



# Screening for Hearing Loss in Preschool-Aged Children: A First in Algeria

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## KEYWORDS

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## ABSTRACT:

**Introduction:** Deafness in children is the cause of speech disorders, school disorders, psychoaffective disorders and mental development disorders. These children have a variety of pathologies that complicate the diagnosis and treatment of the problem.

**Objectives:** The objective of this study is to determine the prevalence of deafness in primary schools in Mostaganem in Algeria through a large-scale active screening program in two steps.

**Methods:** This was a descriptive cross-sectional study based on a systematic screening of preschool children enrolled in schools in Mostaganem over a two-year period. Children were examined using otoscopy and four testing modalities: pure tone audiometry, otoacoustic distortion product emissions (DPOAE), tympanometry, and auditory brainstem response. The first stage at school, the second step is carried out in the ENT department for children with abnormal otoscopy or positive acoustics otoemission test carried out in the first test.

### Results:

3427 children were examined, the sex ratio was 0.87. We accounted 39.84% of children with hearing problem at the first stage of screening. A predominance of cerumen impaction and seromucous otitis, acute otitis media along with other less frequent pathologies. 7% of children had hearing loss requiring long-term treatment and follow-up.

**Conclusions:** These results strongly suggest the potential benefit of systematic screening of preschool-age children for hearing loss.

## 1. Introduction

The World Health Organization estimates that 34 million children worldwide suffer from debilitating hearing loss (1). Studies in various countries have observed that the prevalence rate of hearing drop in school-age children spans from 0.2% to 7.8% (1). In school-age children, the impacts of hearing loss are not only owing to academic limitations, but also negatively impact emotional development and behavior (2). The global burden of hearing loss among children and adolescents is steadily increasing, establishing it as a significant and urgent public health issue worldwide (3).

Hearing impairment is defined as a hearing level equal to or exceeding 20 dB H (4). Specifically, infections like cytomegalovirus (CMV) and rubella are collectively responsible for an estimated 40% of all non-genetic hearing loss identified in newborns (5). The evaluation of hearing loss must consider the suspected diagnosis, type, laterality, and degree of the loss, as well as the age of onset (6).

Proper diagnosis and treatment of this condition can result in poorer academic performance compared to peers with normal hearing (7). Comprehensive public health interventions for hearing health require knowledge of



prevalence and incidence to achieve appropriate resource allocation and provide instructions for prevention, screening, diagnosis, treatment and rehabilitation.

Hearing rehabilitation for children with hearing loss often involves the use of assistive devices like hearing aids, cochlear implants, and bone-anchored devices. Other options may include using assistive devices such as frequency modulating systems, bone anchored devices, or use of assistive devices such as frequency modulating systems (6)

Early diagnosis of hearing impairment is crucial for timely and effective treatment (8). However, limited information are available for Algeria.

The purpose of our study is to evaluate the prevalence of hearing loss in preschool children and demonstrate the significance of hearing loss screening in school-age children.

## 2. Methods

First, we obtained approval from the management of Mostaganem Academy and consent from the students' parents.

The exclusion criteria: children excluded were using hearing aids or cochlear implants, as well as those with chronic medical illnesses such as diabetes mellitus, hypertension, or renal failure in accordance with other studies (9).

All participants underwent primarily a basic hearing evaluation.

Children underwent a systematic screening in schools over a two-year period in two stages: a mass screening at school followed by confirmatory assessments at the ENT department of the university hospital. The evaluation included otoscopic examination and audiometric assessment consisting of pure-tone audiometry, impedance audiometry, otoacoustic emissions, and auditory evoked potentials and/or auditory steady-state responses (ASSR).

Statistical results were analyzed using SPSS software version 17 (SPSS Inc., Chicago, IL, USA).

## 3. Results

3427 preschool children were examined, showing a slight female predominance with a sex ratio of 0.87. The children were aged 5 years. The perinatal histories found included: 0.87% with severe jaundice requiring phototherapy, 0.1% with NICU hospitalization, and during childhood, 0.26% with bacterial meningitis, 0.18% with non-febrile seizures, and 0.06% with head

trauma. We found that 2% of the mothers were affected by COVID-19 during pregnancy.

83% of the children's families had a low socioeconomic status.

Among the patients with hearing loss, 12 suffered from viral meningitis, and 9 had bacterial meningitis.

We found that 39.84% of the children had an abnormal otoscopy result, with a predominance of cerumen impactions (22.65%), seromucous otitis (17.37%), acute otitis media (2.17%), and foreign bodies in the ear (0.12%). The results of clinical examination are summarized in table 1.

The outcomes of the audiological examination showed a predominance of conductive hearing loss (96%) and mild (57.83%) and moderate (44.17%) hearing loss, with 0.14% experiencing severe hearing loss. Sensorineural hearing loss was observed in 1%, primarily owing to progressive hearing impairment (0.41%), post-meningitic hearing loss (0.21%), hereditary hearing loss (0.18%), and post-traumatic hearing loss (0.06%). After treating acute and obstructive causes and transient inflammatory conditions, 32% of the children showed considerable improvement after six months. The prevalence of hearing loss was 7.53%, with a predominance of seromucous otitis and other chronic etiologies of varying frequency.

Results of Brainstem auditory evoked potential are depicted in table 2.

6% of the children suffered from allergic rhinitis and adenoid hypertrophy.

Table 1. Distribution of clinical examination of the patients

Clinical examination	Righ ear	Left ear
Otitis media with effusion	555	530
Ear wax	511	516
Acute otitis media	75	73
Cholesteatoma	2	0
Foreign body	4	0
Tympanique membrane perforation	3	3

Table 2. Results of Brainstem auditory evoked potential (n=39)



Brainstem auditory evoked potential (n=39)	0-20dB	21-39 dB	40-69 dB	70-89	> 90
Right ear	6	1	23	9	0
Left ear	11	1	21	4	1

#### 4. Discussion

Hearing loss in children, whether congenital or acquired, can stem from several causes. Untreated or frequent ear infections, especially otitis media, along with infections such as meningitis, measles, mumps, or whooping cough, and the use of ototoxic drugs, can all cause hearing loss (10).

Studies examining the general prevalence of hearing loss in school-age children have yielded mixed results. Some research suggests a slightly higher prevalence in boys (males) than in girls (females). For example, a study in Iran diagnosed 15 boys and 12 girls with hearing loss. However, the overall sample in this study contained a slightly larger number of boys, which might influence the results (4). The high-frequency hearing loss > 15 dB in the right and left ears was obtained at 1.14% and 1.04%, respectively. Prevalence rate of hearing loss (in all frequencies) in boys was higher than that in girls.

An estimation between 1990 and 2022 revealed that the highest global burden of hearing loss among children and adolescents was in the 15–19 years age group, followed by the 10–14 years, and 5–9 years groups (3). The timing of Hearing Loss is also crucial to point out, it can be congenital or delayed-onset or acquired (6).

The evaluation of hearing loss must consider the suspected diagnosis, type, laterality, and degree of the loss, as well as the age of onset (6).

Hearing loss is when the softest sound a person can hear is 20 dB or higher, on average, for frequencies ranging from 500 to 4000 Hz, in either one or both ears (3).

39.84% of the children enrolled in our study had a hearing problem at the first stage of screening. In Egypt the prevalence of hearing impairment among children was reported as 13.8% and 20.9% (11), this value has reached 33% in Oman (12). Moreover, in Brazil percentages of hearing loss among school-aged were ranging between 16 and 24.6% (13).

7% of children had hearing loss requiring long-term treatment and follow-up, similar low percentages were found in previous studies, with prevalence percentage of 10.3% in Poland (14), 4.92% in China (15), and 2.4% in Zimbabwe (16).

The aim of the comprehensive and child-centred audiologic assessment is to verify the integrity of the auditory system in each ear, measure hearing sensitivity across frequencies, determine the type of hearing loss (i.e., conductive, sensorineural, mixed).

Hearing loss significantly impacts school-aged children, affecting their communication, learning, and social development. The prevalence of mild hearing loss in school-aged children varies significantly depending on the study's location, with estimates ranging from 0.2% to 14.9% (9,1), the hearing loss among preschool-children in our study are included in this percentage interval.

A survey of hearing loss among Children 6 to 19 years of age, revealed that hearing loss was mostly unilateral and mild in severity (16- to 25-dB hearing level) (17).

Mild hearing loss was observed more frequently than moderate or severe degrees of loss. Furthermore, unilateral hearing loss was reported in a greater proportion of children compared to bilateral hearing loss (18). According to Elbeltagy et al., out of 100 students, 23 (23%) were confirmed having mild hearing loss, while 17 (17%) had bilateral conductive hearing loss, and 6 (6%) had bilateral sensorineural hearing loss (9).

In our study, we found that hearing loss was a predominantly linked to cerumen impaction and seromucous otitis. Children have narrow ear canal and are probably more susceptible to cerumen impaction due to their ear's anatomy. Moreover children have skin condition such as eczema that can increase the risk of impaction (19). Conversely, Jalali et al. Noted that there was a strong correlation between a past otitis media and sensorineural or conductive hearing loss (4).

The outcomes of our study are consistent with several studies found in the literature. Undiagnosed mild hearing loss is common in children aged 1 to 9 years (9).

We observe that the prevalence of hearing loss in African countries is higher than in developed countries, possible due to variations in socioeconomic status and access to healthcare. Discrepancies in hearing loss numbers might stem from differing definitions, causes, and the inclusion of high-frequency loss (1).



Previous studies have primarily focused on the global impact of hearing loss across all age groups and specifically within the older adult population (3). Moreover, most developed countries have implemented systematic neonatal hearing screening programs. Whereas most African countries, including Algeria, have not yet implemented systematic childhood hearing screening programs.

However, we strongly recommend the execution of a national childhood hearing screening program to ensure early and effective management. More than half (60%) of hearing loss in children under 15 could be prevented. This is often due to factors like loud noise exposure, secondhand smoke, and using audio devices (9).

Several previous surveys align with our results; these studies are detailed in table 3.

### Conclusion

Based on the findings of our research, which is the first of its type in Algeria, 39.84% of the children had an abnormal otoscopy result. The prevalence of hearing loss among children is 7.53%.

We conclude that the execution of a systematic childhood hearing screening program in our country is imperative for early management.

### Ethic statement

Ethical review and approval were not mandated for this study on human participants, as per local legislation and institutional requirements. All the patients gave their written informed consent to participate in the study.

### Author Contributions

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

### Conflict of Interest

The authors state that the research was carried out without any commercial or financial relationships that could be seen as potential conflicts of interest.

Table 3. Hearing loss prevalence across the world

Author	Country	Age	N	%
Abu-Shaheen et al. [20]	South Africa	3-6	6424	18.7
Niskar et al. [17]	USA	6-19	6166	1.3-2.8

Feder et al. [21]	Canada	6-19	2591	4,7
Le clerk et al. [22]	Holland	8-13	5368	7,8
Fu et al. [23]	China		504348	0.2
Pederson et al. [24]	Zimbabwe	4-13	455	10.3
Brian et al. [25]	Zimbabwe	-	-	2,4
Traore et al. [26]	Mali	1-5	766	13
Jingrong et al. [27]	China	3-6	21427	2.08
Zitouna et al. [28]	Tunisia	4-6	304	12,17
Ahmed et al. [29]	Kuwait	6-12	350	18.9
Fayala et al. [30]	Tunisia	6-8	241	31,53
Jalali et al. [4]	Iran		2019	2
Gyebre et al. [31]	Burkina-Faso	4-7	606	9,46
Ashoor et al. [32]	Saudi Arabia	6-18	800	7.12

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