers aged 1 to 5 years were screened, and the process identified 15% of them with possible language impairments, and 24% with possible hearing impairments.

Screening is a process with simple, low-cost, quick tests that identify subjects with possible impairments in the function assessed. The early identification of children with general difficulties or possible developmental delays is crucial to provide timely intervention, thus enabling these children to reach their full development. Hence, screening at school is greatly important[23]. This study screened possible hearing and language delays and/or impairments in children, opening the way to their development.

Before the hearing screening, all the participating children had their EAM examined to identify possible obstructions in it that might hinder an appropriate response to the hearing screening tests. Thus, the prevalence of hearing impairment found did not include children with excessive cerumen because, when identified, they were referred for otorhinolaryngologic intervention.

The EAM of 36% of the children screened in this study was obstructed with excessive cerumen. In other studies, such a prevalence was 6.3%[24] and 6.5%[25], which evidences a greater index of children with obstructed EAM due to excessive cerumen in the present study.

The purpose of cerumen, naturally produced by gland cells and EAM peeling, is to protect, clean, and lubricate the external auditory canal[26]. It is also known that excessive cerumen can impact hearing when it obstructs the EAM, causing great discomfort and hearing loss. This condition affects approximately 10% of children[26]. Hearing loss due to excessive EAM cerumen can range from 5 to 40 dB, depending on the extent of the obstruction[26]. Therefore, hearing screenings must include an EAM examination before the audiological tests.

In this research, different hearing screening methodologies according to each child's age group[9,13,27,28] were chosen.

Acoustic immittance is a quick, simple, painless test that assesses the mobility of the tympanic-ossicular chain and verifies whether there are acoustic reflexes. This examination provides data on the integrity of the middle ear, which makes it a rather important tool in diagnosis. Since preschoolers are more prone to having middle ear problems[29], this test for the screening process, in the present study, was chosen.

In the acoustic immittance results, type B and C curves and the absence of stapedial acoustic reflex were the most prevalent changes found in the research population. A study was conducted in Marília, São Paulo, with 112 preschoolers aged 4 to 5 years with a vulnerability index similar to the one in this study. It found a 63.4% prevalence of abnormal tympanometry results, predominating type B and C curves – a higher prevalence than the one found in the present study[29]. Another study assessed 130 schoolchildren aged 7 to 10 years, enrolled in public schools in Porto Alegre, Rio Grande do Sul. It found 56.92% abnormal results in the acoustic immittance – 20% abnormal acoustic immittance measures with a predominance of type C curves, and 16% abnormal acoustic reflexes[30]. These data corroborate the results found in the present research, in which 19% of the children had abnormal acoustic immittance measures and 24% did not have the stapedial acoustic reflex. The absence of stapedial acoustic reflex in children with tympanometry type B and/or C curves is explained by the conductive impairments[29]. None of the children in the present study had an absence of stapedial acoustic reflex, type A tympanogram, and normal auditory thresholds. However, this finding may be suggestive of central auditory processing deficits, which impact learning[30].

Middle ear changes, particularly recurrent otitis, are common in developing countries and highly prevalent in childhood[29]. Therefore, some authors suggest that parents and teachers be instructed in order to decrease the incidence of middle ear changes by implementing immunization programs to diminish the episodes of upper airway infections[29].

TEOAE and behavioral hearing assessment were used in children up to 1 year and 11 months old, in this study. Studies show that TEOAE is indicated for children under 2 years old because it is an objective test that does not require smaller children's cooperation; consequently, fewer children refuse to take the test[28]. The behavioral hearing assessment is an easy and low-cost method; however, it does not assess the ears separately and limits the intensity control[13]. Therefore, more abnormal results were found in the TEOAE test than in the behavioral hearing assessment, especially regarding unilateral hearing loss. Studies suggest that TEOAE is an effective method to screen preschoolers[31].

The children 2 to 5 years old were screened with play pure-tone audiometry, which is the method recommended to obtain auditory thresholds at preestablished frequencies and verify whether the peripheral hearing is normal, also quantifying the hearing loss[12,28].

Tanzanian research assessed 403 children 6 to 17 years old and revealed a prevalence of hearing loss ranging from 7.1% to 16.7% in the schools where they conducted the screening[25]. A Polish study identified a 9.4% prevalence of hearing impairment in the screening process[32]. Brazilian research conducted in Rio de Janeiro with 196 children 1 to 5 years old enrolled in public schools found a 17.3% prevalence of hearing loss[27]. Another Brazilian study with 391 students 6 to 9 years old enrolled in public schools in Caxias do Sul, Rio Grande do Sul, verified that 14.6% of them had hearing impairments[24]. These data corroborate the present study, which found possible hearing impairments in 17% of screened preschoolers.

As reported in the literature, school hearing screening enables the early detection of hearing impairments that may negatively impact the learning, reading, and writing processes, thus improving these children's quality of life[24,28]. Given the prevalence of hearing impairments in children 1 to 5 years old, their hearing must be followed up and monitored so they can properly acquire language and learn concepts, as this is the initial phase when they learn to read and write[27]. Furthermore, school hearing screening is an efficient way to establish the adequate procedure to follow when schoolchildren with hearing loss are detected[29].

This study demonstrated that TEOAE and acoustic immittance are the ideal methods to use in children 12 to 24 months old, and play pure-tone audiometry and acoustic immittance, in children 2 to 5 years old. The following steps are used: EAM examination to assess possible obstructions hindering the visualization of the tympanic membrane and the sound from entering the ear canal, otorhinolaryngologic assessment and procedure for the children with changes observed in meatoscopy (EAM obstruction), TEOAE, and/or play pure-tone audiometry, and acoustic immittance.

The children who failed the hearing screening test in this study were reassessed, and the results confirmed unilateral mild to moderate conductive hearing loss, bilateral mild conductive hearing loss, and bilateral mild sensorineural hearing loss. It is important to highlight that one third of the children who failed the hearing screening were reexamined, in which no abnormal results were found. This is explained by the possible association between Eustachian tube dysfunction caused by colds and influenza and temporary abnormal results in hearing tests[30]. In this regard, the diagnosis took place 3 months after the screening, and the children might have recovered during this time.

The adapted Behavior Observation Guide for 0-to-6-Year-Old Children[16] in the language screening was used. This is an easy, low-cost method that encompasses the cognitive, receptive, and productive aspects of language in natural playful situations when the child is more communicative[16,18]. The results obtained in the research with the PI described in the literature[17] were analyzed.

In this study, 15% of the children had possible language impairments. Language production failure predominated, whose overall PI was below 60%. A study assessed 752 children 2 to 23 months old that attended three community health centers in Belo Horizonte, Minas Gerais, with a vulnerability index similar to the one in this study. It demonstrated that 30.3% of those children were at risk of language impairments, and there was a predominance of language production impairments, corroborating the present research[18]. A study with 91 children 2 to 4 years old enrolled in public schools in Belo Horizonte, Minas Gerais, found the prevalence of 22%, 34%, and 35% in receptive, productive, and cognitive language impairment, respectively[4]. In another study, the prevalence of language impairment was 7%[2].

Preschooler language screening is important because of the high language impairment rates found in the different studies. Moreover, it enables timely intervention in cases of delay or disorder[18,33]. In the first years of life, biological maturation and social interaction are essential to language development, benefitting the child's construction of autonomy, socialization, and school achievement[1].

The vulnerability index is another important factor in language development. Places with a higher social vulnerability index have higher language impairment rates[18], which corroborates this research. Studies indicate that external factors related to the environment where children live influence their development[31,34].

The children with possible language impairments were referred for speech-language-hearing diagnosis – which found phonological disorders characterized by atypical speech sound productions, omissions, substitutions, or additions not expected for the age[21,22]; developmental stuttering characterized by broken speech, such as repeated sounds and syllables, blocks, and prolongations[21], and impaired oral language development characterized by poor vocabulary, difficulty combining words to form sentences and intelligible speech[21]. It is important to highlight that 10 out of the 11 children who failed the language screening were diagnosed with language impairment, while only one was not classified with any impairment after specialized evaluation. This finding corroborates the study conducted in Gothenburg, Sweden, which pointed out that nine out of every 10 children who failed the language screening at 2.5 years old were diagnosed with language impairment after specialized evaluation and were referred for intervention[35]. A study carried out in São Paulo with 524 children 0 to 11 years old identified a 22.9% prevalence of phonological disorders, 13% stuttering, and 15% oral language impairments[36]. This differs from the present study, in which a 6.6% prevalence of phonological disorders, 2.6% developmental stuttering, and 4% oral language impairments[36] were found.

No statistically relevant association was observed between hearing and language impairments in the present study. On the other hand, hearing is a required function for oral language development, correlated and interdependent with language. Hence, hearing loss has significant effects on oral language[2,3].

In this study, two children failed both the hearing and language screenings. Some characteristics of these cases must be described. One of them is a 5-year-old child diagnosed with mild steeply sloping sensorineural hearing loss and severely impaired oral language development. The analysis of the case indicates that extreme prematurity, birth weight under 1,500 grams, and prolonged neonatal ICU stay were possibly the risk factors for language impairment and hearing loss[37,38]. The child was referred to the Hearing Health Program.

The other case involves a 2-year-old child diagnosed with bilateral mild conductive hearing loss and mildly impaired oral language development. Studies indicate that auditory sensory deprivation, even a temporary one, can impair oral language development[39].

Conductive hearing loss was the most prevalent in this study. It decreases the intensity of the sounds the child perceives; consequently, the sounds are reduced, muffled, and devoid of their richness[39]. Thus, the results of this study do not exclude the hypothesis that such hearing impairments can precede language impairments.

Studies report that difficulties learning to read and write may be the outcome of conductive hearing impairments in the first years of life[39,40]. A study with 122 children found an association between child hearing impairment confirmed with pure-tone audiometry and diagnostic hypothesis of language impairment[3].

One of the limitations of this study was the sample size, which limits the possible generalizations to preschoolers at large.

Given the results of this study, preschooler hearing and language screenings are essential to timely detect the hearing and language impairments that may affect the full development of social, psychic, and school skills, and ensure early diagnosis and intervention to improve schoolchildren's quality of life and academic achievements.

These results validate the need for implementing screening programs that include hearing and language. Although these impairments may not occur concomitantly, both screenings are necessary to avoid these children's loss in cognitive and school development.

CONCLUSION

Out of the 75 children in the study, 24% had hearing impairment and 15% had language impairment. Of these, 12 (16%) were diagnosed with hearing loss and 10 (13%), with language impairment. However, there was no association between the hearing and language conditions in the studied group.

This result emphasizes the need for developing strategies to implement school screening programs involving hearing and language, thus, optimizing the development and integration of sensory, perceptive, and cognitive aspects towards full learning development.

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