

Exceptional Children:

A Guide to Audiologic Management



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Table of Contents

Introduction-----3

Intellectual Disabilities-----4

Learning Disabilities-----7

Attention Deficit Hyperactivity Disorder-----9

Emotional or Behavioral Disorder-----12

Blindness or Low Vision-----15

Autism Spectrum Disorders-----18

Physical Disabilities-----21

Works Cited-----23

Introduction

Estimates of the numbers of children with hearing loss who have additional disabilities range from 25-40% (Thorpe et al 2001). These disabilities include visual impairments, intellectual disabilities, Autism Spectrum Disorders, and physical disabilities, among others. Within the population of children with each individual disability, there is also a higher incidence of hearing loss than in the general population. It is therefore important for audiologists to be familiar with disabilities affecting children—and to know the best ways to test hearing and fit hearing aids on these children. Audiologists also need to be vigilant for the signs of disability in all patients, as they may be the first professionals to recognize conditions like intellectual disabilities or Autism spectrum disorders. Prompt referral to specialists is essential in those cases.

This resource guide describes various disabilities that pediatric audiologists may encounter, including diagnostic criteria. Relevant research has been assessed to determine best practices for diagnosis and management of children with hearing loss and another disability. Much work needs to be done to reach definitive answers for many of these populations—and exceptional children as a whole tend to be a heterogeneous group. However, this guide can act as a good starting point for pediatric audiologists working with children with multiple disabilities.

Intellectual Disability

Background and Definition

The American Association on Intellectual and Developmental Disability (AAIDD) defines Intellectual Disability as “a disability characterized by significant limitations both in intellectual functioning and in adaptive behavior as expressed in conceptual, social, and practical adaptive skills. This disability originates before age 18.” (Hallahan, Kauffman and Pullen, 2009)

Diagnostic Criteria

Individuals are diagnosed as having ID based on IQ score. There are four classifications of ID: mild (IQ of 50 to 70), moderate (IQ of 25 to 50), severe (IQ of 20 to 35), and profound (IQ below 20). (Hallahan, Kauffman and Pullen, 2009)

Prevalence

Approximately 1% of children are identified as having an intellectual disability. (Hallahan, Kauffman and Pullen, 2009)

Possible Etiologies

A variety of prenatal, perinatal and postnatal insults can cause ID.

Prenatal causes:

- Down Syndrome
- Williams Syndrome
- Fragile X Syndrome
- Prader-Willi Syndrome
- Inborn Errors of Metabolism (for example, PKU)
- Developmental Disorders of Brain Formation (for example, hydrocephalus)
- Environmental Influences (for example, fetal alcohol spectrum disorders, rubella)

Perinatal causes:

- Anoxic episode during birth
- Low birth weight
- Perinatal infections (for example, syphilis, herpes simplex)

Postnatal causes

- Biological causes
 - Traumatic brain injury (TBI)
 - Meningitis
 - Encephalitis
- Psychosocial

- Children raised in poor environmental circumstances are at increased risk for ID (Hallahan, Kauffman and Pullen, 2009).

Implications for Audiologic Testing

Regular hearing screenings are important for children with ID. An assessment of hearing status of athletes at the Special Olympics found that nearly 20% of adults and children with intellectual disabilities had a hearing loss (Hild et al 2008). Children with a developmental age of 5 years or more can be screened using traditional audiometry. Children who have a developmental age younger than 5 must be screened using physiologic measures such as OAEs (Evenhuis et al 1997). It should be noted that children with Down's Syndrome are far more likely to experience conductive hearing loss secondary to ear infections, due to anatomical abnormalities with the Eustachian tube. Due to this risk factor for hearing loss, children with Down's Syndrome should be screened for hearing loss at least once per year.

Full audiologic evaluations must also be modified for the child's developmental age. Children with a developmental age of 6 months-3 years can be tested using visual reinforcement audiometry, and children with a developmental age of 3-6 years can be tested using play audiometry. While children with a developmental age of greater than 6 years can be tested using conventional audiometry, it is likely that these children will continue to respond best to play audiometry.

Implications for Audiologic Management

Children with ID may or may not have challenges with amplification. Retention issues can be a challenge for any child who is distressed by wearing devices on their ears. It is likely that children with mild-moderate ID will be compliant hearing aid or cochlear implant wearers; the performance of children with severe-profound ID is harder to predict.

Tharpe et al (2001) surveyed audiologists to assess hearing aid fitting practices for children with multiple impairments, including mild-moderate ID. Those surveyed did not feel that moderate ID should prevent children from obtaining hearing aids. 65% of the respondents indicated that they fit hearing aids on these children before two years of age. Holt and Kirk (2005) examined the outcomes post-cochlear implant of typically developing children and children with a mild intellectual disability. While the children with ID were not able to achieve the same language skills as the typically developing children, they did show significant improvements in both receptive and expressive language after being implanted. Holt and Kirk determined that mild ID should not be a

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contraindication for cochlear implantation, as these children showed significant benefit from amplification.

Learning Disability

Background and Definition

Children with learning disabilities perform poorly in school—they cannot learn—with apparently no good reason—that is, no coexisting disability. The Individuals with Disabilities Education Act (IDEA) defines learning disability as “a disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, which disorder may manifest itself in an imperfect ability to listen, think, speak, read, write, spell, or do mathematical calculations.” The definition notes that this category does not include children who have a learning problem due to a sensory or motor disability, mental retardation, or environmental disadvantage. The National Joint Committee on Learning Disabilities identified several weaknesses in the federal definition of learning disability, and so refined the definition to state that the learning disability is “intrinsic to the individual, presumed to be due to central nervous system dysfunction, and may occur across the lifespan.” (Hallahan, Kauffman and Pullen, 2009)

Diagnostic Criteria

The identification process for children with a learning disability is in flux, but many states use an IQ-achievement discrepancy. States note children whose academic performance is far poorer than would be expected based on their IQ, and identify them as having a learning disability if no other disability can account for their poor academic performance (Hallahan, Kauffman and Pullen, 2009).

Prevalence

Approximately 5-6% of school-aged children are identified as having a learning disability (Hallahan, Kauffman and Pullen, 2009).

Possible Etiologies

Recent efforts have been made to determine whether children with learning disabilities have central nervous system dysfunction. Neuroimaging studies have shown that some children with learning disabilities have structural and functional anomalies in the left temporal lobe, but these studies have not been conclusive about all children with learning disabilities. Further efforts have been made to determine genetic, teratogenic, or medical factors that cause these children to have neurological differences, but there still is no definitive cause for learning disability (Hallahan, Kauffman and Pullen, 2009).

Implications for Audiologic Testing

Children with learning disabilities will most likely be able to participate in standard audiologic testing. More complicated word recognition testing should not be done with any written word lists, as literacy could be a concern for these children.

Implications for Audiologic Management

Children with learning disabilities should pose no unique challenges to hearing aid compliance, aside from the challenges of a typically developing child. However, poor literacy skills among children with learning disabilities means they need to rely more heavily on auditory learning skills—which means that proper hearing aid fitting and use of assistive listening devices is essential. Additionally, more complicated AR programs should not rely on written works because literacy skills are poor among children with a learning disability. Audiologists must be flexible and willing to de-emphasize written resources when working with this population.

Attention Deficit Hyperactivity Disorder

Background and Definition

ADHD is a complicated disorder that encompasses a wide variety of attention problems. Children with ADHD exhibit challenges with behavioral inhibition, executive functioning, goal-directed behavior, and time management. They also have challenges socializing and are at higher risk for learning disability, emotional or behavioral disorders, and substance abuse (Hallahan, Kauffman and Pullen, 2009).

Diagnostic Criteria

The American Psychiatric Association (APA) *Diagnostic and Statistical Manual of Mental Disorders* (DSM) criteria can be read below.

DSM-IV Criteria for ADHD

I. Either A or B:

- A. Six or more of the following symptoms of inattention have been present for at least 6 months to a point that is inappropriate for developmental level:**

Inattention

1. Often does not give close attention to details or makes careless mistakes in schoolwork, work, or other activities.
 2. Often has trouble keeping attention on tasks or play activities.
 3. Often does not seem to listen when spoken to directly.
 4. Often does not follow through on instructions and fails to finish schoolwork, chores, or duties in the workplace (not due to oppositional behavior or failure to understand instructions).
 5. Often has trouble organizing activities.
 6. Often avoids, dislikes, or doesn't want to do things that take a lot of mental effort for a long period of time (such as schoolwork or homework).
 7. Often loses things needed for tasks and activities (e.g. toys, school assignments, pencils, books, or tools).
 8. Is often easily distracted.
 9. Is often forgetful in daily activities.
- B. Six or more of the following symptoms of hyperactivity-impulsivity have been present for at least 6 months to an extent that is disruptive and inappropriate for developmental level:**

Hyperactivity

1. Often fidgets with hands or feet or squirms in seat when sitting still is expected.
2. Often gets up from seat when remaining in seat is expected.

3. Often excessively runs about or climbs when and where it is not appropriate (adolescents or adults may feel very restless).
4. Often has trouble playing or doing leisure activities quietly.
5. Is often "on the go" or often acts as if "driven by a motor".
6. Often talks excessively.
1. **Impulsivity**
 7. Often blurts out answers before questions have been finished.
 8. Often has trouble waiting one's turn.
 9. Often interrupts or intrudes on others (e.g., butts into conversations or games).

II. Some symptoms that cause impairment were present before age 7 years.

III. Some impairment from the symptoms is present in two or more settings (e.g. at school/work and at home).

IV. There must be clear evidence of clinically significant impairment in social, school, or work functioning.

V. The symptoms do not happen only during the course of a Pervasive Developmental Disorder, Schizophrenia, or other Psychotic Disorder. The symptoms are not better accounted for by another mental disorder (e.g. Mood Disorder, Anxiety Disorder, Dissociative Disorder, or a Personality Disorder).

Based on these criteria, three types of ADHD are identified:

IA. ADHD, *Combined Type*: if both criteria IA and IB are met for the past 6 months

IB. ADHD, *Predominantly Inattentive Type*: if criterion IA is met but criterion IB is not met for the past six months

IC. ADHD, *Predominantly Hyperactive-Impulsive Type*: if Criterion IB is met but Criterion IA is not met for the past six months (Hallahan, Kauffman and Pullen, 2009).

Prevalence

Approximately 3-7% of school-age children have ADHD. ADHD occurs three times more frequently in boys than in girls (Hallahan, Kauffman and Pullen, 2009).

Possible Etiologies

Some researchers attribute ADHD to abnormalities in the frontal lobes, prefrontal lobes, cerebellum, basal ganglia, and corpus callosum. Other researchers assert that abnormalities in neurotransmitters can account for ADHD, or that there is a hereditary factor to ADHD. In general, this research has not been conclusive or able to generalize to all children with ADHD (Hallahan, Kauffman and Pullen, 2009).

Implications for Audiologic Testing

It is important to screen hearing among children diagnosed with ADHD to ensure that a co-occurring hearing loss is not contributing to behavior problems. When it comes time to diagnose a hearing loss, children with ADHD may be challenged by extended behavioral testing. They will likely benefit from a test assistant working with them. Having a variety of games to choose from—and offering frequent breaks—may keep children with ADHD motivated to participate in lengthy testing. It may be unrealistic to plan to get a full audiogram during one session, and so children may need to be brought back for multiple appointments to get a complete test.

Central auditory processing disorder (CAPD) is a disorder that affects an individual's ability to process higher-order auditory stimuli (Bellis 2012). Many children with CAPD exhibit behavior problems similar to children with ADHD. If children diagnosed with ADHD are not responding well to typical management practices, they should be referred to CAPD screening by a specially trained audiologist.

Implications for Audiologic Management

Children with ADHD may have challenges with hearing aid compliance, due to a lack of executive function and goal-directed behavior. These children may also have challenges with aural rehabilitation. Pundir et al (2007) assessed aural rehabilitation post-cochlear implant in two children with ADHD. While these children were not making progress in auditory skills before the administration of medication by psychiatrists, they began to improve once their ADHD was better managed. The researchers emphasized the need to refer to other specialists if it seems that children with hearing loss are exhibiting symptoms of ADHD.

Emotional or Behavioral Disorders

Background

Children with emotional and behavioral disorders are very complicated for professionals to work with. They exhibit a wide variety of behaviors, but their problems are typically extreme, chronic, and unacceptable because of social or cultural expectations (Hallahan, Kauffman and Pullen, 2009).

Definition and Diagnostic Criteria

The Individuals with Disabilities Education Act (IDEA) defines emotionally disturbed as:

1. The term means a condition exhibiting one or more of the following characteristics over a long period of time and to a marked extent, which adversely affects educational performance:
 - a. An inability to learn that cannot be explained by intellectual, sensory, or health factors
 - b. An inability to build or maintain satisfactory relationships with peers and teachers
 - c. Inappropriate types of behavior or feelings under normal circumstances
 - d. A general pervasive mood of unhappiness or depression; or
 - e. A tendency to develop physical symptoms or fears associated with personal or school problems
2. The term includes children who are schizophrenic. The term does not include children who are socially maladjusted unless it is determined that they are emotionally disturbed.

The National Mental Health and Special Education Coalition proposed an alternative definition to the federal one:

1. The term emotional or behavioral disorder means a disability characterized by behavioral or emotional responses in school so different from appropriate age, cultural, or ethnic norms that they adversely affect educational performance. Educational performance includes academic, social, vocational, and personal skills. Such a disability:
 - a. Is more than a temporary, expected response to stressful events in the environment
 - b. Is consistently exhibited in two different settings, at least one of which is school-related

- c. Is unresponsive to direct intervention in general education, or the child's condition is such that general education interventions would be insufficient
- 2. Emotional and behavioral disorders can co-exist with other disabilities
- 3. This category may include children or youths with schizophrenic disorders, affective disorder, anxiety disorder, or other sustained disorders of conduct or adjustment when they adversely affect educational performance in accordance with section (1). (Hallahan, Kauffman and Pullen, 2009)

Prevalence

Studies have shown that 6-10% of school-age children have serious and persistent emotional and behavioral problems, but that less than 1% of children are identified with this diagnosis for special education purposes. There are two broad dimensions of disordered behavior: externalizing and internalizing. Externalizing behavior involves striking out against others, while internalizing behavior involves mental or emotional conflicts (such as depression and anxiety). It is possible that children who are internalizers rather than externalizers are less often identified as emotionally or behaviorally disturbed by teachers and, as such, do not receive special education services (Hallahan, Kauffman and Pullen, 2009).

Possible Etiologies

Emotional or behavioral disorders have been attributed to four major factors: biological disorders and diseases, pathological family relationships, undesirable experiences at school, and negative cultural influences. Typically, a complex interplay of these factors is to blame for a child having emotional or behavioral problems (Hallahan, Kauffman and Pullen, 2009).

Implications for Audiologic Testing

These children should not need any special accommodations during audiologic testing, though they may benefit from a test assistant to keep them motivated during extended testing.

Implications for Audiologic Management

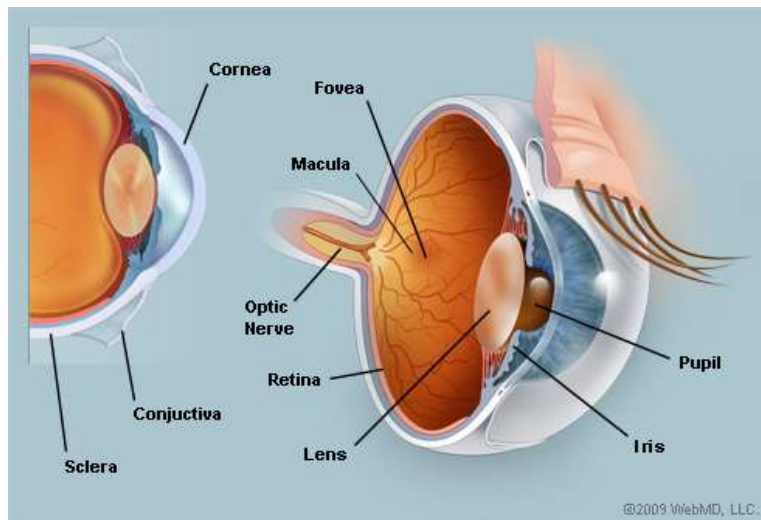
Children with emotional and behavioral problems may have significant challenges with amplification and aural rehabilitation. Audiologists may need to work with mental health professionals to develop the best hearing aid and aural rehabilitation strategies. Stevenson et al (2009) were interested in determining if children with hearing loss were at a higher risk for developing behavior problems than children with normal hearing. The researchers determined that children with hearing loss and poor language

development showed a higher incidence of behavior problems than the general population, though hearing-impaired children with typically developing language did not. Stevenson et al concluded that hearing loss itself was not a risk factor for behavior problems, though the language problems that typically occur secondary to hearing loss do put children at greater risk for disordered behavior. Roberts and Hindley (1999) surveyed the literature to determine the psychiatric and psychological needs of children with hearing loss. Their results were similar to those of Stevenson et al (2009) in that communications disorders secondary to hearing loss put these children at a higher risk for emotional and behavior problems, such as conduct disorder and anxiety disorder. Roberts and Hindley also noted that estimates of the prevalence of sexual abuse in the hearing-impaired population ranged from 11-50%, emphasizing the need for professionals to work to recognize the signs of sexual abuse in children with hearing loss. This study also assessed service delivery of psychiatric treatment for children with hearing loss, and Roberts and Hindley determined that hearing-impaired and Deaf children should be referred to mental health professionals who are either Deaf or hearing-impaired whenever possible.

Blindness or Low Vision

Anatomy and Physiology

The anatomy of the eye is incredibly complex, so this description is simplified. Light rays first pass through the cornea (a transparent cover in front of the iris and pupil), which refracts the light rays so that the image will be focused. The rays then pass through the aqueous humor (a watery substance between the cornea and the lens of the eye) and then the pupil, which contracts or expands depending on the amount of light striking it. The light then passes through the lens, which refines and changes the focus of the light rays before they pass through the vitreous humor (a transparent gelatinous substance that fills the eyeball). The light rays then come to a focus on the retina, a structure in the back of the eye that contains fibers connected to the optic nerve.



Visual acuity is the ability to see fine details; normal visual acuity is 20/20, which means that objects 20 feet away appear as if they are 20 feet away. If a person has visual acuity of 20/70, it means that they are able to process details of objects 20 feet away as if they are 70 feet away (Hallahan, Kauffman and Pullen, 2009).

Definition/Diagnostic Criteria

A child with visual impairments can be described using a legal or an educational definition.

The legal definition states that a child is legally blind if he/she has a visual acuity of 20/200 or less in the better eye even with correction or has a field of vision so narrow that its widest diameter subtends an angular distance no greater than 20 degrees. A

child with low vision has visual acuity falling between 20/70 and 20/200 in the better eye with correction.

The educational definition classifies a child as blind if he/she needs to use braille or aural methods for reading. Low vision under this definition is being able to read print if it is enlarged or magnified (Hallahan, Kauffman and Pullen, 2009).

Prevalence

Visual impairment is one of the least prevalent childhood disabilities; the federal government classifies only 0.05% of school-aged children as having blindness or low vision (Hallahan, Kauffman and Pullen, 2009).

Possible Etiologies

Some disorders that cause serious visual problems can affect both adults and children, such as glaucoma, cataracts, and diabetes. Glaucoma is a group of eye diseases that cause damage to the optic nerve. Cataracts are caused by a clouding of the lens of the eye, which leads to blurred vision. Diabetes can lead to diabetic retinopathy. While these disorders typically manifest themselves during adulthood, they can also occur in childhood.

Other disorders are congenital or occur most frequently in childhood. The leading cause of visual impairment in children is cortical visual impairment, which results from damage to cortical areas responsible for vision. Retinitis pigmentosa (RP) is a condition that causes progressive vision loss, starting with tunnel vision (a narrowing of the field of vision) and night blindness. It should be noted that RP co-occurs with hearing loss in Usher's Syndrome, a genetic condition with autosomal recessive inheritance.

Retinopathy of prematurity (ROP) results in abnormal growth of blood vessels in the eye; it is caused by factors related to premature birth, including the administration of an excessive concentration of oxygen at birth. Other visual disorders (strabismus and nystagmus) are caused by improper functioning of ocular muscles (Hallahan, Kauffman and Pullen, 2009).

Implications for Audiologic Testing

Young children with visual impairments can be difficult to test using traditional methods, since many rely on visual reinforcements to encourage the children to respond to auditory stimuli. Both visual reinforcement audiometry (VRA) and, to a lesser extent, play audiometry, will likely not work for children who have visual impairment. Children with low vision may respond to flickering lights during VRA testing, but they will probably habituate very quickly. Physiologic measures (OAE or

ABR testing) will likely need to be used to assess hearing levels. Older children may be taught to manipulate larger peg boards or buttons to participate in play audiometry. Children older than 6 years of age who have no cognitive challenges can participate in conventional audiometry.

Implications for Audiologic Management

It is very important for children with visual impairment and hearing impairment to receive targeted early intervention and good amplification. Holte et al (2006) surveyed relevant research to determine best practices for children with both visual and hearing impairment. They found that early fitting of hearing aids and cochlear implants is essential for these children, and that (due to limited behavioral responses) audiologists may need to rely on physiologic measures for hearing aid programming. The authors noted that even if families are choosing a manual mode of communication for their child, it is still important to fit children with hearing aids and/or cochlear implants so they can have auditory input from an early age. Evidence also emphasized the importance of a wide bandwidth for high-frequency audibility as well as multiple programs with omnidirectional and directional microphones. Tharpe et al (2001) surveyed audiologists to assess hearing aid fitting practices for children with multiple impairments, including visual impairments. Over 50% of professionals indicated that they fit hearing aids on children with dual sensory impairments before 12 months of age, highlighting the importance of early access to sound for this population.

Autism Spectrum Disorders

Background and Definition

Autism spectrum disorders (ASD) are a variety of disorders characterized by varying degrees of impairment in three areas: communication skills, social interactions, and repetitive and stereotyped patterns of behavior. The table below summarizes the different disorders that fall under the umbrella of ASD:

<i>Disorder</i>	<i>Characteristics</i>
Autism	Extreme social withdrawal and impairment in communication; often includes stereotypical movements, resistance to change, and unusual responses to sensory experiences; usually manifests before three years of age
Asperger Syndrome	Much like mild autism, but without significant impairments in cognition and language
Rett Syndrome	Normal development for five months to four years, followed by regression and intellectual disabilities; much more prevalent in females
Childhood disintegrative disorder	Normal development for at least two and up to 10 years, followed by significant loss of skills; much more prevalent in males
Pervasive developmental disorder not otherwise specified (PDD-NOS)	Persons who display behaviors typical of autism but to a lesser degree and/or with an onset later than three years of age

(Hallahan, Kauffman and Pullen, 2009)

Prevalence

Prevalence studies indicate that about 0.6% of the population has an ASD, but only 0.27% of school-age children are receiving special education services due to a diagnosis of autism. Approximately three times as many boys as girls are diagnosed as having ASD. The prevalence of children with ASD has increased since the first epidemiological studies done in the 1970's; there are many theories to account for this increase. A consensus has not been reached in the research community as to the reason for the higher prevalence of ASD (Hallahan, Kauffman and Pullen, 2009).

Possible Etiologies

There is wide variation in the different characteristics of the different autism spectrum disorders, so it is unlikely that any one genetic or neurologic condition causes all variants of ASD. Researchers have found abnormalities in the cerebral cortex, amygdala, hippocampus, basal ganglia, corpus collosum, brainstem, and cerebellum. Twin studies and family studies have shown that there is a familial cause of ASD as well. Brain imaging and genetic studies are growing research fields that will likely make significant advances in the coming years (Hallahan, Kauffman and Pullen, 2009).

Implications for Audiologic Testing

Ulf et al (1999) were interested in determining the prevalence of hearing loss in children with Autism. They found that mild-to-moderate hearing loss was diagnosed in 7.9%, severe-to-profound hearing loss was found in 3.5%, and unilateral hearing loss was found in 1.6% of these children, significantly higher than the general population. The researchers were interested in determining if hearing loss was more strongly correlated with intellectual disability in the population with autism, but they found that cognitive skills had no relationship with hearing status in this group. The rates of serous otitis media (23.5%) and conductive hearing loss (18.3%) were also increased in children with Autism. They also found that hyperacusis was far more common in children with Autism relative to the general population, occurring at a rate of 18.0% and 0%, respectively. The children were assessed with both behavioral and physiologic measures; Ulf et al found that 63.3% of the children gave reliable behavioral responses while 36.7% did not. ABR has to be used with children who are unable to participate in behavioral testing.

While children with ASD may be very difficult to test, it is essential to monitor hearing status in this population due to a significantly increased risk for hearing loss. If children are unable to be tested behaviorally, physiologic measures will need to be used.

Implications for Audiologic Management

Tharpe et al (2001) surveyed audiologists to assess hearing aid fitting practices for children with multiple impairments, including Autism. The age of first fitting was higher for children with autism than those with hearing loss alone, with over half of the children being fit with hearing aids after 3 years of age. Anecdotal evidence from clinicians has shown that retention is a huge problem with children with ASD, as they are often more sensitive to wearing devices on their ears. Many clinicians and families have a “choose your battles” approach to audiologic management of these children, and unfortunately hearing health often takes a backseat to other health concerns. Hopefully

future collaborations between audiologists and professionals working with children with ASD will lead to improved audiologic management for this vulnerable population. Unaided hearing loss can only make life more challenging for children with ASD and their families.

Vernon and Rhodes (2009) surveyed the literature regarding the dual diagnosis of Autism and Deafness. They noted that, while the prevalence of autism in the general population is 1 in 150, it is 1 in 80 among children who are deaf. Children who are deaf typically are diagnosed with autism later than hearing children, at least in part because many of the tests used to diagnose autism are not suitable for children who are Deaf. This study also noted that many conditions that caused hearing loss also seemed to cause a higher incidence of autism, such as rubella, CMV, toxoplasmosis, mumps, and extreme prematurity. The researchers concluded that it was very important for professionals working with Deaf children to be watchful for ASD, and that early referral for ASD diagnosis was essential.

Physical Disabilities

Background and Definition

Children with physical disabilities are those whose physical limitations interfere with school attendance or learning to such an extent that special services, training, equipment, materials, or facilities are required. The characteristics of children with physical disabilities are highly varied (Hallahan, Kauffman and Pullen, 2009).

Prevalence

About 0.9% of the school-age population receives special education due to physical disabilities. About 0.14% has orthopedic disabilities and about 0.76% have other health problems (Hallahan, Kauffman and Pullen, 2009).

Disorders Causing Physical Disabilities

- Neuromotor impairments
 - Cerebral palsy (CP) is a condition characterized by paralysis, weakness, lack of coordination, and/or other motor dysfunction. CP is caused by damage to the brain before it has matured.
 - Epilepsy is a chronic neurological condition in which a person has repeated seizures. Seizures are a sudden alteration of consciousness, usually accompanied by motor activity and/or sensory phenomena; they are caused by an abnormal discharge of electrical energy in the brain.
 - Spina bifida is a type of neural tube defect; it is a congenital midline defect that results from failure of the bony spinal column to close completely during fetal development.
- Orthopedic and Musculoskeletal Disorders
 - Muscular dystrophy is a hereditary disease characterized by progressive weakness caused by degeneration of muscle fibers
 - Juvenile rheumatoid arthritis is a systematic disease with major symptoms involving the muscles and joints (Hallahan, Kauffman and Pullen, 2009).

Implications for Audiologic Testing

Children with physical disabilities may need modified testing strategies to compensate for their motor difficulties. Infants who cannot sit up and turn their heads will need to be tested with physiologic measures rather than visual reinforcement audiometry. Play audiometry may need to be modified with a large button or easy-to-manipulate toys. Children who are old enough to participate in conventional audiometry may need to use a button push or verbal indication rather than a hand raise.

Implications for Audiologic Management

Children with physical disabilities are a heterogeneous group, so it is difficult to generalize best practices for this population as a whole. Children with some forms of physical disability may not require any special practices with amplification, while some with milder forms of physical impairment might require modifications like those used with older adults with dexterity issues (larger hearing aids, magnetic battery implements). Tharpe et al (2001) surveyed audiologists to assess hearing aid fitting practices for children with multiple impairments, including physical impairments. The respondents indicated that they fit hearing aids on children with physical disabilities at the same age as children with hearing loss alone.

The population of children with severe physical disabilities may need significant modifications from standard hearing aid fitting protocol. Anecdotal evidence from clinicians described hearing aid fittings for children whose physical disabilities meant they were continually leaning on one side of the head; since one ear would always be up against the headrest of a wheelchair, putting a hearing aid in that ear would lead to constant feedback problems. Unilateral fittings were a better choice for children in this unique case.

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