Minimal Hearing Loss, Grade Failure, and Cognitive Testing in Children

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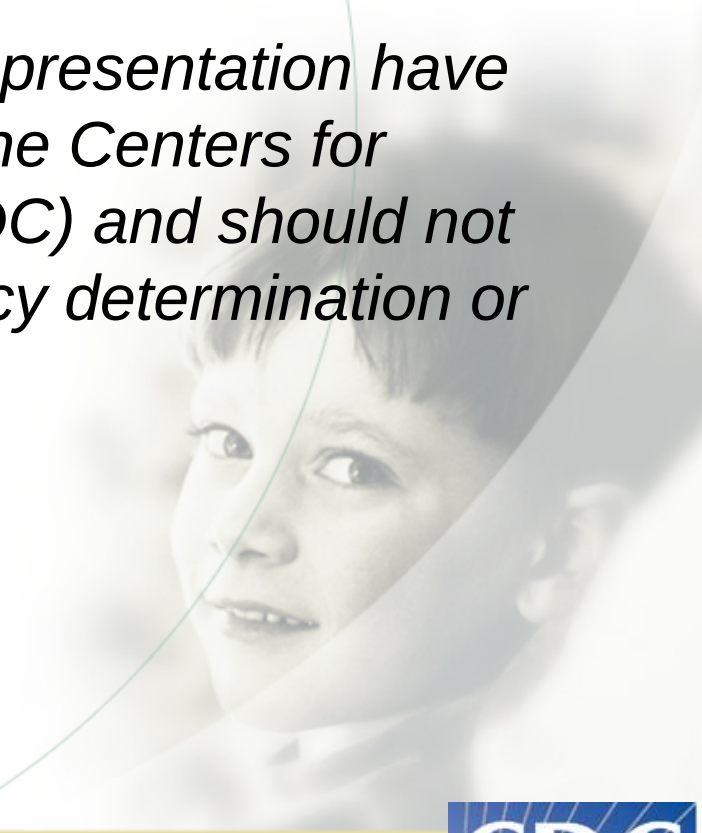


Purpose

- Estimate the prevalence of unilateral & slight–mild bilateral HL among a nationally representative sample of school-aged children in the U.S. (using working definition).

- **Evaluate the relationship between unilateral and mild bilateral hearing loss & grade failure & standardized cognitive tests.**

Background

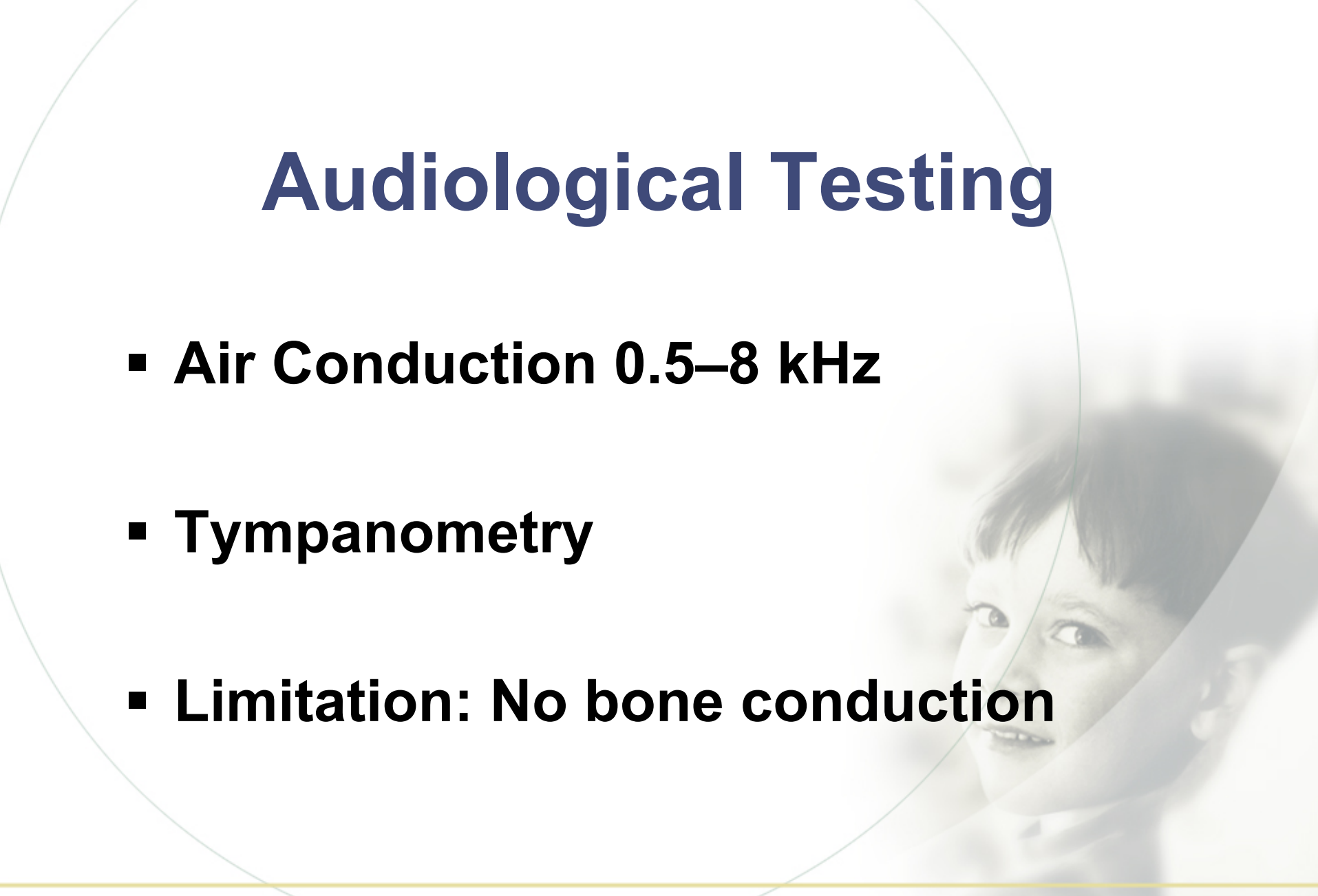
- **NHANES-III (1988-1994): national population-based cross-sectional survey**
  - **Household interview**
  - **Laboratory exam**
  - **Physical exam, including tympanometry & audiometric testing**
  - **Cognitive testing**

- **Sample**
  - **Child version 6908 6–19 years**
  - **Current study: 5326 6–16 years**

  (cognitive tests normed 6–16 years)

Audiological Testing

- **Air Conduction 0.5–8 kHz**
- **Tympanometry**
- **Limitation: No bone conduction**

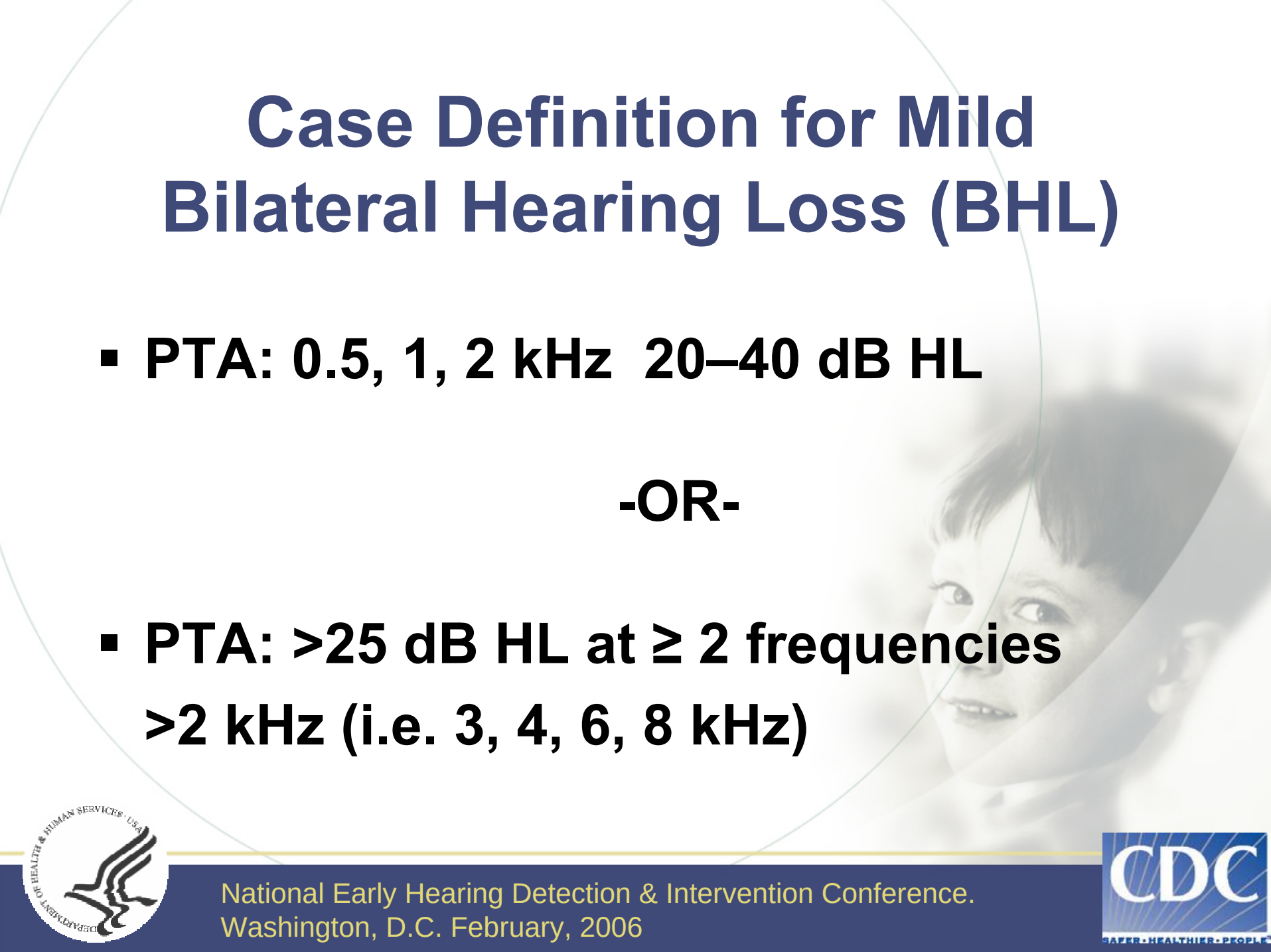


Case Definition for Mild Bilateral Hearing Loss (BHL)

- **PTA: 0.5, 1, 2 kHz 20–40 dB HL**

-OR-

- **PTA: >25 dB HL at ≥ 2 frequencies >2 kHz (i.e. 3, 4, 6, 8 kHz)**

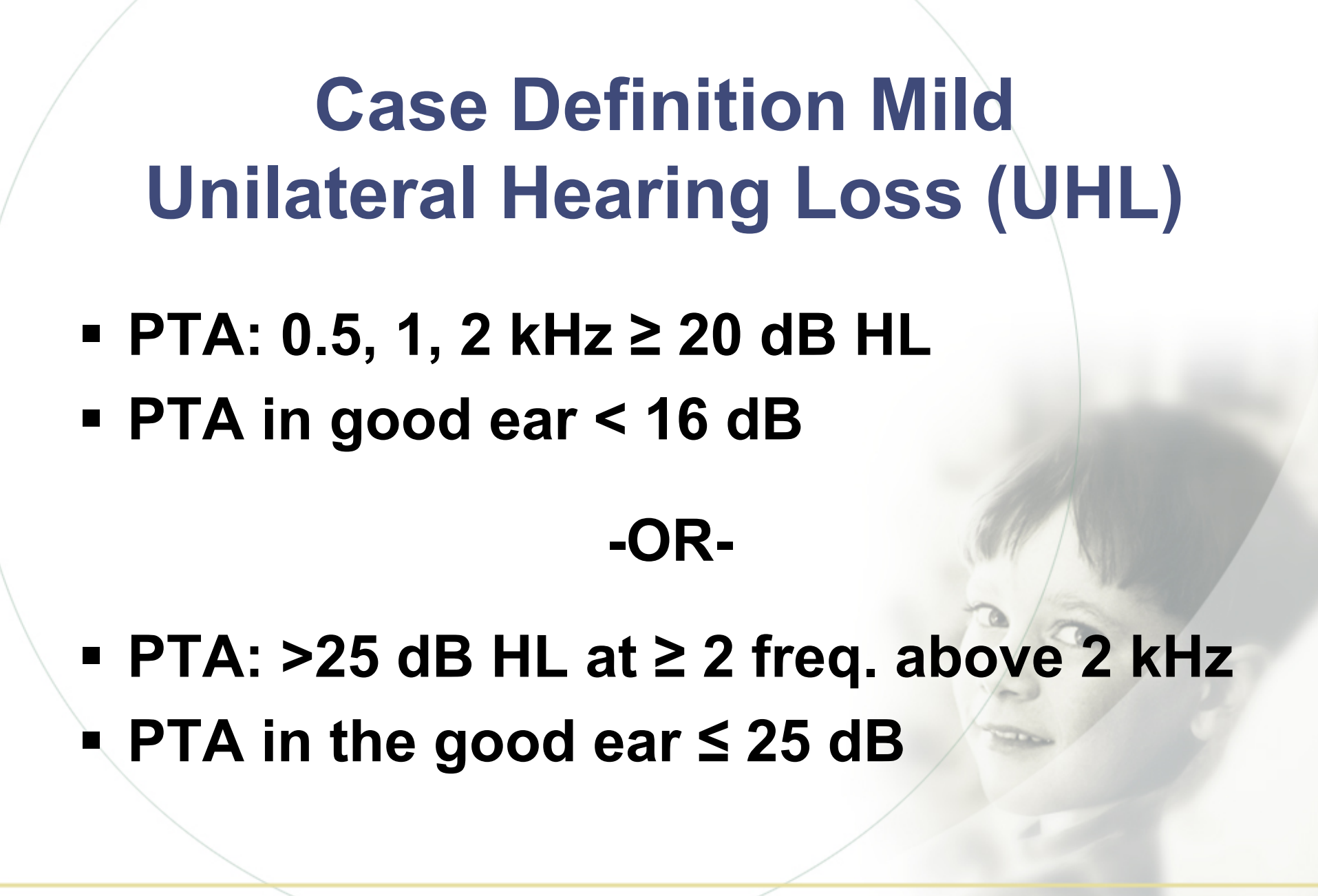


Case Definition Mild Unilateral Hearing Loss (UHL)

- **PTA: 0.5, 1, 2 kHz ≥ 20 dB HL**
- **PTA in good ear < 16 dB**

-OR-

- **PTA: >25 dB HL at ≥ 2 freq. above 2 kHz**
- **PTA in the good ear ≤ 25 dB**



Case Definition for Slight Unilateral & Bilateral

Unilateral

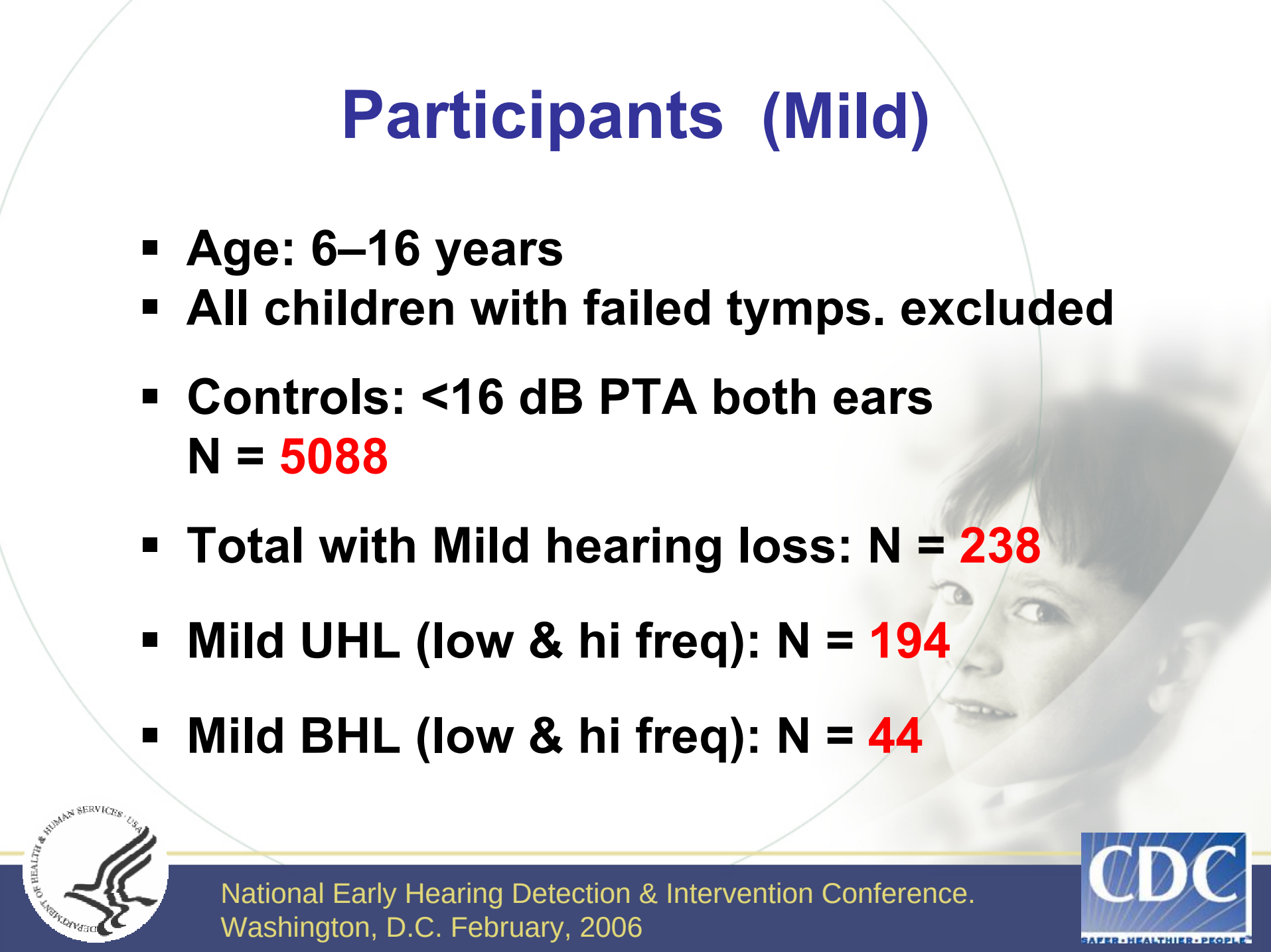
- PTA: 0.5, 1, 2 kHz 16–19 dB HL in affected ear
- PTA <16 dB HL in normal ear

Bilateral

- PTA: 16–19 dB HL in both ears

Participants (Mild)

- Age: 6–16 years
- All children with failed tymps. excluded
- Controls: <16 dB PTA both ears
  N = 5088
- Total with Mild hearing loss: N = 238
- Mild UHL (low & hi freq): N = 194
- Mild BHL (low & hi freq): N = 44



Participants

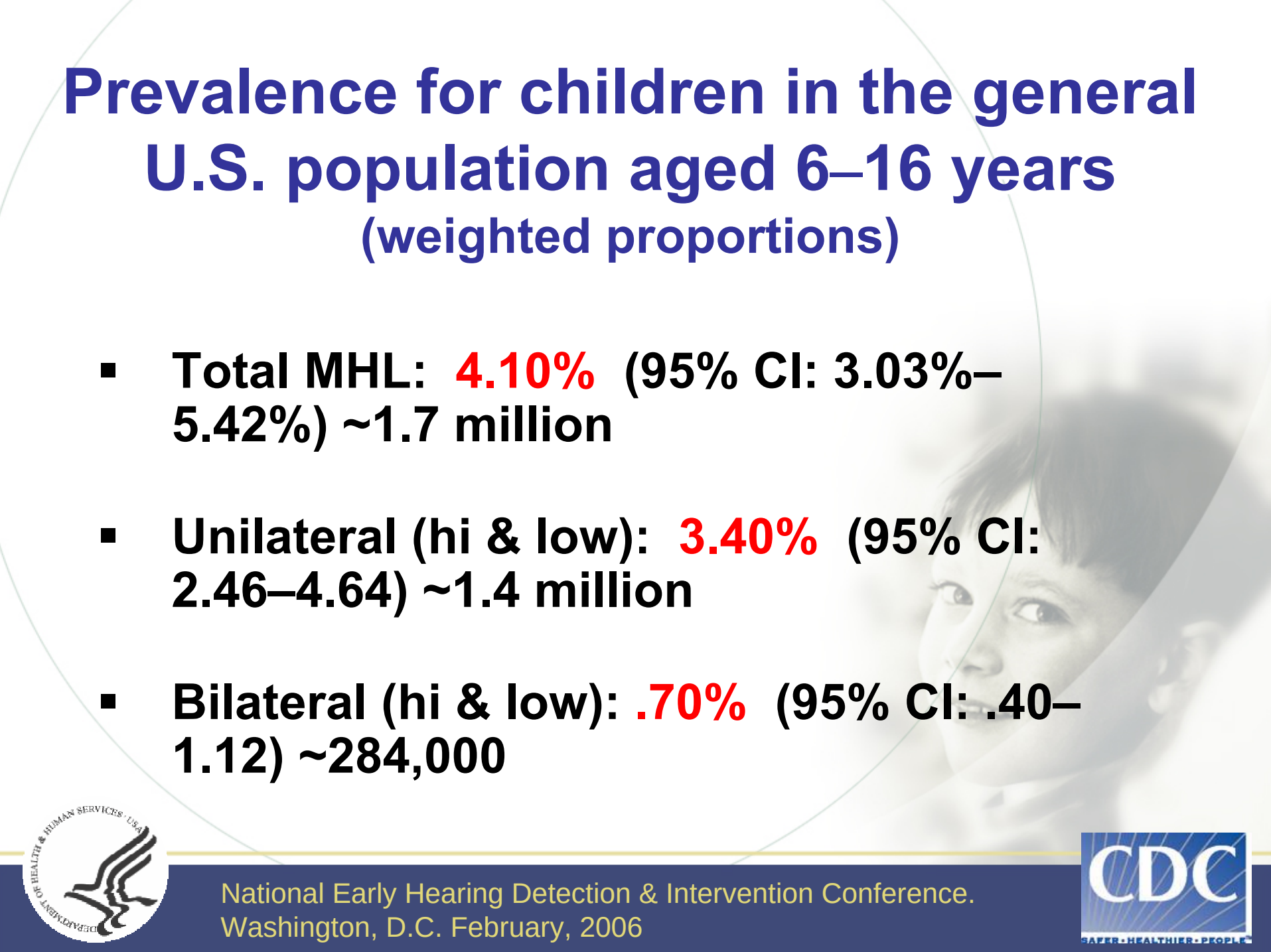
- UHL Mild (low freq): N = 138
- UHL Mild (high freq): N = 56

- Bilateral Mild (low freq): N = 29
- Bilateral Mild (high freq): N = 15

- UHL (slight low freq) N = 139
- Bilateral (slight low freq) N = 15

Prevalence for children in the general U.S. population aged 6–16 years
(weighted proportions)

- **Total MHL: 4.10% (95% CI: 3.03%–5.42%) ~1.7 million**
- **Unilateral (hi & low): 3.40% (95% CI: 2.46–4.64) ~1.4 million**
- **Bilateral (hi & low): .70% (95% CI: .40–1.12) ~284,000**



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

- **Unilateral (low): 2.35% (95% CI: 1.54 – 3.58) ~994,000**
- **Unilateral (high) 1.00% (95% CI: .67 – 1.58) ~434,000**
- **Bilateral (low): .40% (95% CI: .23 – .80) ~181,000**
- **Bilateral (high) .20% (95% CI: .10 –.57) ~103,000**

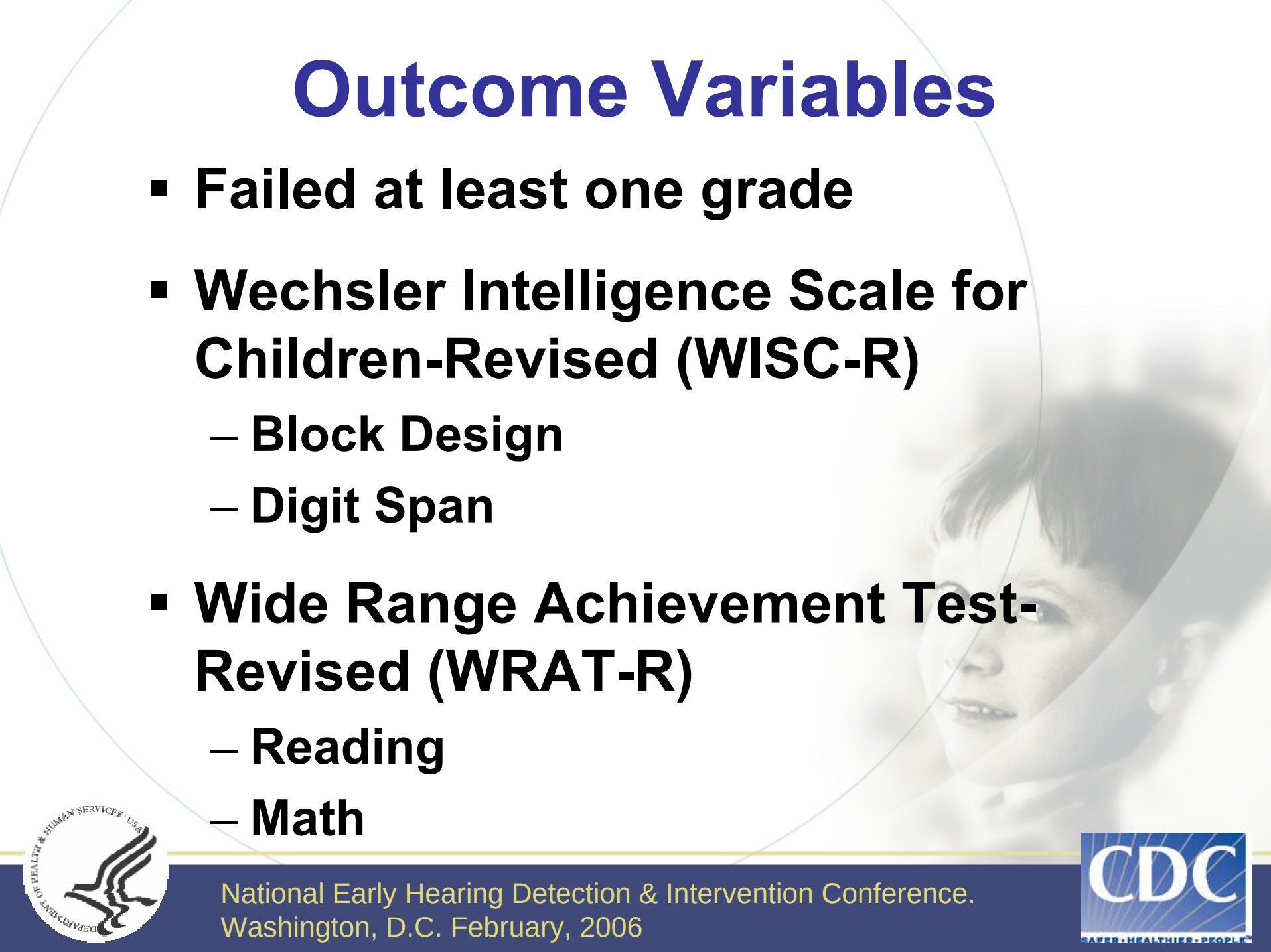
Prevalence for children in the general U.S. population aged 6–16

(weighted proportions)

- **Total Slight (low): 2.7% (95% CI: 2.1–3.5) ~1.14 million**
- **Unilateral Slight (low): 2.5% (95% CI: 1.96–3.4) ~1.0 million**
- **Bilateral Slight (low) .20% (95% CI: .08–.37) ~73,400**

Outcome Variables

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



Results: WISC-R & WRAT-R

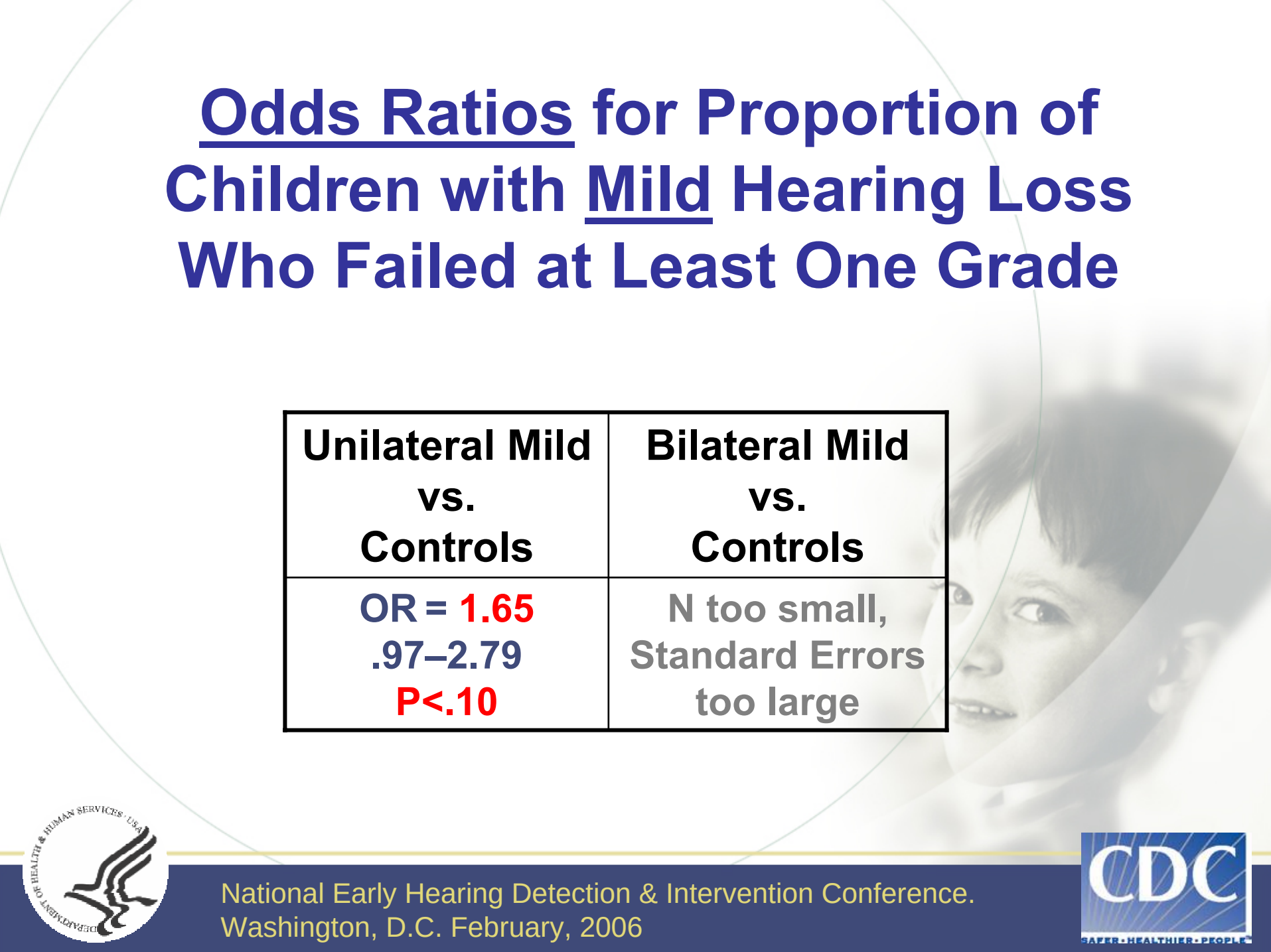
- **All analyses controlled for:**
  - **Sex**
  - **Age (6-11 years/12-16 years)**
  - **Rural/Urban code**
  - **Race (Black/White/Other)**
  - **Test Language (English/Spanish)**
  - **Poverty**

Proportion of Children with Mild Hearing Loss who Failed at Least One Grade

Controls	Unilateral	Bilateral
16.80 14.37–19.45	24.89 16.37–35.94	N too small, Standard Errors too large

Odds Ratios for Proportion of Children with Mild Hearing Loss Who Failed at Least One Grade

Unilateral Mild vs. Controls	Bilateral Mild vs. Controls
OR = 1.65 .97–2.79 P<.10	N too small, Standard Errors too large



Proportion of Children with Slight-Mild Hearing Loss who Failed at Least One Grade

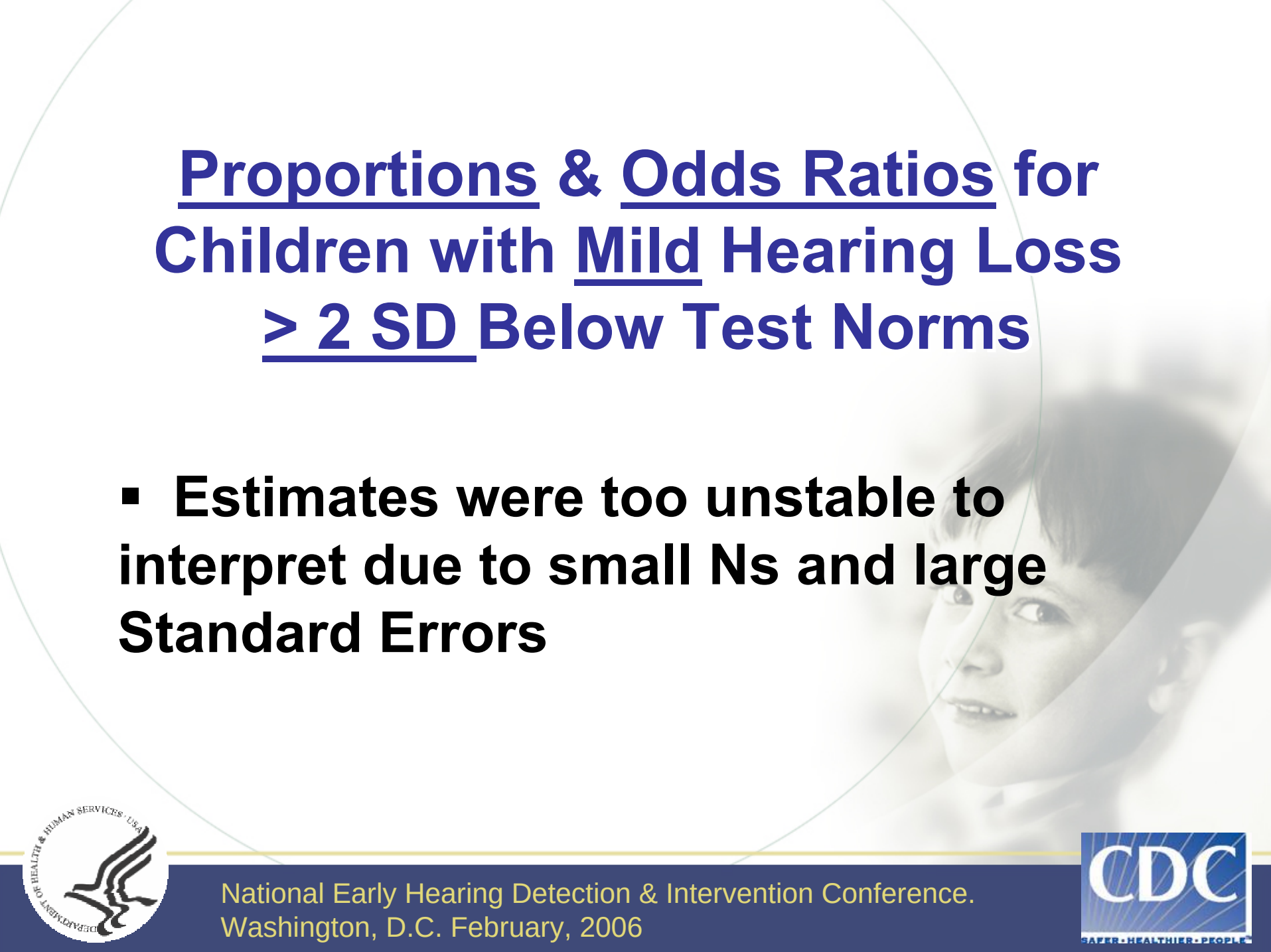
Controls	Slight-Mild Unilateral	Slight-Mild Bilateral
16.8 14.4–19.6	22.1 15.1–30.5	15.5 4.9–39.7

Odds Ratios for Proportion of Children with Slight-Mild Hearing Loss who Failed at Least One Grade

Unilateral Mild vs. Controls	Bilateral Mild vs. Controls
OR = 1.40 .83–2.35 P<.23	OR = .91 .25–2.72 P<.88

Proportions & Odds Ratios for Children with Mild Hearing Loss > 2 SD Below Test Norms

- **Estimates were too unstable to interpret due to small Ns and large Standard Errors**



Proportion of Children with Mild Hearing Loss >1 SD Below Test Norm

	Controls	Unilateral Mild	Bilateral Mild
Block Design	15.70 13.84–17.76	30.98 19.94–44.72	2.26 .47–10.13
Reading	31.55 28.81–34.43	38.60 28.33–49.99	17.40 7.13–36.64
Math	29.23 26.82–31.75	33.08 22.80–45.28	15.78 13.90–17.87

Odds Ratios for Proportion of Children with Mild Loss >1 SD Below Test Norm

	Unilateral Mild vs. Controls	Bilateral Mild vs. Controls
Block Design	OR = 2.41 1.38–4.21 P<.01	N too small, Standard Errors too large
Reading	OR = 1.36 .85–2.18 P<.18	N too small, Standard Errors too large
Math	OR = 1.20 .74–1.92 P<.43	N too small, Standard Errors too large

Proportion of children with Slight–Mild Hearing Loss >1 SD below test norm

	Controls	Unilateral Mild	Bilateral Mild
Block Design	15.70 13.84–17.76	26.10 17.86–36.45	33.16 16.96–54.64
Reading	31.55 28.81–34.43	36.90 27.36–47.58	39.57 20.95–61.80
Math	29.23 26.82–31.75	35.35 27.90–43.59	39.14 20.42–61.72

Odds Ratios for Proportion of Children with Slight–Mild Loss >1 SD Below Test Norm

	Unilateral Mild vs. Controls	Bilateral Mild vs. Controls
Block Design	OR = 1.90 1.17–3.07 P<.02	OR = 2.65 1.09–6.48 P<.07
Reading	OR = 1.41 .58–3.42 P<.43	OR = 1.36 .85–2.18 P<.18
Math	OR = 1.32 .95–1.85 P<.10	OR = 1.55 .60–4.00 P<.37

Discussion

- **There are ~1.7 million children in the U.S. aged 6-16 with mild unilateral or bilateral HL according to the working definition used in this study.**

- **There are an additional ~1.14 million children in the U.S. aged 6-16 with slight unilateral or bilateral HL**

Discussion

- **Children (6-16) with UHL or slight-mild bilateral HL may be at higher risk to score 1SD below the norm on the Block Design subtest of the WISC**
  - **Subtests that require visual & auditory processing may require different administration**

Conclusion

- **Some children in this sample may have underlying deficit(s) related to etiology (analyses to be done).**
- **Testers should be aware child has HL**
- **Defining a profile of children with UHL or slight-mild bilateral HL who are at risk for failure on standardized tests could be an important focus for clinicians and researchers**

Future Studies

- **Future studies will compare the prevalence and cognitive test results using two different definitions of hearing loss.**

- **These results will demonstrate the influence of the case definition in hearing loss research.**
- **Implications for research and practice will be discussed.**

Questions?

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Thank You!