

Critical Review: Is there Evidence to Support the Use of FM Technology within the Preschool Population?

Johnson, J.
M.Cl.Sc. (Aud) Candidate
School of Communication Sciences and Disorders, U.W.O.

Abstract

This critical review examines the current research and trends in using FM technology in preschool children. Study designs include: critical review, case control and cohort study. Overall research supports the use of FM technology in enhancing speech perception for adults and school-age children; however, less attention has been directed at investigating if FM systems are useful in the development of speech and language skills in the preschool population.

Introduction

Sensorineural hearing loss, even to a mild degree, can have a significant impact on a child's ability to perceive speech in noise and quiet. As a result, remediation is necessary in order to facilitate language development. Identifying and treating hearing loss early on in life has posed many challenges for audiologists. The use of amplification has generally been the first step in this process. Advances in hearing instrument technologies over the last decade have provided people with hearing loss benefits of comfort and enhanced speech recognition. Particularly, the use of FM systems has been shown to enhance speech perception for children and adults in the classroom, in auditoriums, churches, and at the theatre (Ross, 1992).

Less attention has been directed at investigating if FM systems are beneficial for infants and young children with hearing loss. Studies have shown that early intervention with hearing aids has significantly improved the speech and language skills of young children with hearing loss. Given that we know FM systems have additional proven benefits for older children and adults, should it be a consideration when fitting young children? In situations where sufficient audibility may not be possible, due to noise or speaker-listener distance, children with hearing loss are particularly vulnerable. Oller and Eilers (1988) contended that the audibility of

speech is crucial for speech and language development. Accordingly, since the first 3 years of life are known to be crucial for speech and language development, the benefits of using FM technology need to be further explored for this age group (Moeller et al, 1990). Is there evidence that suggests the use of FM technology is beneficial in hearing aid fittings for preschoolers? To answer this question it is important to examine the current research and trends in using FM technology in young children and what considerations should be evaluated when fitting a young child with an FM system.

Objective

The primary objective of this work was to critically evaluate existing literature regarding the benefits of speech and language skill development in using FM technology in the preschool population. The secondary objective is to propose evidence-based recommendations about the use of FM systems for preschool children. Lastly, recommendations will be proposed on how future studies on this subject matter should be conducted.

Method

Search Strategy

Computerized databases, including PubMed, and Cochrane Library, were searched using the following search strategy:

((FM technology) OR (hearing loss)) AND ((speech intelligibility) OR (audibility) OR (language development) OR (preschool children)).

The search was limited to articles written in English between 1985 and 2005.

Selection Criteria

Studies selected for inclusion in this critical review were required to investigate the impact of FM technology on audibility, speech intelligibility, and language development in individuals with mild to severe sensorineural hearing loss. Limits on age were set on the demographics of research participants. The focus was to examine the impact of FM technology on the preschool population; therefore individuals were to be between the ages of 2-5 years of age. As well, studies that included children with disabilities that affect speech and language development were not chosen for this critical review.

Data Collection

Results of the literature search yielded the following types of articles congruent with the aforementioned selection criteria: critical review, case control, and cohort study.

Results

FM technology impact on formal language measures

Moeller et al. (1993) conducted a longitudinal study at Boys Town National Research Hospital to evaluate the impact of FM systems on auditory skill development and speech and language acquisition in the preschool years. Ten children with mild to severe sensorineural hearing loss participated in this study over a two year period. The children were randomly assigned to one of two groups. The first group included children that used only their hearing aids in the home setting and the second group was instructed to use their FM system as often as possible at home. The audiologists found that there were no significant differences in formal language measures, such as pronoun and morpheme usage, between the FM group and the hearing aid group. However, some subjects in the FM group had higher rates of language acquisition which suggested that the use of FM systems may be beneficial for some children.

Changes in grammar development were measured using the developmental sequence scoring (D.S.S) and the mean sentence length (MSL) for both groups at baseline and at the end of the study. The results showed that the FM group had an average change in language age equivalent of 36.3 months while the hearing aid group had an average language change of 29.5 months. However, comparisons of chronological age and language age were not significant between the two groups. When separating the two groups by age of identification, it showed that those children who were identified earlier showed D.S.S scores that were age appropriate or that exceeded developmental expectations for their age. As a result, earlier identification was shown to be a greater predictor of language development than the use of FM technology.

FM technology impact on speech perception in quiet and background noise

The Moeller et al. study (1993) also discussed the impact of FM systems on speech intelligibility. Differences were noted when comparing parental records of the children's performances. The parents in the FM group reported that their children asked for repetitions or clarification less often than their hearing aid counterparts. Furthermore, the FM group parents reported higher comprehension in their children's understanding and participation in conversations. Also according to parental observations, the FM group was found to have higher reports of pragmatic skills, language complexity, and speech intelligibility. Additionally, subjective reports indicated that FM technology may be beneficial in specific circumstances such as in background noise, during story-telling, in situations with one speaker like in Sunday School, or in situations when parents need to exert parental control such as at the zoo or at shopping malls.

Ross (1992) also explored the importance of considering FM systems for young children with hearing loss. Under ideal conditions, he contended that standard behind-the-ear (BTE) hearing aids may sufficiently amplify speech inputs for children with mild to moderately-severe hearing losses. However, he noted that children with greater hearing impairments may still miss auditory information even under ideal distances of 3-6 feet. Since children cannot exist in such a controlled environment, Ross (1992) recommended the use

of FM system to improve the listening environment. Furthermore, he noted that in the presence of noise and reverberation, even children with mild hearing losses may have more difficulties hearing compared to their normal hearing counterparts. Noise sources such as open windows, televisions, appliances and talking from adults and other children can make even the home a less than ideal listening environment.

Many studies (Benoit, 1989 and Madell, 1992) support the recommendations by Ross (1992). Benoit (1989) provided FM systems to 6 children between the ages of 2-4 years. At the end of the year, parents were asked to discuss their experiences with the FM system. Parents reported that communication was possible at a greater distance and since it was not as necessary to be close, it was more convenient for them. As well, parents also reported that background noise was not an obstacle in communication with their children.

In evaluating the benefits of FM systems, Madell (1992) compared hearing aid usage to the use of FM systems with an active environmental microphone with three subjects between the ages of 3 and 5 years of age. Although he discovered no significant differences for warbles tones, he noticed a significant advantage with the FM system in his speech recognition results; subjects showed an improvement of 5-20 dB, particularly greater gains in the frequency regions needed for speech.

At the 3rd International Conference for early amplification, Sandra Abbott Gabbard (2003) discussed the benefits of FM and implementing its use for young children. In children with varying degrees of hearing loss, a higher signal to noise ratio is needed in order to preserve speech perception in noise. (Killion, 1997) Consequently, Gabbard (2003) recommended FM technology to maintain the higher signal to noise ratio for children. She discussed how FM has been widely used in educational settings for children with and without hearing loss. Like Ross (1992), Gabbard (2003) noted FM systems help by improving the listening environment by eliminating speaker-to-listener distance, increasing signal to noise ratio, and improving room reverberation conditions for adults and children. Gabbard (2003) discussed how these same listening environment challenges exist for infants, toddlers, and younger children as well. She stressed that FM

systems may be particularly helpful during this period as children need good speech perception abilities in acquisition of speech and language and developing their auditory skills. Gabbard (2003) stated that although FM technology is not commonly used in younger children, a study in 1989 by Benoit showed that parents reported talking to their children more when using the FM system. The parents in this study also reported that their children were more likely to imitate speech. Similar to previous recommendations, Gabbard (2003) also noted benefits of FM technology when the speaker to talker distance increases. Gabbard (2003) noted that implementing FM use will be increasing important as the child ages. As infants become toddlers, they become increasingly independent and the distance between the child's ear and the parent's mouth becomes greater. In conclusion, Gabbard (2003) recommended that with adequate parental training and support FM technology can improve the listening environment needed to support the language and speech development of children's critical years.

Discussion

Current regulation bodies support FM technology usage in young children. In 2003, The American Academy of Audiology created a document that outlined what guidelines should be followed for assessment and intervention of children with hearing loss. Part of this protocol included considerations for amplification and what features should be chosen when fitting hearing aids on newborns, infants, and children. One of their recommendations was to choose a behind-the-ear (BTE) hearing aid style so that an FM receiver can be accommodated. This document advised that FM systems provide the best solution for listening at a distance or with noise present.

Several studies (Benoit, 1989 and Madell, 1992) in this review only used children with severe to profound hearing losses and failed to evaluate the participants over a period of time that would allow researchers to interpret meaningful changes to speech and language development. Although Moeller et al. 1993 study was reviewed over a two year period and did include children with varying degrees of hearing loss, this study did not include an adequate number of participants and the subjects were all drawn from the same preschool program for the hearing impaired.

Conclusions

Upon evaluating and analyzing the existing research on the use of FM systems in preschool children, it is clear that the current research is insufficient and further research needs to be conducted on this subject matter. Future studies need to incorporate study designs that can be generalized to all children who have hearing loss so that recommendations and protocols can be developed for the use of FM systems in this population.

Recommendations

Future regulations should provide more detailed recommendations such as the age FM should be considered and in what situations FM technology should be used. More evidence-based research is needed to answer these questions.

Future studies should include a more representative sample of the population to consider the breadth of socio-economic, educational, and geographical diversity represented in the real world. New studies should aim to include a greater number of participants between the ages of 2-5 years of age. As well, since these studies were conducted, many technological advances to FM systems have been made that may alleviate some of the problems that prevented full-time use. For example, now the receivers are housed within the behind-the-ear (BTE) casing, which prevents the problem of bulkiness and cosmetic concerns. Furthermore, specific situations where FM technology may be particularly useful, such as in the car, at the playground or at home, should be explored in greater depth in future studies.

At this present time, Audiologists should make informed decisions based on the personal and social factors of the young child and their family. Specific training of FM systems should be provided to families with on-going guidance and counselling to supplement this process.

References

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