Outcomes of Children with Hearing Loss

A study of children with mild-severe hearing loss

A study funded by the National Institutes of Health – National Institute on Deafness and Other Communication Disorders

(NIH-NIDCD)

Grant # DC009560

Project Background

- December 2006 NIH/NIDCD convened a meeting regarding the state of knowledge regarding children with mild-severe hearing loss

- Identify research gaps in:
  - Language and Literacy
  - Speech Recognition and Production
  - Academic Achievement
  - Psychosocial Development
  - Research Methodology

- Spring 2007 call for proposals

Prevalence and Incidence of Pediatric Hearing Loss In the U.S.

- 3/1000 newborns have hearing loss. [1]
- Incidence increases by school age to 6/1000.
  - late identification
  - late onset
  - progressive hearing losses
- 930,000 children 6-19 years of age have mild to severe HL [2] If children 1-6 are included the number is estimated to be well above 1 million. (NHNES, NIDCD)

Why is the OCHL Study Important?

- Most outcome studies have focused on children with severe to profound hearing loss
- Few have focused on children with mild-severe hearing loss
  - Sample sizes are small or are mixed HH/D
  - Lack of control of amplification histories/audibility
  - Few studies have attempted a population sample
    - Samples of convenience
- Need to understand sources of individual differences

Why is the OCHL Study Important?

- Gaps in the Research
  - Reduced body of literature regarding children with hearing losses less than severe or profound. To date, the largest group of subjects consisted of a group of 40 children
    - What are the unique needs of these children today?
    - What else can we do to better serve them?
  - Limited research on the access to, benefits from, and outcomes of services for children with mild to severe hearing losses.
  - Is early identification and intervention helping to reduce speech, language and academic delays?

All Degrees of HL Place Children at Risk

- Children with "minimal losses:
  - 37% fail one grade
  - 8% don’t have skills at grade level
  - 12-41% receive educational assistance

“Minimal Is not inconsequential”

~Fred Bess

Speech Production

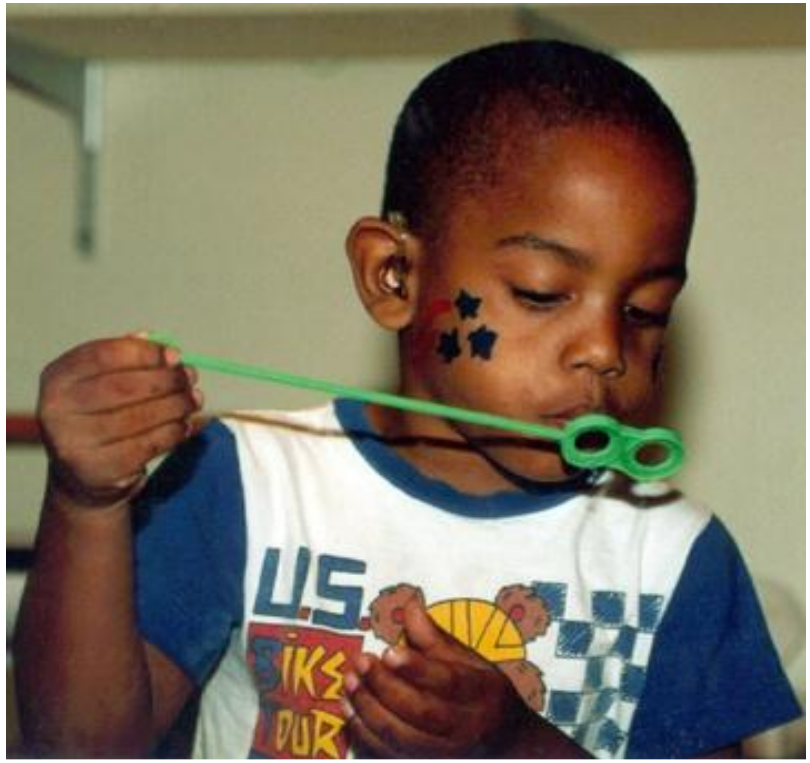
- Delays in onset of babble increase with increases in level of hearing loss (Carney, 1996)
- Some children are at risk for slow transitions from babble to word production (Moeller et al, 2007)
- Differences in consonant repertoires (McGowen et al, 2008: Moeller et al, 2007)
- Speech production generally intelligible as children mature

Receptive and Expressive Language

- Wide variability is found in previous studies of language abilities of children with hearing loss.
- Children with hearing loss perform similarly to age matched peers on grammar (Briscoe, Bishop & Norbury, 2001)
- Children with hearing loss performed similarly to younger children with normal hearing on tests of grammar understanding
- Speech production generally becomes more intelligible as children (Gilbertson & Khami, 1995)

Academic Outcomes

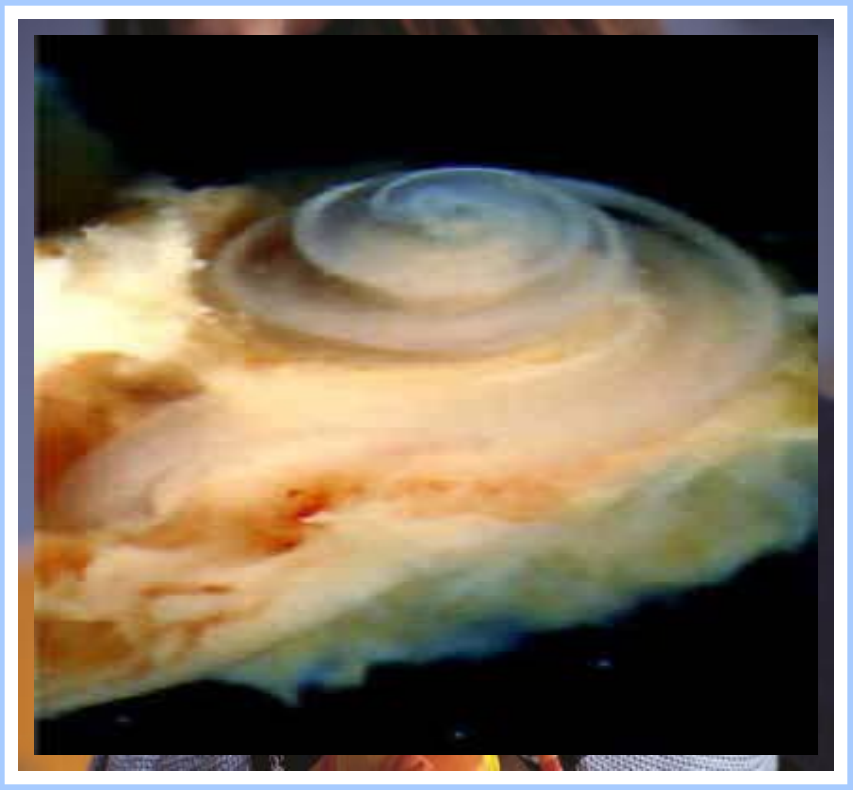
- Educational success is strongly tied to performance in language and communication skills
- The extent to which HL limits development of language may reflect academic outcomes in school.
  - Verbal IQ
  - Speech Perception in Noise
  - Localization of Sound



Social Communication Outcomes

- More likely than their peers to demonstrate concerns about making friends, being teased and being socially accepted
- Delays in the use of advanced language to explain complex cognitive processes and social reasoning skills (ex: recounting past events, making excuses) 9
- Social reasoning, Theory of Mind and narrative discourse skills
- These skills are essential for social interactions and literacy development 10-12

Recent Changes that May Promote Better Outcomes



- Newborn Hearing Screening
  - 96% of newborns are screened at or shortly after birth in the U.S.
  - *However, a*s many as 80% of mild bilateral and unilateral losses can be missed at birth [16]
  - About 50% of babies who do not pass NHS do not receive follow-up care

- Technological advances in amplification provide improved access to spoken language
  - Frequency Compression Hearing Aids
  - Personal FM use at home and school
  - Increased bandwidth, directional microphones
  - Noise reduction

- Early Intervention Programs
  - By first grade, children identified before 6 months are 1-2 years ahead of their later identified peers in language, cognitive and social skills. [17, 20, 21]
  - Parents of Early Identified Children are better prepared to implement Early Intervention goals [22]

OCHL Overview

- Five Year Longitudinal Study
- Involving three research teams at different locations
  - The University of Iowa
  - Boys Town National Research Hospital
  - The University of North Carolina

OCHL Goals

1. Measure the developmental, behavioral, and familial outcomes of children with mild to severe hearing loss.
2. Examine the background characteristics of the child and family.
3. Characterize intervention services and factors associated with service variations.

OCHL Goals

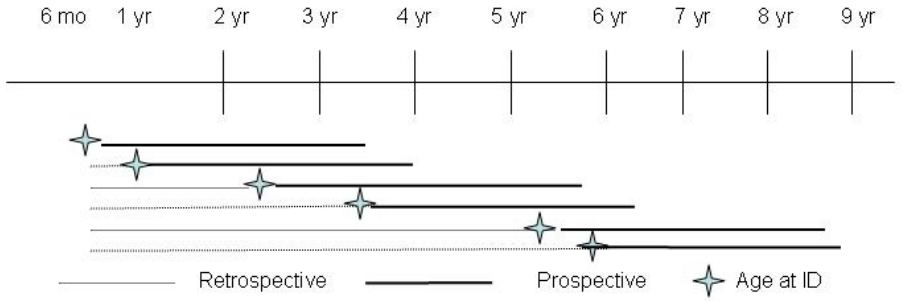
4. Identify variance in age of fitting and type of hearing aid, and identify barriers in hearing aid use.

5. Identify to what extent child, family, and community factors contribute to the access of intervention services and functional outcomes.

Target Populations

- 400 children with hearing loss
  - Permanent mild-severe hearing loss PTA 25-75 dB (500, 1k, 2k, 4k)
- 150 children with normal hearing
- Ages 6 months to 6 years 11 months at entry to study
- English spoken in the home by at least one parent
- No significant disabilities

Accelerated Longitudinal Design



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Domains of the Study

- **Audiological Information**
  - Tympanometry
  - Audiogram
  - Speech Perception
  - Hearing aid verification
- **Speech Production**
  - Articulation
  - Speech Intelligibility
- **Language**
  - Understanding and use of
    - syntax
    - vocabulary
    - narrative discourse
    - morphological use
  - Social reasoning (Theory of Mind)
- **Academic**
  - Spelling
  - Reading comprehension
  - Word recognition
  - Math
  - Verbal reasoning
- **Psychosocial behavioral/cognitive**
  - Cognitive reasoning
  - Social behavior
  - Teacher reports
- **Family outcomes**
  - Parenting
  - Quality of life/ Family Life
  - Satisfaction of service delivery

Complexity of Interactions

- Background characteristics of the child and the family
- The nature of interventions
  - who provides services
  - how much experience with children who have had mild-severe hearing loss have they had
  - what is their case load
  - how frequently does the child receive services

- Hearing and speech perception/audibility
- Language environments
- Academic environments
- Psychosocial and behavioral influences

How do all these factors interact?

Test Battery 1 yr 9 mos To 2 yrs 3 mos

AGE FIRST SEEN: 1YR 9MOS TO 2YRS 3MOS AND CHILDREN AGES 1YR 9MOS- 2YR 3 MOS AT LATER VISITS

All batteries for hearing loss subjects; Batteries also assumed for control subjects are highlighted

Test Type	Test Name	Given To	How Given	Time	Primary Responsibility
Speech Production:	Ertmer Open and Closed Set Test (O & C)	Child	Elicited	15 minutes	SLP; Audiologist
	CASPP	Child	Elicited	15 minutes	SLP; Audiologist
Hearing Function:	Hx, Audiogram (VRA) + Tymps	Child	Elicited	30 minutes	Audiologist
	Electroacoustic Analysis 60/90	Child	Elicited	5 minutes	Audiologist
	Aided Speech Intelligibility Index (Verifit SII)	Child	Elicited	15 minutes	Audiologist
	ESP lo-verbal	Child	Elicited	15 minutes	Audiologist
	Hearing Aid Checklist	Parent	Given Checklist	20 minutes	Audiologist
	Little Ears Questionnaire	Parent	Given Questionnaire	15 minutes	Audiologist
Language:	Mullen Scales	Child	Elicited	15 minutes	SLP
	MBCDI + Upper Extension	Parent	Given Checklist	15 minutes	SLP
Psychosocial, Behavioral, and Family:	Vineland Adaptive Behavior Scales	Parent	Interviewed	20 minutes	SLP; Audiologist
	Child Behavior Checklist	Parent	Given Checklist	20 minutes	SLP; Audiologist
	Infant Behavior Questionnaire	Parent	Given Questionnaire	20 minutes	SLP; Audiologist
	Beach Center Family Survey	Parent	Given Checklist	20 minutes	SLP; Audiologist
	OCHL Family Interview	Parent	Phone Interview following the visit	60 minutes	
	OCHL SPS Audiology	Service Provider	Online Survey	30 minutes	
	OCHL SPS 0 to 3 Years	Service Provider	Online Survey	30 minutes	

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Test Battery: 4 yrs 3 mos To 4 yrs 9 mos

AGE FIRST SEEN: 4YRS 3MOS TO 4YRS 9MOS

All batteries for hearing loss subjects; Batteries also assumed for control subjects are highlighted

Test Type	Test Name	Given To	How Given	Time	Primary Responsibility
Academic:	TOPEL	Child	Elicited	30 minutes	SLP
	WPPSI	Child	Elicited	30 minutes	SLP; Audiologist
Language:	Morphological Elicitation Procedure	Child	Elicited	45 minutes	SLP
	CASL Core 3-4	Child	Elicited	45 minutes	SLP
Hearing Function:	Hx, Audiogram (CPA) + Tymps	Child	Elicited	30 minutes	Audiologist
	Electroacoustic Analysis 60/90	Child	Elicited	5 minutes	Audiologist
	Aided Speech Intelligibility Index (Verifit SII)	Child	Elicited	15 minutes	Audiologist
	LNT/MLNT	Child	Elicited	15 minutes	Audiologist
	Hearing Aid Checklist	Parent	Given checklist	20 minutes	Audiologist
	SSQ Revised	Parent	Given checklist	15 minutes	Audiologist
Psychosocial, Behavioral, and Family:	Child Behavior Checklist	Parent	Given checklist	20 minutes	SLP; Audiologist
	Vineland Adaptive Behavior Scales	Parent	Interviewed	20 minutes	SLP; Audiologist
	Family Activities Checklist & Parent Issues Checklist	Parent	Given checklist	20 minutes	SLP; Audiologist
	Children's Behavior Questionnaire	Parent	Given Questionnaire	15 minutes	SLP; Audiologist
	Beach Center Family Survey	Parent	Given Questionnaire	20 minutes	SLP; Audiologist
	OCHL Family Interview	Parent	Phone interview following the visit	60 minutes	SLP; Audiologist
	OCHL SPS Audiology	Service Provider	Online survey	30 minutes	
	OCHL SPS Preschool	Service Provider	Online survey	30 minutes	
	Teacher Report Forms	Teacher	Sent forms	20 minutes	SLP; Audiologist

Test Battery: 5 yrs 9 mos To 6 yrs

AGE FIRST SEEN: 5YRS 9MOS TO 6YRS

All batteries for hearing loss subjects; Batteries also assumed for control subjects are highlighted

Test Type	Test Name	Given To	How Given	Time	Primary Responsibility
Academic:	WRMT-R: Word Attack Subtest	Child	Elicited	5 minutes	SLP
	WRMT-R: Word Identification	Child	Elicited	5 minutes	SLP
	WRMT-R: Passage Comprehension	Child	Elicited	15 minutes	SLP
	WASI	Child	Elicited	30 minutes	SLP
	Head to Toes	Child	Elicited	5 minutes	SLP
Language:	CASL Core 5-6	Child	Elicited	60 minutes	SLP
	Spontaneous Language Sample	Child	Elicited	20 minutes	SLP
Hearing Function:	Hx, Audiogram (Conventional) + Tymps	Child	Elicited	30 minutes	Audiologist
	Electroacoustic Analysis 60/90	Child	Elicited	5 minutes	Audiologist
	Aided Speech Intelligibility Index (Verifit SII)	Child	Elicited	15 minutes	Audiologist
	PBK	Child	Elicited	15 minutes	Audiologist
	Hearing Aid Checklist	Parent	Given checklist	20 minutes	Audiologist
	SSQ Revised	Parent	Given checklist	15 minutes	Audiologist
Psychosocial, Behavioral, and Family:	Friendship Interview	Child	Interviewed	15 minutes	Speech Pathologist; Audiologist
	Child Behavior Checklist	Parent	Given checklist	20 minutes	SLP; Audiologist
	Family Activities Checklist & Parent Issues Checklist	Parent	Given checklist	20 minutes	SLP; Audiologist
	Children's Behavior Questionnaire	Parent	Given Questionnaire	15 minutes	SLP; Audiologist
	Beach Center Family Survey	Parent	Given Questionnaire	20 minutes	SLP; Audiologist
	OCHL Family Interview	Parent	Phone interview following the visit	60 minutes	
	OCHL SPS Audiology	Service Provider	Online Survey	30 minutes	
	OCHL SPS School-Age	Service Provider	Online Survey	30 minutes	
	Teacher Report Forms	Teacher	Sent forms	20 minutes	SLP; Audiologist

Data Collection and Management

- Family Intake Questionnaire at first visit
- Telephone Interview of Parents (annual)
  - One individual conducts all the interviews
- Online Services and Provider Survey (annual)
  - Birth-to-Three
  - Preschool
  - School Age
- Teacher Survey - Online
  - Preschool
  - School Age
- Teacher questionnaires - Paper
- Medical Records
  - Birthing hospital
  - Pediatrician
  - ENT

Data Collection and Management

- Centralized Data Entry Access
  - For all service providers and teachers
  - For entry of annual parent telephone interview
  - Each of the three research teams
    - Enrollment data
    - Scheduling and tracking information
    - Item level entry for test data collected at each site
- Sharepoint site for research teams
  - Discussion forum
  - Shared documents
  - Team calendars

Family Intake Interviews

- Information about the children
  - 207 children included thus far
    - Male: 107 (51.7%)
    - Female 100 (48.3%)
  - Age at entry into the study
    - Range 6 - 86 months
    - Mean 43 months
    - Median 43 months

All the OCHL Team Members

- The Univ of Iowa
  - Bruce Tomblin Co-PI
  - John Knutson
  - Ruth Bentler
  - Lenore Holte
  - Sandie Bass-Ringdahl
  - Connie Ferguson
  - Elizabeth Walker
  - Marcia St. Clair
  - Wendy Fick
  - Rick Arenas
  - Jacob Oleson
  - Jane Pendergrast
  - Marlea O'Brien Project Coordinator

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- Pat Stelmachowicz
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- Emlie Sweet
- Laura Kreigshauser
- Lauren Berry
- Sophie Ambrose
- Amelia Schuster
- Lisa Burton

The Univ of North Carolina

- Melody Harrison
- Patricia Roush
- Shana Jacobs
- Thomas Page
- Aneesha Pretto

Because the data presented at the EHDI IFSC meeting reflects only a small part of the first year of data collected, and are potentially misleading, all data slides have been deleted.