

# Longitudinal Outcomes of Children with Hearing Impairment (LOCHI)

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# Who do the work

- ◆ Emma van Wanrooy, Leanne Skinner, Patricia van Buynder, Robyn Massie, Lauren Burns, Joanne Maritz, Carina Law
- ◆ Julia Day, Kathryn Crowe, Lisa Nailand, Alison Jagger, Nicole Mahler-Thompson
- ◆ Samantha Youn
- ◆ Emma Rushbrooke, Lynda Close (Hear & Say)
- ◆ Greg Leigh (Royal Institute for Deaf and Blind Children)
- ◆ Jamie Leigh (CI centre, Victoria Eye & Ear Hospital)
- ◆ Lynne Paul (St Gabriel's School for Hearing impaired children, Strathfield Catholic Centre for hearing impaired children)
- ◆ Tracy Hopkins, Maree Doble (The Shepherd Centre)
- ◆ Kylie Rankine, Colleen Psarros, Sharan Westcott (Sydney Cochlear Implant Centre)

*Others:*

*Gillian Zavos, Andrew Geyl, Anne Fulcher, Isabelle Rousseau, Lyndal Carter*

# Background

- ◆ **Prevalence** (Russ et al, 2003; Ching et al, 2006)
  - $\geq 40$  dB HL: 1.05/1000
  - $< 40$  dB HL: 0.3/1000
- ◆ **Impact on children**
  - **Auditory skills** (Sininger et al, 1999; Ruben, 1997)
  - **Speech and language** (Davis et al, 1997; Helfand et al, 2001)
  - **Social** (Watson et al, 1990)
  - **Education** (Punch et al, 2004)
- ◆ **Economic impact**
  - AUD 11 bn per annum (Access Economics Report, 2006)

# Early detection improves outcomes?

- ◆ Retrospective association between detection at 6 or 9 months of age and better language at 3 to 5 years (Yoshinaga-Itano et al, 1998; Moeller, 2000).
- ◆ Newborn hearing screening leads to early detection
  - Median age of amplification is 3 to 4 months (AH Statistics; Ching et al, 2006; Uus & Bamford, 2007)
- ◆ But, evidence on whether early intervention improves outcomes is inconclusive (Thompson et al, 2001; Cochrane Review, 2005)
  - No prospective controlled comparison of early and later identified children

# State of the States in Australia

(Leigh, 2006; Ching et al, 2006)

State	Prop. births	Year	Status	Method	Coverage
NSW	0.33	2002	Universal	2-stage AABR	> 95%
VIC	0.24	2005	Partial	2-stage AABR	~30%
QLD	0.20	2004	Universal	2-stage AABR	>97%
WA	0.10	2002-03	Partial	2-stage OAE & AABR	~48%
SA	0.07	2003	Universal	3-stage, 2 OAEs + AABR	>95%

We have commenced a  
Longitudinal comparison of  
Outcomes of  
Children with  
Hearing  
Impairment ...



# Aims

- ◆ To establish an evidence base for the speech, language, functional, psychosocial and educational outcomes of children who use hearing aids and/or cochlear implants;
- ◆ To quantify the effect of a range of factors, including age of intervention, on different outcomes.

## Factors

### Child factors

- ❖ *Age of intervention*
- ❖ *Aetiology*
- ❖ *Hearing thresholds*
- ❖ *Demographics*
- ❖ *Socio-economic status*
- ❖ *Cognitive ability*
- ❖ *Additional disabilities*

### Device factors

- ❖ *Hearing aid prescription*
- ❖ *Cochlear implants*
- ❖ *Implant characteristics*
- ❖ *Aided Cortical responses*

### Intervention factors

- ❖ *Age of enrolment*
- ❖ *Type and Amount*
- ❖ *Family involvement*

## Outcomes

*Speech production*  
*Speech intelligibility*  
*Binaural Speech perception*  
*Receptive Language*  
*Expressive Language*  
*Vocabulary*  
*Phonological awareness*  
*Reading words*  
*Reading Comprehension*  
*Functional performance*  
*Psycho-social skills*  
*Educational attainment*

# Participants

- ◆ 400 children who first received amplification under 3 years of age
  - All children who first presented for hearing aids at Australian Hearing paediatric centres in NSW, Queensland and Victoria after April 2005 are invited to participate.
- ◆ All SWISH children in NSW

# Method

- ◆ Fit hearing aids accurately to prescriptions (NAL vs DSL)
- ◆ Collect demographic, audiological information and information about non-device intervention for each participant.
- ◆ Measure non-verbal cognitive ability at 5 years of age

# Method (aetiology of hearing loss)

- ◆ Parental questions
- ◆ Tests of newborn blood spots
  - CMV ~ 25% (Morton & Nance, 2006)
  - mutations in GJB2 (Cx 26) ~ 15-21%
  - Mutations in SLC26A4 (Pendred) ~3-7%
  - A1555G mutations (aminoglycosides ototoxicity) ~ 1%

# Method: Assessments

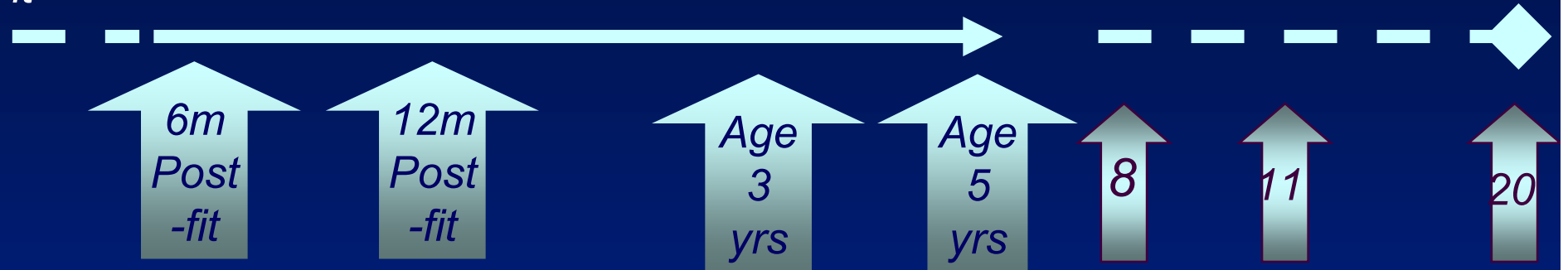
<i>Domains</i>	<i>Measures</i>
Speech production	DEAP
Speech intelligibility	BIT
Binaural Speech perception – release of masking	NU-CHIPS BKB/BEST lists
Language	M-BCDI PLS-4 Child Development Inventory CELF-4
Reading	WDRB - WA, WI, Reading vocabulary, Passage comprehension
Phonological awareness	PAT – letter naming CTOPP
Phonological memory	CTOPP – memory for digits Dollaghan & Campbell – nonword repetition

# Outcomes measures (cont'd)

<i>Domains</i>	<i>Measures</i>
Receptive vocabulary	PPVT-IV
Functional performance	PEACH, TEACH
Psychosocial skills	Child Development Inventory SDQ, PHSCS
Educational attainment	WIAT – numeracy TWS, WDRB State-wide assessments

# Method

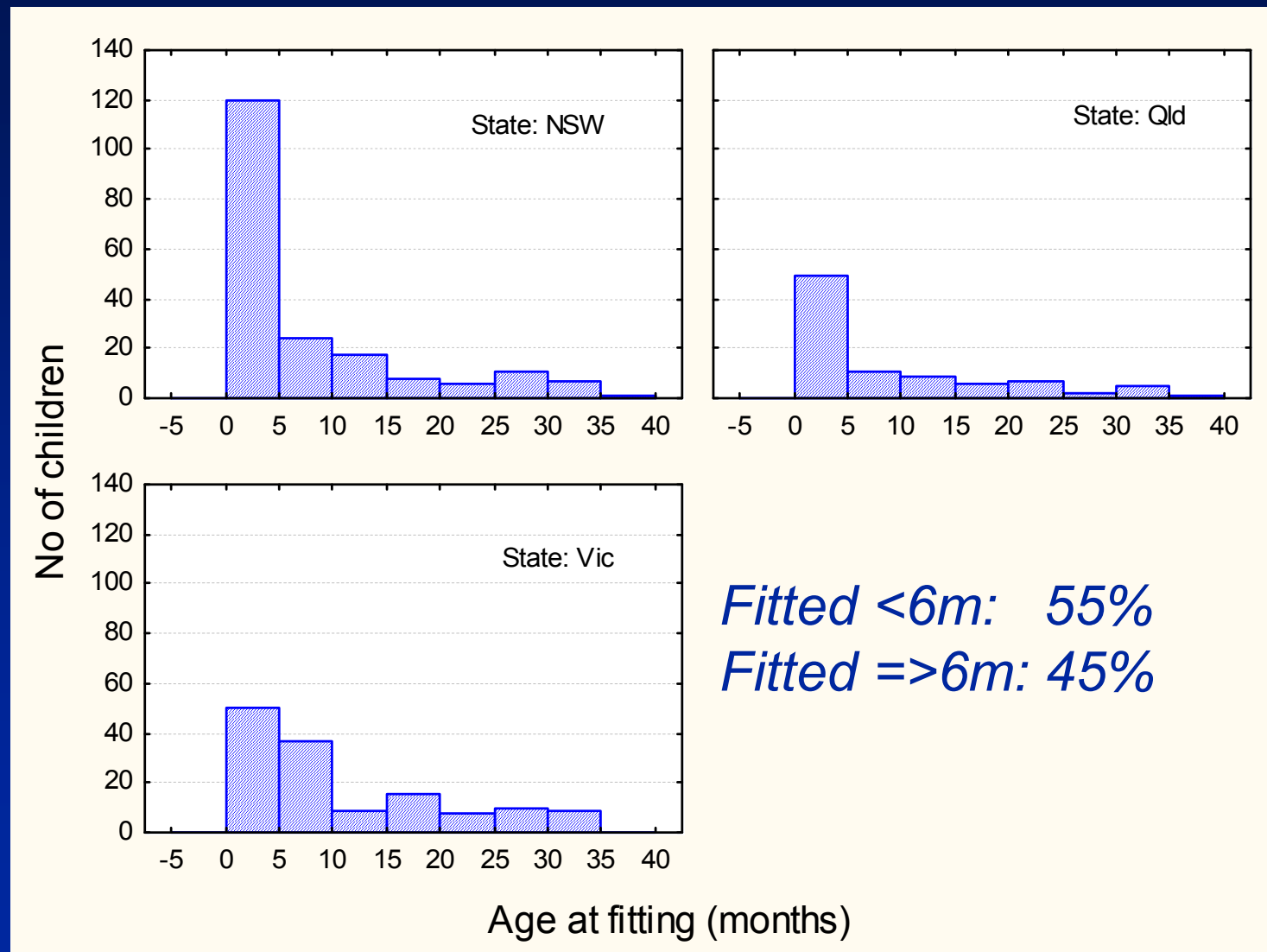
*First  
Fit*



- ◆ Multiple assessments over time
  - to track rate of development
  - To assess relative impact of different factors at different age

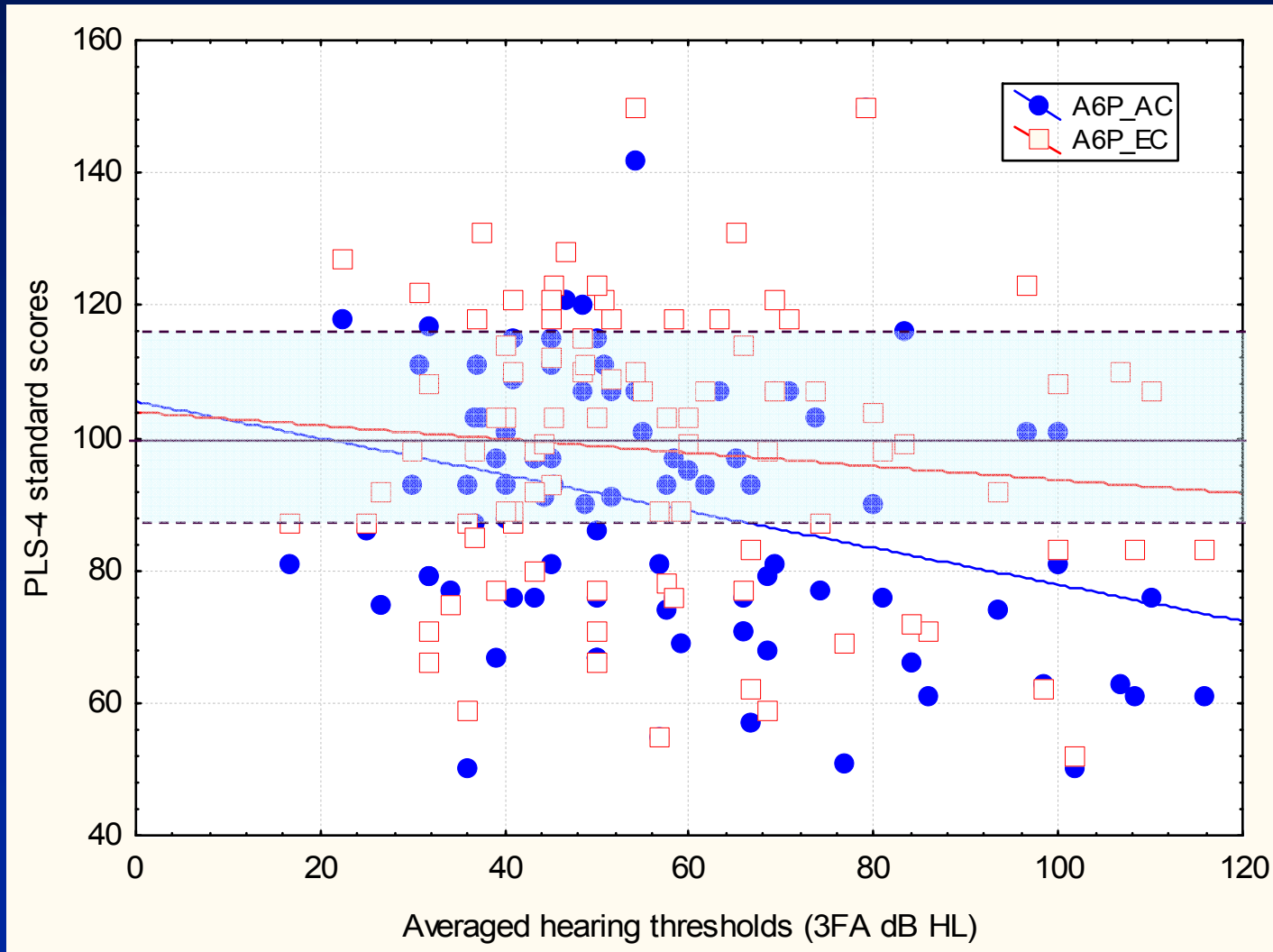
Progress to date ...

# Participants





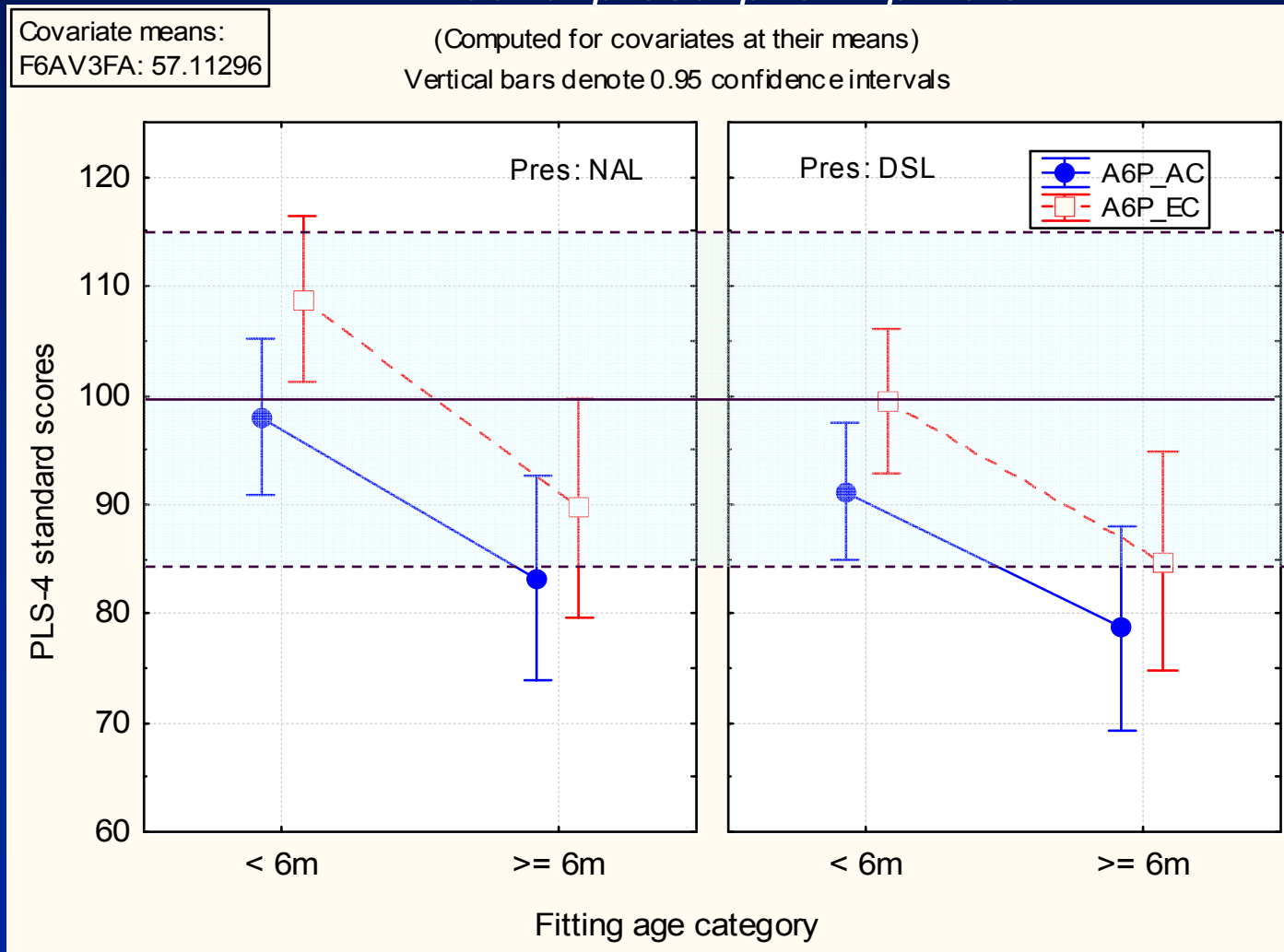
# Language ability decreases with increase in hearing loss



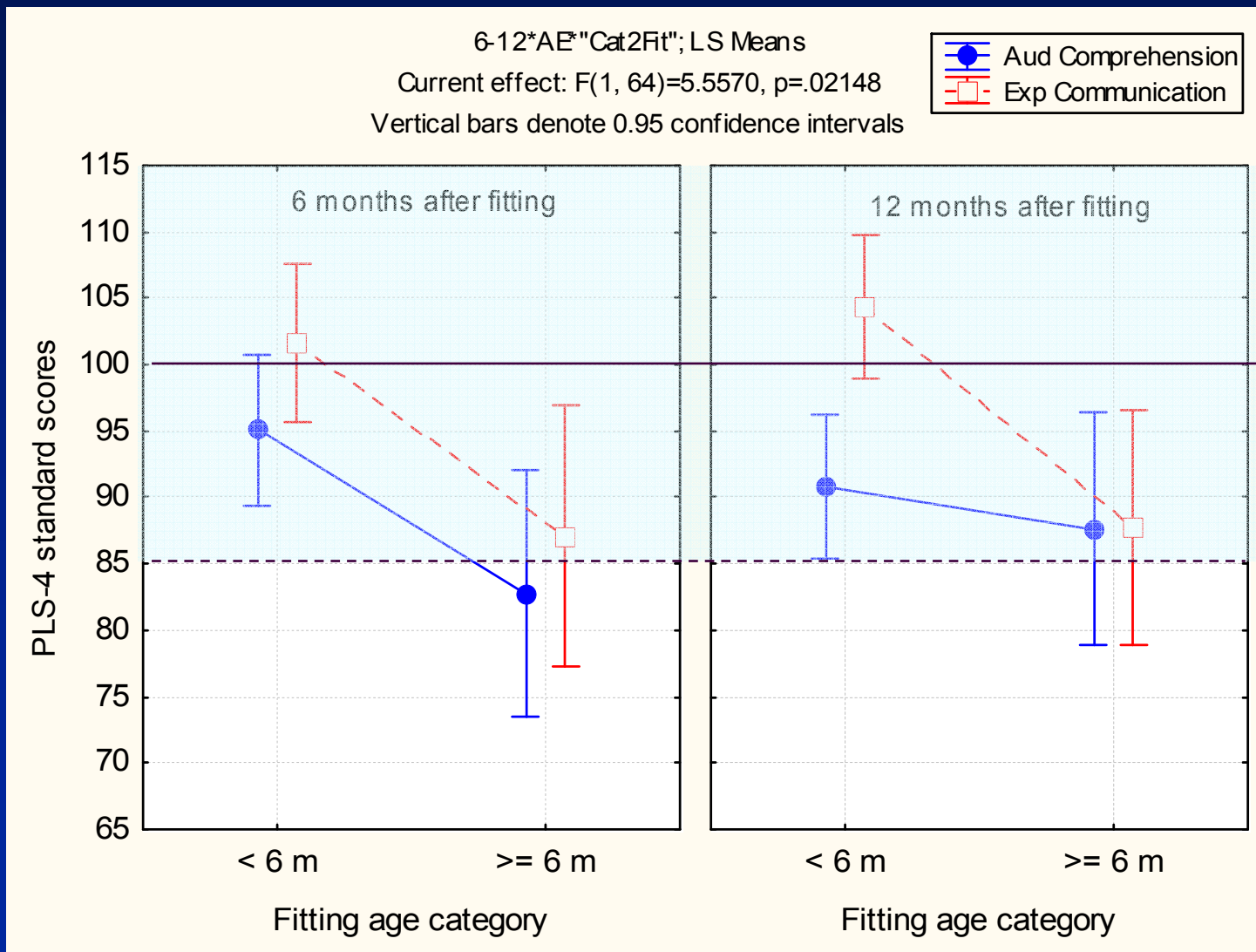
# Early intervention leads to better language development at 6 months after fitting

Significant effect of age of fitting:  $p = 0.001^*$

Effect of prescription:  $p = 0.3$

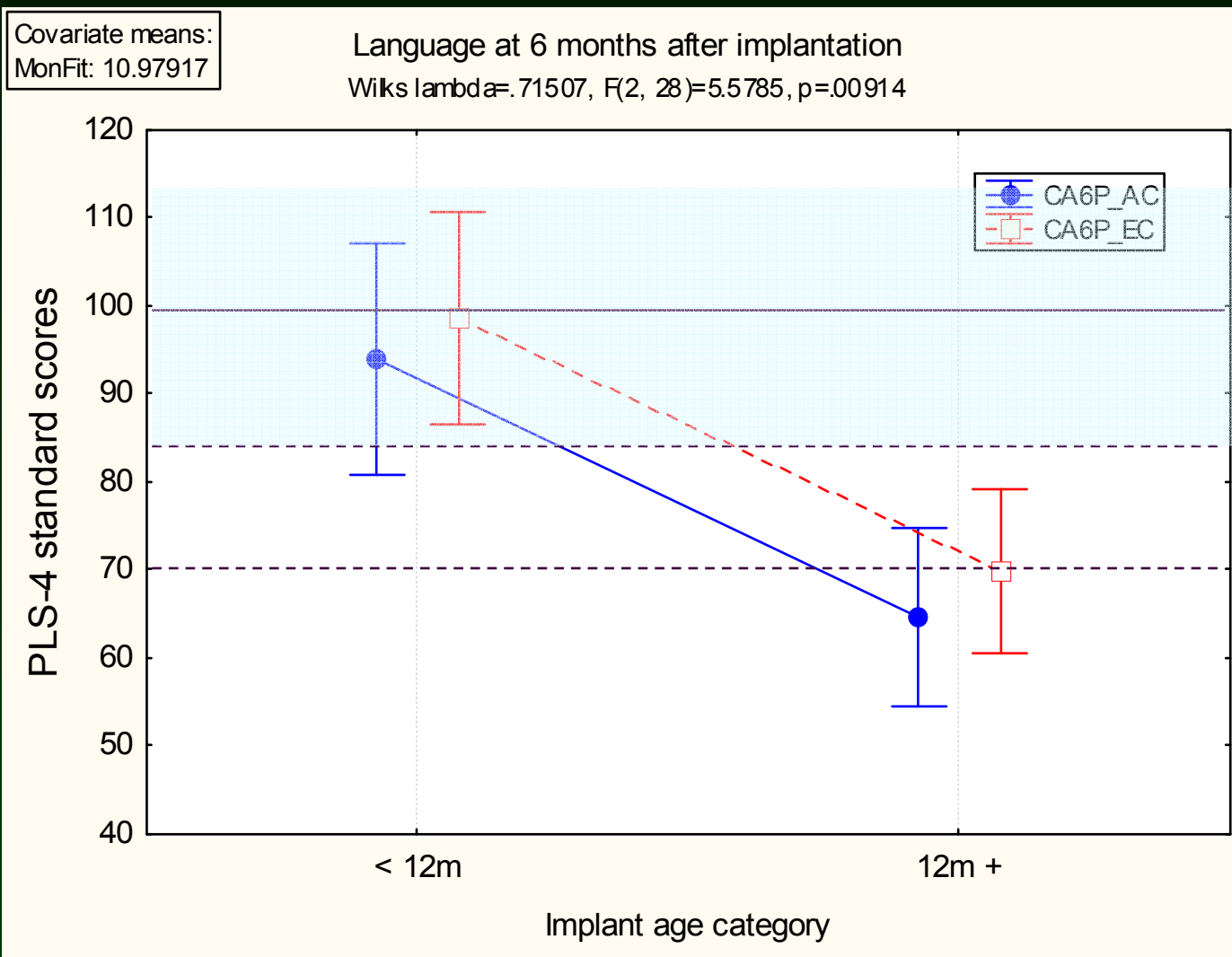


# At 6 and 12 months after fitting,

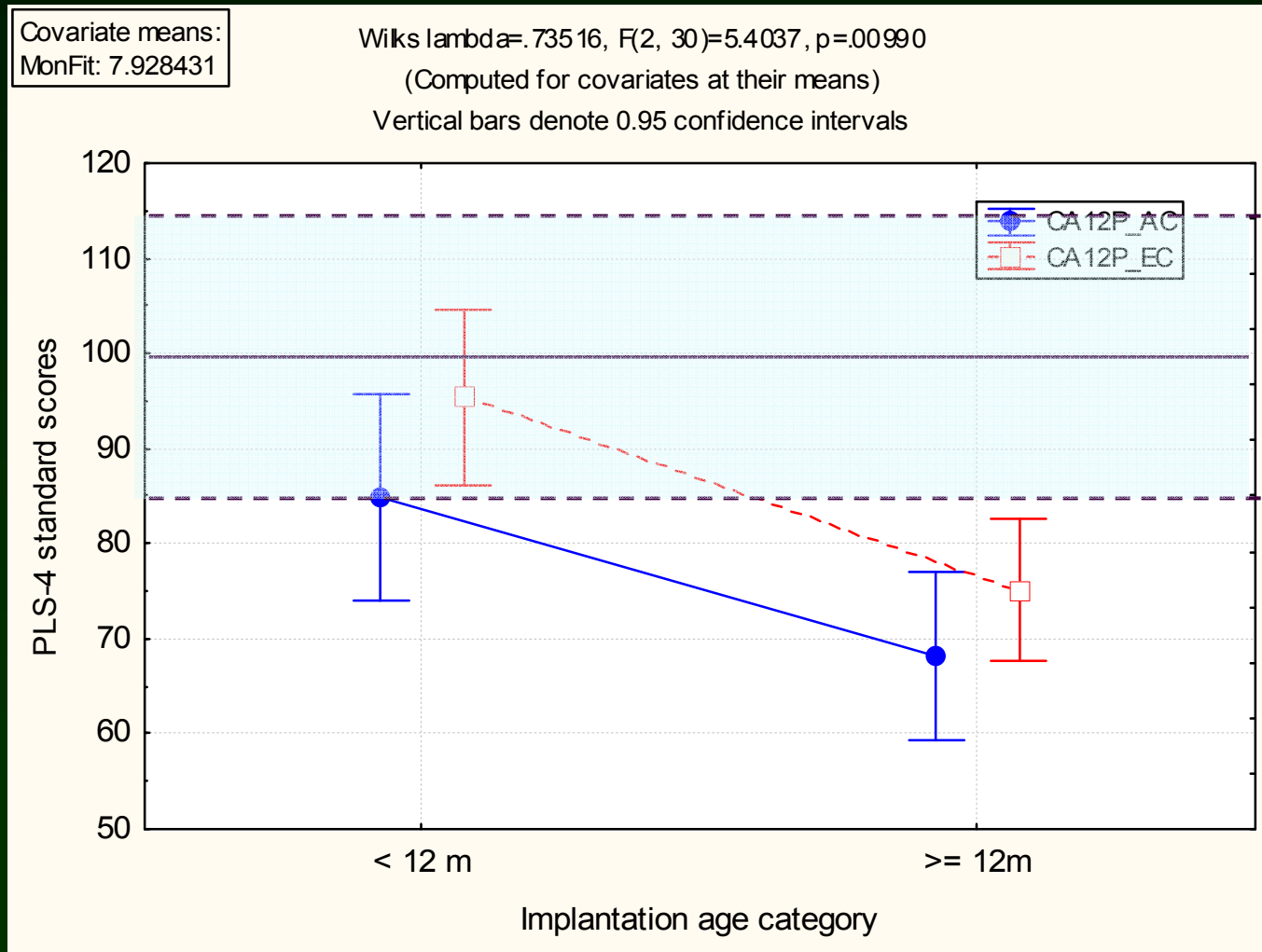




# Language ability at 6 months after implantation



# Language ability at 12 months after implantation



## Interim findings indicate:

- ◆ Children who received intervention before 6 months of age developed normal language at 6 and 12 months after fitting.
- ◆ Age of fitting and severity of hearing loss affected development.
- ◆ Growth rate of language is near-normal on average, but variability is high

## Interim findings (cont'd)

- ◆ Children who received CI prior to 12 months of age developed normal language.
- ◆ Children who received CI after 12 months of age performed at 2 SD below the mean.
- ◆ Growth rate near normal on average, but considerable variability.

# However,

- ◆ Insufficient data to perform multi-linear regression analysis to investigate the effects of multiple factors on performance in different domains.
- ◆ Therefore, the effect of age of intervention is still open to question ...

## When all data become available ...

- ◆ Investigate the effect of multiple factors on performance;
- ◆ Investigate if normal development early in life would be maintained through school-age;
- ◆ Examine the impact of age of intervention on long-term speech, language, functional, psychosocial, educational attainment.

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- ◆ Cochlear Implant Clinic, Royal Victorian Eye & Ear Hospital
- ◆ Hear and Say Centre
- ◆ Matilda Rose Early Intervention Centre
- ◆ Royal Institute for Deaf and Blind Children
- ◆ St Gabriel's School for Hearing impaired children
- ◆ The Shepherd Centre
- ◆ Strathfield Catholic Centre for hearing impaired children
- ◆ Sydney Cochlear Implant Centre



# Outcomes of Children with Hearing Impairment



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Hi, I'm LOCHI the lion from the Longitudinal Outcomes of Children with Hearing Impairment study. This study is conducted by the

## National Acoustic Laboratories (NAL)

to examine the long-term speech, language, psychosocial and educational outcomes of children with hearing impairment. Children who wear hearing aids and/or cochlear implants are included.



To review information on outcomes study:

[www.outcomes.nal.gov.au](http://www.outcomes.nal.gov.au)

[www.nal.gov.au](http://www.nal.gov.au)

For more information:

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