

Review

Current trends in outcome studies for children with hearing loss and the need to establish a comprehensive framework of measuring outcomes in children with hearing loss in China

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Abstract

Since the 1970s, outcome studies for children with hearing loss expanded from focusing on assessing auditory awareness and speech perception skills to evaluating language and speech development. Since the early 2000s, the multi-center large scale research systematically studied outcomes in the areas of auditory awareness, speech-perception, language development, speech development, educational achievements, cognitive development, and psychosocial development. These studies advocated the establishment of baseline and regular follow-up evaluations with a comprehensive framework centered on language development. Recent research interests also include understanding the vast differences in outcomes for children with hearing loss, understanding the relationships between neurocognitive development and language acquisition in children with hearing loss, and using outcome studies to guide evidence-based clinical practice. After the establishment of standardized Mandarin language assessments, outcomes research in Mainland China has the potential to expand beyond auditory awareness and speech perception studies.

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1. History

What is the ultimate goal of audiological intervention and aural rehabilitation for children with hearing loss? This question was pondered by great minds like Thomas H. Gallaudet and Laurent Clerc, who established the American Asylum for the Education of the Deaf and Dumb (now named the American School for the Deaf) in the United States in 1817. The goal of the program was to teach “deaf children” how to communicate, give them an education, and allow them to have a social life through manual communication (i.e. signing). Another group of pioneers include Greene Hubbard, who established the Clarke School (now called the Clarke School for Hearing and Speech) in 1863 and Alexander Graham Bell, who set up the American Association to Promote the Teaching of Speech to the Deaf (now called the Alexander Graham Bell Association for the Deaf and Hard of Hearing) in 1890. These pioneers advocated rehabilitation be centered on oral communication, instead of manual communication rehabilitation, to prepare a child with hearing loss for education and social development primarily through residual hearing, lip reading and tactile cues many years before the advent of hearing technology. Experts from both the manual communication camps and the oral communication camps have debated for over 100 years on the best ultimate communication goal for children with hearing impairment.

2. A framework of outcome assessments

Over the last two decades, universal newborn hearing screenings (UNHS), more sophisticated hearing assessment methods, and advanced hearing technologies such as digital hearing aids and cochlear implants, significantly contributed to the interest in research on outcome studies for children with hearing loss whose intervention and rehabilitation emphasizes developing listening and speaking skills. The ultimate goal for these interventions and rehabilitation procedures is for a child with hearing loss to develop language and speech through listening, receive a mainstream education, acquire social skills with normal hearing children, and potentially have a career among the normal hearing population. As a result, a framework of outcome measurements is needed to study the outcomes in the development of these different areas.

Outcome studies in the areas of language development, education, and psychosocial behavior have existed within the field of deaf education since the 1970s (Davis, 1977; Davis et al., 1981, 1986). A framework of a pediatric outcome evaluation after audiological intervention (e.g. fitting of

appropriate hearing technology) and during aural (re)habilitation includes the following components:

- Assessment of auditory awareness and sound discrimination,
- Speech recognition (or speech perception) assessment: speech perception is the process by which a perceiver internally generates linguistic structures believed to correspond with those generated by a talker (Boothroyd et al., 1991),
- Language development assessment,
- Speech development assessment,
- Play/cognition skills assessment,
- Social communication skills assessment,
- Other related assessments (e.g. sensory processing, sensory integration, sensory-motor, academic skills, and quality of life assessments).

3. Speech perception assessments: initial focus of outcome studies for implanted children

The early outcome studies from the Melbourne clinic for cochlear implantation in children focused on speech perception assessments, especially in the area of open-set speech understanding (Clark et al., 1987; Dawson et al., 1989). These outcome studies influenced early clinical trial study in the United States for the Food and Drug Administration (FDA) (Staller et al., 1991). Speech perception assessments have played an important role in assessing outcomes of hearing aid and cochlear implant use in children with hearing loss (Barker and Tomblin, 2004; Boothroyd et al., 1991; Boothroyd, 2004; Davidson et al., 2011; Geers et al., 2003a,b; Houston et al., 2003; O'Donoghue et al., 1999; Psarros et al., 2002; Seyle and Brown, 2002; Snik et al., 1997; Young et al., 1999).

4. Language development assessments: evaluation of the developmental impact of speech recognition skills

As early as the 1970s, Vandenberg (1972) used language development assessments in outcome studies for children who wore hearing aids. Hasenstab and Tobey (1991) measured language development of children with cochlear implants (CIs). Initial reports of outcomes for CI users (Coerts and Mills, 1995; Dawson et al., 1995) and comparisons of CI and hearing aid use in children (Geers and Moog, 1994) also used language development assessments. The 100th NIH Consensus Development Conference keynote speech entitled *Cochlear Implants in Adults and Children* recognized the

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