

skills of children with cochlear implants. Outcome measures included a variety of speech and language tests. Research studies exclusively focusing on speech perception outcomes were not included. No limits were set on the demographics of research participants or their socio-economic status.

Data Collection

Results of the literature search yielded seven non-randomized clinical studies in accordance with the previously mentioned selection criteria.

Results

Non-randomized clinical trials

Non-randomized clinical trials are a type of quasi-experimental design, in which the participants have not been assigned to treatment groups by chance. The researchers have either used natural groups or have assigned participants to groups using a non-random procedure, due to various practical reasons. The ability to control for confounding variables determines the strength of these studies (Axelrod & Hayward, 2006).

Connor, Hieber, Arts, and Zwolan (2000) conducted a longitudinal cohort study to compare consonant production accuracy and vocabulary development of children using cochlear implants that were enrolled in OC and TC education programs. A total of 147 children met inclusion criteria and

accounted for, thus posing a possible threat to the internal validity of the study. The methodology and procedures of this study were also not reported in great detail, making it difficult to critically appraise these sections. Overall, the results of this study provide somewhat suggestive evidence for positive expressive language outcomes for children in an OC setting.

More recently, Jiménez et al. (2009) conducted a non-randomized clinical trial to compare speech development in 18 pre-lingual deaf children with cochlear implants who had been educated using two different modes of communication. Participants were divided into groups based on their environment—a group that used both sign language and spoken language (G1) and a group that used only spoken language (G2). The authors used chi-square statistical analyses to determine the equivalence of

Discussion/Recommendations

The studies included in this critical review looked at both speech and language outcome measures. Overall, the critical appraisal of available research provides conflicting evidence regarding the benefits of one intervention over another for improving the language skills of children with cochlear implants. When considering all of the studies, there appears to be a general finding that there are no differences in language outcomes in regards to an OC approach versus a TC approach. Furthermore, findings that examined speech intelligibility were consistent and found that children enrolled in an OC setting performed significantly better on speech intelligibility measures (Connor et al. (2000), Geers (2000), Jiménez et al. (2009), Percy-Smith et al. (2010), Tobey et al. (2007), and Geers et al. (2002)).

There are several methodological reasons that could account for some of the differences between studies. These include

Geers, A., Nicholas, J., Tye-Murray, N., Uchanski, R., Brenner, C., Davidson, L., Toretta, G., & Tobey, E. (2000). Effects of communication mode on skills of long-term cochlear implant users. *The Annals of Otology, Rhinology & Laryngology*, 115, 89-92.

Geers, A. (2002). Factors affecting the development of speech, language, and literacy in children with early cochlear implantation. *Language, Speech, and Hearing Services in Schools*, 33, 172-183.

Jiménez, M.S., Pino, M.J., & Herruzo, J. (2009). A comparative study of speech development between deaf children with cochlear im