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# Otitis Media, Hearing Loss, and Child Development: a NICHD Conference Summary

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This summary was drawn from presentations at a NICHD conference, "Otitis Media and Child Development," held from September 30 to October 2, 1985 in Bethesda, MD.

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## Synopsis .....

*Growing evidence indicates that a significant relationship exists between the conductive hearing loss resulting from recurrent otitis media (OM) during the first 3-5 years of life and subsequent problems in acquisition of language and academic skills. To assess current knowledge of OM and its consequences for cognitive and linguistic development, to exchange viewpoints, and, if possible, to*

*determine directions for future research, a conference was sponsored by the National Institute of Child Health and Human Development (NICHD).*

*Among the epidemiologic studies cited, some found a very high incidence of OM in North American Indians and Eskimos, caused, according to one hypothesis, by a genetically different eustachian tube. Another researcher advised that basic language development should be carefully assessed in all cases of OM in young children.*

*Conferees agreed that intervention programs must be developed and implemented until preventive measures are available. One model program emphasizes prevention of developmental difficulties based on the known and suspected sequelae of OM and on the known principles of language development.*

*Conference participants recommended that all infants and young children, particularly those at risk, be examined for OM during regular medical checkups. In addition to treating the disorder, measures should be taken to deal with any significant hearing loss. If drug therapy is inadequate to clear effusion from the middle ear, surgery should be considered. Speech and language intervention should be undertaken when required.*

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**T**HE FACT THAT A PERMANENT AND PROFOUND hearing loss adversely affects language development and in turn the development of academic competence is well accepted by researchers and clinicians alike. Transient hearing losses of a lesser degree, however, such as those associated with one of the most common diseases of young childhood, recurrent otitis media (OM), have only recently begun to be widely suspected of being related to deficits in language and academic functioning. Over the past several years, a number of studies have claimed to demonstrate a relationship between recurrent OM during the first 3-5 years of life and subsequent problems in the acquisition of language and academic skills. Although many of these studies have methodological flaws, an increasing body of data from increasingly better controlled studies indicates that a significant relation exists. In a recent policy statement, the American Academy of Pediatrics asserted: "There

is growing evidence demonstrating a correlation between middle ear disease with hearing impairment and delays in the development of speech, language, and cognitive skills" (1).

To assess the current knowledge of OM and its consequences for cognitive and linguistic development, to exchange information and points of view on this complex disorder, to identify areas of agreement and disagreement, and, if possible, to determine directions for future research, the National Institute of Child Health and Human Development (NICHD) brought together investigators from pediatrics, audiology, otolaryngology, speech and language, and psychology. The multidisciplinary group met at the National Institutes of Health in Bethesda, MD, from September 30 to October 2, 1985, to participate in a conference sponsored by NICHD. The conference proceedings will be published by York Press in 1986 (2). Highlights of that meeting follow.

*'Indeed, . . . the conference participants agreed that the effects of even a 'mild' hearing loss of 15-25 dB in early childhood, if persistent (as it may well be) and if neglected (as it often is for a variety of reasons, including difficulties in detection) may not only disturb the acquisition of language but also adversely affect the social and emotional development of a child, with the full implications of these consequences yet to be determined.'*

## **The Role of Hearing in Language Development**

The type of hearing impairment mainly considered was the mild-to-moderate learning loss that accompanies persistent, recurring OM and that may or may not be permanent. This infectious disease, which afflicts millions of infants and preschool children, is characterized by the accumulation of fluids containing mucus and pus in the middle ear, resulting in inflammation and obstruction of the conductive sound channel. In spite of appropriate treatment, the fluid may persist for weeks and even months after each episode of OM with hearing losses accompanying the presence of the fluid. The incidence of OM is highest during the first 3 years of life, a very important period in the acquisition of language, and then begins to taper off slowly over the next several years.

Children with only occasional acute episodes of OM were not considered, as there is no evidence that they are cognitively or academically at risk from these few incidents. Nor were children with permanent, profound hearing losses considered, as there is no doubt that such afflictions result in extremely high risks of language and academic deficits and require urgent and prolonged intervention with special remedial measures, including the use of sight to learn language.

In discussing the role of hearing in the development of speech and language, Noel D. Matkin, PhD, Director of the Children's Hearing Clinic, University of Arizona, Tucson, pointed out that

language, on which so much of cognitive and academic achievements depend, is acquired almost exclusively through hearing. Moreover, studies of children with normal hearing and language development over the past several decades have revealed, as noted by Dr. Matkin, that the preschool years are marked by an extremely rapid growth with respect to the form and use of language (3). This is the primary reason that the years between 1 and 5 are considered the critical or sensitive period for the acquisition of language, and, as a consequence, the earlier in life that a recurrent and often prolonged hearing loss disrupts the reception of speech, the greater the risk of linguistic and subsequent cognitive disfunctioning. This is perhaps even more apparent when one considers the abilities of young infants to perceive the sounds of speech. Although they have been shown to be able to perceive very fine acoustic differences during the first few months of life, the effects of parental language on these abilities begins to be evident as early as 10-12 months of age—when the incidence of OM peaks.

Although investigations of the impact of mild and moderate hearing losses in early childhood are limited, recent studies, including a survey by Schery (4) of more than 700 children, have highlighted the relationship between a child's hearing status and both receptive and expressive language development. Generally, studies of this nature have shown that the magnitude of the difficulties with language correlate with the degree of hearing loss. Data of this nature substantiate the belief that OM, although often producing only temporary conductive hearing losses, might still exert a negative influence on the acquisition of language. Indeed, in discussing these and related findings, the conference participants agreed that the effects of even a "mild" hearing loss of 15-25 dB in early childhood, if persistent (as it may well be) and if neglected (as it often is for a variety of reasons, including difficulties in detection) may not only disturb the acquisition of language but also adversely affect the social and emotional development of a child, with the full implications of these consequences yet to be determined.

In discussing the linguistic deficits of children, several conferees noted that the status of the entire child must be considered inasmuch as factors other than hearing ability may profoundly influence the development of language. These factors include the sex and cognitive capacities of the child, the socioeconomic status of the family, and the nature of communication between child and parents.

Following discussions on the effects from all causes of mild-to-moderate hearing loss on child development, the conferees focused on the specific developmental problems associated with OM.

### **Effects of Hearing Losses From OM**

In citing the prevalence of OM and the accompanying risk factors, Jerome O. Klein, MD, Department of Pediatrics, Boston University School of Medicine, reported an epidemiological study he conducted with 2,565 children, who were followed prospectively from birth (5). By the age of 3 years, more than two-thirds of the children had one episode of OM, and more than one-third had three or more episodes. Factors associated with increased risk of a single episode or recurrent episodes of OM were being male, being in a family with a sibling with a history of OM, and not being breast-fed. These data again indicated a possible genetic disposition of middle ear infection. There was agreement with Dr. Klein's assertion that the initial episode of OM places the child at high risk of other episodes, that it is a "red flag" warning to the physician not only to treat the disease but to consider the accompanying hearing problems and potential sequelae.

Other epidemiologic studies have identified race as an important risk factor in OM. Studies of American Indians as well as Alaskan and Canadian Eskimos have found that there is a very high incidence of OM. W. Wendell Todd, MD, Assistant Professor of Otolaryngology, Emory University, School of Medicine, Atlanta, hypothesized that a "different" eustachian tube is probably the prime etiologic factor for OM. Having an abnormally large caliber, the genetically different eustachian tube among high-risk populations is the mechanism of low pressurization in the middle ear, of inhalant allergens and irritants contributing to the infection, and of reflux from the nasopharynx into the middle ear during supine bottle feeding.

In a recently completed longitudinal study that overcame many of the methodological difficulties of earlier studies, the speech and language processing competence of 192 7-year-old children was examined. All children were closely followed early in life to determine carefully the incidence and severity of the individual episodes of OM. Dr. Paula Menyuk, PhD, Professor of Psycholinguistics at Boston University, reported that overall findings showed "very significant deficits in specific aspects of speech and language behavior but no across-the-board consequences." Of course, it

should be noted that not all children who experience severe, recurrent OM showed language deficits, but the reasons for the invulnerability of some children are by no means apparent at the present time.

Stating that he was "reasonably convinced" from findings in the literature and from his earlier studies that OM could adversely affect the linguistic development of young children, Peter D. Eimas, PhD, Professor of Psychology at Brown University, Providence, RI, reported on current studies in which he is attempting to determine some of the specifics of these detrimental effects. He is investigating the role of OM in the abilities of children to categorize simple speech sounds that vary systematically in their acoustic properties. The evidence to date appears to indicate that there is an independent effect of OM, but it remains to be determined just how great and pervasive this specific deficit in speech processing is.

In considering factors other than OM that may place a child at risk of developing language disabilities, some conferees noted that language disorders may have a genetic determination and no apparent external triggering factor. However, children with a history of OM during the preschool years and a genetic disposition for language difficulties may be particularly at risk for language dysfunctions.

In treating young children with OM, communicative skills are often ignored according to Peter Zinkus, PhD, Pediatric Psychologist, University of Tennessee at Memphis. He advised that in all cases careful assessment should be made of basic language development, which includes a family history of language delays or auditory-based learning disabilities, inasmuch as early intervention in children who are at risk for developmental delays in speech and language may have a significant, beneficial effect that is well worth the costs of such a general treatment program.

### **Diagnosis, Treatment, and Prevention**

Because OM may begin early in the first year of life, diagnostic methods aimed at early detection and management of the disease must be applicable to infants. Paul A. Shurin, MD, Cleveland Metropolitan General Hospital, reported that pneumatic otoscopy is currently the most widely used and reliable diagnostic technique. Tympanometry is accurate in indicating OM in children more than 7 months of age, but it produces many false negatives in infants under that age. Acoustic

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reflectometry, a relatively new technique, requires further evaluation in its use with young infants.

The audiometric procedures used in the detection and assessment of the hearing deficit that accompanies OM were reviewed by Fred E. Bess, PhD, Director, Division of Hearing the Speech Science at the Vanderbilt University Medical Center, Nashville, TN. These procedures, used alone or as part of a test battery, include pure tone audiometry, electroacoustic immittance, tympanometry, and acoustic reflectometry. The advantages and limitations of these procedures were described.

Drug treatment for OM, as reported by G. Scott Giebink, MD, of the University of Minnesota Medical School, Minneapolis, includes the use of antimicrobial, decongestant, antihistamine, and anti-inflammatory agents. Although antimicrobial drugs are effective in eliminating the acute symptoms in nearly all children within 72 hours, effusion persists in 50 percent of the children for 2 weeks and in 5-10 percent of the children for 12 weeks after treatment. Moreover, persistence of effusion is not alleviated by decongestants or antihistamines.

The importance of surgery in the management of OM and its complications was stressed by LaVonne Bergstrom, MD, Professor of Surgery, University of California, Los Angeles. She noted that both conductive hearing loss, which is the principal sequel of OM, and other, less well known complications of OM require surgery. These complications include masses of tympanosclerosis in the middle ear, fibrocystic and adhesive otitis media, ossicular discontinuity, facial palsy, acute mastoiditis, zygomatic abscess, and sensorineural hearing loss.

It is not known whether any form of medical, or surgical treatment of OM prevents future develop-

mental complications of the disease. Although prompt therapy would be expected to reduce the incidence and severity of sequelae, prevention of OM is the only certain way to eliminate complications. With respect to prevention, the conferees heard that antimicrobial drug prophylaxis has been shown to greatly reduce the incidence of the disease in high-risk infants. Vaccines are not as yet available for most of the pathogens associated with OM, although pneumococcal vaccine is partially effective in children more than 2 years of age. Currently, with NICHD support, a research team headed by Dr. Shurin is conducting a trial of the efficacy of human hyperimmune globulin in preventing OM in high-risk infants.

### **Speech and Language Intervention**

One of the most important and controversial subjects examined by the conferees was the need for routine assessment of hearing as well as of competence in speech and language for children with recurrent OM coupled with a program of intervention for those children with deficits in any of these functions. It was noted that inasmuch as the disease with its often accompanying hearing loss and cognitive and linguistic deficits cannot be satisfactorily prevented, successful intervention programs would eliminate a great deal of the future misery of children who otherwise would be likely to endure a number of linguistic and intellectual deficits. While there was considerable optimism that intervention programs could successfully prevent or overcome the consequences of OM, it was noted that we know little about the details of intervention programs that are currently in place or the extent to which they have been successful. Moreover, given the difficulties in developing such programs and evaluating their effects, a strong case can be made for extended efforts in developing procedures to prevent the disease itself.

But until such preventive measures are available, intervention programs must be developed and implemented. One model of intervention, directed toward the development of hearing, speech, and language, was presented by Julia Davis, PhD, Department of Speech Pathology and Audiology, University of Iowa, Iowa City. The program emphasizes prevention of developmental difficulties based on the known and suspected sequelae of OM and on the known principles of language development. In the program, information is disseminated to educate and alert parents and the medical

community to the potential hazards of OM. Parents are instructed by specialists how to stimulate language activity in the child by reading, talking, singing, and using games and toys. Remedial measures, when deemed necessary, are undertaken, and include hearing aids, auditory training, and speech and language therapy to improve communicative skills. Further discussion centered on the efficacy of various components of the program as well as its effectiveness and how it compares with other models of language intervention.

### Conclusions and Recommendations

There is growing evidence that the hearing loss that accompanies recurrent OM contributes to subsequent language and learning disorders in many children. Given the prevalence of this disease, the potential for subsequent developmental difficulties is enormous. Although there is also an increasing awareness of the potential harm to individuals and costs to society as a consequence of OM, we are only beginning to understand how to prevent OM effectively and, in the absence of effective preventive measures, how to treat the potential developmental consequences. It was the hope of the conferees that sufficient funds and interest in the scientific community could be generated to mount a major programmatic effort to combat this disease, which afflicts so many children throughout the world.

The conference participants recommended that all infants and young children, particularly those considered at risk of OM because of family history of the disease, environmental factors, or previous episodes of infection, should receive, as part of regular medical checkups, examination for middle ear disease. If the disorder is found, not only should it be promptly treated to eradicate the infection, but measures should be taken to deal with any significant hearing loss that accompanies the condition. If drug therapy proves inadequate to clear effusion from the middle ear, surgical procedures should be considered, for, although they entail some hazards to the child, the risk is minor when compared with the consequences of language and learning disabilities. To prevent language disorders that seriously threaten the child's normal development and quality of life, speech and language intervention programs should be undertaken when required.

The expansion of research efforts to identify better the extent of hearing impairment during recurrent episodes of OM and the duration of the

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effusion is also recommended, as is the development of new procedures to assess the cognitive profile of young children.

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