Neurodevelopment in children after preterm birth: How parents can help

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SUB CRUCE LUMEN

Neuromotor Plasticity & Development

How do early life factors influence:

- Development of brain areas controlling motor and cognitive function?
- The risk of developing neurodegenerative disorders in later life?

Can we develop interventions that utilise the brain's ability to "rewire" itself to:

- Make the under-developed brain catch up?
- Rehabilitate the older brain damaged by neurodegenerative disorders?

Preterm birth in Australia

- 294,737 live births in 2008
- 24,372 (8.2%) born preterm i.e. < 37 completed weeks of gestation
  - Late preterm (32 – 36 wks GA) = 19,335 infants (6.5% of all births)
  - Very preterm (28 – 31 wks GA) = 4,404 infants (1.5% of all births)
  - Extremely preterm (<20 – 27 wks GA) = 1,340 infants (0.4% of all births)

6 reasons we should worry about late preterm infants

1. Numbers increasing : older mothers, ART, labour induction.
2. Higher rates of newborn illness and postnatal re-hospitalisations than term babies.
3. Poorer neurodevelopment evident at 12-18 months (Romeo *et al*., 2010).
4. Increasing evidence of co-existing motor and cognitive dysfunction when children start school.
5. Greater participation in special education programs (Chyi *et al*., 2008).
6. Associated with lower net income and reduced likelihood of completing a university education, even without evidence of disability (Lindstrom *et al*., 2007).

The majority of these children have no obvious brain lesion, so what is causing their neurodevelopmental problems?

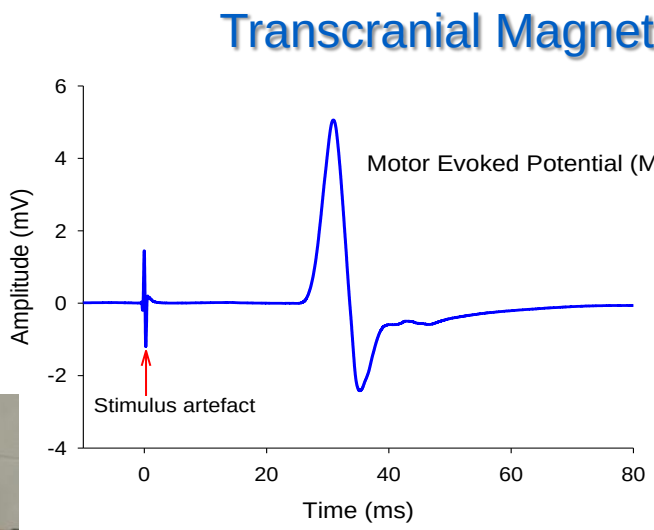
The PREMOCODE Study

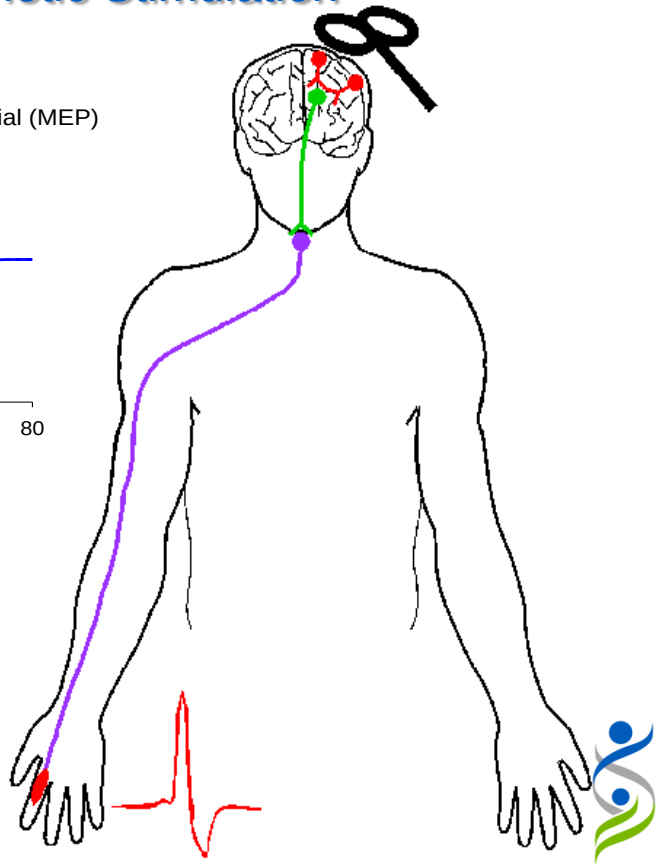
PREMOCODE = PREterm MOtor and COgnitive Development

- 200 children born at Women's and Children's Hospital (11.5 years ± 6.4 months)
- 24 – 41 weeks GA
- Neurophysiological development of motor cortex area of brain
- Age-appropriate motor skill development
- Comprehensive assessment of cognitive abilities
- Neonatal medical history, socioeconomic factors, parental education/occupation

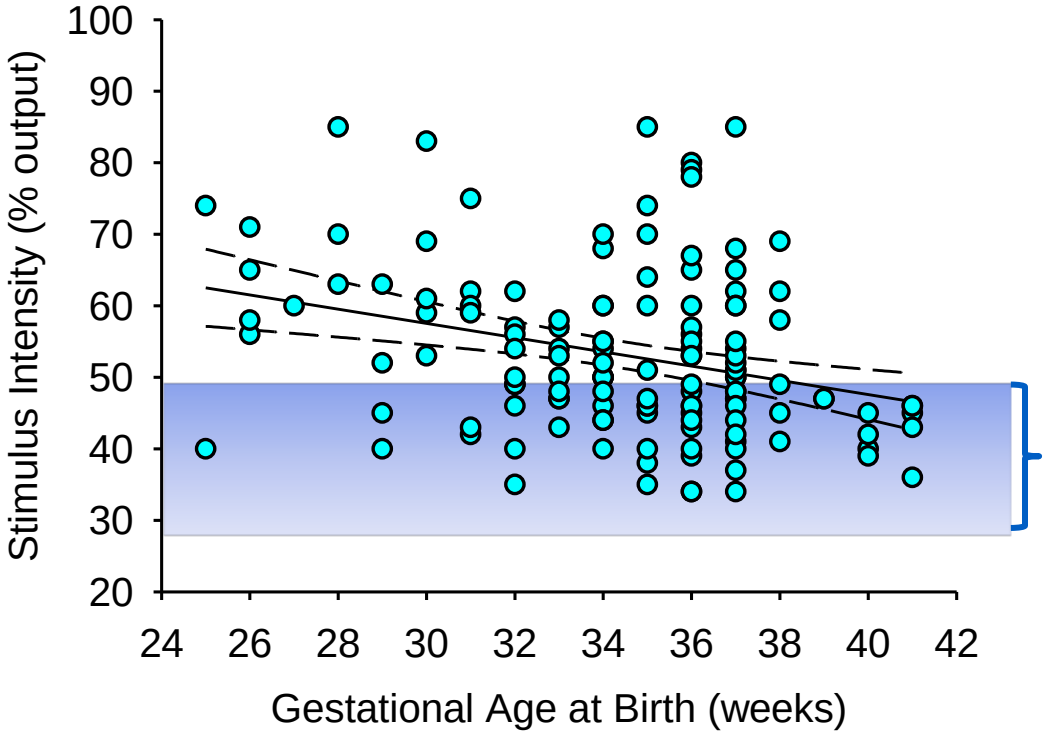
Development of the motor cortex

- Motor cortex is main brain centre for controlling movement
- Motor threshold (rMT) = Lowest stimulation intensity needed to evoke a response in the muscle (MEP)
- Gradually decreases during childhood – adult values at around 11-13 years
- Low threshold correlated with greater regional white matter integrity (maturation, myelination, axon diameter & density) (Klöppel *et al.* 2008).



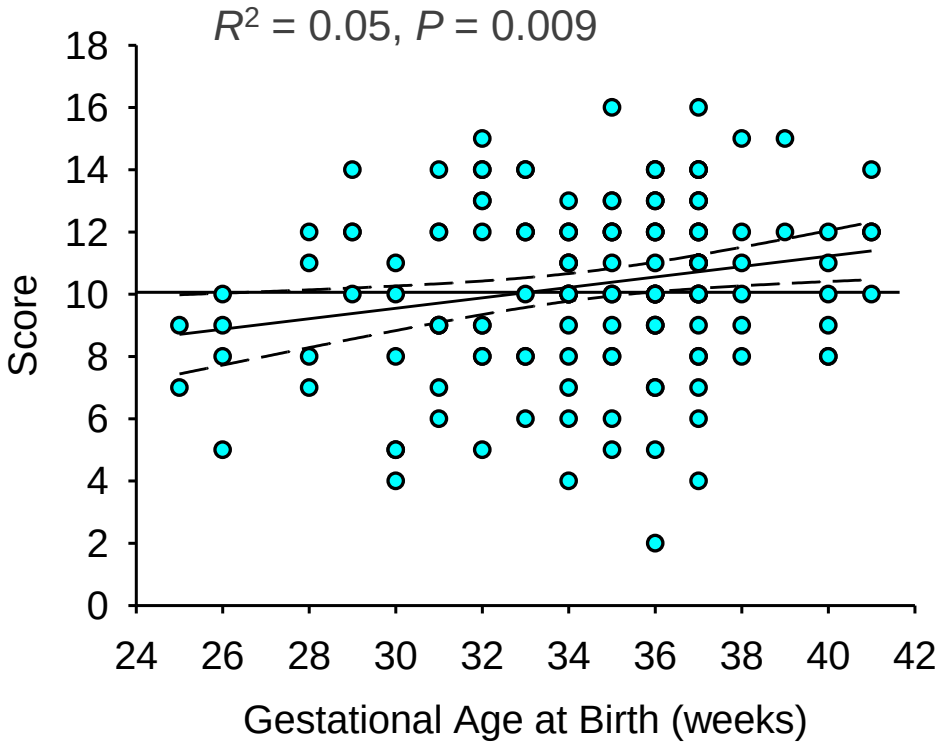


Every week of gestation is important for cortical development



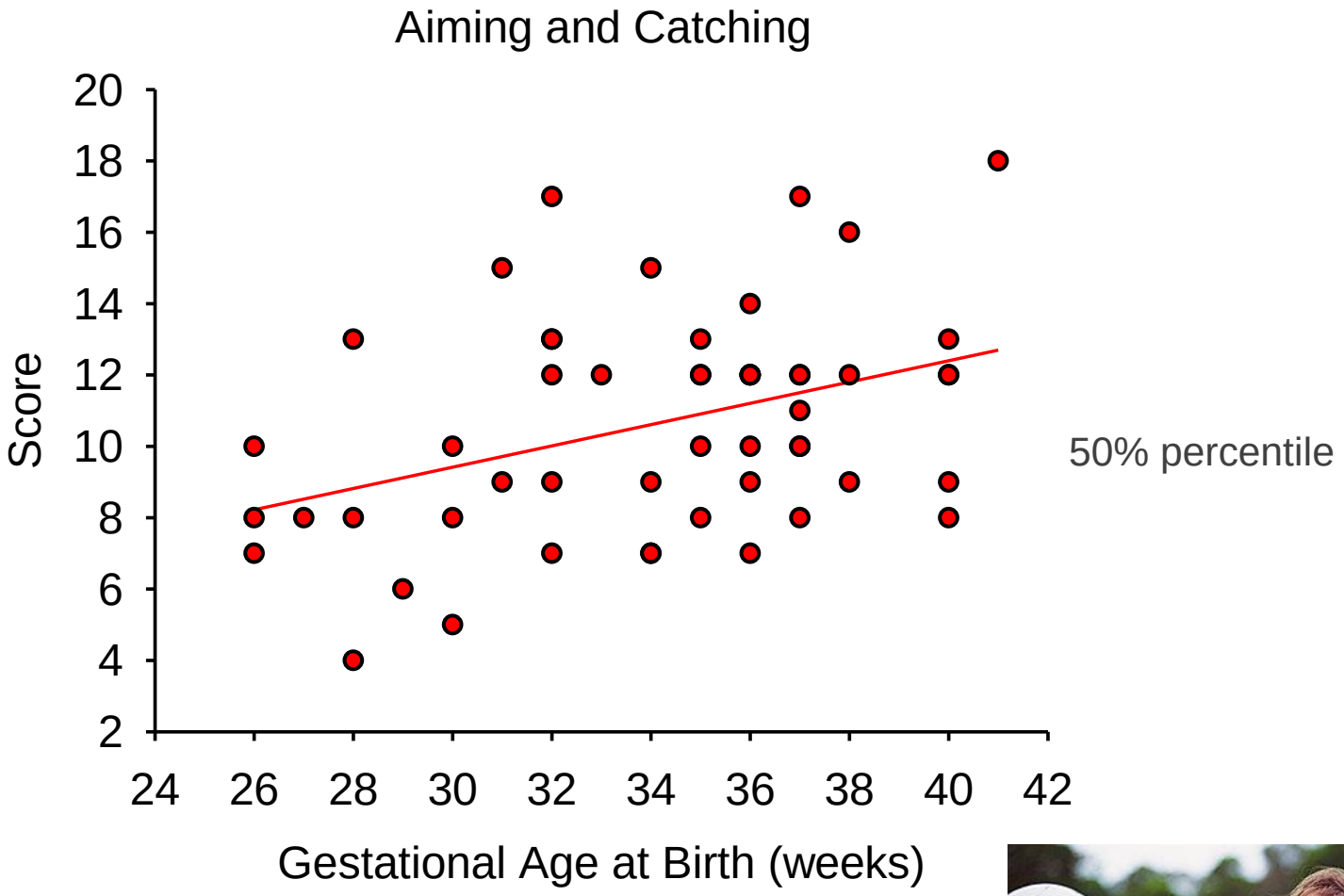
- For every week of gestation lost, motor cortex needs an increasingly stronger stimulus to respond.
- May be due to fewer neurons, less white matter development, reduced axon size
- Underestimates effect – only those children in whom a response could be evoked.

Motor skills development

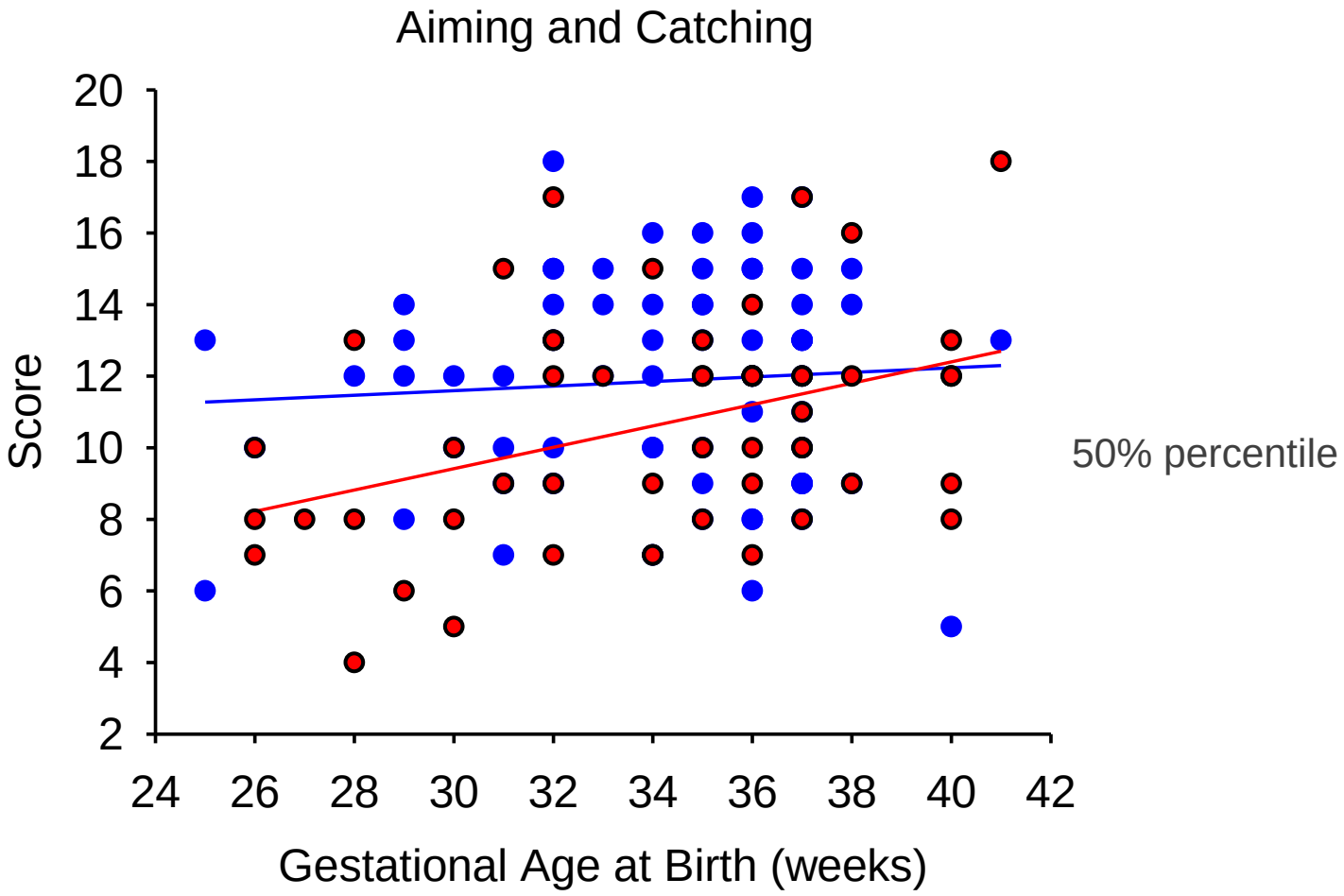


- Movement ABC assessment: manual dexterity + aiming & catching + balance = total MABC score
- Significant association between GA and score but explains exceedingly small amount of variance
- Best skills development predicted by the child having good motor cortex excitability, a lower body fat%, and having a father with an managerial/professional occupation (at birth).
- Suggest the post-natal environment may be more important than preterm birth *per se.*

Preterm girls have poorer aiming and catching skills

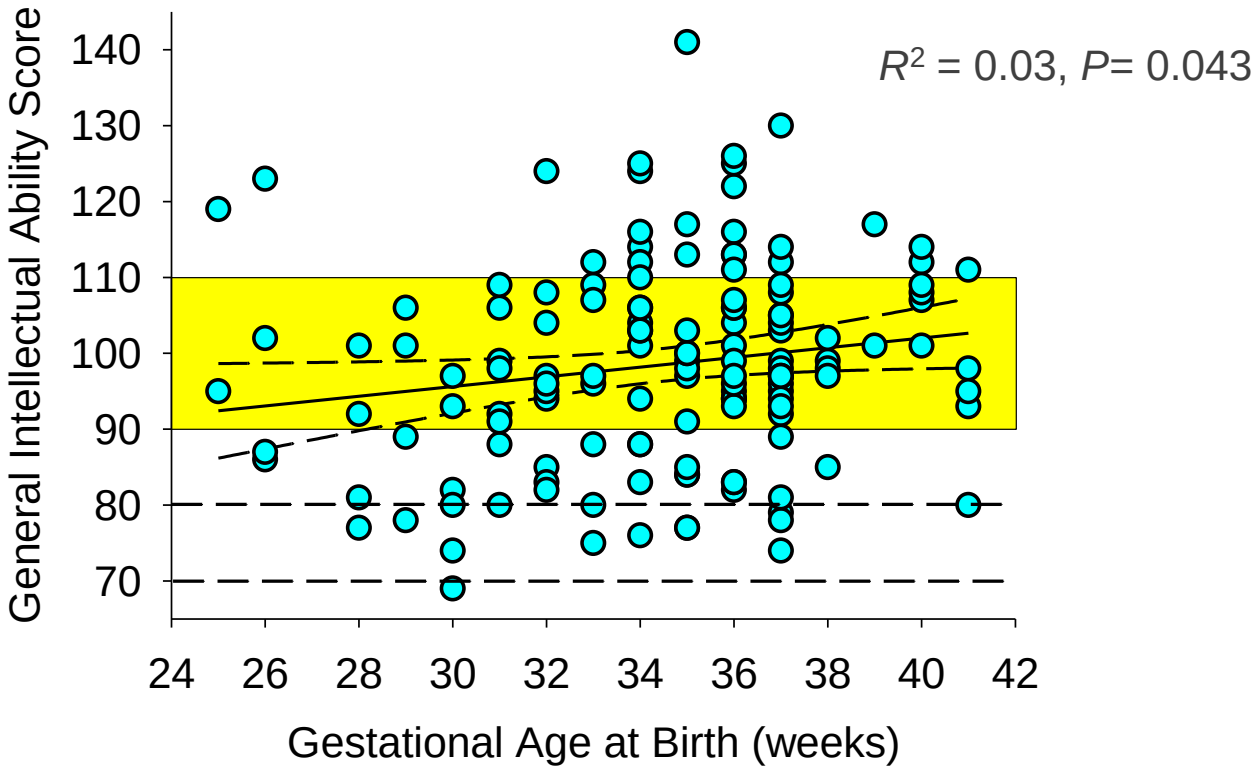


...but this is not evident in boys.



- No association between preterm birth and throwing/catching skills in boys
- Mean score for boys is above 50% percentile regardless of GA
- Boys more likely to regularly engage in activities that develop ball skills

Preterm birth alone is not a good predictor of cognitive ability



- GIA = overall intellectual processing, memory and speed and is predictor of academic success
- Preterm birth alone only associated with poorer auditory working memory (remembering words and numbers while re-ordering sequence)
- Highest GIAs in children with high birthweight centiles, good motor cortex development and good motor skills development

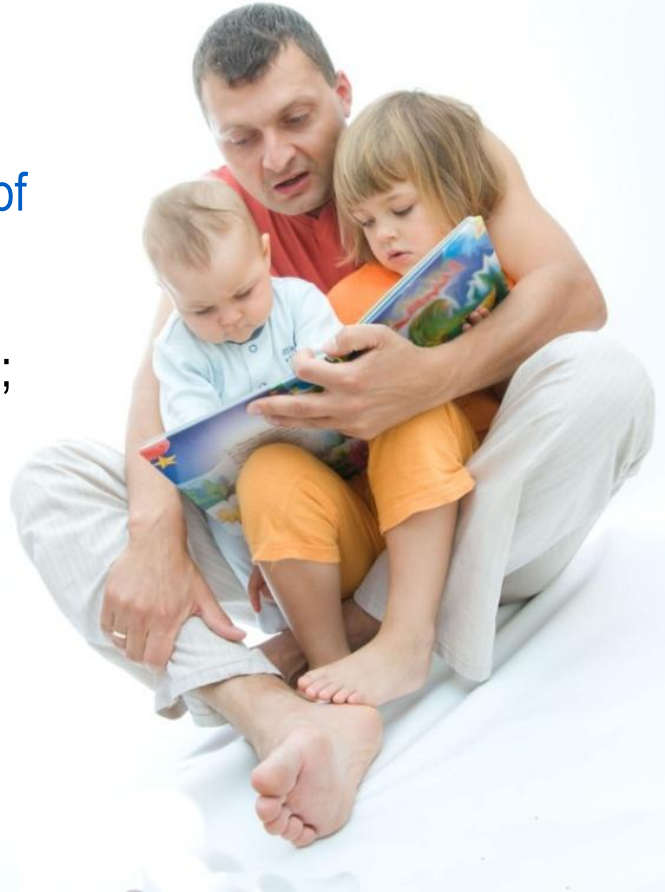
Key messages

- Every week of gestation is important in optimising brain development
- Being born preterm *confers an increased risk* of sub-optimal motor and cognitive development during childhood
- Strong association between motor and cognitive outcomes

BUT

Key messages

- The nature and quality of the post-natal environment has a large influence on how that risk manifests
- Parallels between motor and cognitive development likely due to functional overlap
- Parents play a key role:
  - children encouraged to regularly practice broad range of motor skills also have better cognitive development
- Service provision – early identification and early intervention; appropriate parental education and support
- Re-channel services into proactive rather than reactive strategies



The PREMOCODE Team

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Collaborators:

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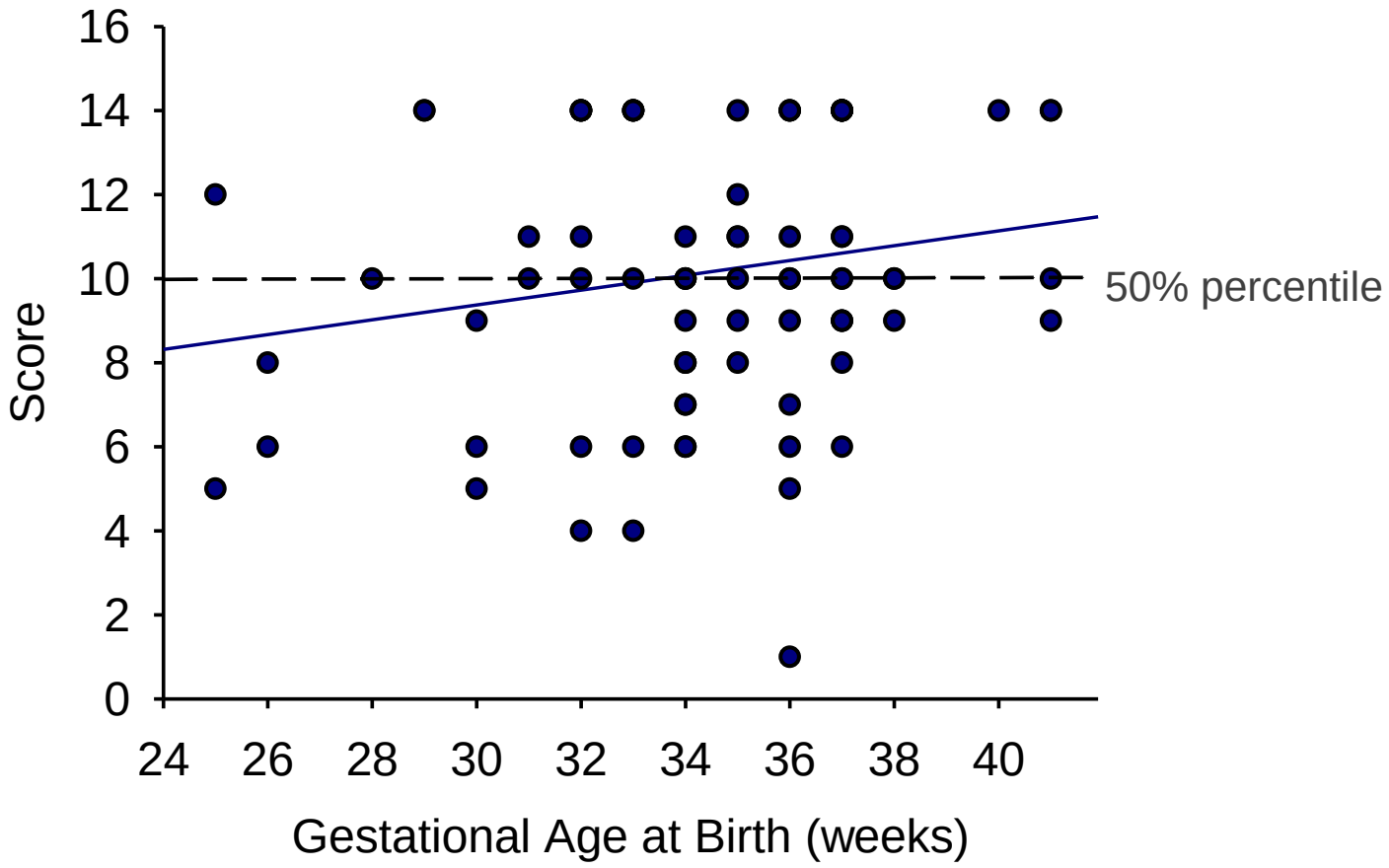
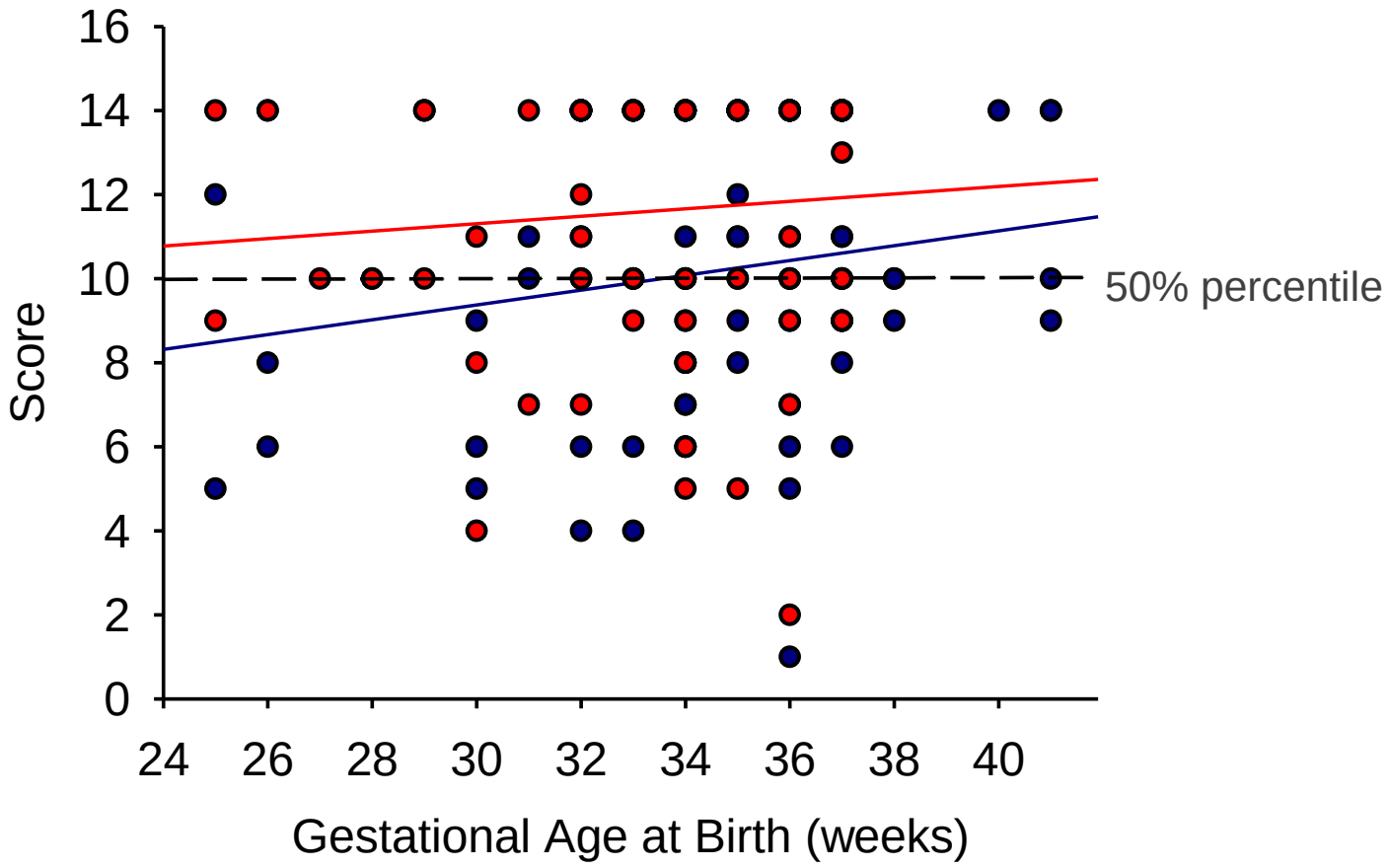
Preterm boys have poor balance skills

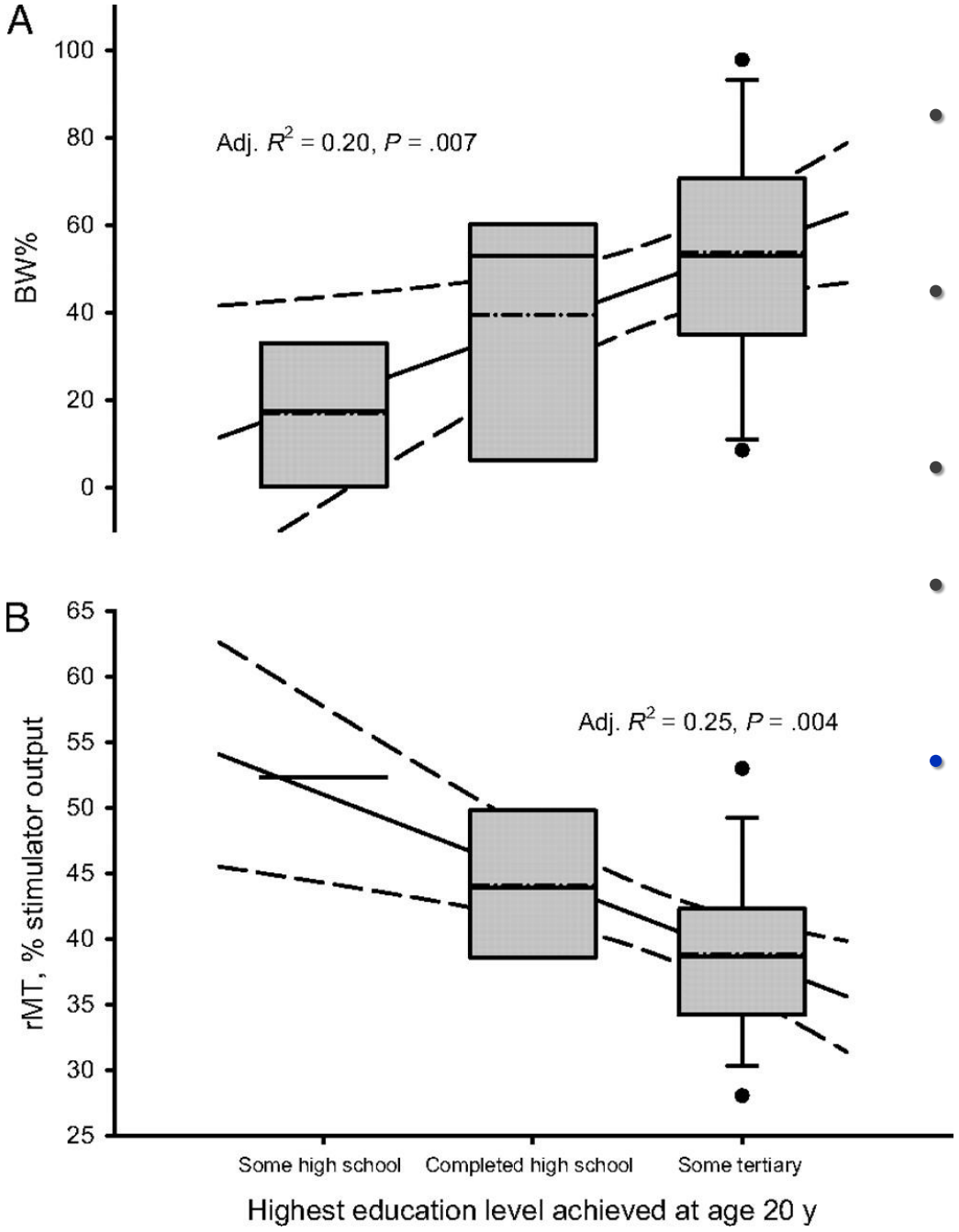


- Association with GA significant but weak
- Worst scores in boys with poor motor cortex development whose current home was socially-disadvantaged (SEIFA scores)

...this is not evident in girls



- No association between GA and balance skills in girls
- Mean score for girls above the 50th percentile
- Worst scores were in girls with high body fat



- 28 year olds followed since birth for longitudinal cardiovascular disease study
- All born ≥37 weeks gestation (i.e. Not preterm)
- Range of BW% (2 – 100%)
- Socioeconomic & educational history (parents & subjects).
- Poor fetal growth & reduced motor cortex excitability (rMT) associated with poorer educational achievement at age 20 years.

From Pitcher et al. *Pediatrics* 2009

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