Studies of Early Language Development in High-Risk Populations

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Facts About Prematurity

- Preterm birth rates continue to ↑ in the US
- 62,000 VLBW infants < 1500 grams
- 30,000 ELBW infants < 1000 grams are born annually
- Survival of ELBW infants has increased to 66-88%
Why are VLBW at ↑ Risk of Developmental Morbidity?
VLBW Infants are Exposed to the Atypical Environment of the Typical NICU for Weeks to Months

- In addition to the risk of multiple neonatal morbidities and prolonged hospitalizations
- Prolonged exposure to noise levels > 45 dB
- Increased ambient light, often 24 hours per day
- Stressful manipulation
- Painful procedures
- Lack of soothing tactile stimulation
- Lack of developmentally appropriate stimulation
Preterm's and Language

- VLBW infants often display slower rates of growth in vocabulary and grammar than do term infants.
- Preterm infants may be at heightened risk for specific language impairments (Foster-Cohen, Edgin, Champion, & Woodward, 2007; Kern & Gayraud, 2007; Marston, Peacock, Calvert, Greenough, & Marlow, 2007; Ortiz-Mantilla, Choudhury, Leevers, & Benasich, 2008; Sansavini et al., 2007; Stolt et al., 2007; Vohr et al., 1988; Vohr et al., 1989; Vohr et al., 2000).
Preterm's and Language

• Early language delays are associated with deficits in early school achievement (Pritchard et al., 2009; Wolke, et al., 2008)

• 44-56% of VLBW children require Special Education Resources (Vohr & Msall, 2000)

• At school age they have ↑ deficits in executive function, working memory, verbal fluency, verbal memory, and attention
Improving PPVT Scores from 3 to 12 years
Evidence for recovery with increasing age?
Raw Scores on PPVT from 3-12 y Indomethacin cohort

Luu et al SPR 2008
Study 1: The Very Low Birth Weight Infant

- Low birth weight infants < 1250 grams cared for in the NICU at WIH are participating in a longitudinal study of the effects of language and sound exposure at 32 and 36 weeks of gestation in the NICU on infant vocalizations and language development.

- Language development will be assessed to 18 months corrected age.

- There have not been prior studies of immature preterm infants prior to their due date.
Study 2: Late Preterm Infants

- Late preterm infants born at 34-36 weeks gestation are the largest and fastest growing subgroup of preterm infants in the United States.

- The substantial increase in the rate of late preterm births is the primary factor for a rising incidence of prematurity in the U.S.

- Although late preterm infants account for more than 70% of all premature births, the majority of research has focused on extremely low birth weight and very preterm infants.
Study 2: Late Preterm Infants

- There is limited data on neurodevelopmental outcome of late preterm infants including language development
- This study will examine the effects of language and sound exposure for the late preterm and term infant at birth and 44 weeks and subsequent language development
Late Preterm Methods

- Study Groups:
  - Late Preterm NICU;
  - Late Preterm Well Baby;
  - Term Infants

- Recordings are performed in the NICU or newborn nursery prior to discharge, at 44 weeks post conceptual age (PCA), 7 months corrected age, and 18 months corrected age for the 3 groups
Late Preterm Methods

• The results from these recording samples will then be compared to language scores on the Bayley Scales of Infant Development III, which will be performed at 7 months and 18 months corrected age.

• It is hypothesized that late preterm infants, a group at risk for neurodevelopmental impairment, will have lower rates of infant vocalization and lower language scores at 7 and 18 months corrected age compared to term controls.

• It is hypothesized that there will be a positive relationship between the rate of infant vocalization, adult word counts, and conversation turns and language scores at 7 and 18 months.
Child vocalizations during newborn recording

Johnson et al
Study 3: Longitudinal Assessment of Children with Hearing Loss

- Infants with congenital hearing loss (HL) identified late are at increased risk of:
  - language,
  - cognitive,
  - behavior, and
  - academic delays
Study 3: Longitudinal Assessment of Children with Hearing Loss

- This is a prospective study of the language outcomes of infants identified in the RI newborn hearing screening program who were born between 10/15/02 and 1/31/05.

- The cohort consists of infants screened in either the NICU or well baby nursery and diagnosed with congenital HL and matched hearing controls who passed the newborn screen.

- The children have been followed prospectively to 6 years of age and we are obtaining 16 hour LENA recordings in conjunction with comprehensive 6 year cognitive and language assessments on the children with HL and controls.
Hypotheses for Ages 5 and 6

• Children with bilateral moderate, severe, or profound HL will have lower language and adaptive scores than children with mild or unilateral HL and children with typical hearing

• Children with moderate, severe, or profound HL will receive more IEP services than children with mild or unilateral HL or hearing children
Hypotheses

- Children with bilateral moderate, severe, or profound HL will have ↓ vocalizations, ↓ reciprocal vocalizations and ↓ MLU with LENA

- MLU on LENA will be correlated with language scores

- Among both HL and hearing controls, ↑ adult language will be associated with ↑ child conversational turns
## Reynell Scores at 3-5 Years of Age

<table>
<thead>
<tr>
<th>Hearing Status (N)</th>
<th>Mod-Pro (19)</th>
<th>Mild/Uni (10)</th>
<th>Hearing (74)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at Test (Months)</td>
<td>62.5±10</td>
<td>62.3±12</td>
<td>60.4±9.7</td>
<td>.6609</td>
</tr>
<tr>
<td>Verbal Comprehension</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard Score (M±SD)</td>
<td>72±17**</td>
<td>81±22*</td>
<td>95±15</td>
<td>.0001</td>
</tr>
<tr>
<td>Standard Score &lt; 70</td>
<td>13(68%)</td>
<td>4(40%)</td>
<td>5(7%)</td>
<td>.0001</td>
</tr>
<tr>
<td>Test Age Equivalent</td>
<td>38±15*</td>
<td>46±17*</td>
<td>53±10</td>
<td>.0001</td>
</tr>
<tr>
<td>Expressive Language</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard Score (M±SD)</td>
<td>81±17*</td>
<td>86±16*</td>
<td>97±16</td>
<td>.0002</td>
</tr>
<tr>
<td>Standard Score &lt; 70</td>
<td>8(42%)</td>
<td>3(20%)</td>
<td>6(8%)</td>
<td>.001</td>
</tr>
</tbody>
</table>

* Test score for older age used

Test score for older age used
- Average Test Score = 100
- 1SD = 85
- 2SD = 70

* vs Hearing
* vs Moderate-Profound
## Services at 3-5 Years of Age

<table>
<thead>
<tr>
<th>Services</th>
<th>Mod-Pro (19)</th>
<th>Mild/Uni (10)</th>
<th>Hearing (74)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early Intervention</td>
<td>19(100%)</td>
<td>8(80%)</td>
<td>24(32%)</td>
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<tr>
<td>Family Guidance</td>
<td>17(89)</td>
<td>6(60)</td>
<td>2(3)</td>
</tr>
<tr>
<td>Physical Therapy</td>
<td>13(68)</td>
<td>4(40)</td>
<td>15(20)</td>
</tr>
<tr>
<td>Occupational Therapy</td>
<td>8(42)</td>
<td>5(50)</td>
<td>15(20)</td>
</tr>
<tr>
<td>Speech/Language</td>
<td>18(95)*</td>
<td>6(60)</td>
<td>22(30)</td>
</tr>
<tr>
<td>VNA Services</td>
<td>8(42)</td>
<td>1(10)</td>
<td>5(7)</td>
</tr>
<tr>
<td>Any Services</td>
<td>19(100)</td>
<td>8(80)</td>
<td>27(36)</td>
</tr>
</tbody>
</table>

*ASL
6 Year Assessment of HL Cohort

- K-ABC non-verbal subtest
- Woodcock Johnson Reading Mastery Test
- Reynell Developmental Language Scales
- Child Behavior Checklist
- LENA 16 hour recordings
- Vineland Adaptive Behavior Scales
- Parent reports
Summary

We are in the early phases of our studies.

Preliminary data on VLBW Cohort will be presented by Melinda Caskey, MD.