Prevalence of Hearing Problems among School-aged Children Enrolled in Special Education in Selected Public Schools in Ilocos Norte

Joy C. Alvarez, MD, MClinAud,[1] Carlos Diego A. Rozul, MClinAud[2] and Jose B. Orosa III, MD, MPM-HG[1]

[1]*Department of Otorhinolaryngology Head and Neck Surgery, Mariano Marcos Memorial Hospital and Medical Center, Batac City, Ilocos Norte*
[2]*Philippine National Ear Institute, National Institutes of Health, University of the Philippines Manila*

ABSTRACT

Background. Hearing screening for school-aged children is crucial to identify cases missed by newborn screening, detect delayed-onset hearing loss, and address middle ear conditions that can cause hearing impairment. This is particularly important for children with special educational needs, who may present atypical developmental patterns, increasing their risk for undetected hearing issues.

Objective. This study aimed to determine the prevalence of hearing problems among students enrolled in inclusive classes at selected public special education (SPED) schools in Ilocos Norte, Philippines, during the 2023–2024 academic year.

Methods. Fifty-six (56) children aged 6 to18 years old with various disabilities, with or without medical diagnoses, were screened using a protocol that included visual inspection, otoscopy, tympanometry, screening pure tone audiometry (PTA), and transient evoked otoacoustic emissions (TEOAE). Children unable to complete the tests were classified as "unable to test" (UTT) and included in the analysis.

Results. Out of 56 participants, 15 (26.79%) had otologic problems, with impacted cerumen being the most common issue (19.61%). Sensorineural hearing loss (93.33%) was more prevalent than conductive hearing loss (6.66%), with severity ranging from mild (33.33%) to moderate (6.66%) to profound (60%). Children with autism spectrum disorder (ASD) showed the highest UTT rates. Compliance was higher for TEOAE (72.72%) compared to screening PTA (52.72%). There was an overall 78% average compliance with all procedures.

Conclusion. The study highlights a significant prevalence of hearing problems among children with disabilities, emphasizing the importance of early detection. Prioritizing otoscopy, tympanometry with ipsilateral acoustic reflex testing, and TEOAE may improve screening efficiency and compliance in this population.

Keywords: hearing loss, children with special needs, special education

Paper presentation – 18th Philippine National Health Research System Week, August 14, 2025, Legazpi City, Albay, Philippines.

eISSN 2094-9278 (Online)
Published: July 31, 2026
https://doi.org/10.47895/amp.v60i14.13135

Corresponding author: Joy C. Alvarez, MD, MClinAud
Mariano Marcos Memorial Hospital and Medical Center
Brgy. 6, San Julian, City of Batac
Ilocos Norte, Philippines
Email: jcalvarez@up.edu.ph

INTRODUCTION

As of 2024, the World Health Organization reports that 430 million people worldwide, including 34 million children, are affected by hearing loss, with half of these cases being preventable.[1-3] In the Philippines, hearing loss is both more prevalent and more severe compared to high-income countries, with 15% of the population, including 7.5% of children, suffering from moderate or worse hearing loss.[4] This condition can deeply impact children's attention,

learning, and social interactions, making early detection and intervention crucial.[5,6]

Individuals with disabilities often have limited access to hearing care and a higher prevalence of undiagnosed hearing loss.[7,8] A 2023 study in Singapore found that 10.8% of children with disabilities had hearing loss, with higher rates of bilateral loss in those with autism (ASD) and global developmental delay (GDD).[9] Children with disabilities, particularly those with ASD or Attention Deficit Hyperactivity Disorder (ADHD), are at even greater risk for undiagnosed hearing loss, often due to limited access to screenings and a lack of awareness.[7,10-12]

Neonatal screening is effective for detecting hearing loss, but ongoing monitoring throughout the school years is essential for continuous care. High-income countries with early detection programs demonstrate that early screening and support improve developmental outcomes for children with hearing impairments.[13,14] In the Philippines, there is no standardized protocol for hearing screenings in school-aged children, particularly for those with special health and educational needs, leading to the potential undetected or delayed-onset hearing loss.[15,16]

The absence of consistent hearing screening practices, including mandated or recommended routine screening at specific ages even in the absence of symptoms, results in many children, especially those with special needs, remaining undetected and not receiving timely intervention. When left untreated, it can cause speech delays, academic difficulties, and emotional challenges, underscoring the importance of early hearing screenings to improve language skills, academic success, and overall quality of life.[5]

Efforts have been made to establish screening programs for school-aged children in the country; however, no such programs have been implemented in SPED or the Ilocos Region.[16] As a result, children with special needs are often overlooked. Increased research and greater awareness are essential to improving hearing care for this vulnerable population.

Operational Definition of Terms

Age Groups – for this study, participants were classified based on chronological age as follows: Middle Childhood, 6 to 11 years; Early Adolescence, 12 to 14 years; and Late Adolescence, 15 to 18 years.

Hearing loss – any frequency greater than the 4FA given at presentation levels of 25 dBHL at 500 Hz, 20 dB HL at 1000 Hz, 2000 Hz, and 4000 Hz.

Hearing problem – also known as hearing loss or hearing impairment.

Learner Information System (LIS) – is the centralized database of the Department of Education (DepEd) that collects and manages information on learners, including demographics, enrollment, and special education needs, to support planning and inclusive education programs.

Otologic Problem – refers to any condition, disorder, or abnormality involving the outer ear, middle ear, or inner ear structures. For this study, an otologic problem includes issues such as impacted cerumen, otitis externa, otitis media, and microtia.

Off-site referral – referral to Mariano Marcos Memorial Hospital and Medical Center

School-aged children – includes children enrolled in grades 1 to 12 with a chronological age of 6-18 years old as defined by the DepEd.

OBJECTIVES

This study aimed to determine the prevalence of hearing problems among school-aged children enrolled in inclusive Special Education (SPED) classes in selected public schools in Ilocos Norte who participated in a hearing screening program conducted from August 2023 to February 2024 through funding from the Department of Science and Technology–Philippine Council for Health Research and Development (DOST–PCHRD). Specifically, the study described the demographic characteristics of participating children, characterized the spectrum of otologic conditions identified during screening, and determined hearing status using the four-frequency average (4FA). It also examined the presence of established risk factors for hearing loss based on the criteria of the American Speech-Language-Hearing Association (ASHA) and determined the proportion of children who were unable to complete the hearing screening procedures. The findings are intended to provide baseline epidemiologic data to inform school-based hearing screening initiatives and support the development of evidence-based hearing health programs for children enrolled in inclusive SPED settings.

METHODS

Research Design

A descriptive cross-sectional study design was utilized to determine the prevalence of hearing problems among school-aged children enrolled in the inclusive class in the public SPED in Ilocos Norte for the school year 2023-2024 who participated in the hearing screening program funded by DOST-PCHRD.

Research Setting

The study was conducted in selected public special education schools in Ilocos Norte, which include Catalino Acosta Memorial Elementary School (CAMES) located in Brgy.17, Tabug, Batac City; A.P. Santos Elementary School (A.P. Santos) located in Brgy 4, San Guillermo, Laoag City; Bacarra Special Education Center (BSEC) in Brgy. 1, Sta. Rita, Bacarra, and Badoc South Central School (BSCS) located in Brgy. 2, Garreta, Badoc. The schools were selected based on the list provided by the National Council on Disability Affairs (NCDA) in Ilocos Norte.

Study Participants

Participants of the study included school children aged 6 to 18 years old enrolled in public special education elementary schools in Ilocos Norte under the inclusive class. These children have been identified as learners with disabilities through prior medical diagnoses and teacher ratings in the Multi-Factored Assessment Tool (MFAT) and Early Childhood Care and Development of the Philippines DepEd.

Inclusion Criteria

All students from inclusive classes of selected special education schools were invited to participate. Learners with formal diagnoses from licensed professionals were verified through school records, including psychoeducational and medical evaluation reports and eligibility documents, in line with DepEd guidelines. Learners without formal diagnoses but showing functional indicators of learning disabilities were identified using the Learner Information System (LIS), which classifies learners as either clinically diagnosed or displaying disability symptoms based on the International Classification of Functioning (ICF).[17] SPED teachers accessed the LIS and provided classification information to the research team. Identification was further supported by structured teacher observations, developmental assessments, and referral records, ensuring a methodologically rigorous, dual-criteria approach. All records were reviewed by school authorities for verification but not retained by the researchers to maintain confidentiality. [17] Participants only included students whose parents or legal guardians assented to their participation in the hearing screening protocol.

Exclusion Criteria

The study excluded students who were enrolled in the self-contained, resource room, and mainstreaming classes of the school as determined using official school records. Participants who had underlying conditions that make them vulnerable to severe illnesses due to COVID-19, such as bronchial asthma and cardiovascular diseases, were also excluded from the study as determined health documentation submitted to the school, as well as reports teachers. Class placement exclusions were verified via enrollment lists, while health-related exclusions were based on medical records or health reports maintained by the school. No clinical assessments were conducted by the research team. The ability to follow commands was not a part of the exclusion criteria. Finally, participants whose parents or legal guardians did not assent to hearing screening were not included in the study.

Withdrawal Criteria

Participants and their parents were able to withdraw their participation from the study at any point during the conduct of the study without any consequences regarding their education or access to future health services.

Sample Size and Sampling Technique

The study employed **purposive sampling**, a non-probability sampling method in which participants were selected based on their **enrollment in SPED inclusive classes** in specific schools in Ilocos Norte that participated in the **hearing screening program conducted by the DOST-Philippine Council for Health Research and Development (DOST-PCHRD).** These public elementary schools in Ilocos Norte were chosen because they are listed by the **National Council on Disability Affairs**. There were 25 students enrolled in the SPED inclusive class at CAMES, 22 at BSSC, 17 at AP Santos, and 15 at BSEC, but out of the total 79 eligible children enrolled, only 56 participants were given assent to the study.

Data Collection

Hearing Screening Environment

In locating the screening environment prior to tympanometry, screening PTA, and TEOAE, the ambient sound in each test room was determined using a sound level meter (*NOYAFA-NF 562*) in an unoccupied room. Hearing tests were conducted only if the ambient noise was 50 dBA or less, as suggested by Gloria-Cruz.[16] The screening environment did not exceed 50 dBA from 500, 1000, 2000, and 4000 Hz as measured by the sound level meter. Whenever the environment failed the listening check, the room selection was changed, or the screening was postponed until the appropriate acoustics of the screening environment were ensured.

Hearing Screening Protocol

Screeners administering visual inspection and otoscopy, tympanometry, and TEOAE were second year otorhinolaryngology-head and neck surgery (ORL-HNS) residents from Mariano Marcos Memorial Hospital and Medical Center (MMMHMC) Ilocos Norte who had been provided 4 hours of relevant training on administering and recording their assigned procedures. An external audiometrist was employed to administer the screening PTA. The screening process began with visual inspection and otoscopy using a *Welch Allyn Otoscope*. Children with detected ear abnormalities, such as impacted cerumen and ear infections, received management and were scheduled for a repeat screening after one week. Tympanometry with the *Amplivox Otowave 102* was conducted for those with normal otoscopic findings, and only those with normal results proceeded to screening PTA and TEOAE. Any tympanometric abnormalities were also managed, with a follow-up screening after one week. In screening PTA using *Resonance r07a Audiometer*, tones were presented at 25 dB HL 500 Hz, 20 dB HL at 1000 Hz, 2000 Hz, and 4000 Hz. If the child did not respond to at least one of the frequencies at the specified intensity level, they were considered to have failed in screening audiometry. If there were no responses at the specified levels, the audiometrist was allowed to obtain a threshold utilizing the Modified Hughson-

Westlake down-up method. Children with "REFER" on TEOAE using *Resonance r14o* proceeded to off-site referral, specifically auditory brainstem response (ABR) and formal or diagnostic PTA. No further screening and intervention were done among children with normal results.

Data Analysis

The data collected underwent analysis using the Statistical Package for the Social Sciences (SPSS) Version 21 software. This analysis used frequency and percentage to determine the prevalence of hearing problems, the various types of hearing problems, hearing thresholds, and risk factors. Descriptive statistics, including mean, median, and mode, were used to determine the demographic characteristics of the children. Additionally, frequency was used to illustrate the number of children who were unable to complete the hearing tests.

RESULTS

This study examined the prevalence of hearing problems among school-aged children in public SPED inclusive classes in Ilocos Norte. Children unable to complete the hearing exam were classified as "unable to test" (UTT). Figure 1 outlines the hearing screening protocol, UTT counts per procedure, the number of children referred for medical management, and the number of children re-screened per procedure.

Participants Demographics

Most participants are male (58.93%), with most in middle childhood (69.64%), followed by early adolescence (25%) and late adolescence (5.36%). Most participants are in Primary Levels (78.57%). Of the students, 64.29% have a medical diagnosis, with ASD being the most common diagnosed condition (30.36%), while intellectual disability (ID) is the most common undiagnosed condition (17.86%). Nearly half (48.21%) live with extended families, and 46.42% live with nuclear families. Additionally, 67.85% of participants come from low-income families. Table 1 summarizes the demographic profile of the participants.

Medical and Otologic Findings

A total of 112 ears were examined, with 98.11% showing bilateral normal visual inspection results. Only one individual was diagnosed with bilateral microtia, and they were immediately referred for medical and audiologic management. All children completed the visual inspection, and 91.07% completed the otoscopy. Bilateral normal findings were observed in 60.78% of children, while the most common abnormalities were bilateral impacted cerumen (19.61%), unilateral impacted cerumen (13.73%), and acute otitis externa (3.92%). Children with impacted cerumen and acute otitis externa received treatment and were re-evaluated after a week. One child was referred off-site for continued

Table 1. Demographic Characteristics of the Participants

Demographic characteristic		Frequency (N = 56)	Percentage (%)
Sex	Male	33	58.93
	Female	23	41.07
Age (years)	Middle Childhood (6-11)	39	69.64
	Early Adolescence (12-15)	14	25.00
	Late Adolescence (16-18)	3	5.36
Grade level	Primary level (Grades 1-4)	44	78.57
	Intermediate level (Grades 5-6)	12	21.43
Disability (with diagnosis)	ASD	17	30.36
	ID	11	19.64
	HI	3	5.36
	ADHD	3	5.36
	VI	1	1.76
	MPD	1	1.76
Disability (without diagnosis)	ID	10	17.86
	HI+ASD	6	10.71
	ASD	3	5.36
	HI	1	1.76
Family type	Extended family	27	48.21
	Nuclear	26	46.42
	Single parent	2	3.57
	Stepfamily	1	1.78
Monthly family income (PhP)	Low income (9,250.00 - 19,040.00)	38	67.85
	Lower middle (19,040.00 - 38,080.00)	7	12.50
	Middle income (38,080.00 - 66,640.00)	6	10.71
	Poor (<9,520.00)	5	8.92

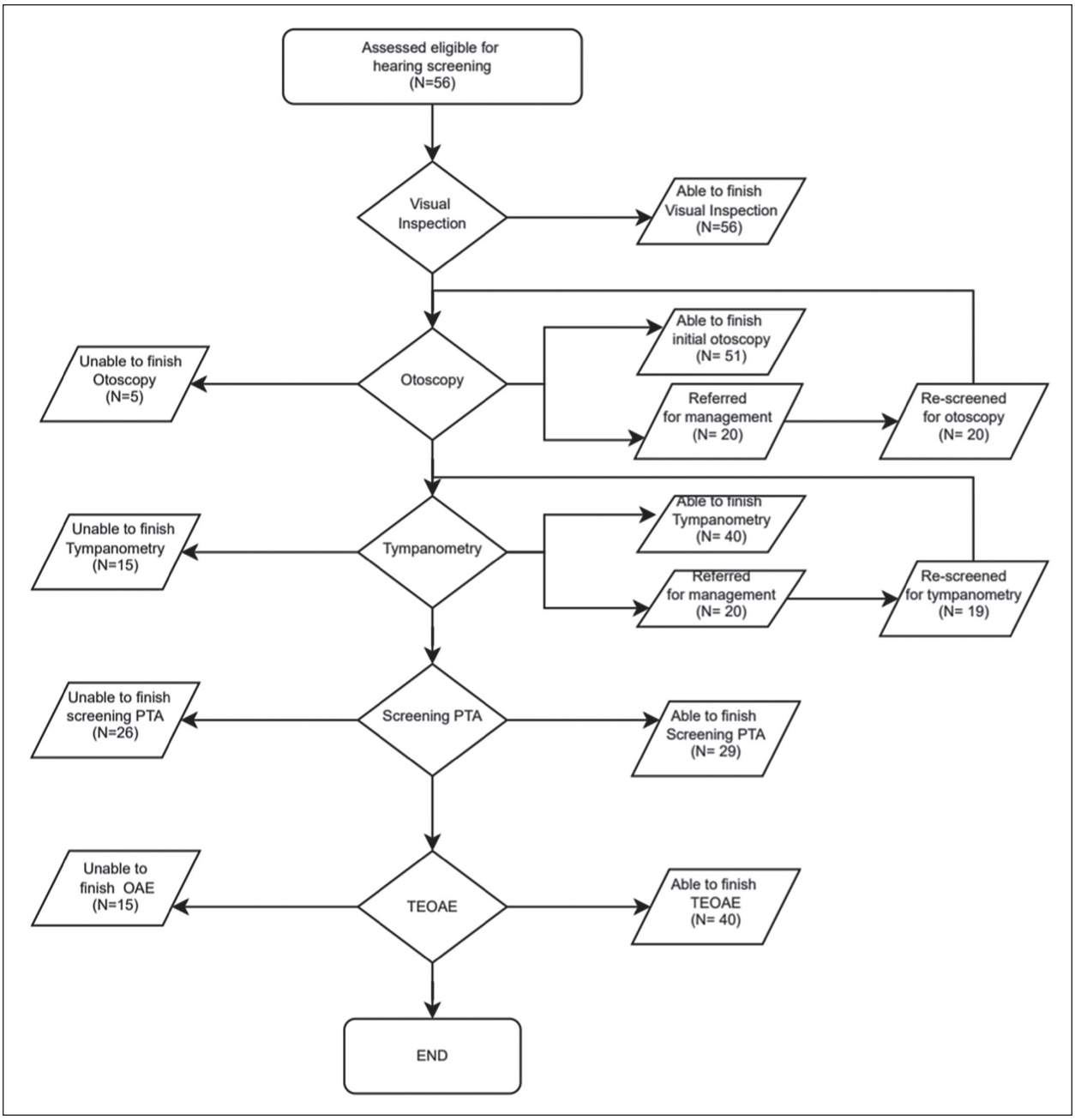

Figure 1. Hearing screening protocol and the number of UTTs.

**Excluded 1 after otoscopy due to microtia*

follow-up due to recurring ear discharge despite treatment at the school. Table 2 shows the initial otologic findings among the participants.

Of the children assessed, 33.92% had a history of ear issues, primarily impacted cerumen and acute otitis externa. For children with different conditions in each ear, such as cerumen in one ear and externa in the other, both conditions were recorded separately and included in the overall prevalence of otologic problems. Regarding prior hearing assessments, 57.14% underwent Newborn Hearing Screening (NBHS) with unrecalled results, while 28.7% had formal or diagnostic PTA and ABR tests, also with unrecalled results. 10.71% had no prior hearing evaluations. Additionally, 28.57% had other conditions, including bronchial asthma, seizure disorder, and Down syndrome. As for hearing loss risk factors, 1.78% had a history of meningitis, 7.14% of measles, 8.92% of mumps, 3.57% were born prematurely, 5.35% had ototoxic medication use, and 10.71% had a family history of hearing impairment. Table 3 shows the different medical conditions identified among the participants

Audiologic Findings

Most children exhibited a Type A result in both the right and left ears, accounting for 54.54% of the population in tympanometry, which suggested normal tympanometric function. This was followed by a Type B tracing, with 14.54% in the right ear and 10.90% in the left ear, and a small percentage showing Type C and Type As results at 1.81%, which suggested abnormal tympanometric function. The bilateral UTT rate for tympanometry is 25.45% and 3.63% for unilateral UTT. Overall, the UTT rate is 29.08%. Children with Type B, Type C, and Type As results were given appropriate treatment. After a week, re-screening was done, which all yielded normal results.

Screening PTA revealed normal results for both left and right ears as the most common findings among the participants. For the severity of hearing loss, bilateral profound hearing loss (16.36%) followed by bilateral mild hearing loss (5.45%) at low and mid frequencies were noted to be the most prevalent types. Almost half of the participants were unable to finish the screening PTA (47.27%). In TEOAE, 41.81%

Table 2. Initial Otologic Findings

Procedure	Findings	Frequency (N = 56)	Percentage (%)
Visual inspection	Bilateral Normal	55	98.21
	Bilateral Microtia	1	1.79
Otoscopy	Bilateral Normal	31	60.78
	Bilateral Impacted Cerumen	10	19.61
	Unilateral Impacted Cerumen	7	13.73
	Unilateral Normal	6	11.76
	Unilateral Acute Otitis Externa	2	3.92
	Bilateral absent EAC	1	1.78
	Bilateral UTT	5	8.93

Table 3. Risk Factors/Facilitating Factors

Risk Factor/ Facilitating Factor		Frequency (N = 56)	Percentage (%)
Previous ear infections	None	33	58.92
	Impacted Cerumen	15	26.78
	Unrecalled	4	7.14
	Acute Otitis Externa	3	5.35
	Acute Otitis Media	1	1.78
	NBHS	32	57.14
Previous hearing test	Unrecalled	11	19.64
	None	6	10.71
	NBHS+ ABR	6	10.71
	NBHS+ PTA	1	1.78
Past medical history	None	35	62.5
	Unrecalled	9	16.07
	Mumps	5	8.92
	Measles	4	7.14
	Prematurity	2	3.57
	Meningitis	1	1.78
Comorbidities and syndromes	None	34	60.71
	Others	7	12.50
	Unrecalled	5	8.92
	Bronchial Asthma	4	7.14
	Epilepsy/ Seizure disorder	2	3.57
	Prematurity	2	3.57
	Down Syndrome	1	1.78
	Goiter	1	1.78
Family history of hearing loss	Without	45	80.35
	With	6	10.71
	Unrecalled	5	8.92
Ototoxic medications	Without	48	85.71
	Unrecalled	5	8.92
	With	3	5.35

Table 4. Initial Hearing Screening Results

Procedure	Findings	Frequency (N = 55)	Percentage (%)
Tympanometry	Bilateral Type A	30	54.54
	Bilateral Type B	5	9.09
	Unilateral Type B	4	7.27
	Bilateral Type As	1	1.81
	Bilateral Type C	1	1.81
	Unilateral UTT	2	3.63
	Bilateral UTT	14	25.45
Screening Audiometry	Bilateral Normal *4FA <25dBHL*	12	21.81
	Bilateral Profound *4FA >80dBHL*	9	16.36
	Bilateral Mild *4FA 25-40dBHL*	3	5.45
	Unilateral Mild *4FA 25-40dBHL*	2	6.89
	Unilateral Moderate *4FA 41-60dBHL*	1	3.63
	Bilateral UTT	26	47.27
OAE	Bilateral PASS	23	41.81
	Bilateral REFER	10	18.18
	Unilateral PASS	1	1.81
	Unilateral REFER	1	1.81
	Bilateral UTT	15	27.27

had PASS results both for the right and left ears; however, 18.18% had bilateral REFER results. The UTT rate of OAE is 27.27%. Among the participants, 15 children (26.79%) were identified with hearing problems, categorized as follows: five with ID without a medical diagnosis, five with both Hearing Impairment (HI) and ASD (HI+ASD) without a medical diagnosis, three with HI with medical diagnosis, one with HI without a medical diagnosis, and one with ASD without a medical diagnosis. All children, excluding the three identified as hearing impaired with medical diagnoses, were referred off-site for confirmatory hearing testing. The UTT participants were also instructed to undergo a re-screening off-site. Parents and guardians of the children were briefed on pre-procedural steps; however, any additional costs for repeat hearing testing were no longer covered by the DOST-PCHRD. On average, compliance with the procedures was 78.26%, with screening PTA having the lowest compliance of 52.72%. Table 4 illustrates the hearing screening results of the participants.

DISCUSSION

This study is the first in the Ilocos Region to implement a hearing screening protocol for school-age children in public SPED schools. Hearing screenings are essential for identifying hearing impairments and providing timely interventions, especially in special education settings where effective protocols are vital for children facing multiple challenges.

Findings provide insights into the prevalence and types of hearing impairments, the need for management, the risk factors associated with hearing loss in this population, and the rate of children unable to complete testing, which are important for assessing and enhancing the effectiveness of the screening protocol in special education settings.

Assessment Methods and Accommodations

The UTT group showed different hearing screening results related to disabilities. Children with ASD had challenges initiating hearing tests and could only complete visual inspections and, in some cases, otoscopy, while those with ADHD could not take part in the standard screening PTA but showed engagement in the OAE assessment. Visual inspection and otoscopic examination revealed that five children had difficulty tolerating visual inspection and otoscopic examination, with four of them having ASD. This issue extended to other hearing tests, as many children in the UTT group also had ASD. Children with ASD often exhibit heightened sensitivity to tactile stimuli, making examinations and hearing tests challenging, especially when testers lack experience with developmental differences.[18,19] To improve testing accuracy and reduce stress, collaboration with specialists like occupational therapists or pediatricians is recommended. Strategies such as using sensory integration tools, allowing interaction with equipment, practicing on plush toys, and providing visual support can enhance the testing experience.[19,20] Adjustments should be made in school settings to accommodate the unique needs of children with ASD.

Otoscopic exams revealed that bilateral impacted cerumen was the most common ear issue (19.61%), followed by acute otitis externa (3.92%), which aligns with the findings of Newall's 2020 study.[4] The children's medical histories also showed that these conditions were common. While most visual inspections and otoscopies were normal, the frequent occurrence of these issues implies the need for regular ear checks and good hygiene. If untreated, they can cause mild to moderate conductive hearing loss.[21]

Hearing Screening Protocol Outcomes

There is a higher prevalence of ear infections among children from low-income families, with most diagnoses occurring in rural health facilities. Despite economic disparities, 78.94% of children were able to access necessary medications, suggesting good healthcare availability in the community. However, 10 out of 15 children identified with hearing loss lacked a medical diagnosis, emphasizing the role of family income in accessing medical support and follow-up care.

Among the 15 children with hearing loss, three already had ABR results and hearing aids, while the remaining 12 had no prior confirmatory testing. These 12 cases included individuals with ID (41.67%), HI+ASD (41.67%), hearing impairment alone (8.33%), and ASD alone (8.33%). Additionally, three children had risk factors for delayed-onset hearing loss (prematurity, meningitis history, and ototoxic drug exposure), while nine had no known risk factors. This indicates the necessity of further hearing evaluations, especially for children with known risk factors, to detect potential delayed-onset hearing loss. Three children with known risk factors for delayed-onset hearing loss showed varying degrees of hearing impairment. The child born prematurely had normal otoscopy and tympanometry results but exhibited mild right-sided hearing loss with a "REFER" result on OAE. The child with a history of meningitis had bilateral profound hearing loss with a bilateral "REFER" result on OAE. The child with ototoxic drug exposure initially showed bilateral Type B tympanometry, mild bilateral hearing loss on PTA, and a bilateral "REFER" result on OAE. These findings emphasize the need for ongoing hearing evaluations, particularly for children with risk factors, as recommended by ASHA.[5]

Interventions were provided to children with abnormal otoscopy and tympanometry results before hearing tests to ensure accurate thresholds. One child with Down Syndrome had persistent otitis externa, requiring off-site treatment. After managing the condition, tympanometry showed a persistent bilateral Type B tracing, leading to further referrals for treatment and imaging. This suggests possible conductive hearing loss. Children with Down Syndrome are more prone to chronic ear infections due to frequent upper respiratory tract infections and anatomical factors. Consistent care and early ORL-HNS referrals for medical or surgical intervention are crucial to reducing the risk of hearing loss in these children.[22]

The 4FA method was used in screening PTA, as frequencies beyond 2kHz impact speech comprehension, sound localization, and environmental awareness. Among participants with hearing loss, nine had bilateral profound hearing loss. Three had undergone ABR testing and received a medical diagnosis, while six had not received confirmatory testing and remained undiagnosed due to limited access to ABR equipment and trained personnel. Despite the Newborn Hearing Screening and Intervention Act of 2009 (RA 9709) mandating newborn hearing screenings in the Philippines, there is no structured program for school-aged children. Additionally, the province has only one facility for confirmatory testing and lacks a clinical audiologist.[23,24] Children with ID lacking a medical diagnosis in LIS exhibited mild to moderate hearing loss at low to mid frequencies, which may contribute to learning difficulties. Without prior hearing tests beyond newborn screening, some may have been misdiagnosed with learning disabilities when hearing loss was the primary issue. One child with ID and frequent headphone use showed signs of potential sensorineural hearing loss, with a down-sloping screening PTA pattern between 2kHz and 4kHz.Children with ADHD and hearing loss were unable to complete screening PTA due to difficulties following instructions, so they underwent OAE testing instead. This highlights the importance of using alternative, non-invasive hearing assessments like OAE, especially for individuals with cognitive or developmental disabilities.[5]

CONCLUSION

The study showed that a hearing screening protocol was executable in children in inclusive classes under the selected special education schools with an average of 78% compliance with procedures. The protocol also showed a prevalence of 26.79% for hearing loss after medical management. The identified risk factors for hearing loss were meningitis, measles, mumps, prematurity, ototoxic medication use, and family history of hearing impairment. The majority of these children with hearing problems lack a medical diagnosis, thus necessitating off-site referral for confirmatory ABR testing.

The UTT group showed different hearing screening results related to children's disabilities. Children with ASD had challenges initiating hearing tests and could only complete visual inspections and, in some cases, otoscopy, while those with ADHD could not take part in the standard screening PTA but showed engagement in the OAE assessment.

Children with ID showed varied results in hearing screenings depending on whether their condition had been previously diagnosed by a medical professional. Notably, ID children lacking a medical diagnosis displayed higher compliance with testing instructions and were found to have mild to moderate hearing loss at low to mid-frequencies. Also, among the children lacking a medical diagnosis, some classified as HI (41.66%) had not undergone confirmatory ABR tests but exhibited bilateral profound hearing loss during screening PTA. Overall, there was a higher rate of compliance with objective methods such as tympanometry and TEOAE in comparison to behavioral measures such as screening PTA.

Results of the study did not include formal diagnostic and confirmatory hearing testing conducted on individuals who passed their hearing assessments. As a result, the exact sensitivity and specificity of the screening methods remain unknown. Another methodological limitation in this study

involves utilizing "PASS" and "REFER" outcomes for TEOAE. It is advisable to include results that show both the OAE and noise amplitudes and incorporate normative data ranges overlaid on the graph for additional insights and interpretation of hearing loss. Additionally, since screening TEOAE was utilized in this study, hearing loss above 4kHz may have been missed.

There was also no information in the LIS regarding the severity of disabilities, which could impact the child's ability to take part in each hearing screening test. This lack of information meant that the screeners had to rely on their observations and interactions with the child to gauge the level of support needed during the examinations. A more thorough history was not conducted, as a significant portion of the results from NBHS, prior PTA, and ABR were labeled unrecalled. It would have been beneficial to have access to these results to ascertain the actual implications of these potential risk factors. It would be beneficial to include detailed information about the severity of disabilities in the data collection to improve the screening processes in the future.

Given the considerable heterogeneity among the participants, effectively delineating the experiences and outcomes of the hearing screening program was challenging. A more homogeneous population would be preferable to establish a detailed hearing screening protocol tailored to each child with a disability. By creating subgroups within larger populations, future researchers can better analyze the data and tailor interventions to meet the unique needs of each group. This will enhance the accuracy of the study results and pave the way for developing more personalized and effective hearing programs for children with disabilities. Furthermore, with the high compliance with tympanometry measures, it would be beneficial to include ipsilateral acoustic reflex testing in the screening protocol.

Future studies could explore the possibility of collaborating with schools to implement a longitudinal study that follows the progress of children over time. This would allow for a deeper understanding of the impact of the interventions on the children's academic performance and overall well-being. Incorporating qualitative research methods such as interviews or focus groups could also provide a richer context for interpreting the quantitative data collected. Inclusion of follow-up assessments and consultations with medical professionals in future studies will develop more strategies for early detection and intervention of hearing loss.

Beyond the screening protocol, the establishment of larger networks for referrals is needed in order to assess the benefits of enhanced hearing for children with disabilities, which should extend beyond the school environment in future evaluations. Additionally, collaborating with specialists like occupational therapists and speech therapists can enhance the outcome of the hearing testing program. Hearing etiquette among children with disabilities should also be given attention. Promoting effective communication methods, such as teaching basic sign language or reevaluating classroom seating arrangements, should be discussed with educators and parents.

Interventions and support programs should not only target children with hearing loss but also consider those with **coexisting developmental disabilities**. In addition to recommendations for teachers and healthcare providers**, school administrators should be engaged in planning and implementing interventions**, ensuring that inclusive strategies, resources, and policies are in place to support learners with both hearing and developmental challenges.

Acknowledgments

The authors thank the patients, teachers, parents, and screeners who participated in this study. They also thank the Department of Education of Ilocos Norte and the Mariano Marcos Memorial Hospital and Medical Center Department of Otorhinolaryngology-Head and Neck Surgery.

Statement of Authorship

All authors certified fulfillment of ICMJE authorship criteria.

Author Disclosure

All authors declared no conflicts of interest. The study was conducted independently, with support from DOST-PCHRD in the form of program collaboration and logistical assistance only. The funders had no role in study design, data collection, analysis, interpretation, or manuscript preparation.

Funding Source

The study was funded by the Department of Science and Technology - Philippine Council for Health Research and Development (DOST-PCHRD).

REFERENCES

1. World Health Organization, Deafness and hearing loss [Internet]. 2024 [cited 2025 Jan 19]. Available from: https://www.who.int/news-room/fact-sheets/detail/deafness-and-hearing-loss.
2. Rao RR, Subramanyam MA, Nair V, Bellur Rajashekhar. Hearing impairment and ear diseases among children of school entry age in rural South India. Int J Pediatr Otorhinolaryngol. 2002 Jun 17;64(2): 105–10. doi: 10.1016/s0165-5876(02)00032-0. PMID: 12049823.
3. World Health Organization, World report on hearing [Internet]. 2021 [cited 2025 Jan 19]. Available from: https://www.who.int/publications/i/item/9789240020481.
4. Newall JP, Martinez N, Swanepoel DW, McMahon CM. A national survey of hearing loss in the Philippines. Asia Pac J Public Health. 2020 Jul;32(5):235–41. doi: 10.1177/1010539520937086. PMID: 32608243.
5. American Academy of Audiology, Clinical Practice Guidelines: Childhood Hearing Screening [Internet]. 2011 [cited 2023 Nov 10]. Available from: https://www.audiology.org/practice-guideline/clinical-practice-guidelines-childhood-hearing-screening/.
6. American Speech-Language-Hearing Association, Causes of Hearing Loss in Children [Internet]. [cited 2022 Jan 24]. Available from: https://www.asha.org/public/hearing/causes-of-hearing-loss-in-children.

7. Evenhuis H, van Splunder J, Vink M, Weerdenburg C, van Zanten B, Stilma J. Obstacles in large-scale epidemiological assessment of sensory impairments in a Dutch population with intellectual disabilities. J Intellect Disabil Res. 2004 Nov;48(8):708–18. doi: 10.1111/j.1365-2788.2003.00562.x. PMID: 15494060.
8. Meuwese-Jongejeugd A, Vink M, van Zanten B, Verschuure H, Eichhorn E, Koopman D, et al. Prevalence of hearing loss in 1598 adults with an intellectual disability: Cross-sectional population-based study. Int J Audiol. 2006 Nov;45(11):660–9. doi: 10.1080/14992020600920812. PMID: 17118908.
9. Ting F, Kiing J, Li W, Chan Y, Loo J, Kang Y. Prevalence and profiles of late-onset hearing loss in preschool children with autism spectrum disorder who passed newborn hearing screening in a South East Asian population. J Autism Dev Disord. 2024 Sep; 54(9):3336–46. doi: 10.1007/s10803-023-06060-0. PMID: 37480440.
10. Quick N, Roush J, Erickson K, Mundy M. A hearing screening pilot study with students with significant cognitive disabilities. Lang Speech Hear Serv Sch. 2020 Apr 7;51(2):494–503. doi: 10.1044/2019_LSHSS-19-00017. PMID: 31951500.
11. Rydzewska E, Hughes-McCormack L, Gillberg C, Henderson A, MacIntyre C, Rintoul J, et al. Prevalence of sensory impairments, physical and intellectual disabilities, and mental health in children and young people with self/proxy-reported autism: Observational study of a whole country population. Autism. 2018 Oct 17;23(5):1201–9. doi: 10.1177/1362361318791279. PMID: 30328695.
12. Tas A, Yagiz R, Tas M, Esme M, Uzun C, Karasalihoglu AR. Evaluation of hearing in children with autism by using TEOAE and ABR. Autism. 2007 Jan;11(1):73–9. doi: 10.1177/1362361307070908. PMID: 17175575.
13. Davis A, Carr G. Early detection of hearing loss in newborn and preschool children. Community Ear and Hearing Health. 2014 Jan 19;11(15):1–12. doi: 10.56920/cehh.64.
14. Gos E, Henryk Skarzynski P, Czajka N, Matusiak M, Kazmierczak W, Janiak-Kiszka J, et al. Results of hearing screening in school-age children from rural areas of the Kujawsko–Pomorskie Region in Poland. J Int Adv Otol. 2022 Mar;18(2):106–11. doi: 10.5152/iao.2022.21164. PMID: 35418357; PMCID: PMC9450216.
15. US Aid from the American People, All Children Reading: Asia Vision and Hearing Screening Tools Pilot Activity in the Philippines [Internet]. 2018 [cited 2023 Nov 10]. Available from: https://ierc-publicfiles.s3.amazonaws.com/public/resources/Vision%20and%20Hearing%20Screening%20Tools%20Pilot%20Activity%20in%20the%20Philippines%20%28USAID%20ACR%20Asia%29.pdf.
16. Gloria-Cruz T, Carrillo J, Chan A, Chiong C, Llanes E, Plete J, et al. The accuracy of the hearing screener device as a hearing screening tool in the school setting for first Graders aged 5-10 Years. Otolaryngology. 2013;3(134). doi: 10.4172/2161-119x.1000134.
17. Department of Education. DepEd Order No. 023, s. 2022: Child Find Policy for Learners with Disabilities Towards Inclusive Education. Quezon City, Philippines. [cited 2023 Nov 10]. Available from: https://www.deped.gov.ph/2022/05/25/may-25-2022-do-023-s-2022-child-find-policy-for-learners-with-disabilities-towards-inclusive-education/.
18. Asmika A, Oktafiani L, Kusworini K, Sujuti H, Andarini S. Autistic children are more responsive to tactile sensory stimulus. Iran J Child Neurol. 2018;12(4):37-44. PMID: 30279707; PMCID: PMC6160628.
19. McTee H, Mood D, Fredrickson T, Thrasher A, Bonino A. Using visual supports to facilitate audiological testing for children with autism spectrum disorder. Am J Audiol. 2019 Dec;28(4):823-33. doi: 10.1044/2019_aja-19-0047. PMID: 31689370; PMCID: PMC7210434.
20. Brueggeman P. 10 tips for testing hearing in children with autism. ASHA Leader. 2012;17(1):5-7. doi: 10.1044/leader.ftr3.17012012.5.
21. Subha S, Raman R. Role of impacted cerumen in hearing loss. Ear Nose Throat J. 2006;85(10):650-3. PMID: 17124935.
22. Shott S. Down syndrome: common otolaryngologic manifestations. Am J Med Genet C Semin Med Genet. 2006;142C(3):131-40. doi: 10.1002/ajmg.c.30095. PMID: 16838306.
23. The Lawphil Project, Republic Acts- 2009 [Internet]. 2009 [cited 2024 May 12]. Available from: https://lawphil.net/statutes/repacts/ra2009/ra2009.html.
24. Healthy hearing, How hearing loss affects school performance [Internet]. 2018 [cited 2024 May 12]. Available from: https://www.healthyhearing.com/report/52433-How-hearing-loss-affects-school-performance.