UNIVERSITY OF LEICESTER

Improving educational outcomes for children born preterm: A new approach to intervention

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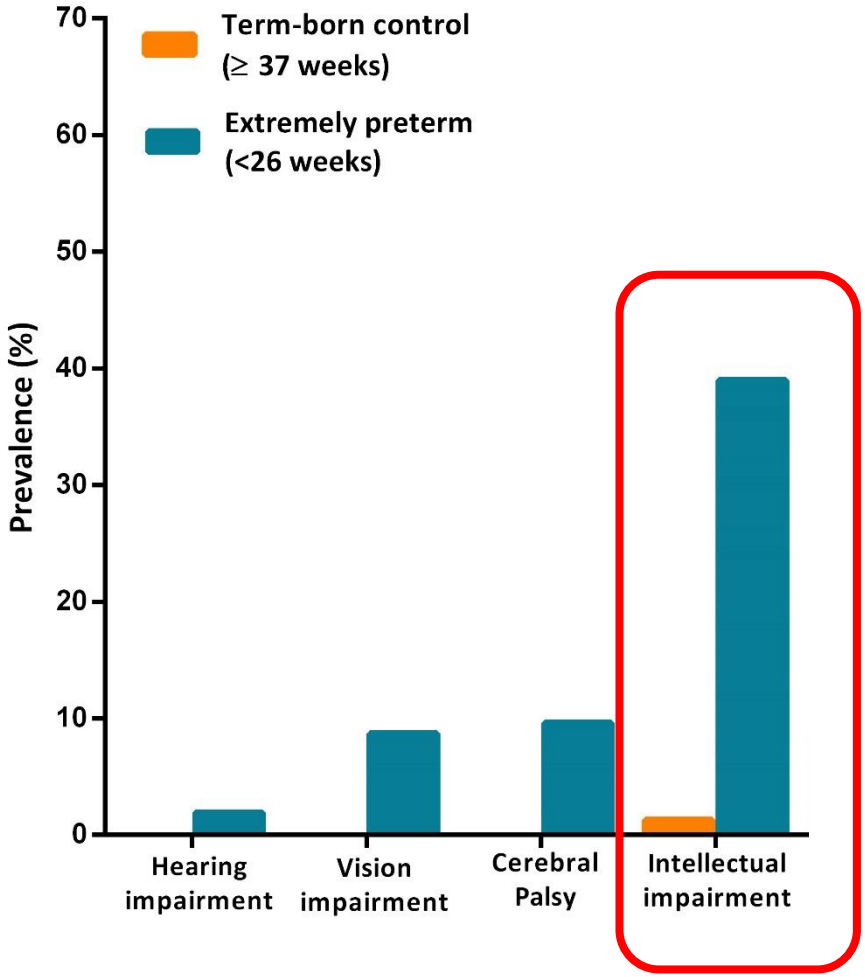
Overview

- The preterm phenotype
- Impact on educational outcomes
- How can we improve outcomes at school?
- Towards a new approach . . .

Neurodevelopmental outcomes



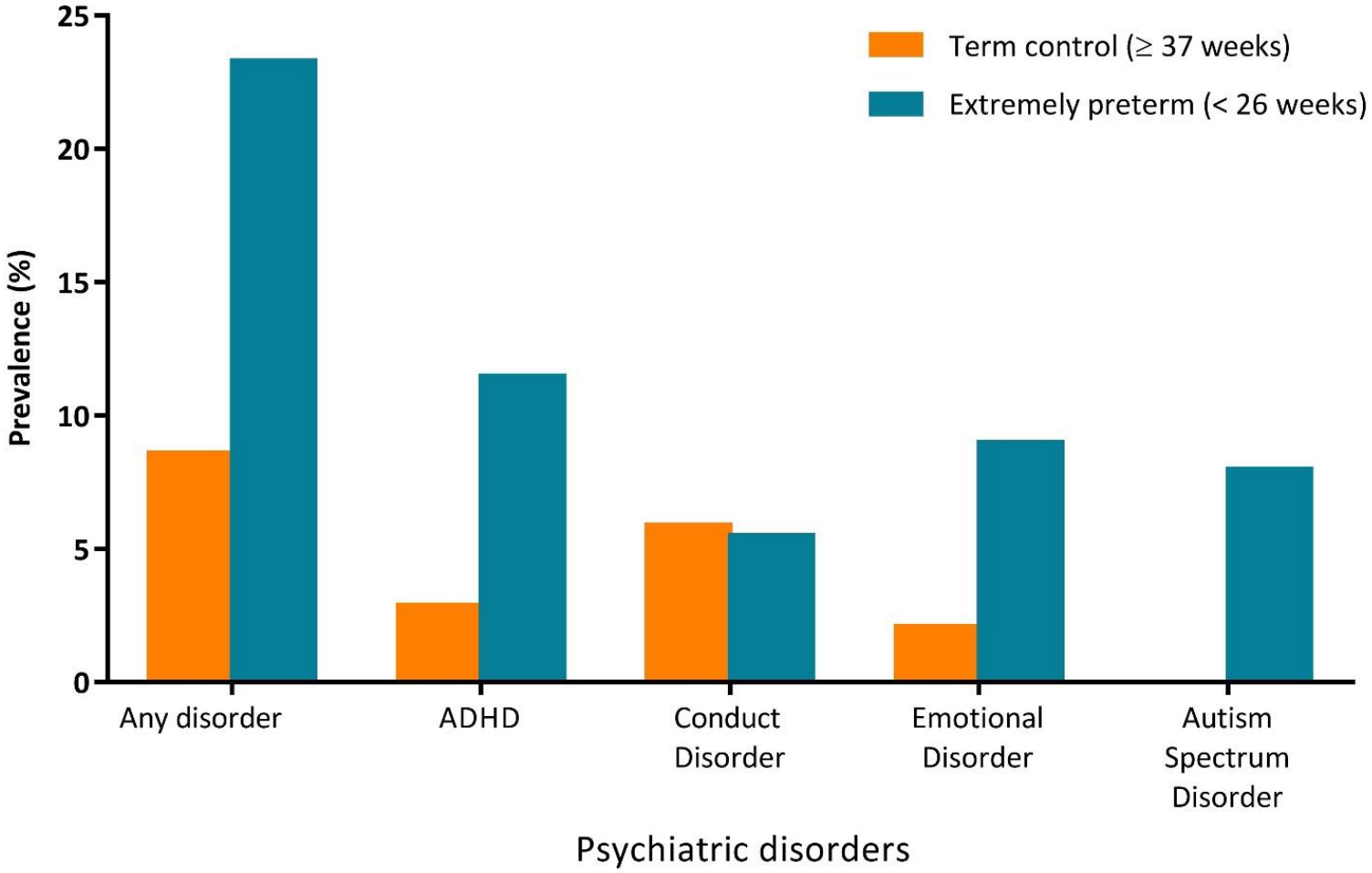
Cognitive difficulties:

- Difficulties problem solving
- Poor simultaneous processing
- Poor working memory
- Poor visuospatial skills
- Poor fine motor skills
- Slow processing speed
- Difficulties planning & organising (executive function)

[Source: Johnson et al. *Pediatrics* 2010]

EPICure

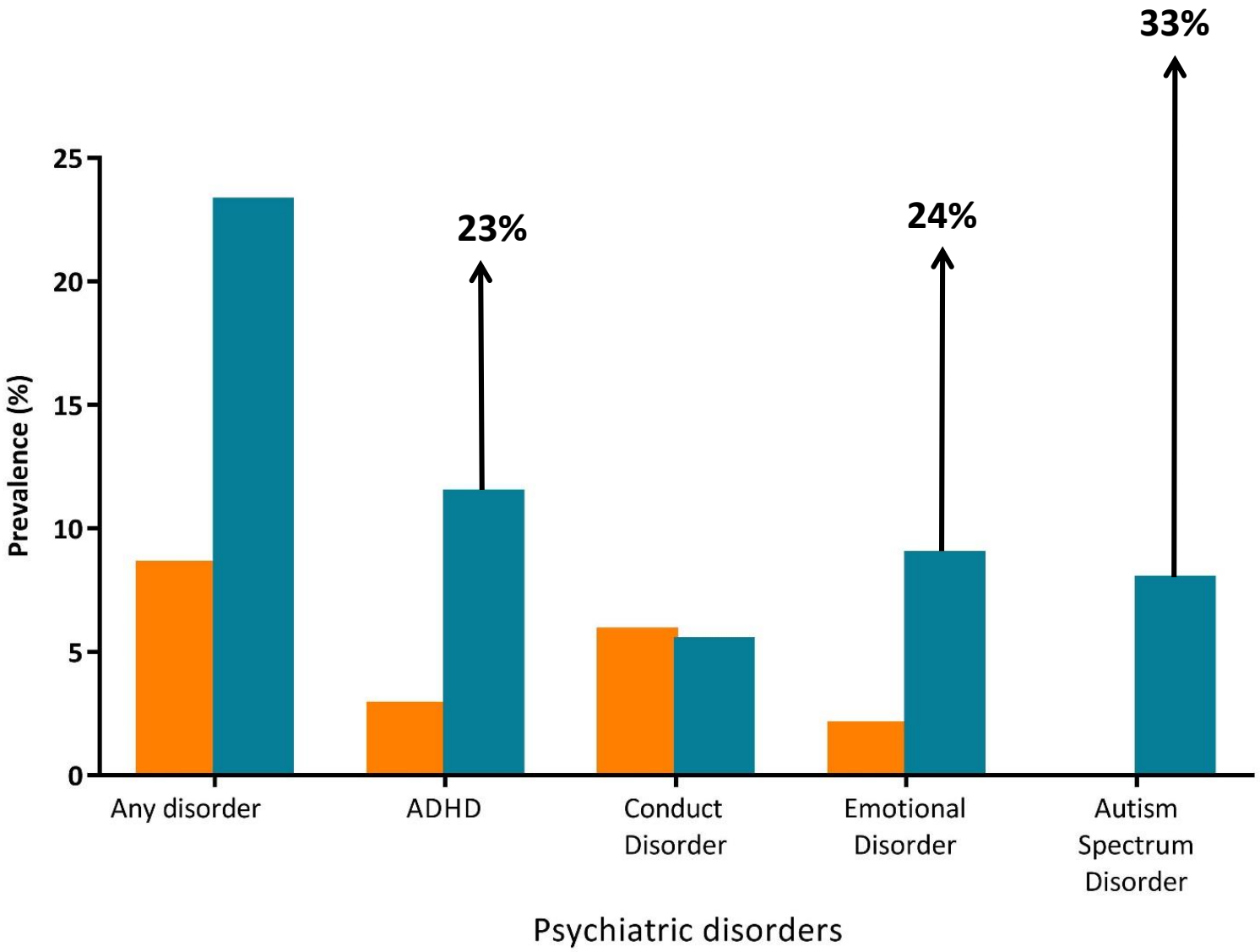
Psychiatric disorders



[Source: Johnson et al. *J Am Acad Child Adolesc Psychiatr* 2010]

EPICure

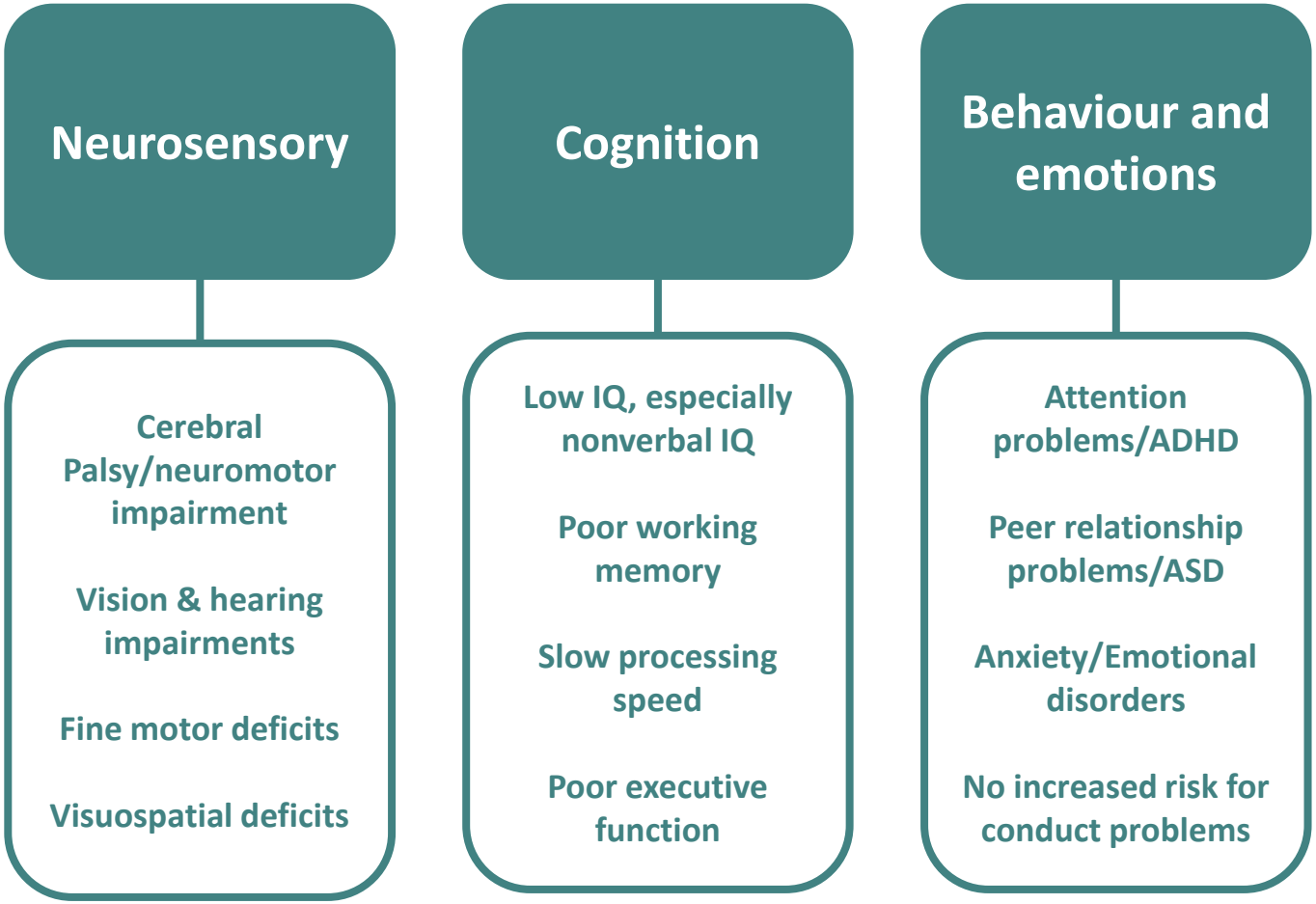
Attention, social & emotional problems



[Source: Johnson et al. *J Am Acad Child Adolesc Psychiatr* 2010]

EPICure

The preterm phenotype



Special educational needs

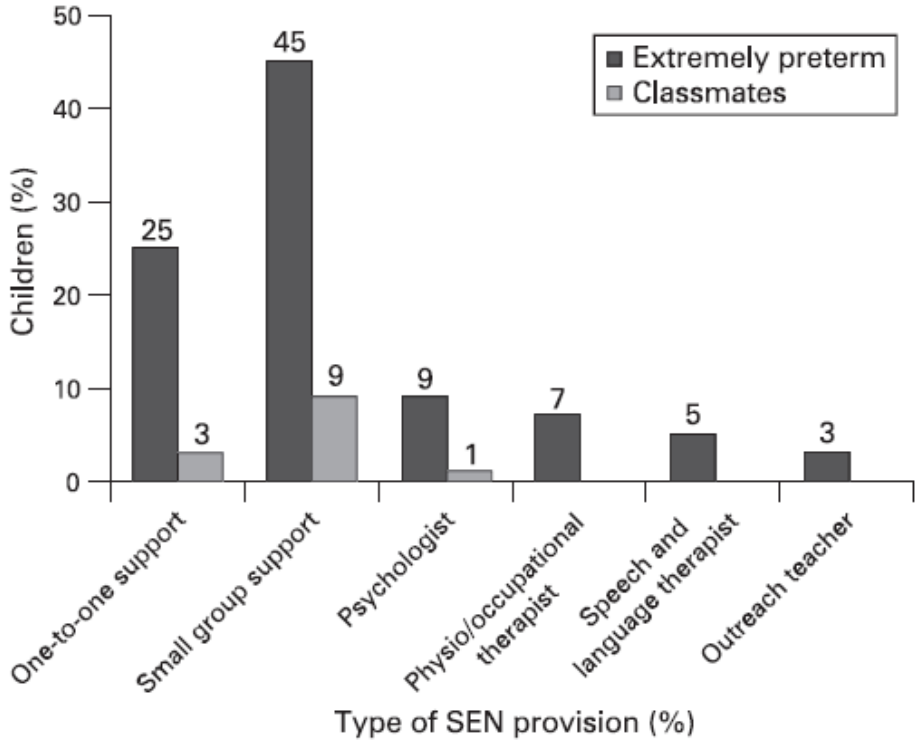
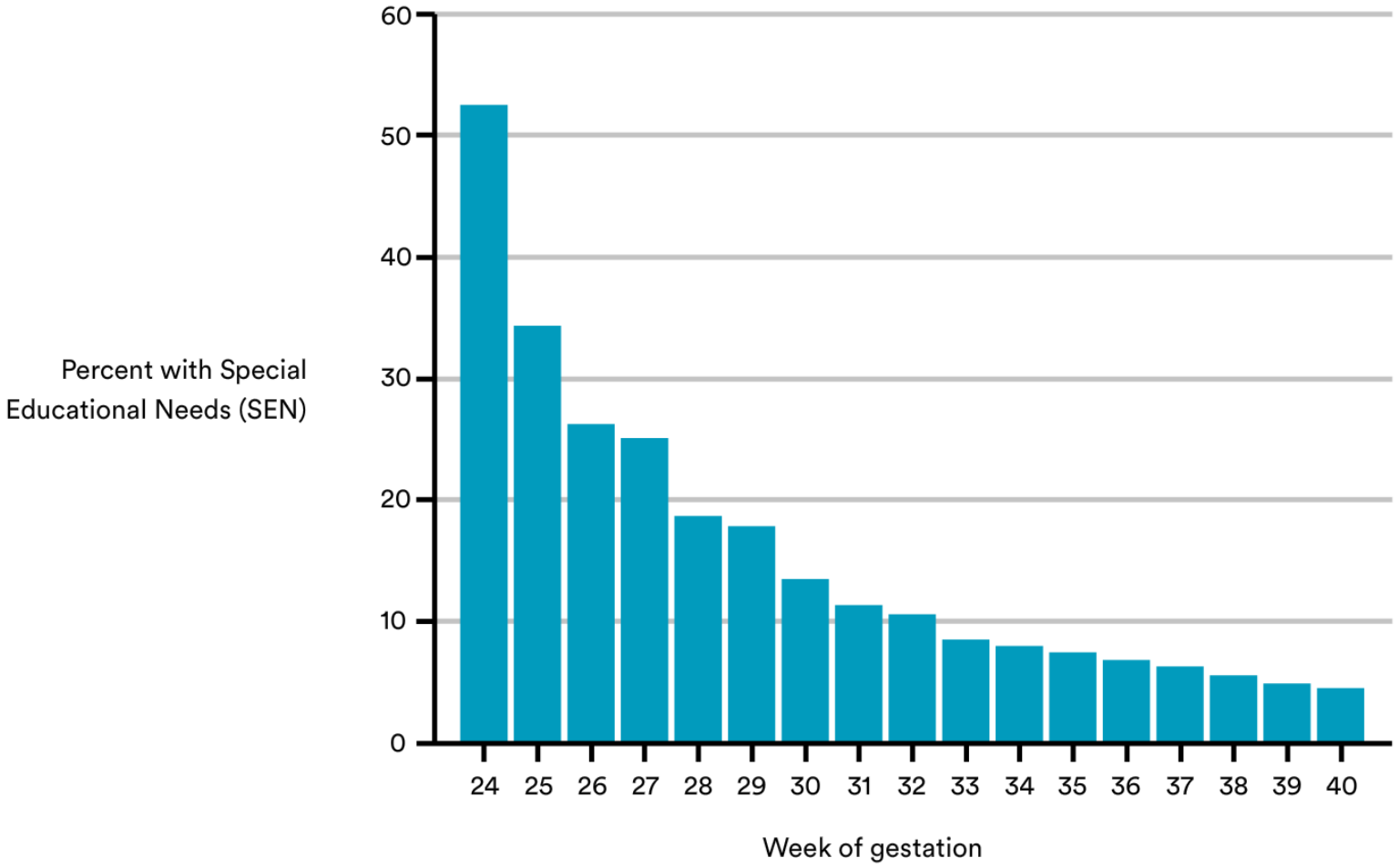


Figure 1 Type of special educational needs (SEN) resource utilised by extremely preterm children and classmates in mainstream schools at 11 years of age.

[Source: Johnson et al *Arch Dis Child Fetal Neonatal Ed* 2009]

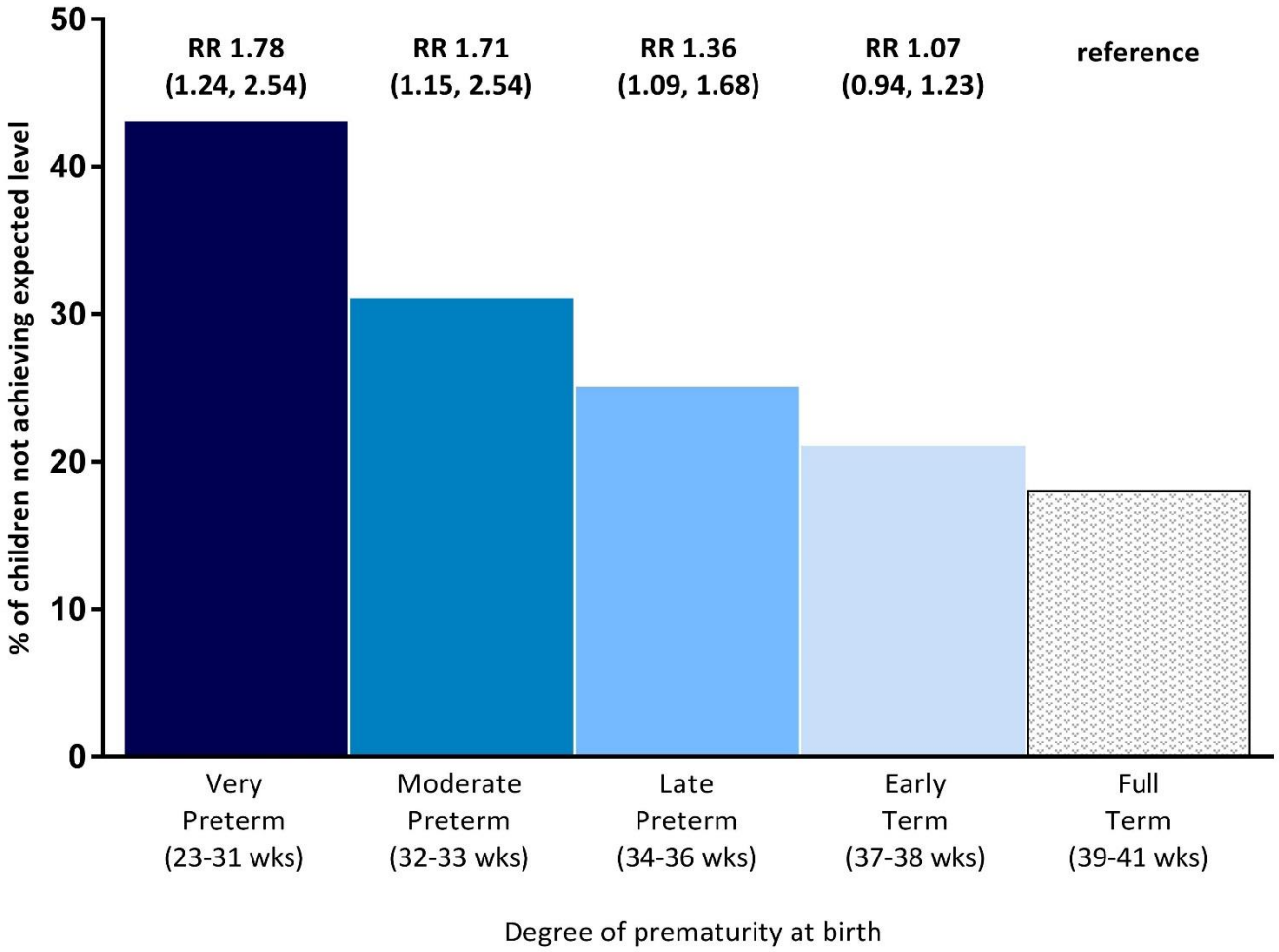
EPICure

Special educational needs



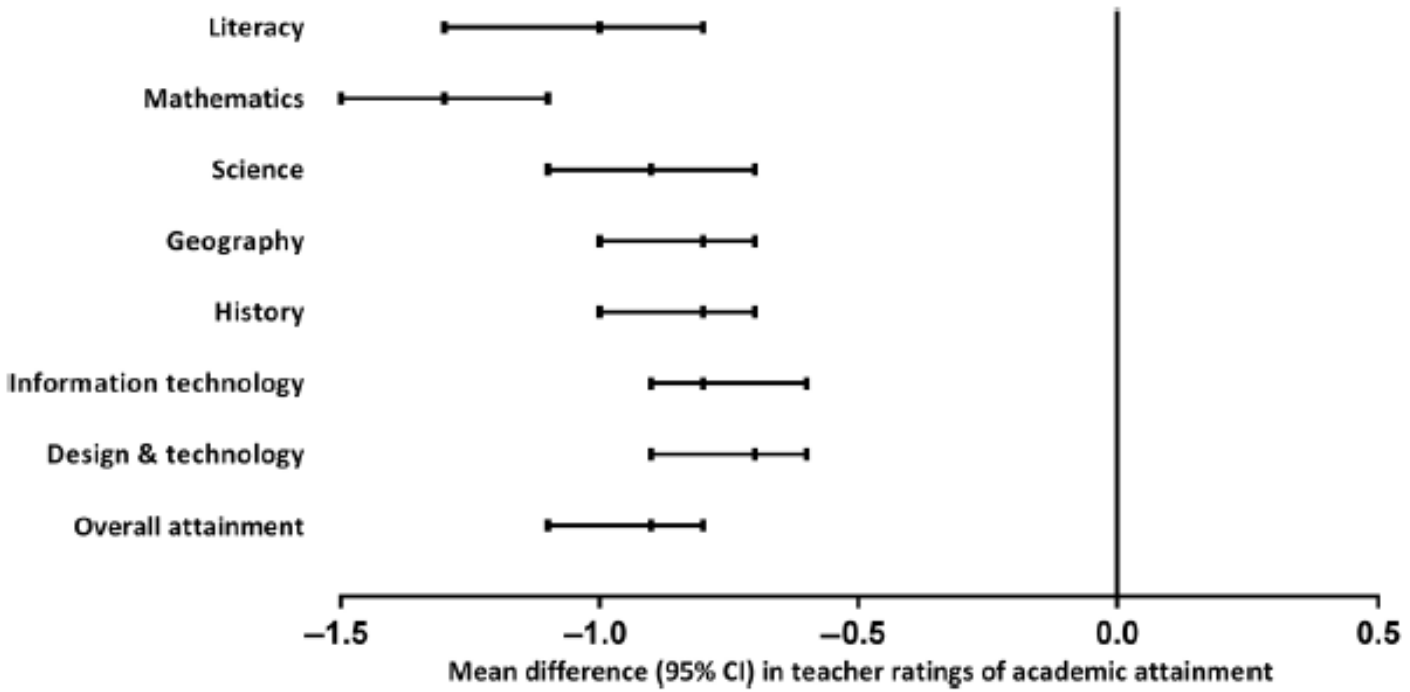
[Source: Data provided by Mackay et al *PLOS Medicine* 2010]

Academic attainment (age 7)



Risk Ratios (RR) adjusted for sex, age in school year, parity, multiple birth, mother's age, marital status & education, social class, smoking during pregnancy.

Academic attainment (age 11)

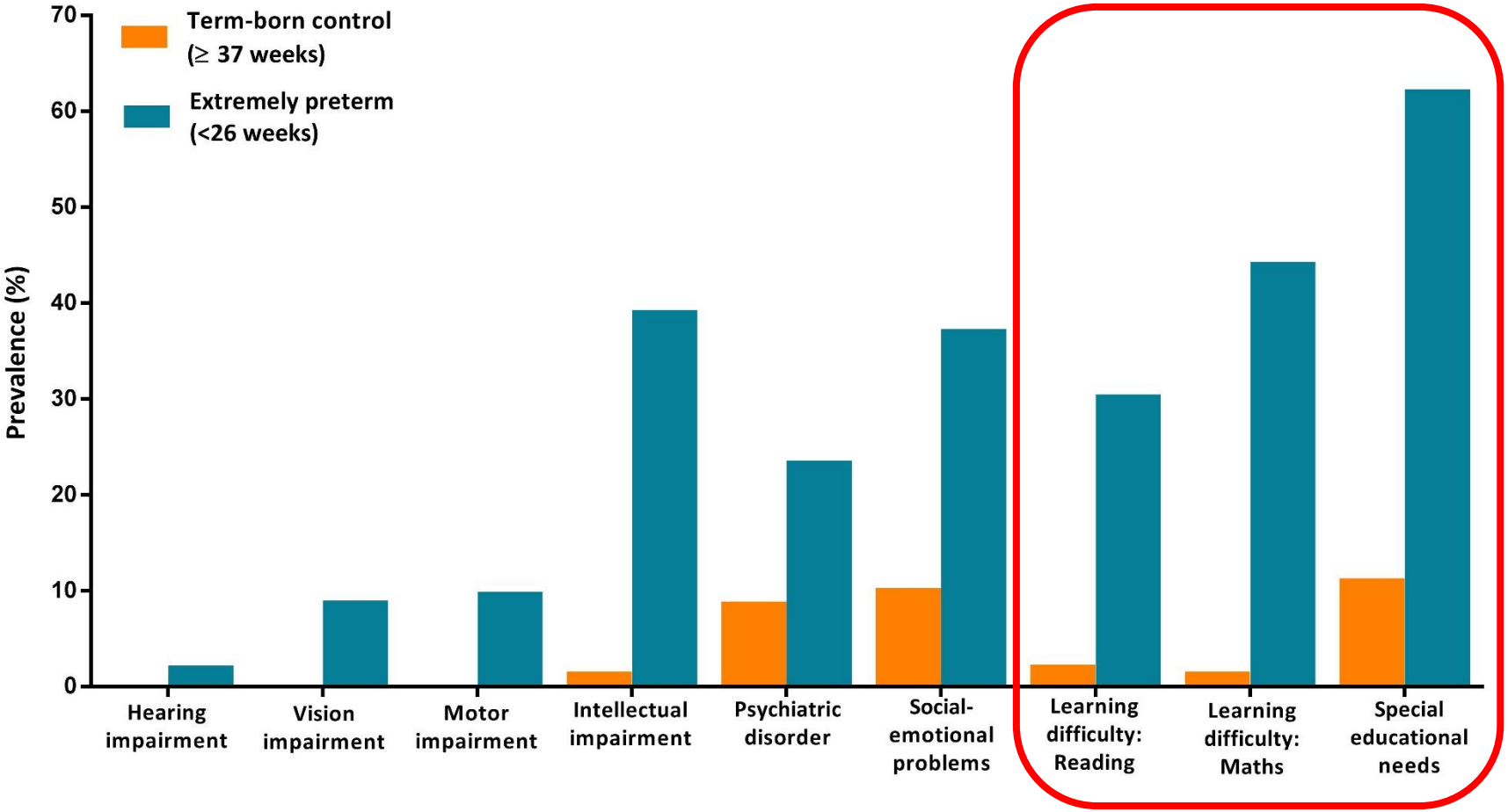


Mean difference (95% CI) in teacher ratings of academic attainment for extremely preterm children compared with term-born controls

[Source: Johnson et al *Dev Neuropsychol* 2011]

EPICure

Putting it all together



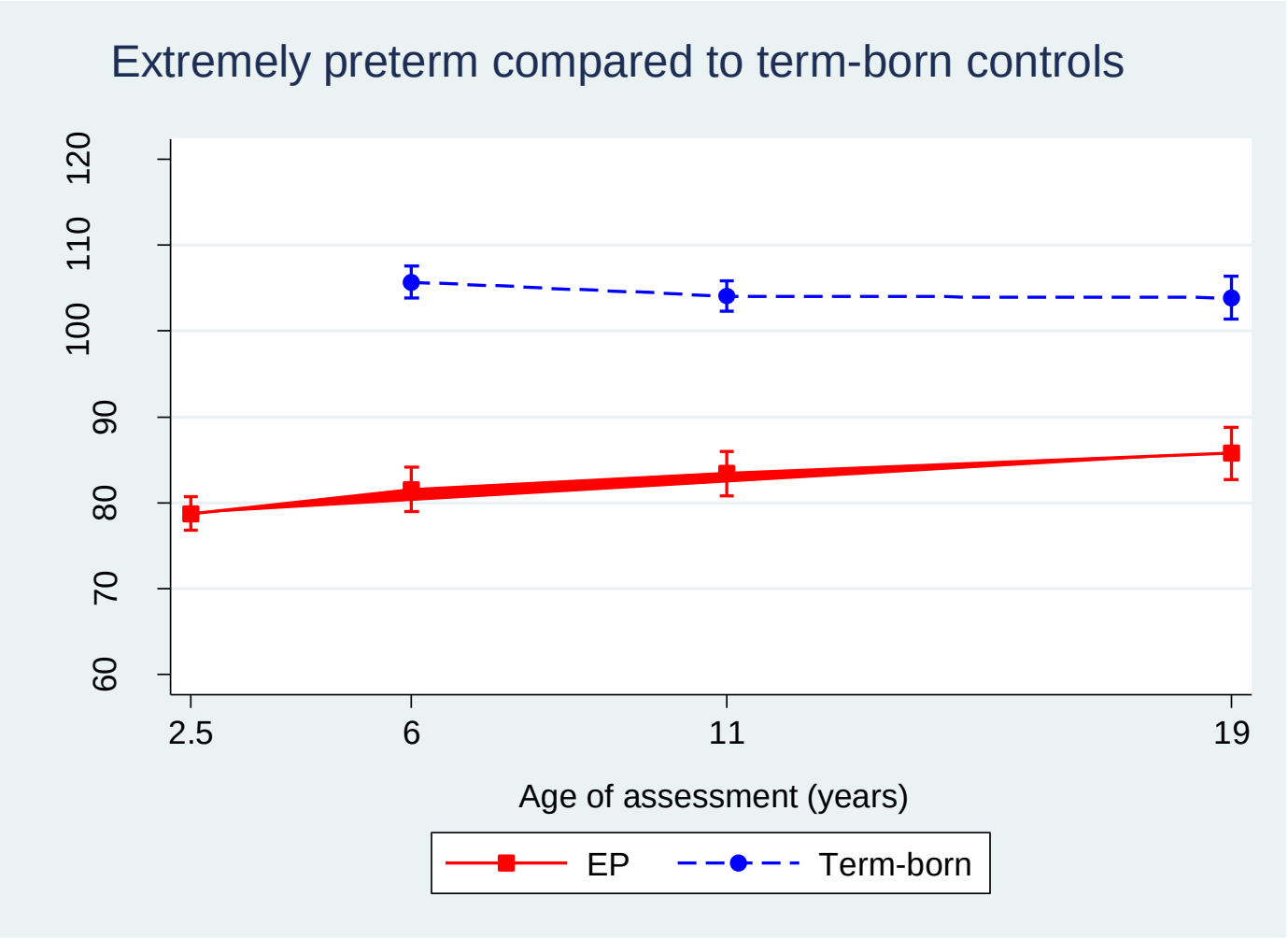
[Source: Johnson et al. *Arch Dis Child Fetal Neonatal Ed* 2009; *Pediatrics* 2009; *J Am Acad Child Adolesc Psychiatr* 2010; *J Pediatr* 2010]

EPICure

How can we improve educational outcomes for children born preterm?

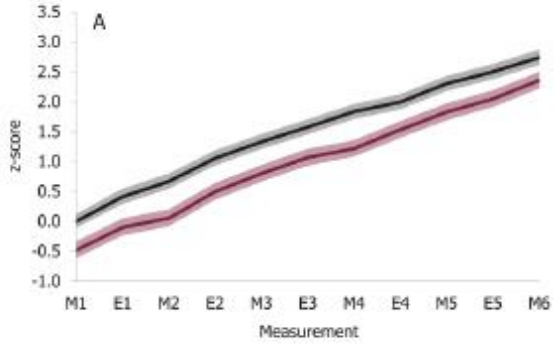

Do nothing
Improve neonatal care
Early intervention
Working memory training
?
How can we improve educational outcomes?

Do nothing?

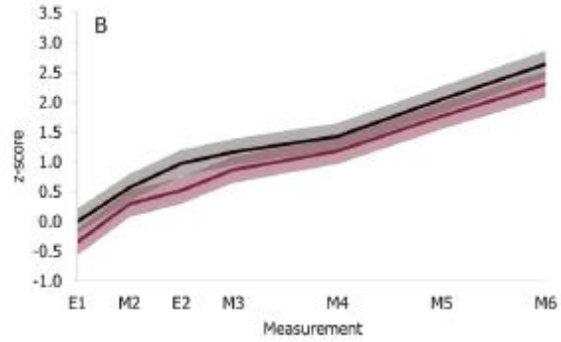


[Source: Linsell et al *Arch Dis Child* 2019]

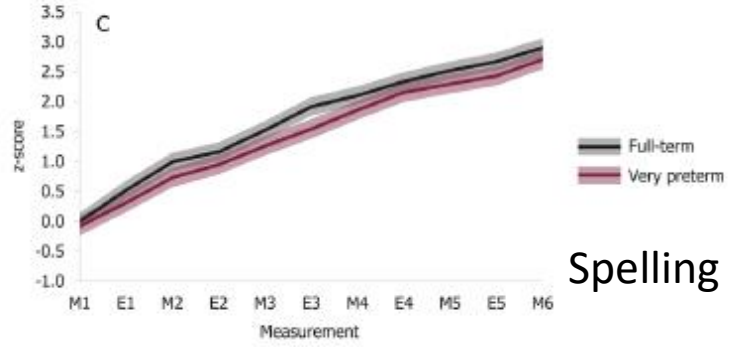
Do nothing?



Arithmetic



Reading comprehension



Spelling

[Source: Twilhaar et al., *Arch Dis Child Fetal Neonatal Ed* 2018]

Do nothing?

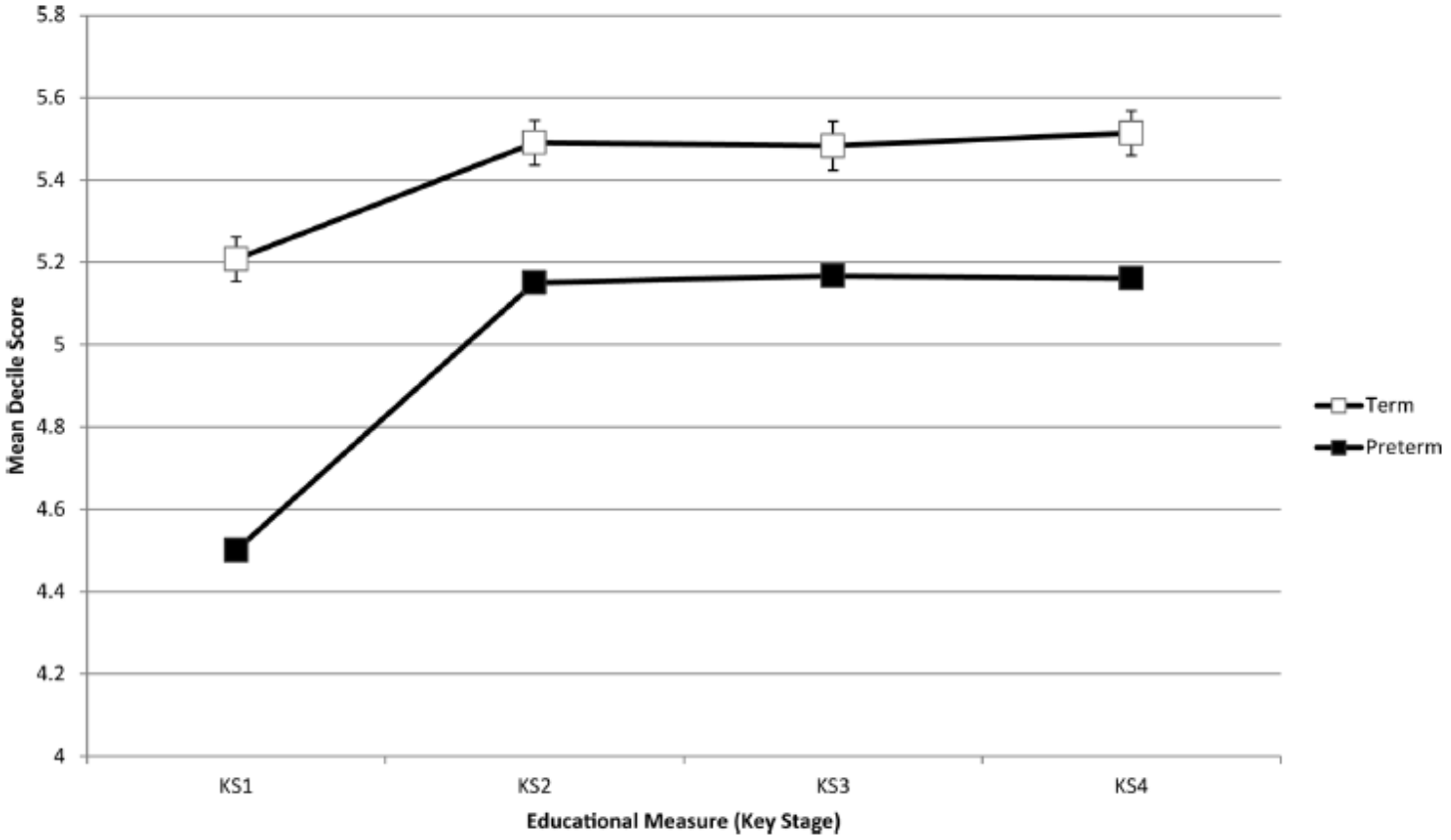


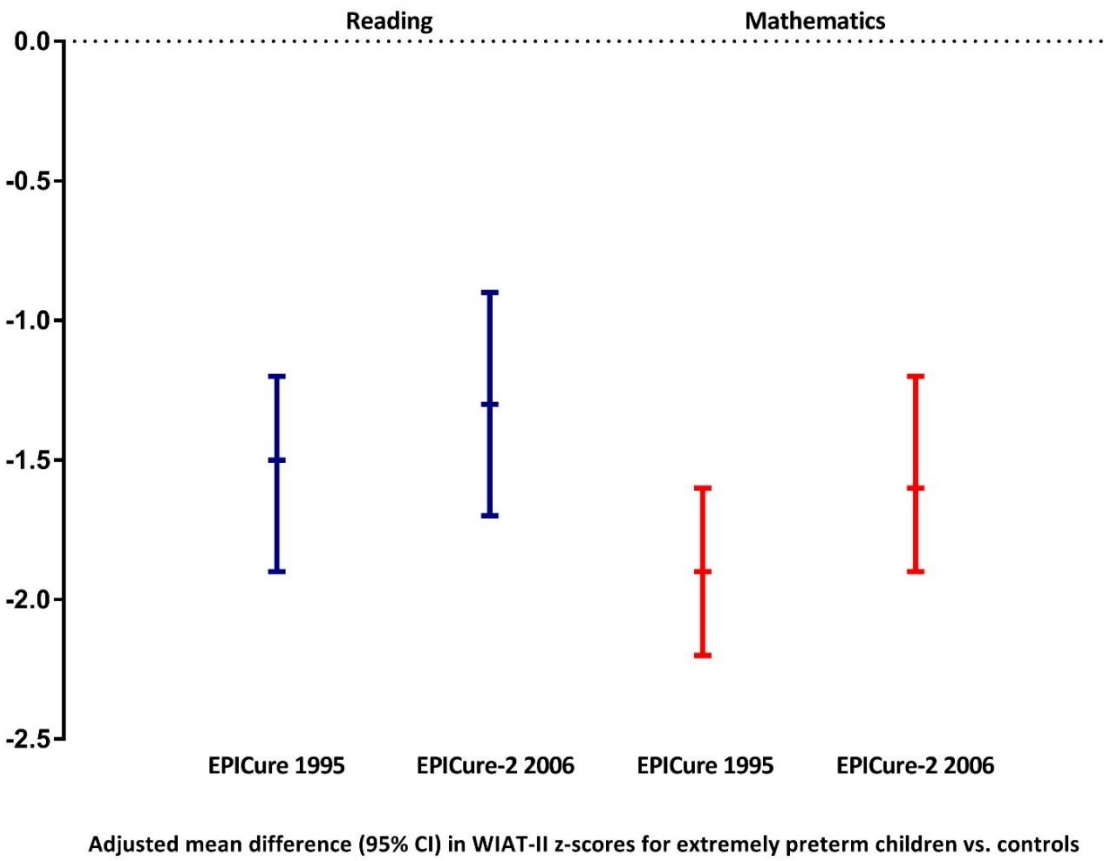
Figure 1 Summary measures of Key Stage scores at each time point, split by gestational age groups.

Odd D, *et al*. *Arch Dis Child* 2019;**104**:348–353. doi:10.1136/archdischild-2018-315441

[Source: Odd et al., *Arch Dis Child* 2019]


Do nothing
?
Improve neonatal care
How can we improve educational outcomes?
Working memory training
Early intervention

Improve neonatal care?



Mean deficit (95% CI) in z-scores in EP children vs. controls in 1995 vs. 2006
adjusted for sex, gestational age, birthweight z-score, multiple birth, maternal age & SES:
Reading: -0.2 (95% CI -0.6 to 0.3); Mathematics: -0.3 (-0.7 to 0.1)

[Source: EPICure Study *UNPUBLISHED DATA*]

EPICure

Improve neonatal care?

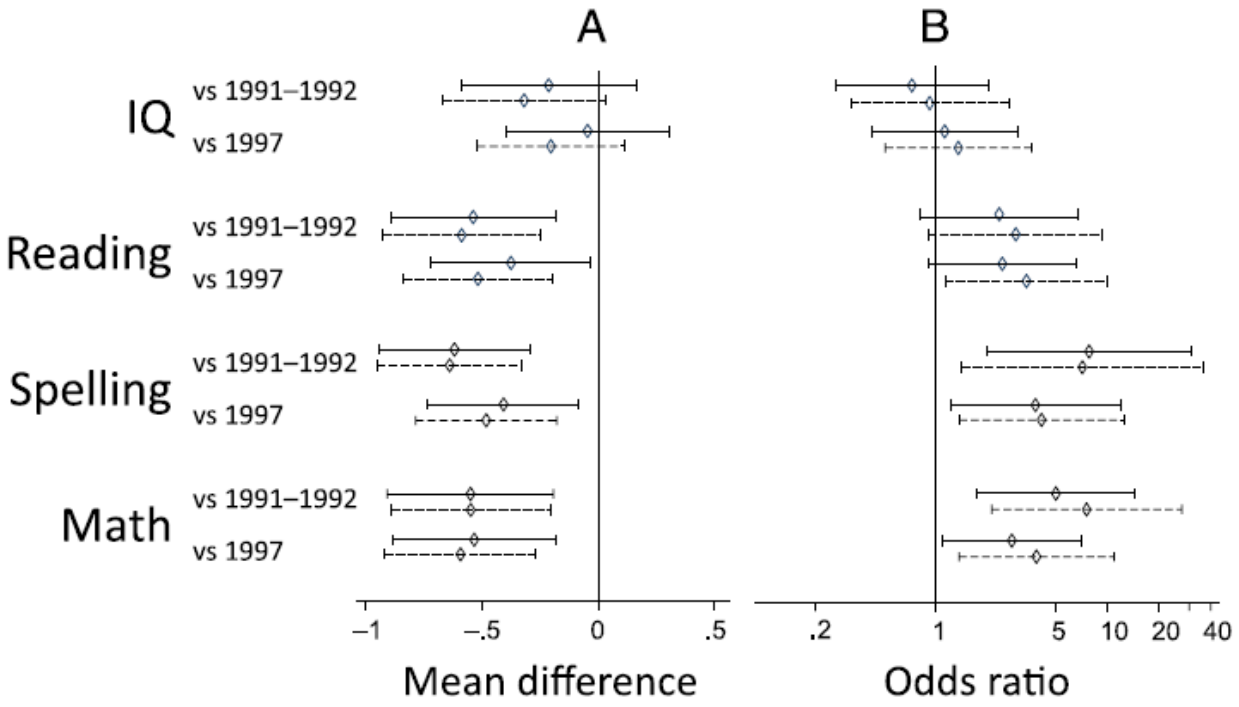


FIGURE 1

Differences on standardized cognitive and academic scores comparing 2005 cohort with both earlier eras. A, Continuous scores. B, Dichotomous scores <−2 SD vs ≥−2 SD. Solid line is adjusted for age at assessment, age of mother, and sociodemographic variables; dashed line is adjusted for age at assessment, age of mother, sociodemographic variables, and perinatal variables.

[Source: Cheong et al, *Pediatrics* 2017;139(6):1-8.]


Do nothing
Improve neonatal care
Early intervention
Working memory training
?
How can we improve educational outcomes?

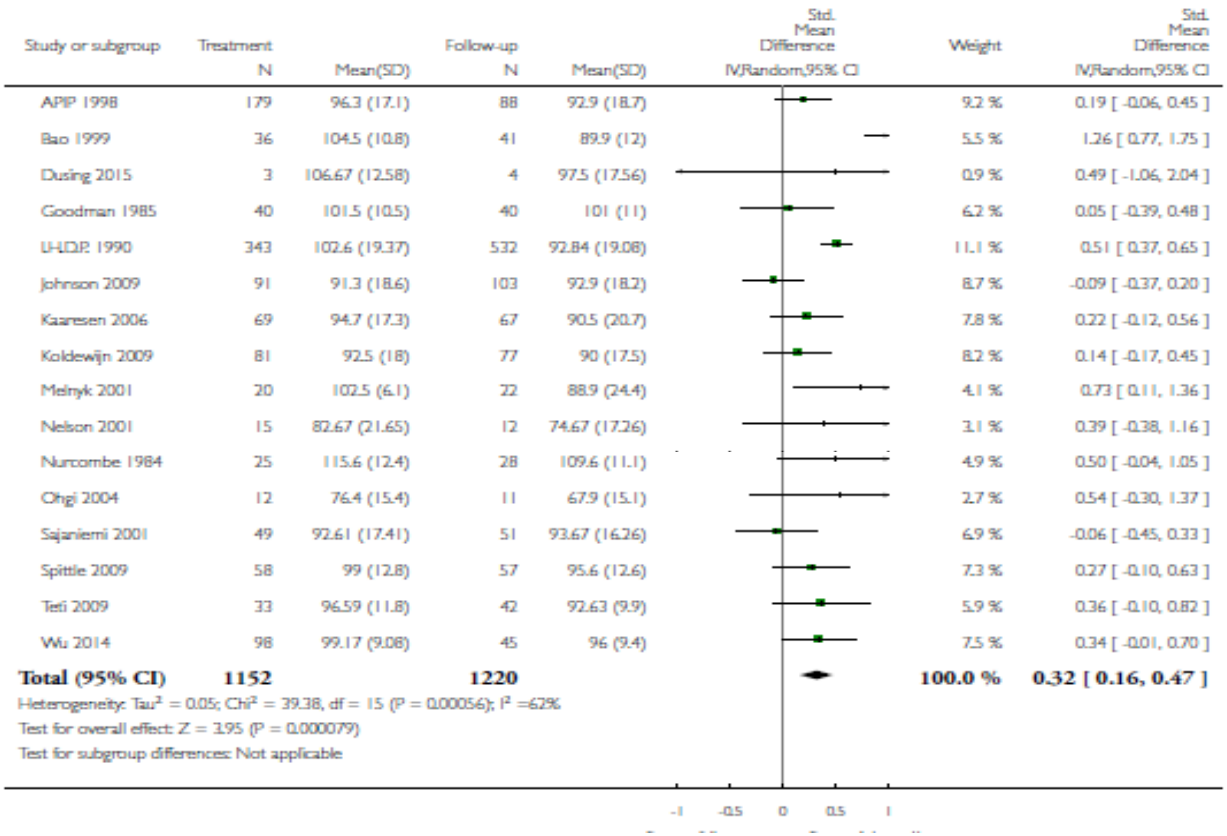
Early intervention?

Analysis 1.1. Comparison 1 Early developmental intervention versus standard follow-up (all studies), Outcome 1 Cognitive outcome at infancy - DQ (Bayley and Griffiths).

Review: Early developmental intervention programmes provided post hospital discharge to prevent motor and cognitive impairment in preterm infants

Comparison: 1 Early developmental intervention versus standard follow-up (all studies)

Outcome: 1 Cognitive outcome at infancy - DQ (Bayley and Griffiths)



Study or subgroup	Treatment N	Mean(SD)	Follow-up N	Mean(SD)	Std. Mean Difference IV,Random,95% CI	Weight	Std. Mean Difference IV,Random,95% CI
APIP 1998	179	96.3 (17.1)	88	92.9 (18.7)		9.2 %	0.19 [-0.06, 0.45]
Bao 1999	36	104.5 (10.8)	41	89.9 (12)		5.5 %	1.26 [0.77, 1.75]
Dusing 2015	3	106.67 (12.58)	4	97.5 (17.56)		0.9 %	0.49 [-1.06, 2.04]
Goodman 1985	40	101.5 (10.5)	40	101 (11)		6.2 %	0.05 [-0.39, 0.48]
IHDP 1990	343	102.6 (19.37)	532	92.84 (19.08)		11.1 %	0.51 [0.37, 0.65]
Johnson 2009	91	91.3 (18.6)	103	92.9 (18.2)		8.7 %	-0.09 [-0.37, 0.20]
Kaaresen 2006	69	94.7 (17.3)	67	90.5 (20.7)		7.8 %	0.22 [-0.12, 0.56]
Koldewijn 2009	81	92.5 (18)	77	90 (17.5)		8.2 %	0.14 [-0.17, 0.45]
Melnyk 2001	20	102.5 (6.1)	22	88.9 (24.4)		4.1 %	0.73 [0.11, 1.36]
Nelson 2001	15	82.67 (21.65)	12	74.67 (17.26)		3.1 %	0.39 [-0.38, 1.16]
Nurcombe 1984	25	115.6 (12.4)	28	109.6 (11.1)		4.9 %	0.50 [-0.04, 1.05]
Ohgi 2004	12	76.4 (15.4)	11	67.9 (15.1)		2.7 %	0.54 [-0.30, 1.37]
Sajaniemi 2001	49	92.61 (17.41)	51	93.67 (16.26)		6.9 %	-0.06 [-0.45, 0.33]
Spittle 2009	58	99 (12.8)	57	95.6 (12.6)		7.3 %	0.27 [-0.10, 0.63]
Teti 2009	33	96.59 (11.8)	42	92.63 (9.9)		5.9 %	0.36 [-0.10, 0.82]
Wu 2014	98	99.17 (9.08)	45	96 (9.4)		7.5 %	0.34 [-0.01, 0.70]
Total (95% CI)	**1152**		**1220**			**100.0 %**	**0.32 [0.16, 0.47]**

Heterogeneity: $Tau^2 = 0.05$; $Chi^2 = 39.38$, df = 15 (P = 0.00056); $I^2 = 62\%$

Test for overall effect: Z = 3.95 (P = 0.000079)

Test for subgroup differences: Not applicable

-1 -0.5 0 0.5 1

[Source: Spittle et al. Cochrane Collaboration. 2012]

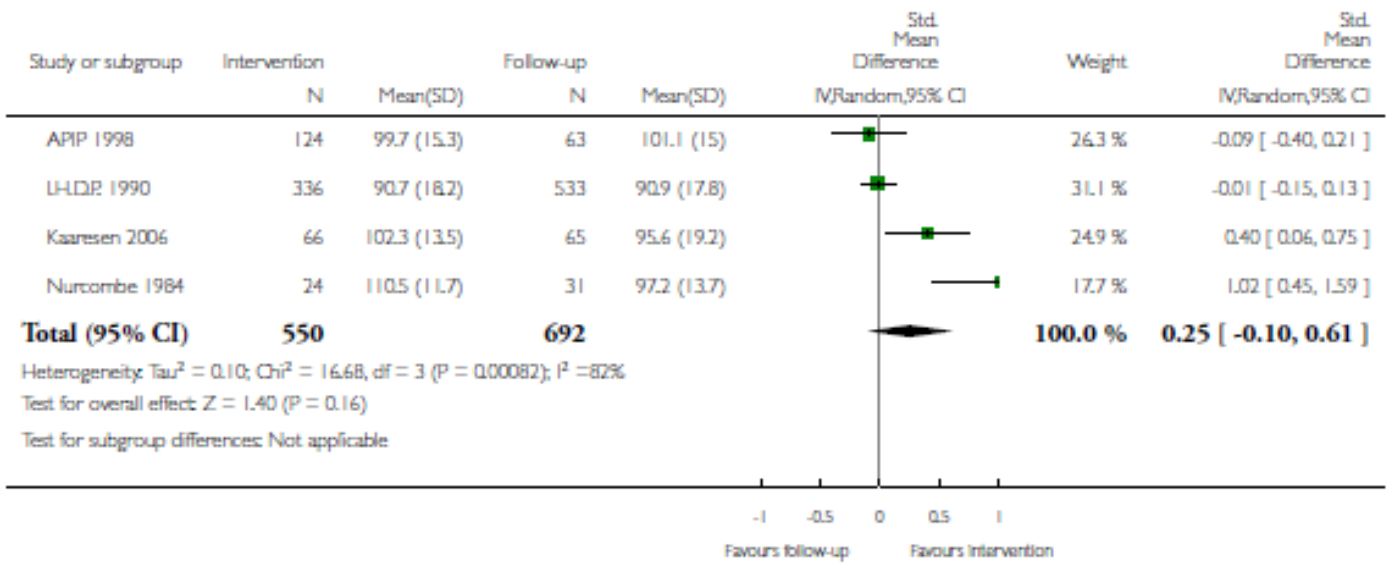
Early intervention?

Analysis 1.3. Comparison 1 Early developmental intervention versus standard follow-up (all studies), Outcome 3 Cognitive outcome at school age - IQ (WISC, Kaufmann).

Review: Early developmental intervention programmes post-hospital discharge to prevent motor and cognitive impairments in preterm infants

Comparison: 1 Early developmental intervention versus standard follow-up (all studies)

Outcome: 3 Cognitive outcome at school age - IQ (WISC, Kaufmann)



[Source: Spittle et al. Cochrane Collaboration. 2012]

Early intervention?

DEVELOPMENTAL MEDICINE & CHILD NEUROLOGY COMMENTARY

Timing and content of interventions to enhance cognitive performance of very-low-birthweight children

Previous research has indicated that interventions in infancy may have short-term but not positive long-term effects on cognitive or academic performance.[2] It is not surprising that interventions in the first few months of life may not be enough to solve the complex issue of cognitive deficits in preterm children at school age. This highlights the need for intervention at around school age

[Source: Woke. *Dev Med Child Neurol* 2015]


Do nothing
Improve neonatal care
Early intervention
Working memory training
?
How can we improve educational outcomes?

Working memory training?

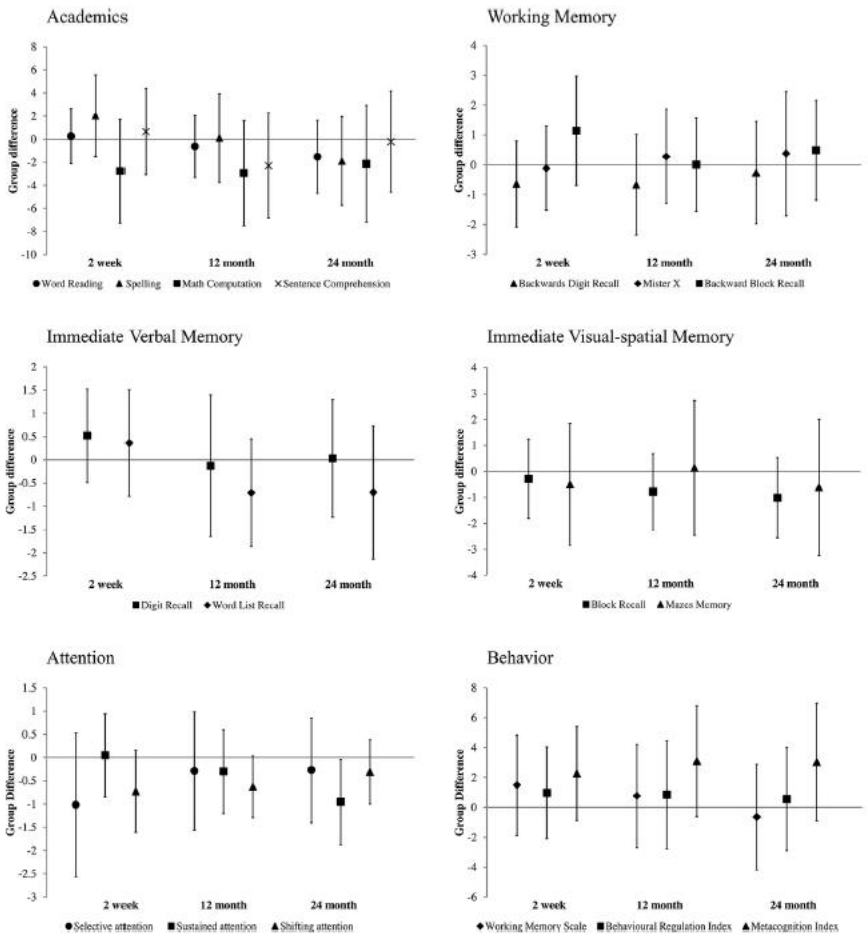


Figure 2. Treatment group differences in academics, working memory, immediate verbal memory, immediate visual-spatial memory, attention, and behavior at 2 weeks, 12 months, and 24 months post-training. Point estimates reflect regression coefficients from mixed-effect models where a group difference >0 reflects a higher score in the Cogmed group, and a group difference <0 reflects a lower score in the Cogmed group. Vertical error bars represent 95% CIs.

Conclusions:

We currently do not recommend administration of Cogmed for early school-aged children born extremely preterm/extremely low birth weight to improve academic functioning.

[Source: Anderson et al. *J Pediatr* 2018]


Do nothing
Improve neonatal care
Early intervention
Working memory training
Teach the teachers
How can we improve educational outcomes?

Research priorities

Open access Original research

BMJ Open

Joint production of research priorities to improve the lives of those with childhood onset conditions that impair learning: the James Lind Alliance Priority Setting Partnership for 'learning difficulties'

Ai Keow Lim ,[1] Sinead Rhodes,[1] Katherine Cowan,[2] Anne O'Hare[1]

Research priorities

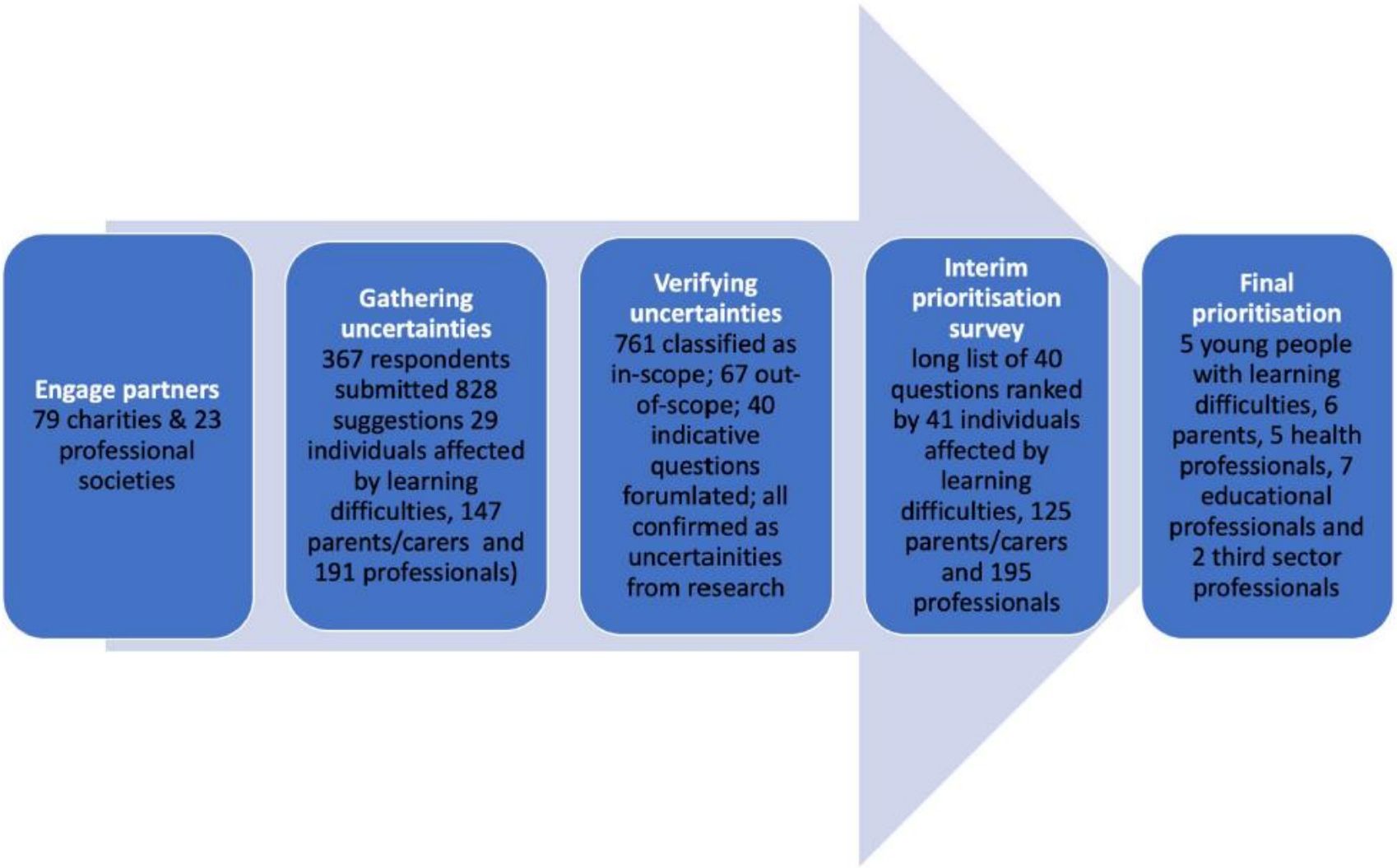


Figure 1 Flow chart showing the process and numbers of participants and research suggestions and questions at each stage.

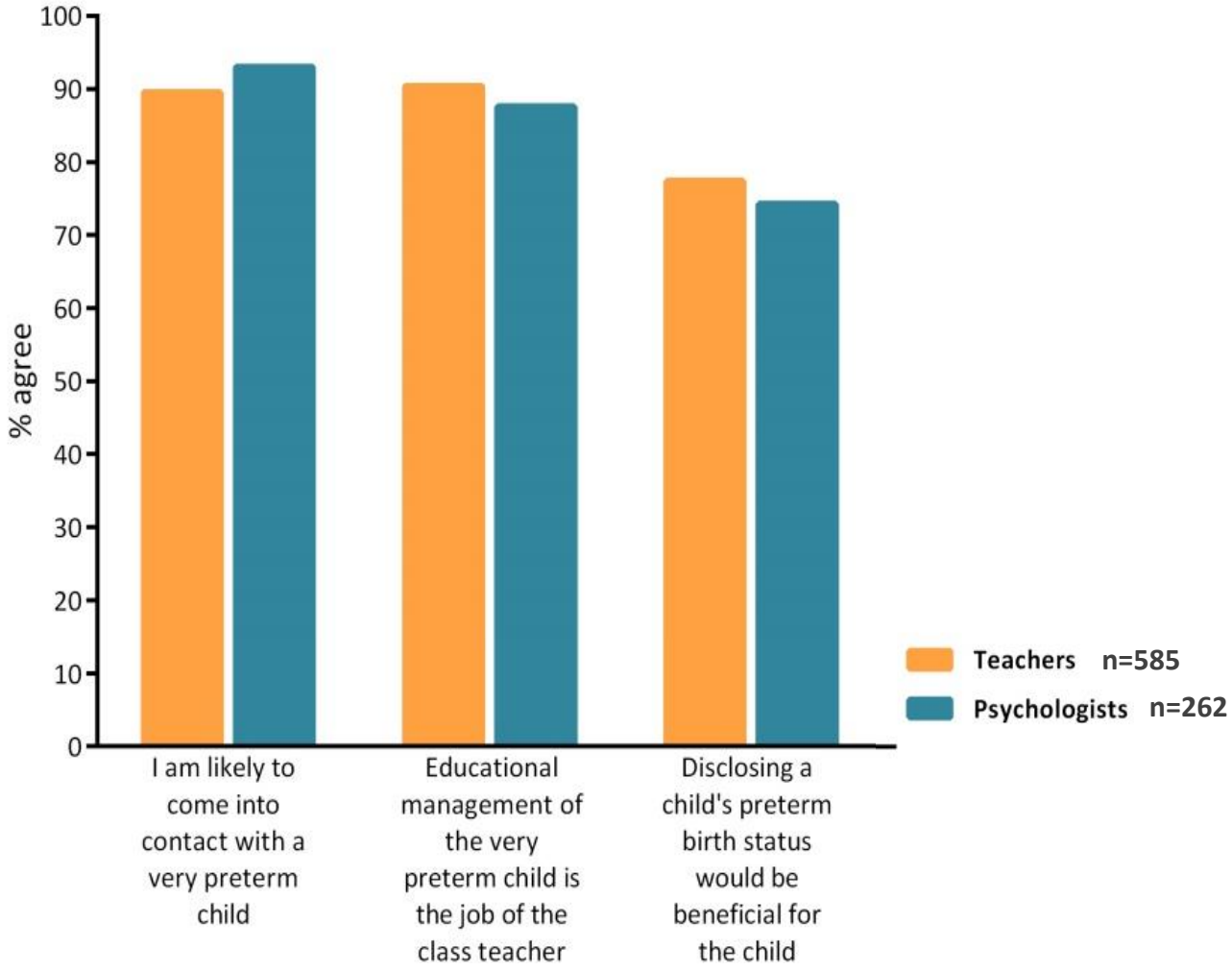
[Source: Lim et al. *BMJ Open*, 2019]

Top research priority

Table 3	Top 10 research questions agreed as shared priorities
(1)	What knowledge, skills and training do educational professionals need to identify the early signs of learning difficulties and provide optimal support for children and young people affected to help them achieve the best possible outcomes?
(2)	What is the best educational and community environment for children and young people with learning difficulties?
(3)	How can multiple types of professionals work together with parents and carers to improve identification, diagnosis, interventions and treatments and achieve the best outcomes for children and young people with learning difficulties?
(4)	Which early interventions are effective for children and young people with learning difficulties, at what ages and stages are they best introduced and what are the long-term outcomes?
(5)	What knowledge, skills and training do health, social work and 'third sector' (eg, charities and support services) professionals need to understand the best support to give children and young people with learning difficulties and their families/carers?
(6)	How can parents, carers, brothers and sisters and extended families of children and young people with learning difficulties, be best supported to achieve their best quality of life before, during and after the diagnosis or identification in home, school and community contexts?
(7)	How can we best identify early features, symptoms and signs of learning difficulties among children, young people and their families/carers?
(8)	What is the best way to assess learning difficulties in children and young people?
(9)	Which strategies are effective in preventing stigma and bullying towards children and young people with learning difficulties?
(10)	Which strategies are effective in helping children and young people with learning difficulties live independent lives, including during times of transition?

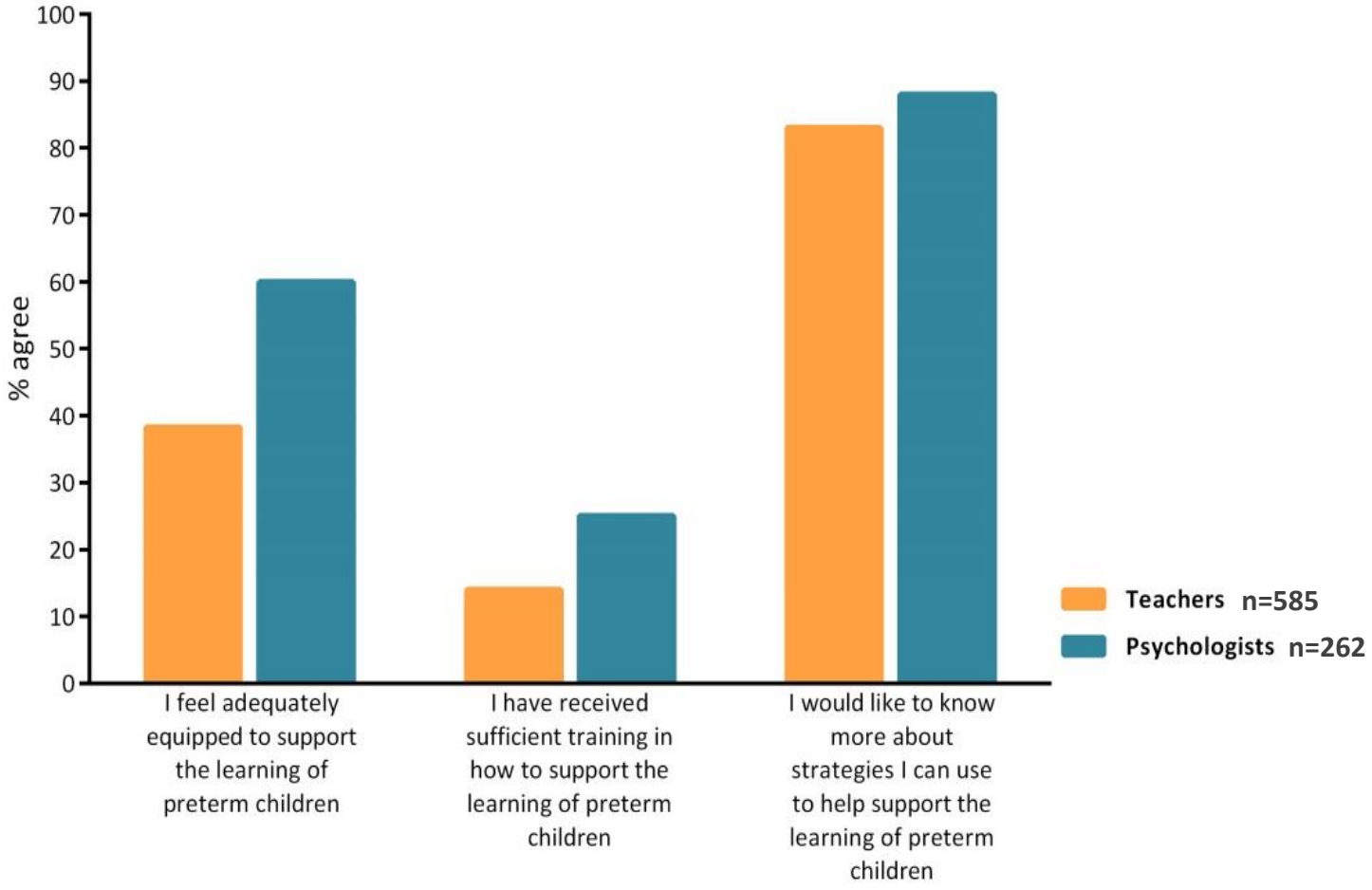
[Source: Lim et al. *BMJ Open*, 2019]

Education professionals' knowledge of preterm birth



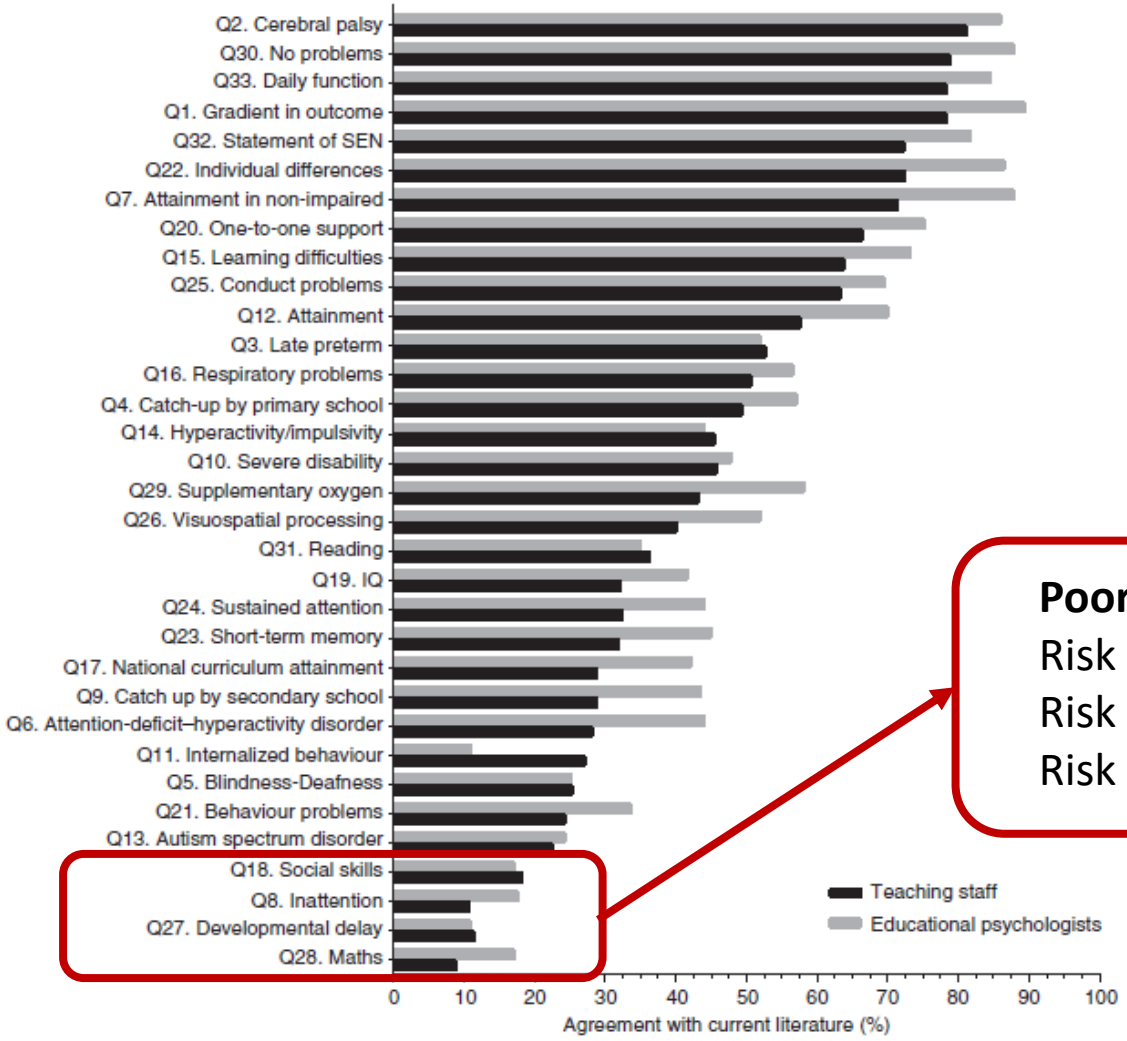
[Source: Johnson et al. *Dev Med Child Neurol*, 2015]

Education professionals' knowledge of preterm birth



[Source: Johnson et al. *Dev Med Child Neurol*, 2015]

Education professionals' knowledge of preterm birth



Poorest knowledge:
Risk for poor social skills
Risk for inattention
Risk for maths difficulties

[Source: Johnson et al. *Dev Med Child Neurol*, 2015]

A different kind of difficulties

This new generation of children and young people includes some . . . who survived extreme prematurity . . . These children have complex learning difficulties and disabilities. They learn and respond differently to previous generations of children with profound and multiple or severe learning difficulties.

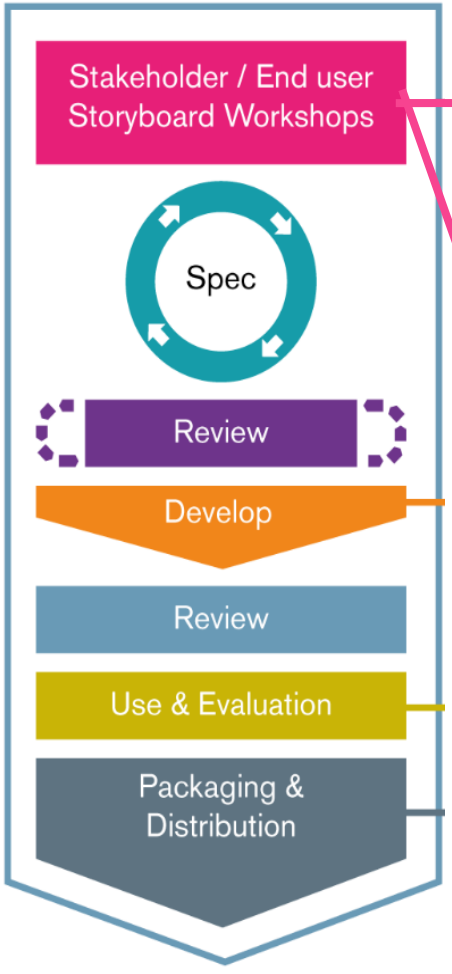
Training for staff to recognise the possible learning disabilities and difficulties associated with extremely preterm birth.

[http://complexld.ssatrust.org.uk]

PRISM e-learning resource for education professionals

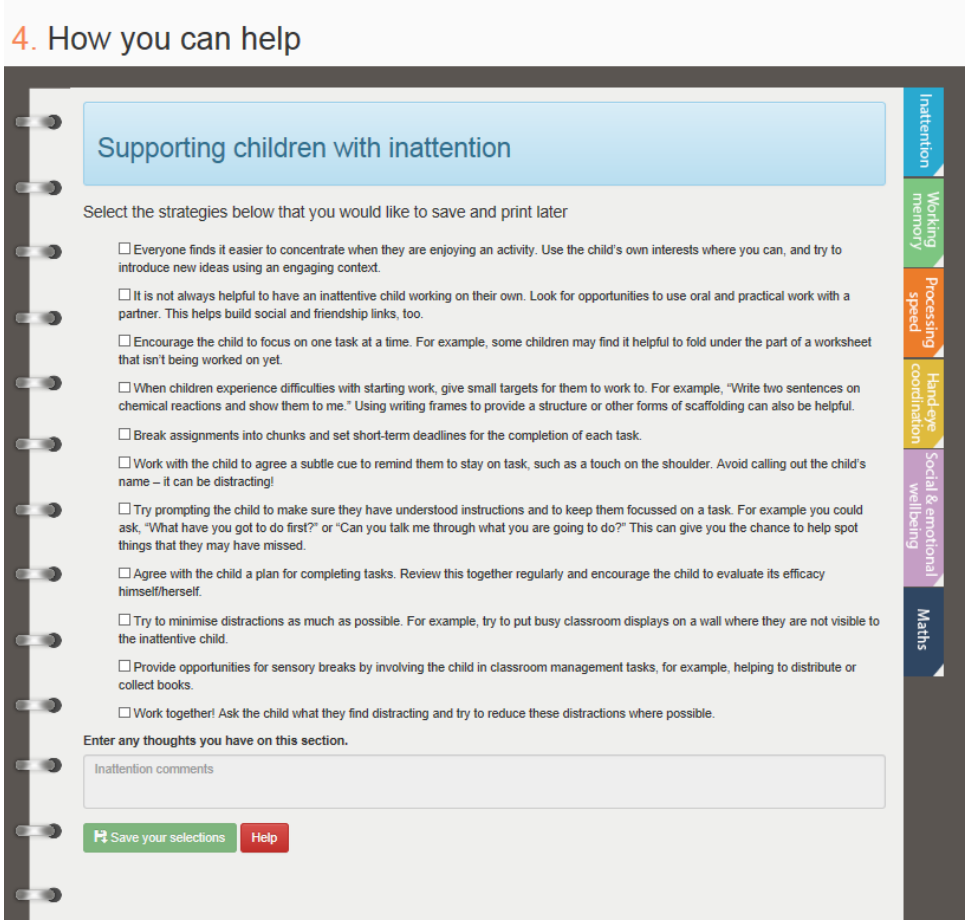
- For education professionals
- 5 short sections
- ~ 1 hour of learning
- Control own pace of learning
- Interactive multimedia content
- Case studies & animations
- Figures and graphs narrated
- Provides strategies to support children in the classroom

Co-designed with stakeholders



Practical strategies for use in the classroom

- Strategies for providing support for children with:
  - Inattention
  - Poor working memory
  - Slow processing speed
  - Poor visuo-spatial processing
  - Social & emotional problems
  - Mathematics difficulties



Evaluation study

- 61 teachers from primary schools in England
- 1 month access to the resource
- Before and after using the resource:
  - Assessed knowledge of outcomes following preterm birth
  - Assessed confidence in supporting preterm children

[Source: Johnson et al. *BMJ Open,* 2019]

PRISM
Premature Infants' Skills in Mathematics

Evaluation study

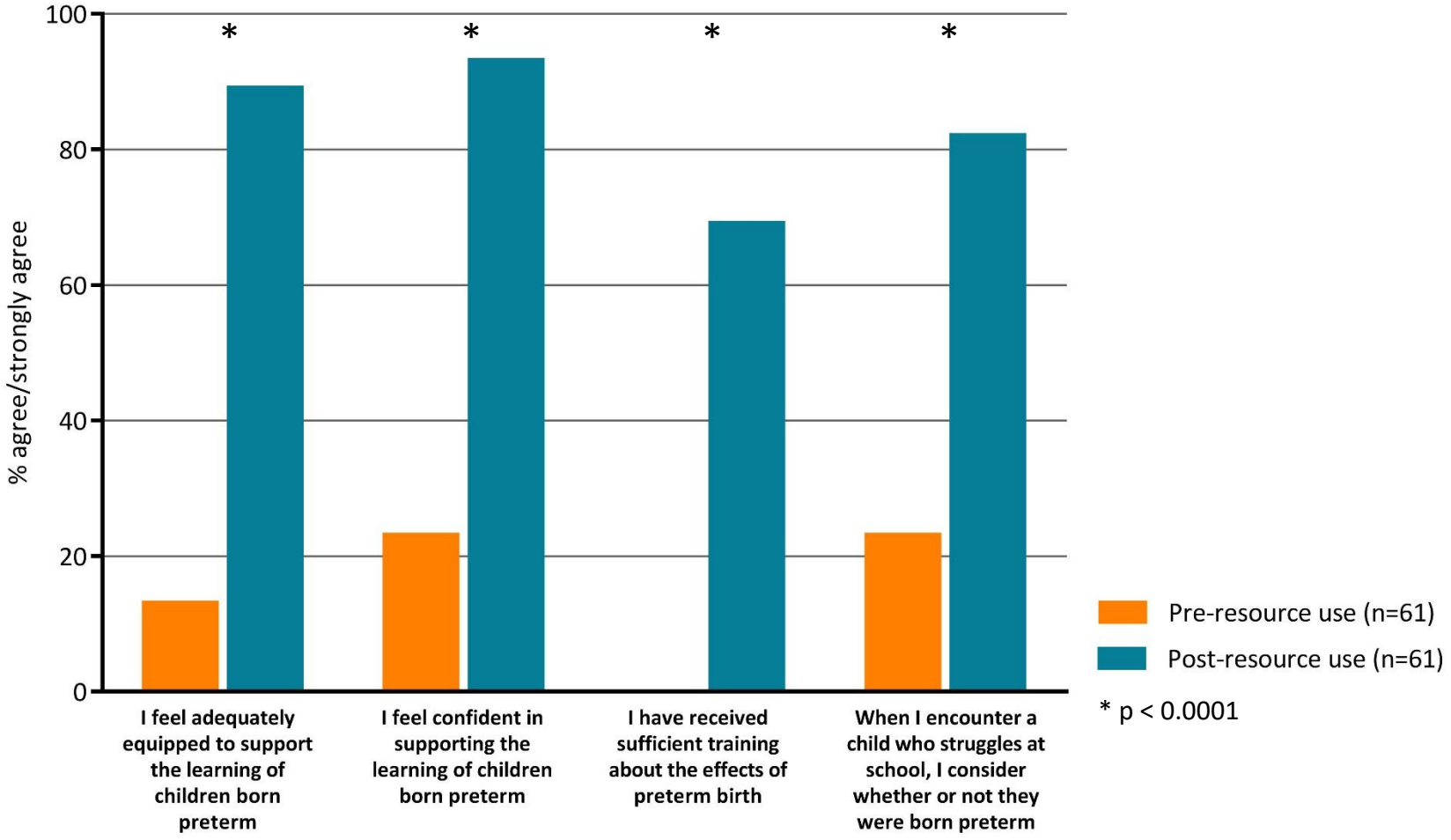
- Preterm Birth Knowledge Scale: mean score
  - Pre-resource use: 13 (SD 6.2); range 0-25
  - Post-resource use: 28 (SD 3.5); range 18-33; $p < 0.001$
- Greatest increase in knowledge

Item	% accuracy pre resoure	% accuracy post resource	% difference in accuracy
Risk for mathematics difficulties	7%	100%	93%
Risk for poor social skills	15%	95%	79%
Risk for inattention	15%	89%	74%
Risk for poor visuospatial skills	26%	100%	74%

[Source: Johnson et al. *BMJ Open,* 2019]

PRISM
Premature Infants' Skills in Mathematics

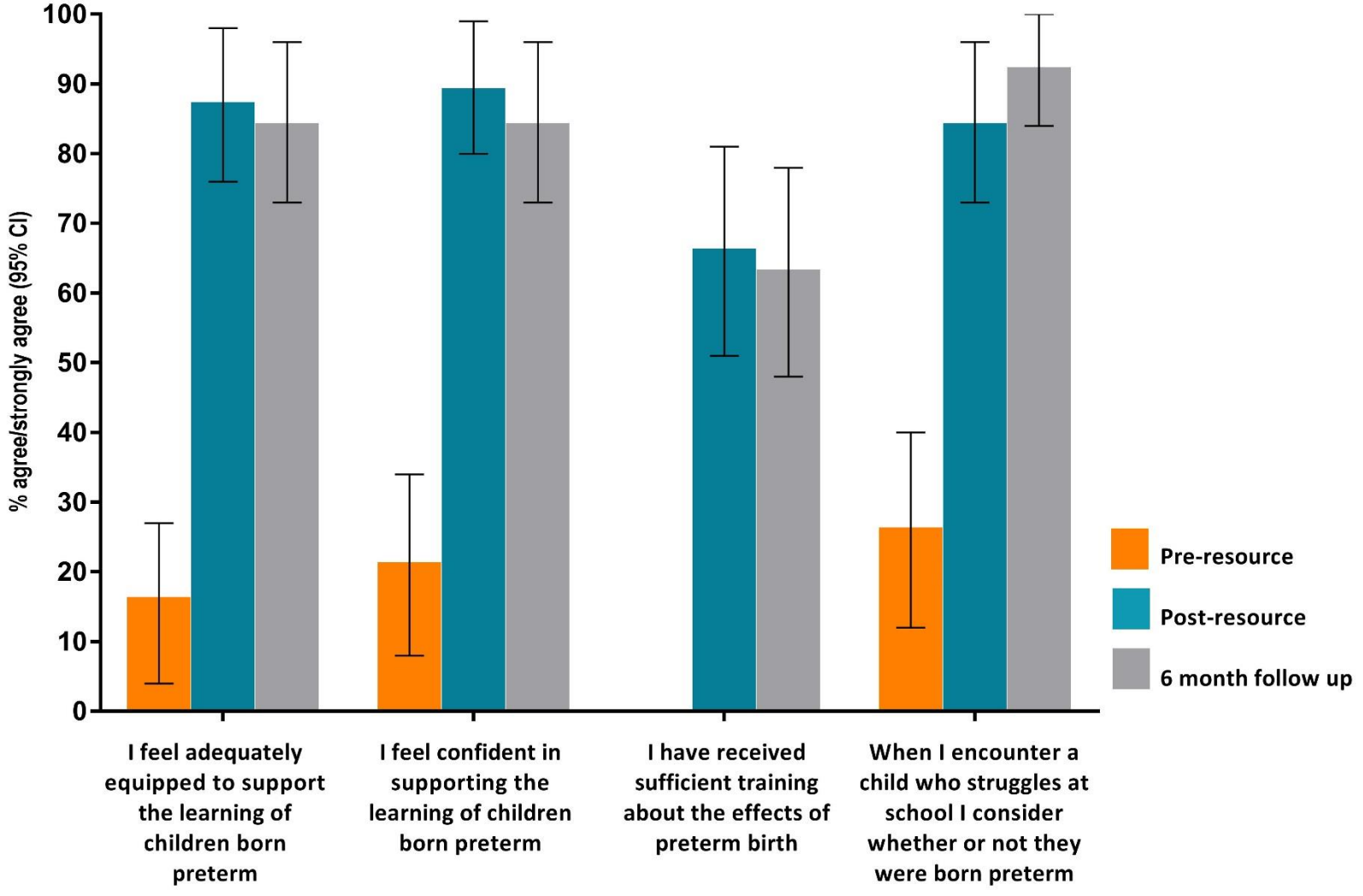
Evaluation study



[Source: Johnson et al. *BMJ Open,* 2019]

PRISM
Premature Infants' Skills in Mathematics

6 month follow up



[Source: PRISM Study *UNPUBLISHED DATA*]

PRISM
Premature Infants' Skills in Mathematics

Changing practice – 6 month follow up

- 90% changed their thinking; 61% changed the way they work

Thinking and planning extra scaffolding to activities

We now routinely collect information from parents of new children starting at school about when the child was born

More aware of the way I deliver maths lessons, making them more practical

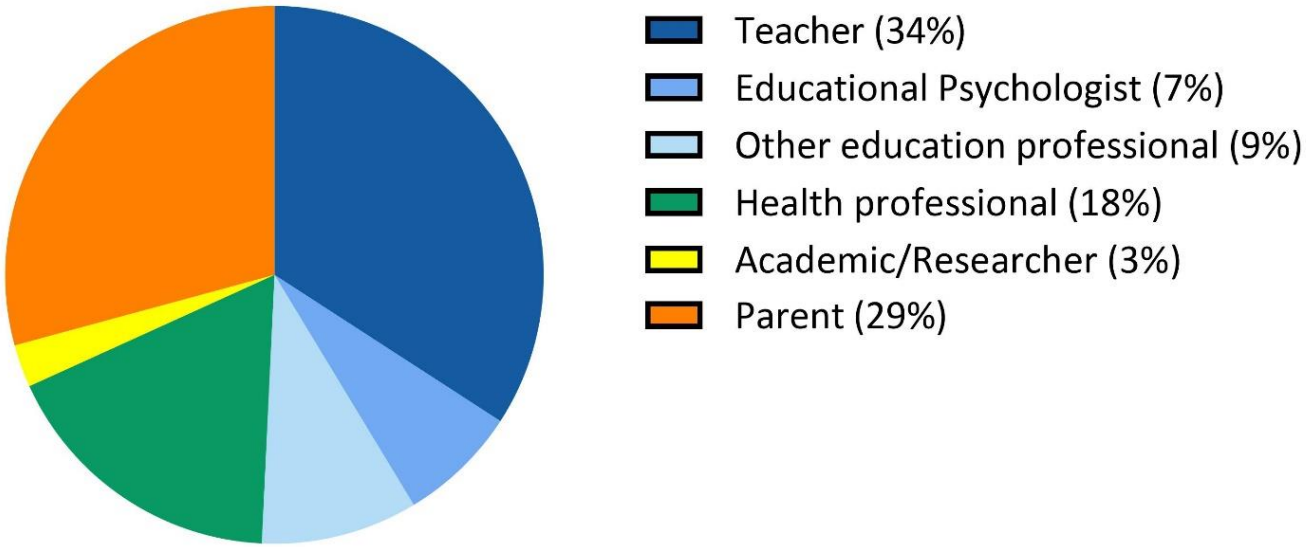
Making sure that the very basics have been fully embedded with these children and realizing that this has to be done first, before other learning will take place

Give more time to explaining, instructing and supporting these children

Available online: www.pretermbirth.info

- **6,883 users in 53 countries in 10 months**

- Structural/organisational change
- Staff training in schools
- Teacher training programmes
- Support staff in higher education
- Educational psychology training
- Clinical recommendation
- Allied health professionals



Total = 2922

Empowering parents

My son was very preterm but because he has no behavioural issues, we have had real difficulties getting his differences acknowledged and understood by his teachers. This site is really excellent in getting the issues across to busy teachers who cannot be experts in everything but do need to know how to help these precious children.

Thank you so much. This is amazing, and I can't wait to share it with my son's teachers. They really need it.

I've felt FOREVER that I wanted a resource like this for the teachers of my Former Micro Preemie Daughter.. Thank you so much!!!"

As a parent of premature children I would like all teachers and people involved in their lives to read this. It rings true

I have shared the teacher resource from the Prism study so often: it has enabled parents and teachers, and young adults to advocate for themselves using verified information for the first time. This is hugely empowering for both the parent and child

PRISM
Premature Infants' Skills in Mathematics


Do nothing
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How can we improve educational outcomes?
Working memory training
Early intervention

UNIVERSITY OF LEICESTER

Thank you

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@SamJPsych