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A test protocol for assessing the hearing status of students with special needs

Hsiao-Chuan Chen [a], Nan-Mai Wang [b], Wen-Chen Chiu [c], Shu-Yu Liu [b], Yi-Ping Chang [c], Pei-Yu Lin [d], King Chung [e,*]

[a] Graduate Institute of Audiology and Speech Therapy, National Kaohsiung Normal University, Kaohsiung, Taiwan, ROC
[b] School of Speech Language Pathology and Audiology, Chung Shan Medical University, No. 110, Section 1, Jiangou North Road, Taichung City 40201, Taiwan, ROC
[c] National Women's League Foundation for the Hearing Impaired, No. 45, Cheng Hsing St., Beitou District, Taipei City 112, Taiwan, ROC
[d] Kaohsiung Municipal Cheng Gong Developmental Disabilities School, Kaohsiung, Taiwan, ROC
[e] Department of Allied Health and Communicative Disorders, Northern Illinois University, 323 Wirtz Hall, DeKalb, IL 60532, United States

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ABSTRACT

Objectives: Individuals with disabilities are often reported to have a high prevalence of undetected hearing disorders/loss, but there is no standardized hearing test protocol for this population. The purposes of this study were (1) to examine the hearing status of students with special needs in Taiwan, and (2) to investigate the use of an on-site hearing test protocol that would adequately detect hearing problems in this population and reduce unnecessary referrals for off-site follow-up services.
Methods: A total of 238 students enrolled in two schools for special education and one habilitation center participated in the study. Most students had intellectual disabilities and some also had additional syndromes or disorders. A hearing screening protocol including otoscopy, tympanometry, and distortion product otoacoustic emissions was administered to examine students' outer, middle, and inner ear functions, respectively. Pure tone tests were then administered as an on-site follow-up for those who failed or could not be tested using the screening protocol.
Results: Only 32.4% of students passed. When administered alone, the referral rate of otoscopy, tympanometry, and otoacoustic emissions were 38.7%, 46.0%, and 48.5%, respectively. The integration of these subtests revealed 52.1% of students needed follow-up services, 11.8% could not be tested, 2.5% had documented hearing loss, and 1.3% needed to be monitored because of negative middle ear pressure. The inclusion of pure tone audiometry increased the passing rate by 9.9% and provided information on hearing sensitivity for an additional 8.6% of students.
Conclusion: Hearing assessments and regular hearing screening should be provided as an integral part of health care services for individuals with special needs because of high occurrences of excessive cerumen, middle ear dysfunction, and sensorineural hearing loss. The training of care-givers and teachers of students with special needs is encouraged so that they can help identify hearing problems and reduce the negative impact of hearing disorders and hearing loss. The screening protocol needs to include subtests that examine the status of different parts of their auditory system. The addition of pure tone audiometry as an on-site follow-up tool reduced the rate of off-site referrals and provided more information on hearing sensitivity.

1. Introduction

The availability of hearing health status information on individuals with special needs, such as persons with intellectual, physical disabilities, or multiple disabilities, is limited. When available, the data unequivocally indicate that they have higher prevalence of hearing disorders (e.g., impacted cerumen, middle ear effusion) and hearing loss (i.e., loss of hearing sensitivity) compared to the general population [1–7]. In 1996 and 2004, American Speech-Language-Hearing Association (ASHA) recommended several clinical practice guidelines to screen or assess the hearing status of children at different ages [8,9]. As children with disabilities represent a diverse population, ASHA cautions hearing professionals to treat the recommended protocols as practice

* Corresponding author. Tel.: +1 8157538033.
E-mail addresses: chenhc@nknucc.nknu.edu.tw (H.-C. Chen), frances@csmu.edu.tw (N.-M. Wang), taipei@nwlhif.org.tw (W.-C. Chiu), audio@csmu.edu.tw (S.-Y. Liu), taichung@nwlhif.org.tw (Y.-P. Chang), pyl.tn@msa.hinet.net (P.-Y. Lin), kchung@niu.edu (K. Chung).

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guidelines but not standards, and encourages the adaptation of different protocols to suit the needs of different sub-populations. This study examined the hearing health status of students with special needs in Taiwan and compared the passing rates of several commonly used audiological tests. The goals were to examine hearing health care needs among these individuals and to determine a practical on-site hearing testing protocol to be used in the field.

The World Health Organization estimated that more than one billion people have some kind of disabilities worldwide [10]. People with disabilities generally experience more barriers to receiving health services than the general public and they tend to have worse health conditions [11,12]. Various organizations and countries advocate for (1) increasing the awareness of the needs, (2) adopting national plans to provide better services, (3) improving the availability, accessibility, and the quality of data regarding disabilities, (4) strengthening research on disabilities around the world, and (5) closing the gap in health disparities between the general public and people with disabilities [10,13–17].

Hearing is one of the most important senses for connecting people with the world and for children to develop speech and language. The loss of hearing can be the result of disorders in the outer, middle, and/or inner ear. Cerumen occlusion/impaction of the ear canal is one of the most common outer ear disorders among individuals with disabilities [6,18–24]. Impacted cerumen can result in mild to moderate degrees of hearing loss [23,25–27]. Individuals with intellectual disabilities also are more likely to have reoccurring cerumen impaction [23]. Additionally, children with a history of cerumen impaction are found to have higher likelihood of developing otitis media with effusion and permanent hearing loss [27].

Otitis media is the most common cause of middle ear disorder [28–30]. Studies in the United States reported 71–83% of children had at least one episode of otitis media by age four [29–31]. In Taiwan, 20–31% of normally developing children are reported to have at least one episode before they are 5 years old [32] and 50% of children have at least one episode before age 10 [33]. Conductive hearing loss caused by otitis media is often temporary/episodic. The degree of hearing loss is generally in the mild to moderate range [34].

Disorders in the inner ear and/or the auditory pathway usually cause sensorineural hearing loss which is usually irreversible. Individuals with intellectual disabilities and congenital syndrome (e.g., Down syndrome, Usher syndrome, or CHARGE syndrome) are reported to have higher prevalence of sensorineural hearing loss and the degree of hearing loss typically increases with age [3,34–36].

In general, children with hearing loss are more likely to have delays in speech and language development, central auditory processing disorders, negative cognitive and educational consequences, problems in communication, and lower quality of life [31,34–48]. They are also more likely to experience fatigue, helplessness, and have social, emotional, or behavior issues [42–49]. The negative effects of hearing loss generally increase with the degree of hearing loss and the duration of hearing loss [43,49]. Additionally, hearing loss interacts negatively with coexisting cognitive disorders [36,49], likely because children with intellectual disabilities have limited cognitive resources to compensate for the loss of sensory information. Fortunately, the negative effects of conductive hearing loss usually can be reversed if the affected individuals are identified and timely follow-up services are provided. The negative effects of sensorineural hearing loss can also be partially alleviated by using various amplification options, such as personal hearing devices, or sound field amplification systems.

While some high income countries mandate hearing assessment as an integral part of services provided for individuals with disabilities (such as the Individuals with Disabilities Educational Act in the United States), hearing health care services are often limited or not available to individuals in other developed or developing countries [5,10,31,50–52]. Sometimes, when other disabilities are so severe and draw so much attention, effort, and time that hearing may be the last item on their health care checklist [50]. Also, the lack of hearing care awareness or knowledge among caregivers and the inability of the individuals to verbalize or describe their hearing conditions (e.g., I can't hear you) may render their hearing loss undetected [49]. If individuals with disabilities do not respond, others may assume they did not understand or they ignored the instructions instead of assuming they could not hear. Consequently, their hearing loss often goes undetected, unidentified, and untreated [5,38,39]. Yet, identifying hearing loss and ensuring instructions are heard may be one of the most effective ways to deliver educational and rehabilitation activities and/or to correct potential emotional–behavioral problems for some individuals [50].

There is a general lack of procedures, guidelines, and research studies on which audiological tests should be used for testing children with special needs, who have syndromes/disorder/conditions that restrict or impose a lack of ability to perform an activity [9]. The American Speech-Language-Hearing Association recommends that protocols assessing children's hearing status should include a battery of tests to examine the outer, middle, and inner ear [8,9]. This recommendation suggests that Guidelines for Standardized Screening Procedures [12] for athletes of Special Olympics are not appropriate for testing *children* with special needs. Specifically, the Special Olympics protocol calls for otoscopy and evoked otoacoustic emissions in the first round, tympanometry and pure tone screening in the second round, and pure tone threshold testing in the third around [12]. Athletes can be discharged from the hearing screening at the end of each round. As children are much more prone to having middle ear disorders than adults but tympanometry is not included in the first round of the protocol, children with robust otoacoustic emissions and middle ear problems may be discharged after the first round, leaving their middle ear disorders undetected.

Widely accepted hearing screening protocols for newborns or normally developing children also may not be appropriate for testing children with special needs. Newborn hearing screening programs typically do not conduct tympanometry to check the middle ear status [7,53] and, again, middle ear disorders in school-aged children can be missed. Additionally, hearing screenings for normally developing children often require behavioral hearing tests, which can be impossible or very time consuming for children with special needs because they may not be able to understand the testing procedures or be conditioned for behavioral testing. A desirable protocol, therefore, need to include the examination of middle ear status and to reduce the need for behavioral tests.

Another concern for establishing test protocols for students with special needs is the "lost to follow-up" rate. In the United States, about half of babies who fail newborn hearing screenings, do not complete follow-up appointments [54–56]. Factors identified by a National Institute of Health study group include transportation barriers, funding barriers, staffing barriers, "lost message" and ineffectiveness communication, and language and literacy barriers [55]. Parents and/or guardians of children with special needs are often under higher levels of stress and experience more struggle in time and financial allocation [50]. Thus, hearing test protocols for individuals with special needs should consider the challenges of follow-up services and include additional on-site testing, if feasible.