

# Mild and Unilateral Hearing Loss Implications for Early Intervention

**W. June Holstrum, PhD; Krista Biernath, MD;  
Sarah McKay, AuD, CCC-A; Danielle S. Ross, PhD, MSc**

Newborn hearing screening has become a standard practice in most birthing hospitals in the United States. Historically, the primary target for the identification of hearing loss has been infants with permanent bilateral loss of moderate degree or greater (ie, >40 dB). However, research indicates that without early identification and intervention, children with mild bilateral hearing loss or unilateral hearing loss can have significant communication, academic, and behavioral difficulties (F. H. Bess, J. Dodd-Murphy, & R. A. Parker, 1998; R. Bovo et al., 1988). Communication between families and professionals is essential to develop intervention strategies that will optimize the outcome of such children. This article presents a brief review of the research and discusses issues related to mild bilateral hearing loss and unilateral hearing loss. Implications for early intervention services, including the importance of collaboration among professionals, are outlined. Suggestions for intervention activities are taken from professionals attending the 2005 National Workshop on Mild and Unilateral Hearing Loss, the Joint Committee on Infant Hearing (JCIH) 2007 position statement, and various early intervention Web sites. **Key words:** *amplification, early hearing detection and intervention, early intervention, mild hearing loss, minimal hearing loss, unilateral hearing loss*

**N**EWBORN HEARING SCREENING has become a standard practice in most birthing hospitals in the United States. Over 90% of all newborns are screened for hearing loss no later than 1 month of age (Centers for Disease Control and Prevention [CDC], 2006). An estimated 2 to 6 out of 1000

babies are born with hearing loss (Dalzell et al., 2000; Vohr, 1995; White et al., 1994). Historically, the primary target for the identification of hearing loss has been infants and children with permanent bilateral loss of moderate degree or greater (ie, >40 dB). However, research indicates that without early identification and intervention, children with mild bilateral hearing loss (MBHL) or unilateral hearing loss (UHL) can have significant difficulties in their ability to listen (Nossa, Wagner, & Crandell, 1988), to develop communication skills, and to achieve learning goals (Bess, Dodd-Murphy, & Parker, 1998; Kiese-Himmel & Ohlwein, 2003; Lieu, 2004). These difficulties can contribute to poor self-esteem and behavioral problems (Bovo et al., 1988).

In July 2005, the National Workshop on Mild and Unilateral Hearing Loss was convened by the CDC and the Marion Downs Hearing Center to discuss the significance of minimal hearing loss (MHL) and to develop recommendations for screening, diagnosis, and intervention. Over 50 national and international experts, including researchers,

---

**Author Affiliations:** *McKing Consulting Corporation, Atlanta, Georgia (Dr Holstrum); National Center on Birth Defects and Developmental Disabilities, Centers for Disease Control and Prevention, Atlanta, Georgia (Drs Biernath and Ross); Center for Childhood Communication, Children's Hospital of Philadelphia, Pennsylvania (Dr McKay).*

**Disclaimer:** *The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the Centers for Disease Control and Prevention (CDC). Links to organizations outside of CDC are included for information only. CDC has no control over the information at these sites. Views and opinions of these organizations are not necessarily those of CDC, the Department of Health and Human Services, or the US Public Health Service.*

**Corresponding Author:** *W. June Holstrum, PhD, 214 Parkside Road, Lexington, SC 29072 (jbolstrum@sc.rr.com).*

clinical practitioners, early interventionists, parents, representatives from national organizations, and state and federal agencies participated in the workshop. Proceedings from the National Workshop are available on the CDC (2005) Web site. This article summarizes a review of the research on MHL, describes issues related to MHL, discusses the importance of partnerships, and provides suggestions for early intervention (EI) activities. For this article, MBHL refers to bilateral hearing loss at the 15 to 40 dB hearing level. UHL refers to unilateral hearing loss of any degree greater than 15 dB hearing level. MHL includes both MBHL and UHL.

## REVIEW OF THE RESEARCH ON MINIMAL HEARING LOSS

There are few published studies examining the developmental effects of MHL on preschool children. This gap in research may be partly due to the following reasons: (1) preschoolers are not routinely screened for hearing loss and (2) the negative outcomes of MHL may not be as evident during the preschool years as in the school-age years. Professionals attending the 2005 National Workshop on Mild and Unilateral Hearing Loss developed recommendations for research to fill in some of the gaps (Gravel, Brown, Tharpe, & Oyler, 2008). The studies that are published suggest that some infants and preschool children may have difficulty with emerging speech and language development (Kiese-Himmel, 2002; von Hapsburg & Davis, 2006). Therefore, it is important to provide EI to prevent later school difficulties. Similar to findings by Bess and colleagues (Bess et al., 1998), a recent study by Most (2006) emphasizes the need for EI for children with MHL by pointing out that "children with unilateral and minimal hearing losses have lower functioning than those with more severe hearing loss." The study's authors suggest the reason for this was that children with less severe hearing losses were identified later and received fewer or no services.

## Mild bilateral hearing loss

Children with MBHL miss from 25% to 50% of speech sounds (Flexer, 1999). For very young children who are just learning to speak, this can have significant consequences during early learning experiences as well as when they enter school-age programs (Table 1). The reported effects of MBHL on development of children at all ages include difficulties with speech recognition, speech discrimination in background noise, reading comprehension (Davis, Elfenbein, Schum, & Bentler, 1986; Bess et al., 1998; Davis, Reeve, Hind, & Bamford, 2001), communication and class participation (Most, 2006), phonology (ie, speech production), vocabulary and language delays (Davis et al., 2001; Briscoe, Bishop, & Norbury, 2001; Elfenbein, Hardin-Jones, & Davis, 1994; Blair, Peterson, & Viehwed, 1985), and short-term memory deficits (Blair et al., 1985). In addition, as children enter school, other reported effects include lower standardized achievement test scores than children without hearing loss (Bess et al., 1998; Davis et al., 1986; Davis et al., 2001; Blair et al., 1985), difficulty in academic progress (Bess et al., 1998; Briscoe et al., 2001), and problems with behavior, energy, stress, social support, and self-esteem (Bess et al., 1998; Davis et al., 1986; Bourland-Hicks & Tharpe, 2002).

## Unilateral hearing loss

The reported effects of UHL on development and later academic achievement include problems in sound localization (Bovo et al., 1988; Bess, Tharpe, & Gibler, 1987), difficulty understanding speech in adverse listening conditions (Bovo et al., 1988; Kiese-Himmel & Ohlwein, 2003), delay in using 2-word phrases (Kiese-Himmel, 2002), difficulty with academic progress (R. F. Oyler, Oyler, & Matkin, 1987; Bovo et al., 1988; Culbertson & Gilbert, 1986), behavioral problems (Culbertson & Gilbert, 1986), lower scores on some subtests of standardized achievement tests than children without hearing loss (Culbertson & Gilbert, 1986), and the

**Table 1.** Potential consequences of hearing loss<sup>a</sup>

Level of hearing loss	Consequences without intervention (Intervention may include amplification, developmental intervention, speech therapy, and parent support)
Minimal or slight, 16-25 dB	Without intervention the child may miss at least 10% of teacher directions. have difficulty in detecting subtle conversational cues. have trouble keeping up with fast-paced communicative interactions. appear immature and more fatigued.
Mild, 26-40 dB	Without intervention, the child may miss 25% to 50% of speech sounds. develop negative self-concept when he or she is repeatedly accused of "daydreaming" or "hearing when he or she wants to" or "not trying." be regarded as inattentive. be more fatigued or irritable than friends and classmates. Background noises may become more difficult to separate out, which may cause more stress for the child.
Moderate, 41-55 dB	Without intervention, the child may miss 50%-75% of the speech signal (40-45 dB). miss 80%-100% of the speech signal (50 dB). be likely to have limited vocabulary, delayed or defective syntax, and imperfect speech production. be likely to be at least 2 grades behind by fourth grade.
Moderately severe, 56-70 dB	Without intervention, the child may miss 100% of classroom information. have delayed language, syntax, reduced speech intelligibility. Social behaviors are also likely to be problematic.
Severe, 71-90 dB	Without intervention, the child cannot hear conversational speech at all without amplification. may not develop spoken language. with amplification, may hear loud voices close to ear and some environmental sounds.
Profound, 91 dB or greater	Without intervention, the child cannot hear any sounds without amplification but is aware of vibrations. will not develop speech. May rely on visual language. Could be eligible for cochlear implant.

<sup>a</sup>Data from Flexer (1999), Hands and Voices (2008), Matkin (1981), Northern and Downs (2002), Ross et al. (1991), and Anderson and Matkin (1991), Brackett (1997).

need for more support services (R. F. Oyler et al., 1987; Bovo et al., 1988). Additional studies have indicated that 22% to 40% of school-aged children with UHL repeat a grade (Bess

et al., 1998; R. F. Oyler et al., 1987; R. F. Oyler, Oyler, & Matkin, 1988; Bovo et al., 1988; Culbertson & Gilbert, 1986; Bess & Tharpe, 1988; Klee & Davis-Dansky, 1986; Lieu, 2004).

Not all children with MHL exhibit developmental delays or academic difficulty. Some children are at higher risk than others. However, beyond the usual conditions that put any child at risk for developmental delay (eg, perinatal infection and low birth weight), the protective and risk factors that influence outcomes in children with MHL are unknown. A recent population-based study by Wake et al. (2006) showed no statistically significant differences on tests of language, reading, and behavior for a large cohort of Australian children in first and fifth grades with slight mild bilateral sensorineural hearing loss (15–40 dB pure tone average) compared with those with normal hearing. However, the children with hearing loss did show poorer phonologic short-term memory than children with no hearing loss. The study by Wake et al. (2006) was cross-sectional; therefore, the authors could not distinguish between children born with hearing loss and those who acquired it later. A robust finding in the literature shows that early age of identification and intervention of hearing loss of any degree in infants and children is highly associated with better speech, language, behavior, and later academic outcomes (Kennedy et al., 2006; Moeller, 2000; Yoshinaga-Itano & Apuzzo, 1998; Yoshinaga-Itano, Sedey, Coulter, & Mehl, 1998).

## ISSUES FOR EARLY INTERVENTION

### Underidentification

Unfortunately, some infants with MHL are not identified through newborn hearing screening programs (Ross et al., 2008; Johnson et al., 2005). Underidentification associated with newborn hearing screening programs may be due to technological or procedural limitations or both. Data from state hearing screening programs that show the prevalence of UHL (0.19 per 1000 screened) and of MBHL (0.09 per 1000 screened) are at least half of the prevalence estimates for these losses that have been reported in the literature, including a study involving 7 birthing

centers (Johnson et al., 2005; Gravel, 2005). In addition, 2006 Early Hearing Detection and Intervention (EHDI) data from the CDC (2006) estimate that 52% of the infants who failed the newborn screening had no documented follow-up evaluation.

### Misconceptions

Commonly held beliefs among professionals and parents have prevented many children with MHL from being referred to EI. These beliefs include the following: one ear is good enough; a child with mild hearing loss will do fine without EI; and there is not enough known about what to do; therefore, it is better to do nothing (Kochkin, Luxford, Northern, Mason, & Tharpe, 2007). Without early identification, infants and young children with hearing loss are not given the opportunity to benefit from EI.

Parents and professionals often interpret the currently used terms “mild” or “minimal” to mean that the hearing loss is of little or no consequence (Haggard & Primus, 1999). They might not understand the developmental significance of UHL or MBHL or the need for intervention. It was noted by the participants at the 2005 National Workshop on Mild and Unilateral Hearing Loss that information and materials being disseminated to professionals, preservice providers, and parents often do not accurately describe the significance and implications of early identification and intervention for infants and children with UHL and MBHL.

### Eligibility

In some states, infants who are identified with MHL might not meet the state’s eligibility criteria to receive Part C services (Individuals With Disabilities Education Improvement Act of 2004). Although MHL can adversely affect a child’s development, obtaining intervention services through Part C for these children can be a challenge. Eligibility requirements for Part C intervention services differ by state, resulting in some children with MBHL or UHL not qualifying for EI services. Eligibility definitions for each state can be found

online (see Shackelford, 2006). At present, only slightly more than half of the states have language in their legislation or regulations that extend coverage for intervention services to children with mild, unilateral, or “any” hearing loss (National Early Childhood Technical Assistance Center, 2008). When states and territories do not include MHL in their Part C and Part B eligibility criteria, it is difficult for children with MHL to receive intervention unless families pay for private services. Some states provide services for children with MHL under the “at-risk” category of Part C. This is a “proactive” approach based on the determination that there is sufficient risk for future delays/deficits to warrant preventative EI.

Private and other state-funded programs are available in some states for children with MHL who do not meet the eligibility requirements of Part C. For example, many states have schools for the deaf that provide monitoring services, home visits, and information and support for families. Some state departments of health also provide monitoring and support services through programs such as the Children With Special Healthcare Needs program. Information on programs available for children with hearing loss can be obtained by contacting the state’s EHDI coordinator (see Appendix).

Eligibility requirements for preschool children (Section 619 under Part B) are frequently more restrictive than those under Part C. As a result, many preschool children with MHL lose intervention services at 3 years of age.

### **Lack of guidelines**

Standard protocols or guidelines for amplification and developmental intervention are lacking for professionals working with infants and children with UHL and MBHL. This should not be used as justification for doing nothing. Some EI specialists also lack the necessary knowledge, skills, and expertise in hearing loss that are necessary to provide services for young children with hearing loss.

### **PARTNERSHIPS BETWEEN STATE EHDI PROGRAMS, AUDIOLOGISTS, AND EARLY INTERVENTION SPECIALISTS**

One way to address these issues is to utilize existing resources within states. All states and most US territories have implemented EHDI programs to help identify and track infants and children with hearing loss. These programs are usually located within state departments of health. EHDI programs are based on the 1-3-6 plan: hearing screening no later than 1 month of age, diagnostic audiologic evaluation no later than 3 months of age, and enrollment in EI no later than 6 months of age for infants identified with a hearing loss.

State EHDI staff, hospitals and physicians, audiologists, and Part C and other EI specialists can work together to document and improve services for children with hearing loss. Effective partnerships can improve information management, provide support to families, and help evaluate the effectiveness of services to children. Currently most state EHDI programs routinely exchange information with hospitals, physicians, and audiologists. The exchange of information between EHDI and EI programs in most states is limited at this time, although, some EI programs are able to send data to their state EHDI program regarding which children with hearing loss are receiving intervention. Additional information such as type and intensity of services, use of assistive devices, and developmental outcomes could provide useful information about the effectiveness of those services. As stated in the Joint Committee on Infant Hearing (JCIH) 2007 position statement, “Parental consent must be obtained according to state and federal requirements to share the Individual Family Service Plan (IFSP) information with providers and transmit data to the state EHDI coordinator” (Joint Committee on Infant Hearing [JCIH], 2007). To receive more information on how to improve such communication, EI coordinators are encouraged to contact their state EHDI coordinators (see Appendix).

## IMPLICATIONS FOR EARLY INTERVENTION SERVICES

The JCIH is composed of a group of experts on early hearing detection and intervention. This committee, established in 1969, has become recognized as a leader in influencing policy with regard to EHDI programs. In the current position statement, the JCIH recommends that "All families of infants with *any* degree of bilateral or unilateral permanent hearing loss should be considered eligible for EI services" (JCIH, 2007).

It has been demonstrated that intervention with children with any degree of hearing loss during the first year of life results in better developmental and academic outcomes (Yoshinaga-Itano et al., 1998; Moeller, 2000). Vohr found evidence that intervention before 3 months of age resulted in better language outcomes (Vohr et al., 2008). Although there is a lack of material designed for young children with MHL, it is important that intervention begin as soon as possible after identification, across a multitude of domains. Intervention can be categorized into medical, audiologic, and developmental.

### Medical intervention

Every child or infant with hearing loss, whether the loss is minimal, severe, or profound, should receive medical care provided by a team of professionals who are knowledgeable and experienced in working with the pediatric population. It is estimated that over 50% of congenital hearing losses are hereditary and approximately 30% to 40% of children with hearing loss have associated disabilities. Therefore, the team should include a pediatrician, family physician, or other primary care health professional who can monitor the general health, development, and well-being of the child and coordinate the medical care; an otolaryngologist (ear, nose, and throat doctor) who can determine if medical and/or surgical intervention may be appropriate; a geneticist who can provide families with information on possible cause of the hearing loss,

prognosis for progression, and likelihood of recurrence in future siblings; and an ophthalmologist who can document visual acuity and rule out concomitant or late-onset vision disorders that might impact the choice of communication options. Referrals to other specialists may be indicated and can be coordinated through the child's primary care provider.

### Audiologic intervention

Communication among the family, audiologist, and intervention providers is essential to optimize use of amplification strategies. As they are often the most consistently in contact with the parent, EI providers can help families by being knowledgeable about amplification and by answering questions and providing appropriate informed guidance.

Infants and children with MHL should be considered possible candidates for amplification with hearing aids, personal frequency modulation systems, or sound-field systems. The purpose of frequency modulation systems is to make speech sounds easier to hear and understand (eg, a teacher's voice) above background noise in the classroom (Tharpe, Ricketts, & Sladen, 2003). A frequency modulation system consists of a microphone placed a few inches from the mouth of the teacher with a wireless frequency modulation signal being sent to the child's hearing aid. The result of this amplification device is an improved "signal-to-noise ratio" in the listener's ear, meaning the speaker's voice is louder than the background noise. The purpose of a classroom sound-field system is to ensure that the teacher's voice can be heard above the background noises in all areas in the classroom. The teacher speaks into a microphone and his or her voice is transmitted to loudspeakers around the room.

According to the American Academy of Audiology Pediatric Amplification Protocol (American Academy of Audiology, 2003), "[T]he decision to use amplification for a child with unilateral hearing loss should be made on an individual basis, taking into consideration the child's or family's preference as

well as audiologic, developmental, communication and educational factors.” Tharpe and colleagues provide a review of hearing technologies as a guide for making amplification decisions for children with MHL on the basis of each child’s listening needs and obstacles (Tharpe, Eiten, & Gabbard, 2008).

Once reliable audiologic diagnostic results are obtained, decisions about amplification can be considered. Audiologists with expertise and the equipment necessary to complete all tests for evaluation, hearing aid selection, and verification procedures are the professionals uniquely qualified to select and fit all forms of amplification for infants and children. Audiologists, specialists in deafness and milder forms of hearing loss, or other qualified personnel can provide orientation, training, and ongoing support for the infant’s or child’s EI providers, including information on basic care and troubleshooting of the hearing aids, wear time recommendations, and issues of any loaner hearing aid program during times of loss or repair. Audiologists or parents may ask EI providers for information on their observation of the child’s auditory behavior, such as responses to environmental sounds, reaction of the child to the teachers’ requests, interactions with other children, and participation in classroom activities. This information can provide valuable feedback to validate the benefits and limitations of amplification.

The general goal of fitting any child with amplification is to provide the child with optimal use of residual hearing so that speech and language can be achieved at appropriate milestones. EI providers need to have a realistic understanding that amplification will not enable a child with hearing loss to perform optimally in all situations. The goal is to make speech audible at safe and comfortable listening levels that provide the best possible speech perception.

### **Developmental intervention**

Many of the principles of EI appropriate for infants and children with MHL apply to all children with a disability; for example,

(1) providing information to the families so that they understand the implications of the hearing loss and can become knowledgeable and skilled at observing and communicating with their children, (2) involving families in the intervention activities and facilitating family decision making about intervention options and amplification, (3) creating an environment that encourages learning, (4) using the infant or child’s cues to facilitate reciprocal interactions between the provider and the child, (5) adjusting the intervention activity to accommodate the child’s interests, and (6) working collaboratively with specialists to ensure that the child’s services are appropriate.

The child’s developmental status (speech, language, vision, cognition, social/emotional development, and motor skills) should be monitored to modify EI activities as needed. It is also important to monitor the child’s hearing status to detect any progression of the severity of loss, since some children with MHL are at risk for progression to greater degrees of loss (Bess et al., 1998) and children with UHL may be at risk for developing bilateral hearing loss (Neault, 2005).

Table 2 contains EI suggestions for infants and children with MHL based on the literature review, ideas discussed at the 2005 National Workshop on Mild and Unilateral Hearing Loss, recommendations from the JCIH 2007 position statement, and suggestions from EI Web sites.

### **SUMMARY**

MBHL and UHL are developmentally significant conditions that can affect a child’s educational and social progress. It is not clearly understood which factors predict success or failure for children with MHL. Infants and children with MHL need to be identified and offered intervention services at the earliest age possible. Infants and young children with MHL may miss up to 50% of speech sounds. For prelingual children, acquiring speech and language milestones may be difficult. School-aged children with MHL may appear

**Table 2.** Developmental intervention for children with minimal hearing loss

<p><b>Supporting and educating families</b></p> <p>Use a family-centered approach.</p> <p>Provide families with contact information for parent-to-parent support groups.</p> <p>Present an unbiased description of intervention approaches. For example, Parent Guide to Hearing Loss (Appendix—Educational Materials)</p> <p>Inform parents as to what sounds the child can and cannot hear.</p> <p>Refer parents to BEGINNINGS for Parents of Children Who are Deaf or Hard of Hearing, Inc., Hands and Voices, and videos designed to support parents (see Appendix).</p> <p><b>Supporting and educating professionals</b></p> <p>Provide information about the potential risks of minimal hearing loss.</p> <p>Refer parents to resources such as Gallaudet Leadership Institute 12-credit certificate program in Early Education Professional Development Leadership and The Collaborative Early Intervention National Training e-Resource (see Appendix).</p> <p><b>Improving the listening environment</b></p> <p>Use visual clues along with auditory communication.</p> <p>Get child's visual attention, use gestures, let child see your lips or auditory toy.</p> <p>Adapt the environment for optimal opportunities to hear. For example, minimize background noise, provide carpeting in classroom, and provide appropriate amplification.</p> <p><b>Promoting communication skills</b></p> <p>With an appropriate listening environment and amplification, the child may be ready to develop better communication skills. For a young child, imitate his or her sounds. Interpret the child's gestures and sounds, and expand his or her words.</p> <p>Tell the child about what he or she is doing and what you are doing, sing songs, read books, and tell stories with gestures; explain what is in the environment, name things around him or her. Give the child the opportunity to respond.</p> <p>Teach communication activities to parents, grandparents, siblings, and others who interact with the child.</p> <p><b>Improving the quality of intervention services</b></p> <p>Include professionals on the intervention team that are knowledgeable about hearing loss.</p> <p>Include parents who have children with hearing loss on the intervention team.</p> <p>Provide access to role models with UHL and MBHL, especially adults who had UHL or MBHL as children.</p>
---

Abbreviations: MBHL, mild bilateral hearing loss; UHL, unilateral hearing loss.

to be inattentive and become more easily fatigued. These children may achieve lower standardized achievement scores and develop problem behaviors and poor self-esteem. All children with MHL should be closely monitored for developmental delays and progression of hearing loss to modify intervention activities as needed.

For children and families to receive comprehensive services, EI specialists can use a family-centered approach that is culturally responsive. Also important to achieving appropriate intervention services is improved communication between EI specialists and

other professionals, such as audiologists and state EHDI staff. Although there is a lack of standardized EI protocols for infants and children with MHL, as illustrated in Table 2 and the Appendix, there is information on listening techniques and ways to promote communication. Thus, early identification of hearing loss followed by early initiation of appropriate family-centered intervention services and information sharing between EI specialists and other EHDI professionals can provide children with MHL and their families the support they need to succeed in early childhood and beyond.



## REFERENCES

- American Academy of Audiology. (2003). *Pediatric amplification protocol*. Retrieved February 10, 2005, from <http://www.audiology.org/resources/documentlibrary/Documents/pedamp.pdf>
- Anderson, K. L., & Matkin N. D. (1991). *Relationship of degree of long-term hearing loss to psychological impact and educational needs*. Retrieved May 2008 from <http://www.phonicear.ca/resourcefiles/DegreeOfLongTermHearingLossToPsychosocialImpactAndEducationalNeeds.PDF>
- Bess, F. H., Dodd-Murphy, J., & Parker, R. A. (1998). Children with minimal sensorineural hearing loss: Prevalence, educational performance, and functional status. *Ear and Hearing, 19*(5), 339-354.
- Bess, F. H. & Tharpe, A. M. (1988). Performance and management of children with unilateral sensorineural hearing loss. *Scandinavian Audiology: Supplementum, 30*, 75-79.
- Bess, F. H., Tharpe, A. M., & Gibler, A. M. (1987). Auditory performance of children with unilateral sensorineural hearing loss. *Ear and Hearing, 7*(1), 20-26.
- Blair, J. C., Peterson, M. E., & Viehwed, S. H. (1985). The effects of mild sensorineural hearing loss on academic performance of young school-age children. *The Volta Review, 87*, 87-93.
- Bourland-Hicks, C., & Tharpe, A. M. (2002). Listening effort and fatigue in school-age children with and without hearing loss. *Journal of Speech, Language, and Hearing Research, 45*(3), 573-584.
- Bovo, R., Martini, A., Agnoletto, M., Beghi, D., Carmignoto, D., Milani, N., et al. (1988). Auditory and academic performance of children with unilateral hearing loss. *Scandinavian Audiology: Supplementum, 39*, 71-74.
- Brackett, D. (1997). Intervention for children with hearing impairment in general education setting. *Language, Speech, and Hearing Services in Schools, 28*, 355-361.
- Briscoe, J., Bishop, D. V., & Norbury, C. F. (2001). Phonological processing, language, and literacy: A comparison of children with mild-to-moderate sensorineural hearing loss and those with specific language impairment. *Journal of Child Psychology and Psychiatry, 42*(3), 329-340.
- Centers for Disease Control and Prevention. (2005). *National workshop on mild and unilateral hearing loss*. Retrieved March 2008 from [http://www.cdc.gov/ncbddd/ehdi/documents/unilaterahl/Mild\\_Uni\\_2005%20Workshop\\_Proceedings.pdf](http://www.cdc.gov/ncbddd/ehdi/documents/unilaterahl/Mild_Uni_2005%20Workshop_Proceedings.pdf)
- Centers for Disease Control and Prevention. (2006). *Annual EHDI data*. Retrieved May 7, 2008, from <http://www.cdc.gov/ncbddd/EHDI/data.htm>
- Culbertson, J. L., & Gilbert, L. E. (1986). Children with unilateral sensorineural hearing loss: Cognitive, academic, and social development. *Ear and Hearing, 7*(1), 38-42.
- Dalzell, L., Orlando, M., MacDonald, M., Berg, A., Bradley, M., Cacace, A., et al. (2000). The New York State universal newborn hearing screening demonstration project: Ages of hearing loss identification, hearing aid fitting, and enrollment in early intervention. *Ear and Hearing, 21*, 118-130.
- Davis, J. M., Elfenbein, J., Schum, R., & Bentler, R. A. (1986). Effects of mild and moderate hearing impairments on language, educational, and psychosocial behavior of children. *Journal of Speech and Hearing Disorders, 51*(1), 53-62.
- Davis, A., Reeve, K., Hind, S., & Bamford, J. (2001). Children with mild and unilateral hearing loss. A sound foundation through early amplification 2001—Proceedings of the second international conference-section v-chapter 14, *Phonak*, 179-186.
- Elfenbein, J. L., Hardin-Jones, M. A., & Davis, J. M. (1994). Oral communication skills of children who are hard of hearing. *Journal of Speech and Hearing Research, 37*(1), 216-226.
- Flexer, C. (1999). *Facilitating hearing and listening in young children* (2nd ed.). San Diego, CA: Singular Publishing.
- Gravel, J. (2005). Prevalence and screening in newborns. *Workshop Proceedings: National Workshop on Mild and Unilateral Hearing Loss, 15-17*. Retrieved April, 2008, from [http://www.cdc.gov/ncbddd/ehdi/documents/unilaterahl/Mild\\_Uni\\_2005%20Workshop\\_Proceedings.pdf](http://www.cdc.gov/ncbddd/ehdi/documents/unilaterahl/Mild_Uni_2005%20Workshop_Proceedings.pdf)
- Gravel, J. S., Brown, A. S., Tharpe, A. M., & Oyler, R. F. (2008). Proposals and research. *Seminars in Hearing, 29*(2), 212-227.
- Haggard, R. S., & Primus, M. A. (1999). Parental perceptions of hearing loss classification in children. *American Journal of Audiology, 8*(2), 83-92.
- Hands and Voices. (2008). *Description of degree of hearing loss versus potential effects*. Retrieved March 2008 from [http://www.cohandsandvoices.org/resources/coGuide/05\\_Lossveffect.htm](http://www.cohandsandvoices.org/resources/coGuide/05_Lossveffect.htm)
- Individuals With Disabilities Education Improvement Act of 2004, Pub. L. No. 108-446.
- Johnson, J. L., White, K. R., Widen, J. E., Gravel, J. S., James, M., Kennalley, T., et al. (2005). A multicenter evaluation of how many infants with permanent hearing loss pass a two-stage otoacoustic emissions/automated auditory brainstem response newborn hearing screening protocol. *Pediatrics, 116*(3), 663-672.
- Joint Committee on Infant Hearing. (2007). Year 2007 position statement: Principles and guidelines for Early Hearing Detection and Intervention programs. *Pediatrics, 120*(4), 898-921.
- Kennedy, C. R., McCann, D. C., Campbell, M. J., Law, C. M., Mullee, M., Petrou S., et al. (2006). Language ability after early detection of permanent childhood

- hearing impairment. *The New England Journal of Medicine*, 354(20), 2131-2141.
- Kiese-Himmel, C. (2002). Unilateral sensorineural hearing impairment in childhood: analysis of 31 consecutive cases. *International Journal of Audiology*, 41(1), 57-63.
- Kiese-Himmel, C., & Ohlwein, S. (2003). Characteristics of children with permanent mild hearing impairment. *Folia Phoniatrica et Logopaedia*, 55(2), 70-79.
- Klee, T. M., & Davis-Dansky, E. (1986). A comparison of unilaterally hearing-impaired children and normal-hearing children on a battery of standardized language tests. *Ear and Hearing*, 7(1), 27-37.
- Kochkin, S. K., Luxford, W., Northern, J. L., Mason, P., & Tharpe, A. M. (2007). *MarkeTrak VII: Are 1 million dependents with hearing loss in America being left behind?* Retrieved May 2007 from [http://www.hearingreview.com/issues/articles/2007-09\\_01.asp](http://www.hearingreview.com/issues/articles/2007-09_01.asp)
- Lieu, J. E. (2004). Speech-language and educational consequences of unilateral hearing loss in children. *Archives of Otolaryngology—Head and Neck Surgery*, 130(5), 524-530.
- Matkin, N. D. (1981). Amplification for children: Current status and future profiles. In F. H. Bess, B. A. Freeman, & J. S. Sinclair (Eds.), *Amplification in education*. Washington, DC: A.G. Bell Publishers.
- Moeller, M. P. (2000). Early intervention and language development in children who are deaf and hard of hearing. *Pediatrics*, 106(3), 1-9.
- Most, T. (2006). Assessment of school functioning among Israeli Arab children with hearing loss in the primary grades. *American Annals of the Deaf*, 151(3), 327-335.
- National Early Childhood Technical Assistance Center. *Part C Early intervention eligibility for infants and toddlers with hearing loss*. Retrieved April 2008 from <http://www.nectac.org/topics/earlyid/partcelig.asp>
- Neault, M. (2005). Progression from unilateral to bilateral hearing loss. *Workshop Proceedings: National Workshop on Mild and Unilateral Hearing Loss*, 30-31. Retrieved March 2008 from [http://www.cdc.gov/ncbddd/ehdi/documents/unilateralhl/Mild\\_Uni\\_2005%20Workshop\\_Proceedings.pdf](http://www.cdc.gov/ncbddd/ehdi/documents/unilateralhl/Mild_Uni_2005%20Workshop_Proceedings.pdf)
- Northern, J. L., & Downs, M. P. (2002). *Hearing in children*. Baltimore, MD: Lippincott, Williams & Wilkins.
- Nossa, R. J., Wagner E. F., & Crandell M. A. (1988). Binaural release from masking for a speech sound in infants, preschoolers, and adults. *Journal of Speech and Hearing Research*, 31, 212-218.
- Oyler, R. F., Oyler, A. L., & Matkin, N. D. (1987). Warning: A unilateral hearing loss may be detrimental to a child's academic career. *The Hearing Journal*, 9, 18-22.
- Oyler, R. F., Oyler, A. L., & Matkin, N. D. (1988). Unilateral hearing loss: demographics and educational impact. *Language, Speech, Hearing Services in Schools*, 19, 191-210.
- Ross, M., Brackett, D., & Maxon, A. B. (1991). *Assessment and management of mainstreamed hearing-impaired children: Principles and practices*. Austin, TX: Pro-Ed.
- Ross, D. S., Holstrum, W. J., Gaffney, M., Green, D., Oyler R. F., & Gravel, J. S. (2008). Hearing screening and diagnostic evaluation of children with unilateral and mild bilateral hearing loss. *Trends in Amplification*, 12(1), 27-34.
- Shackelford, J. (2006). State and jurisdictional eligibility definitions for infants and toddlers with disabilities under IDEA. *Nectac Notes*, 21. Retrieved September 13, 2007, from <http://www.nectac.org/%7Epdfs/pubs/nnotes21.pdf>
- Tharpe, A. M., Eiten, L., & Gabbard, S. A. (2008). Hearing technology. *Seminars in Hearing*, 20(2), 169-177.
- Tharpe, A. M., Ricketts, T., & Sladen, D. P. (2003). *FM systems for children with minimal to mild hearing loss* (pp. 191-197). Chicago, IL: Achieving Clear Communication Employing Sound Solutions.
- Vohr, B. (1995). The Rhode Island Hearing Assessment Program. *Rhode Island Medicine*, 78, 11-13.
- Vohr, B., Jodoin-Krauzyk, J., Tucker, R., Johnson, M. J., Topol, D., & Ahlgren, M. (2008). Early language outcomes of early-identified infants with permanent hearing loss at 12 and 16 months. *Pediatrics*, 122(5), 535-544.
- von Hapsburg, D., & Davis B. L. (2006). Auditory sensitivity and the prelinguistic vocalizations of early-amplified infants. *Journal of Speech Language and Hearing Research*, 49(4), 809-822.
- Wake, M., Tobin, S., Cone-Wesson, B., Dahl, H. H., Gillam, L., McCormick, L., et al. (2006). Slight/mild sensorineural hearing loss in children. *Pediatrics*, 118(5), 1842-1851.
- White, L. R., Vohr, B. R., Maxon, A. B., Behrens, R. R., McPherson, M. G., & Mauk, G. W. (1994). Screening all newborns for hearing loss using transient evoked otoacoustic emissions. *International Journal of Pediatric Otorhinolaryngology*, 29, 203-217.
- Yoshinaga-Itano, C., & Apuzzo, M. L. (1998). Identification of hearing loss after age 18 months is not early enough. *American Annals of the Deaf*, 145(5), 380-387.
- Yoshinaga-Itano, C., Sedey A. L., Coulter, B. A., & Mehl A. L. (1998). Language of early- and later-identified children with hearing loss. *Pediatrics*, 102(5), 1161-1171.

## APPENDIX

### Useful Web sites

EHDI Coordinators: [www.cdc.gov/ncbddd/ehdi/documents/EHDI.Contact.pdf](http://www.cdc.gov/ncbddd/ehdi/documents/EHDI.Contact.pdf): State EHDI contacts.

<http://www.ncbegin.org/>: BEGINNINGS for Parents of Children Who Are Deaf or Hard of Hearing

<http://www.cdc.gov/ncbddd/ehdi/edmaterials.htm>: Educational Materials for parents and professionals in English and Spanish. Includes the following:

Questions to ask professionals

Parents Guide to Hearing Loss

EHDI Brochure

EHDI Fact Sheet

“Just in Time” booklets and posters

Early Intervention: Communication and Language for Families of Deaf and Hard of Hearing Infants

A Parent’s Guide to Genetics and Hearing Loss

<http://www.cdc.gov/NCBDDD/ehdi/unilateralhi.htm>: Web site on mild and unilateral hearing loss

<http://center.uncg.edu/>: Collaborative Early Intervention National Training e-Resource

<http://asha.org>: American Speech-Language-Hearing Association

<http://www.netac.rit.edu/publication/tipsheet/alds.html>: National Early Childhood Technical Assistance center

<http://www.babyhearing.org/LanguageLearning/BuildConcepts/hear.asp>: Boys Town National Research Hospital—My Baby’s Hearing