Minimal Hearing Loss & Cognitive Performance in Children (Preliminary Results 3/05)

Danielle S. Ross, PhD, MSc
Susanna Visser, MS
June Holstrum, PhD
Aileen Kenneson, PhD, MS

Centers for Disease Control and Prevention

National Center on Birth Defects
and Developmental Disabilities

Purpose

- Estimate the prevalence of unilateral & slight–mild bilateral HL among a nationally representative sample of school-aged children in the U.S.
- **Evaluate the relationship between unilateral and slight-mild bilateral HL & intelligence & achievement test performance in this population**

Background: General

- Prevalence of minimal HL varies greatly in the literature
- Children with minimal HL score lower than children with no HL on tests of
  - Speech
  - Language
  - School achievement
  - Behavior

Background: General

- Often not identified until school age
- May account for
  - Wide range of prevalence rates
  - Poorer performance in school, behavior problems, speech & language delays

Background: This study

- NHANES-III (1988-1994): national population-based cross-sectional survey
  - Household interview
  - Laboratory exam
  - Physical exam, including tympanometry & audiometric testing
  - Cognitive testing
- Child version includes total of 6908 children aged 6 through 19 years

Methods: Audiological Testing

- Air Conduction 500-8K Hz
- Tympanometry
- Limitation: No bone conduction

Case Definitions (PTA .5, 1, 2K Hz)

- **CONTROL: <15 dB HL both ears**
  - **N = 4852**
- **UHL: <15dB HL better ear; ≥15dB worse ear**
  - **N = 333** (Slight 304; Mild 3; Mod+ 26)
- **BILATERAL Slight-Mild: 15-30dB HL better ear**
  - **N = 123** (Slight 120; Mild 3)

Methods: Cognitive Testing

- Wechsler Intelligence Scale for Children-Revised (WISC-R)
  - Block Design
  - Digit Span
- Wide Range Achievement Test-Revised (WRAT-R)
  - Reading
  - Math

Results: Prevalence for children in the general U.S. population aged 6-16 (weighted proportions)

- Total UHL & Slight-Mild Bilateral HL: 7.70% (95% CI: 6.42-9.21)
  ~3.2 million

- Unilateral: 6.27% (95% CI: 5.16-7.60)
  ~2.6 million

- Bilateral: 1.62% (95% CI: 1.14-2.30)
  ~639,000

Results: WISC-R & WRAT-R

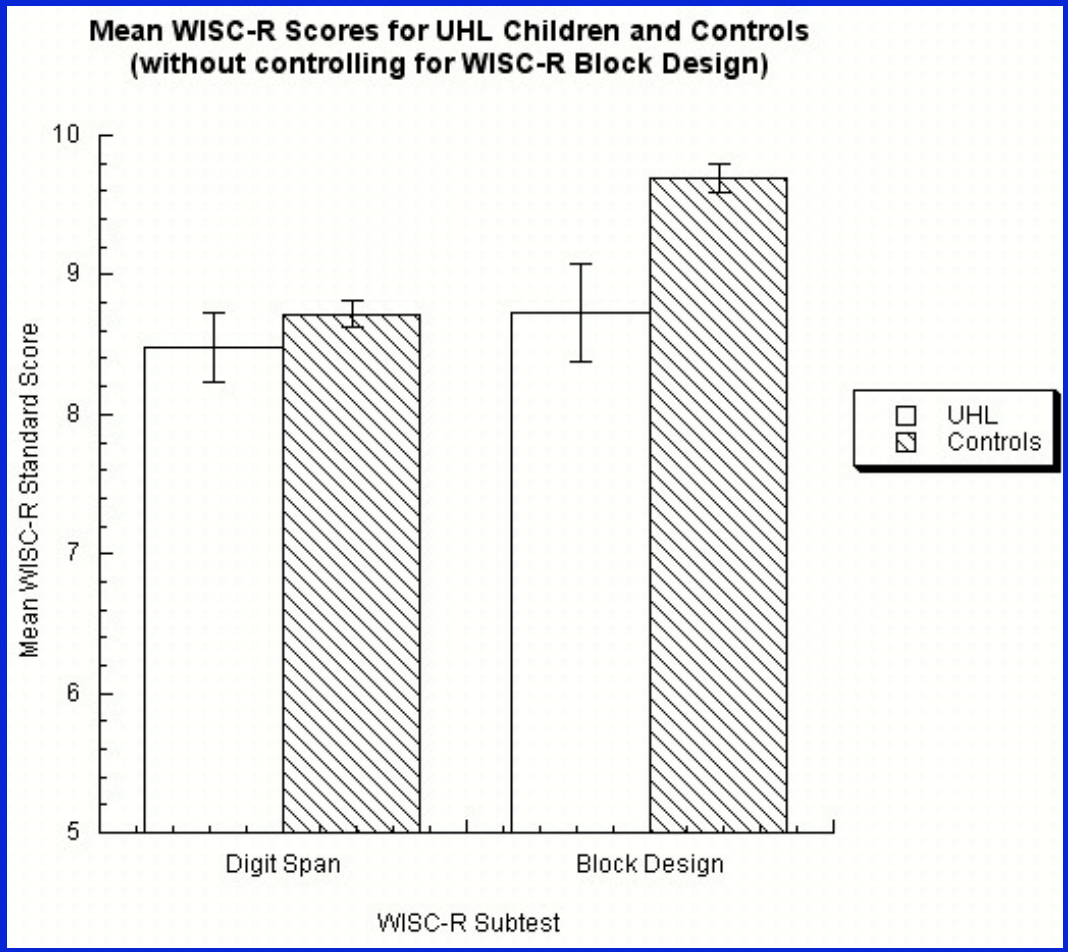
- All analyses controlled for:
  - Sex
  - Age (6-11 years/12-16 years)
  - Rural/Urban code
  - Race (Black/White/Other)
  - Test Language (English/Spanish)
  - Poverty

WISC-R: UNILATERAL

- Digit Span:
  - UHL vs. Controls

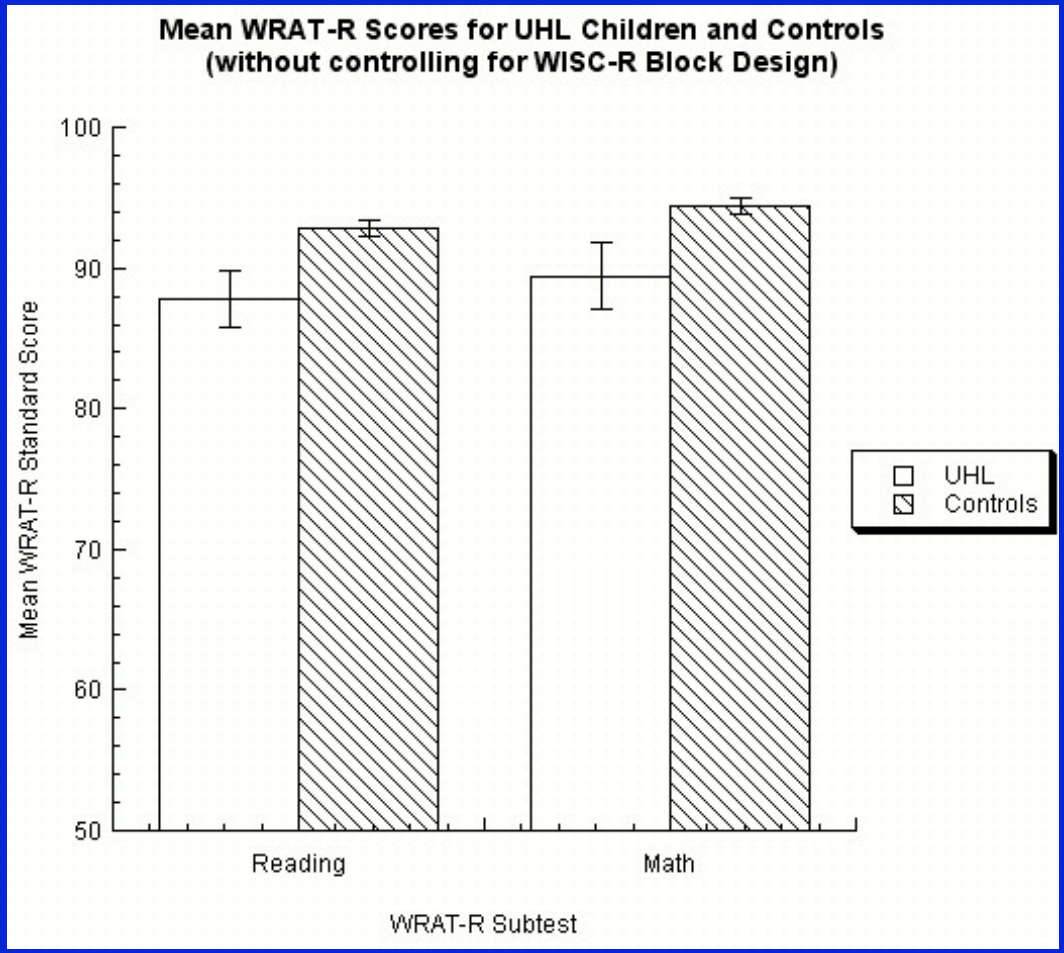
    NS
- Block Design:
  - UHL vs. Controls

    p < .02



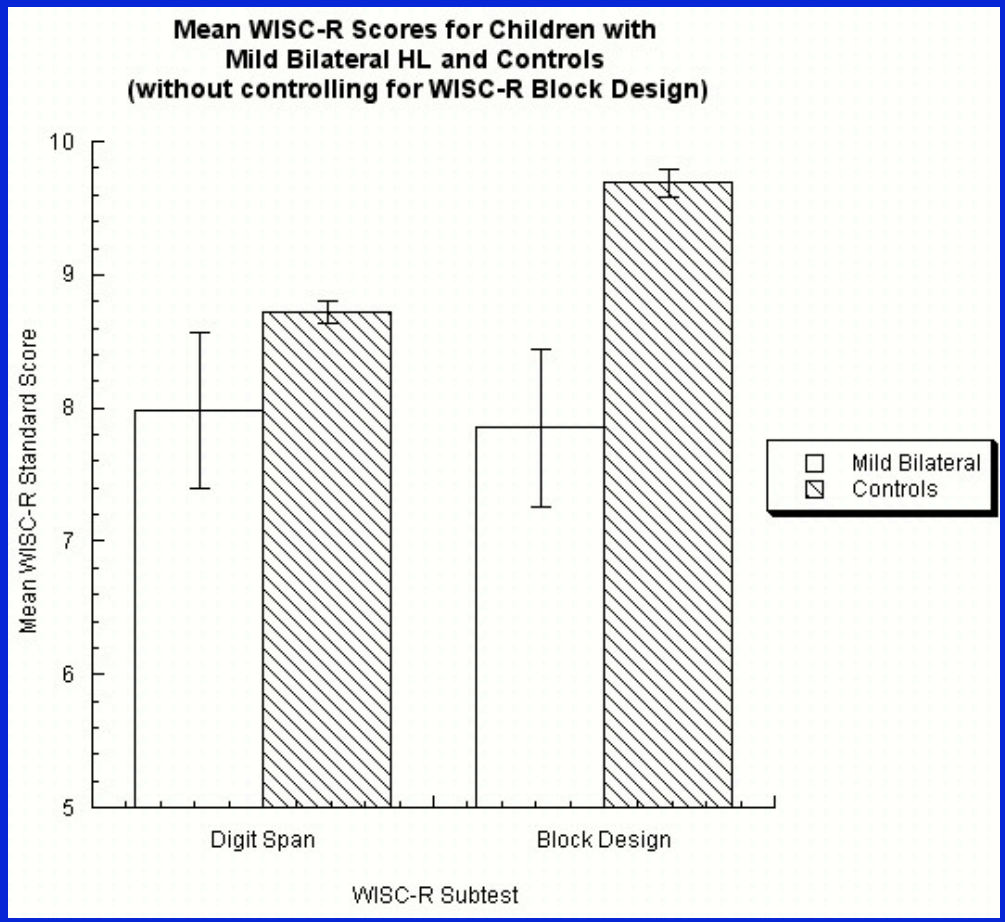
WRAT-R: UNILATERAL

- **Reading:**
  - UHL vs. Controls
    $p < .03$
- **Math:**
  - UHL vs. Controls
    $p < .05$



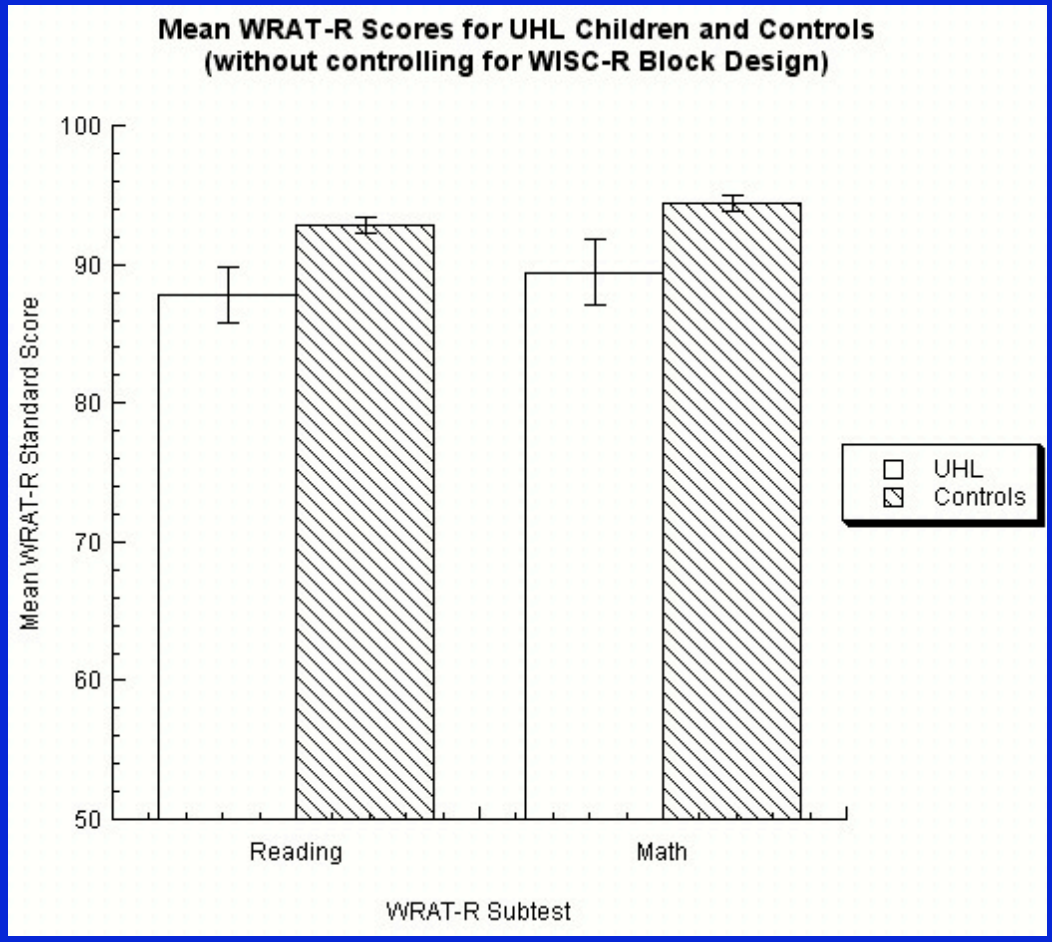
WISC-R: BILATERAL

- Digit Span:
  - Bilateral vs. Controls
    NS
- Block Design:
  - Bilateral vs. Controls
    p < .007



WRAT-R: BILATERAL

- **Reading:**
  - **Bilateral vs. Controls**
    $p < .05$
- **Math:**
  - **Bilateral vs. Controls**
    $p < .002$



WRAT-R controlling for Block Design

- Unilateral vs. Controls
  - Reading: NS
  - Math: NS

- Bilateral vs. Controls
  - Reading: NS
  - Math: NS

CHI Squares for Proportion of children ≥ 2 SD below test norm

	Unilateral vs. Controls	Bilateral vs. Controls
Block Design	$X^2 = 0.00$ NS	$X^2 = 1.44$ NS
Reading	$X^2 = 3.39$ $p < .08$	$X^2 = 3.57$ $p < .06$
Math	$X^2 = 1.39$ NS	$X^2 = 3.23$ $p < .08$

Summary: Prevalence

- There are ~3.2 million children in the U.S. aged 6-16 with unilateral or slight-mild bilateral HL
- ~2.6 million have unilateral HL
- ~639,000 have slight-mild bilateral HL

Summary: WISC-R

- Children with HL showed lower mean score than controls on Block Design subtest of WISC-R
- However, mean was within normal range.
  - Proportion scoring ≥ 2SDs below the norm did not differ from controls
  - Therefore they scored in low-normal range
- No differences on Digit Span vs. controls

Summary: WRAT-R

- Differences in means for reading & math no longer significant when controlled for difference in Block Design
- However, a higher proportion of children with HL scored ≥ than 2 SDs below the test norms than controls
  - Although differences were not statistically significant, they may be clinically significant

Hypotheses for Future Study

- Children with UHL or slight-mild bilateral HL may need different administration for standardized testing than children without HL
  - Being aware the child has a HL can help testers make minor adjustments in test administration that may help the child
  - Subtests requiring visual & auditory processing may require different administration than tests where the child does not have to listen while looking at test materials
- Some children in this sample may have underlying deficit(s) related to etiology

Conclusion: What does this mean for EHDI?

- Most children in this study had slight HL
- Children with mild-moderate losses likely have as much or more difficulty with standardized testing as children with slight or slight-mild HL
- Knowledge of slight-mild HL may lead to helpful changes being made in the child's environment (e.g. test administration)
- The earlier these children are identified, the earlier they can be provided with interventions

Future Analyses

- Include 4K Hz!
- Include children with high freq. losses
- Proportion of children scoring ≥ 1 SD below Block Design, Reading, & Math norms
- Variables related to ≥ 2 SD below norm
- Proportion of children who repeated a grade
- Parental interviews:
  - Parent's recognition of child's hearing loss
  - Parent's report of behavioral problems

Questions?

Danielle S. Ross, Ph.D., M.S.

dross3@cdc.gov

Thank You!

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