

Early child  
development in  
developing countries  
:  
**the role of nutrition  
and stimulation**

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# Acknowledgements

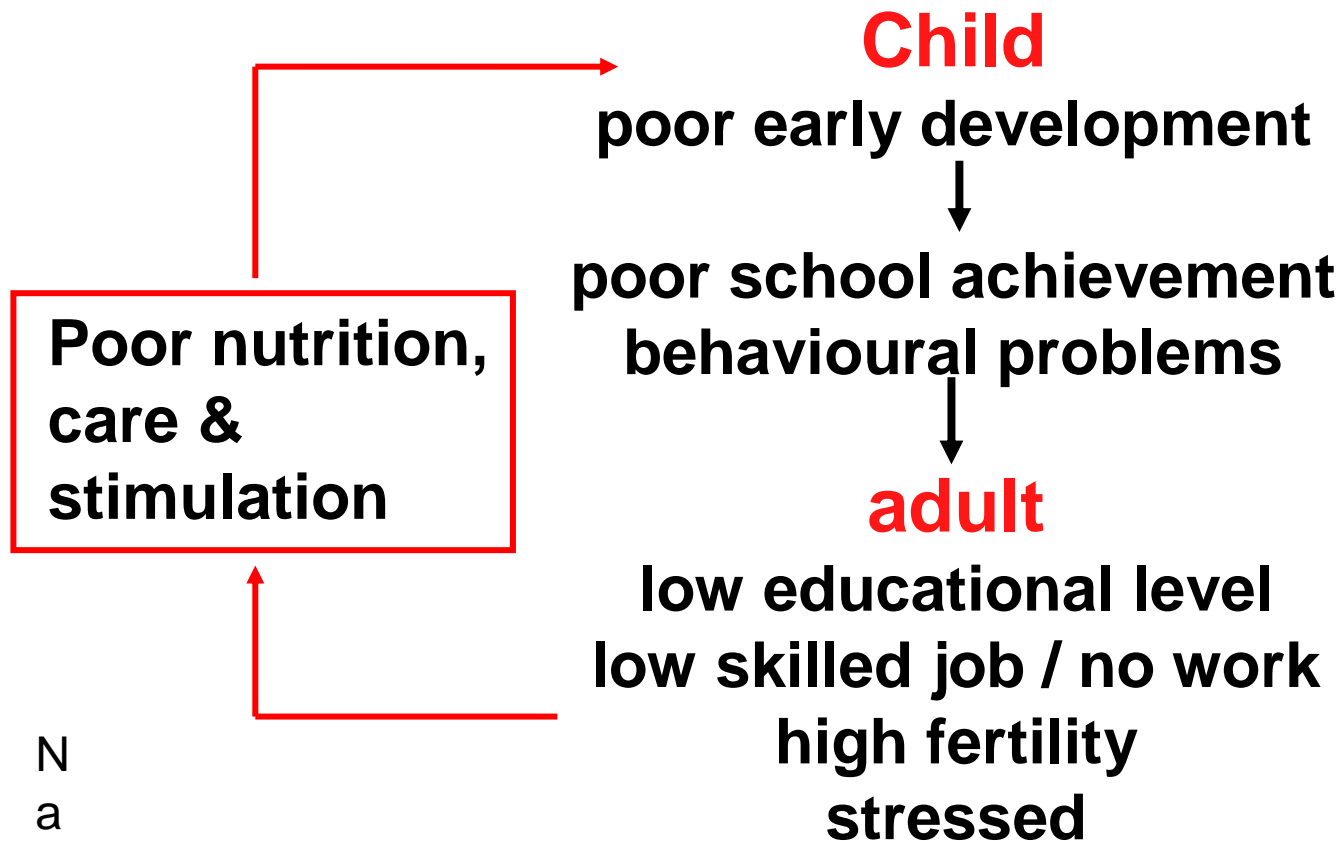
## Jamaica

- S Walker, S Chang, C Powell,
- H henningham, J Meeks Gardner

## Bangladesh

- J Hamadani, F Tofail, S Huda

# Implications: Intergenerational transmission of poverty



## Focus on early childhood

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- Sensitive period when experience has maximum effect on brain development (conception- 5 yrs)
- Effects of insults and interventions can be lasting
- Ability on entry → school progress → productivity
- Early interventions more cost effective than later

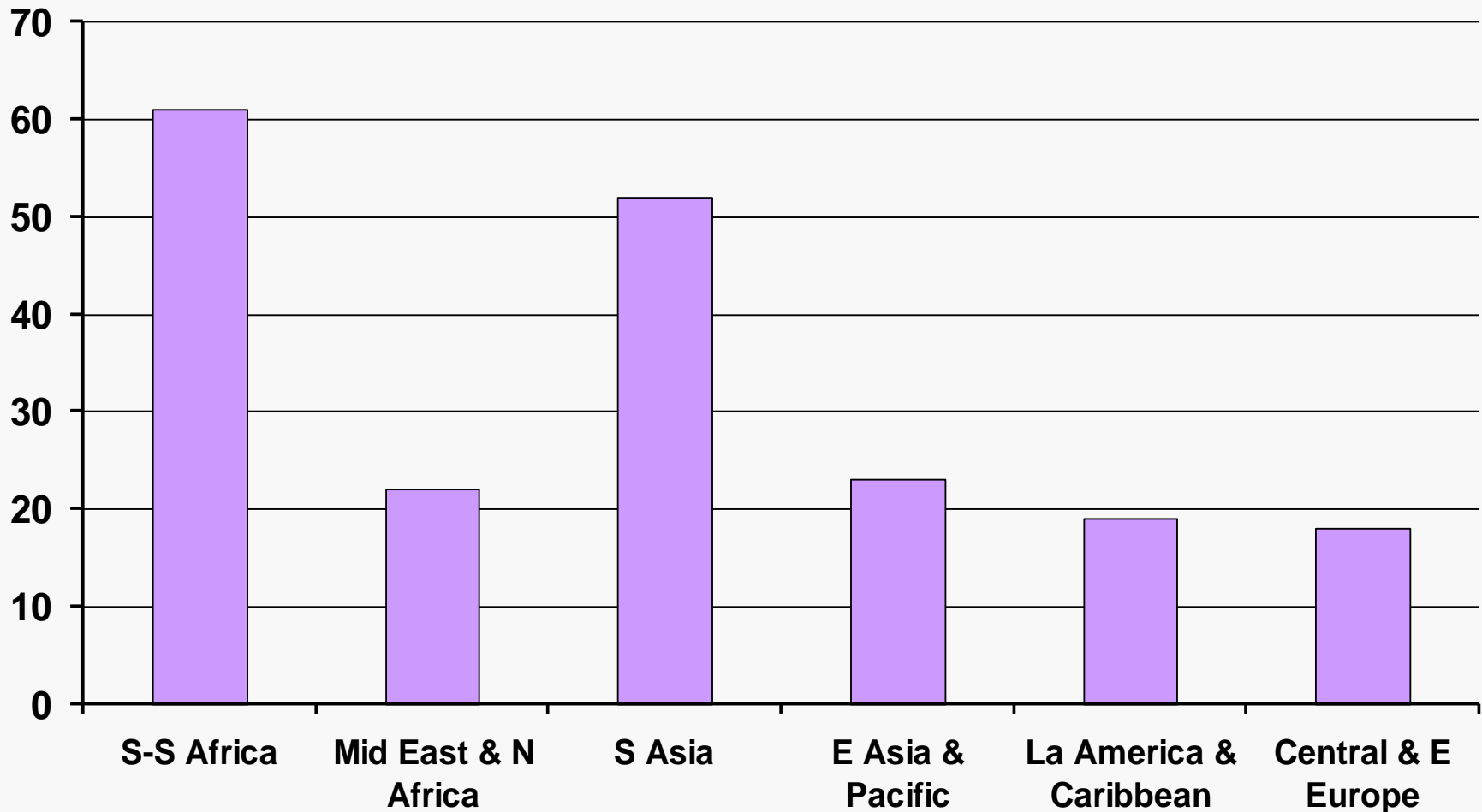
# The Problem

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- > 200 million children < 5years in developing countries are failing to reach their potential in cognitive and socio-emotional development

(Lancet child development series 2007)

# % of disadvantaged children <5yrs by region



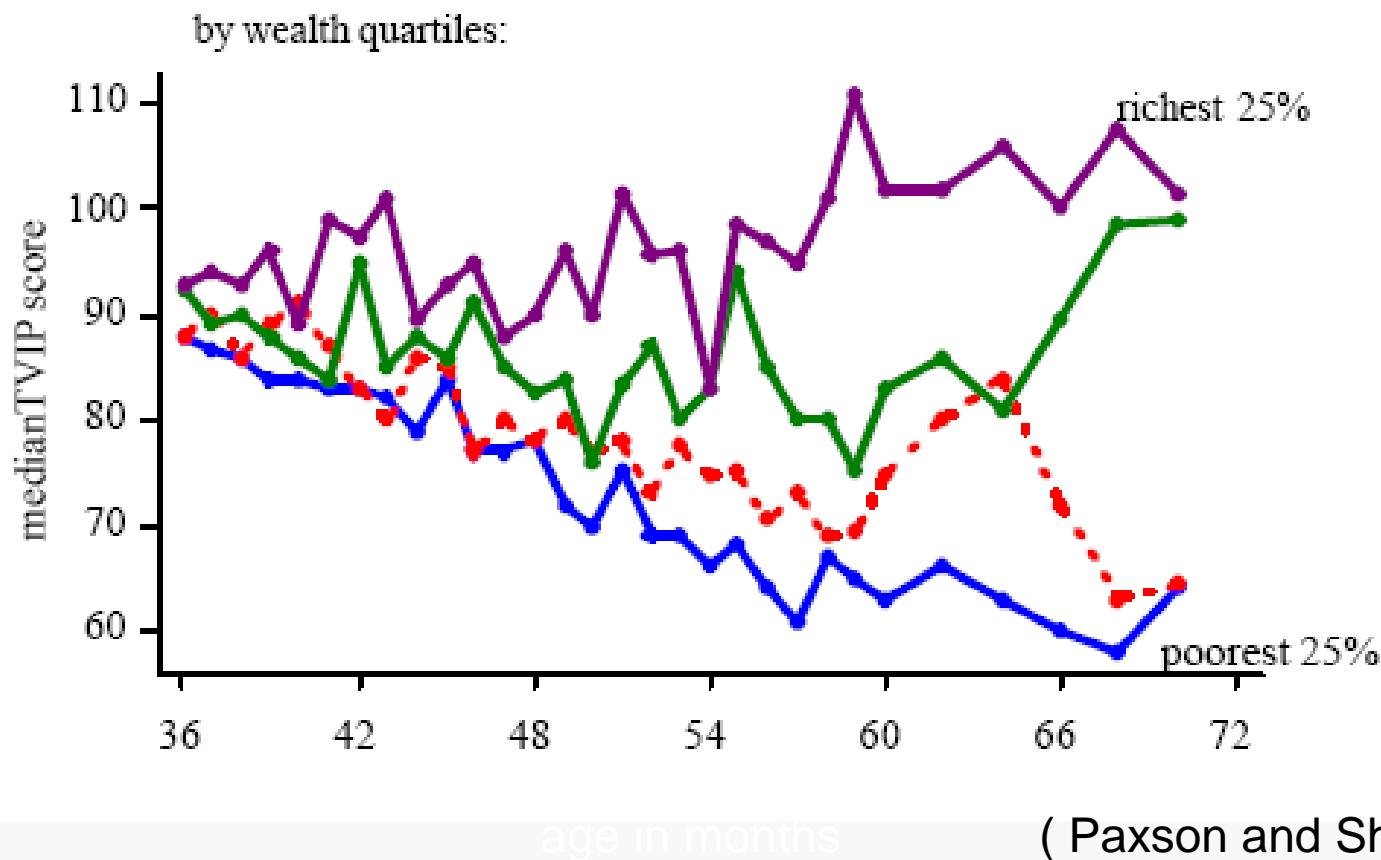
Grantham-McGregor et al 2007; Lancet series

# Poverty



>60 X-sectional studies showed associations with wealth and school achievement or cognition

# Cumulative Effects: Vocabulary scores by SES quartiles in 3 to 6 yr old children in Ecuador

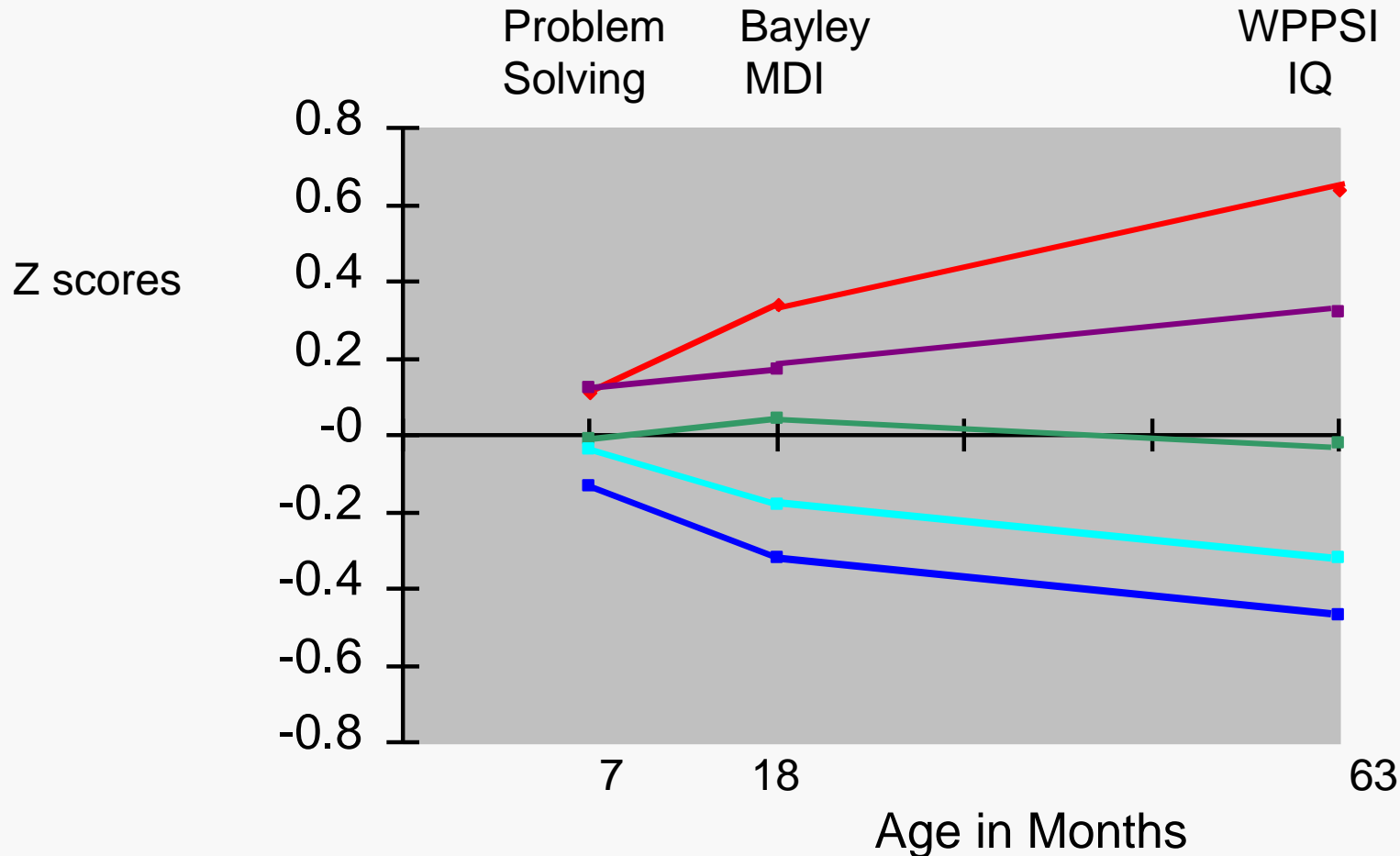


( Paxson and Shady 2005)



# Timing of cognitive gap: Mental development by wealth quintiles at birth in 1,579 children in rural Bangladesh

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- What is the role of nutrition and lack of stimulation in decline in developmental levels in the first 5 years?

# Prevalence of nutritional deficits in children <5 years in developing countries 9 (Black et al 2008; UNICEF 2110)

Stunting = 192.5 million (34%)

Wasting = 73.6 million (13%)

LBW = 16% - IUGR = 11%

Iron deficiency anaemia = 158.6 million (28%)

Iodine deficiency ?35% of total population

# Intra-uterine growth restriction (11% of births)



- Consistent evidence for poorer development up to age 3 years.
- Limited evidence from developing countries at later ages

# Iron deficiency anaemia

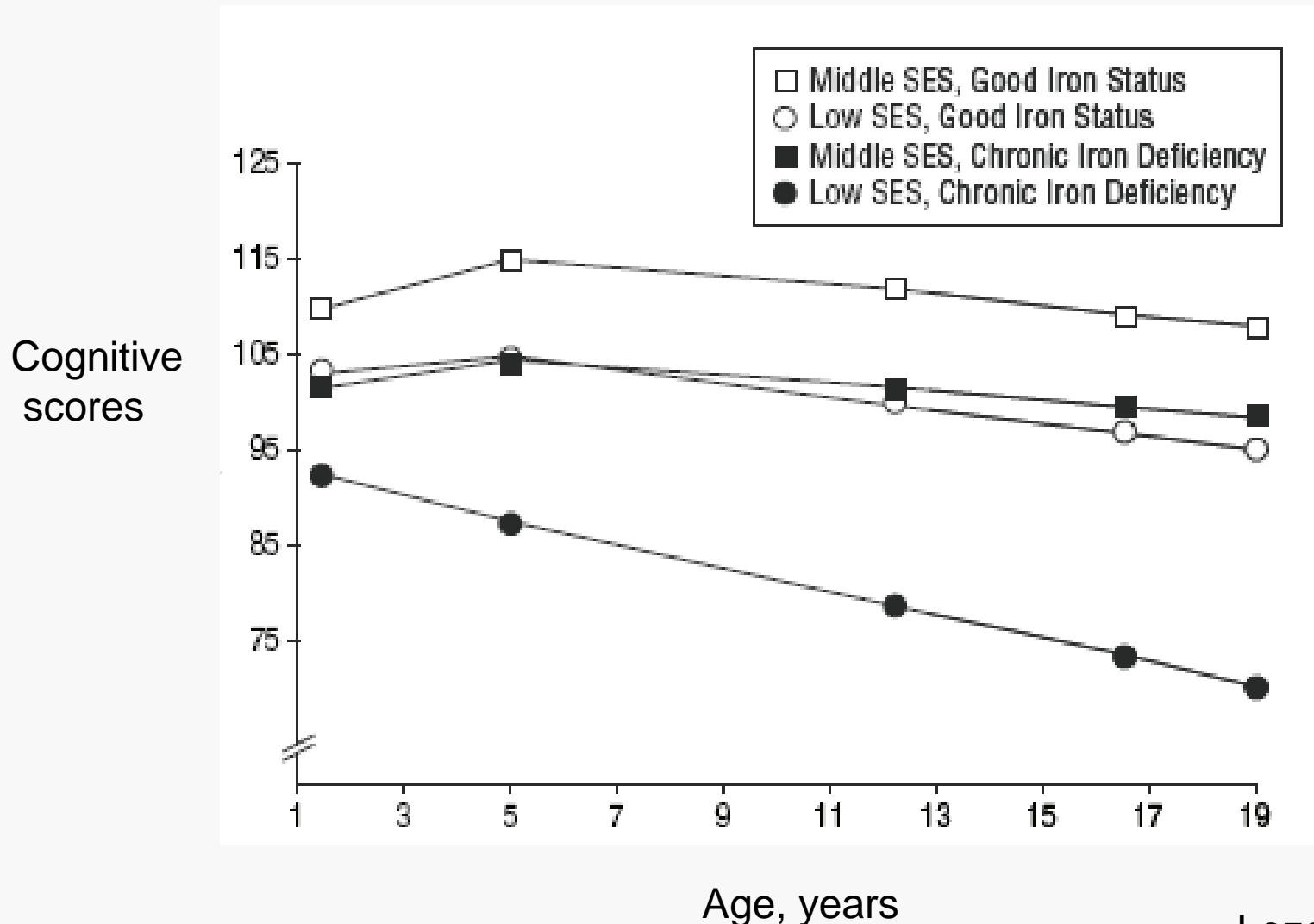
## 158.6 million (28%)

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- 8 longitudinal studies of anaemia in early childhood followed to 4 – 19 years
- All but one showed sustained deficits

Cantwell 1974, Palti 1983, Lozoff 2000, De Andraca 1991,  
Wasserman 1994, Dommergues 1989, Hurtado 1999, Sherriff 2001

# Longest follow-up: Cognitive scores to 19 years by iron status and SES, Costa Rica



# 8 robust RCTs with iron supplementation in children <3 years (lasting 2 months)

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- 6/8 benefited motor development
- 2/7 benefited mental development

Moffatt 1994, Freil 2003, Black 2004, Lind 2004, Olney 2006,  
Stoltzfus 2001, Idjradinata 1993, Aukett 1986,

# 7 RCTs with multiple micronutrients

- 5/7 benefited motor development
- 1/3 benefited mental development (not randomised)

Black 2004, Olney 2006, Abdu-Afarwuah 2007, Faber 2005, Dhingra 2004, Katz 2010, **Chen 2010**



# Effects of multiple micronutrient & iron supplementation

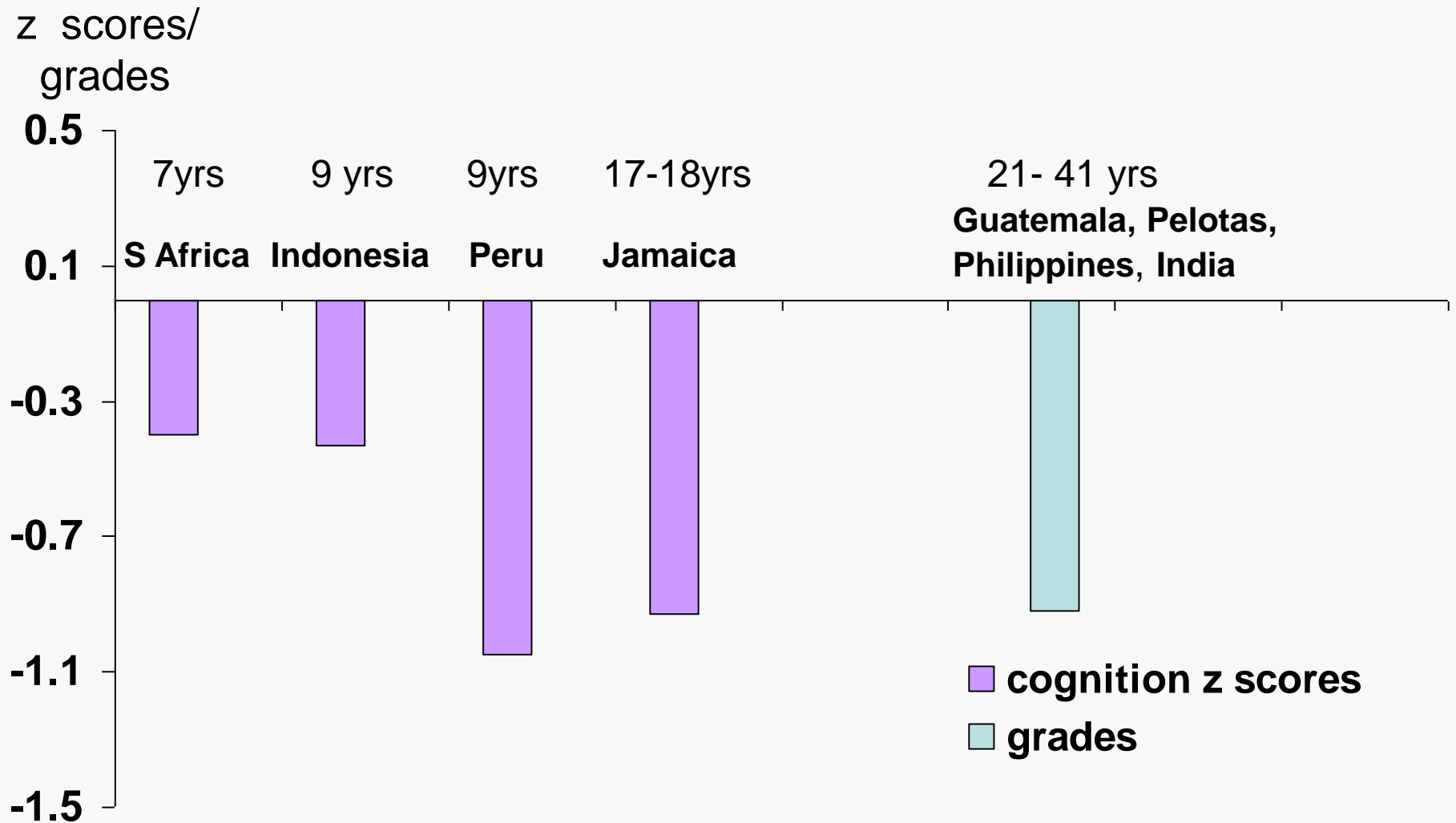
- Usually benefits motor development
- Insufficient evidence for effect on mental development
- treatment duration insufficient OR irremediable?
- Insufficient evidence to show that multiple micronutrients better than iron alone

# Stunting (192.5 million)



- 4 Longitudinal studies up to  $\geq 5$  years
- 8 longitudinal  $>5$  yrs

# Effects of stunting (height/age $\leq -2SD$ ) <3yrs on later cognition or grades attained



Grantham-McGregor et al Lancet 2007, Martorell et al 2010

# Comprehensive deficits: Jamaican children stunted before 2 yrs at 17 & 22 yrs

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- IQ, cognitive function
- Reading/ maths/ school drop out
- Depression, anxiety, self esteem, hyperactive, attention
- School suspension/ expulsion





# 9 RCTs of macronutrient supplementation

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## *Pregnancy*

Bangladesh

Tofail 2009

Taiwan, Province of China

Joos 1983

## **Pregnancy + early childhood**

Guatemala

Pollitt 1993

Bogota

Waber 1981

## **Early childhood**

Ghana

Adu-Afarwuah 2007

Jamaica

Grantham-McGregor 1991

Indonesia

Pollitt 2000

—————→  
No effect

Indonesia

Husaini 1991

Cali

McKay 1978

# Sustained benefits from supplementation

Timing of supplement (months)		Age of Follow up (years)	Effect
P for 1m	Bangladesh	5	-
P+lactation	Taiwan, Province of China	1.5	-
P + 6m	Bogota	3	-
P + 24m (Guatemala)		32	++
P + 36m (Bogota)		7	?
6-20 for 4m (Indonesia)		8	+/- 1 test
9-24 for 24m	Jamaica	17	-
20-60 for 4m	Indonesia	8	-
>36 to 84m	Guatemala	32	-

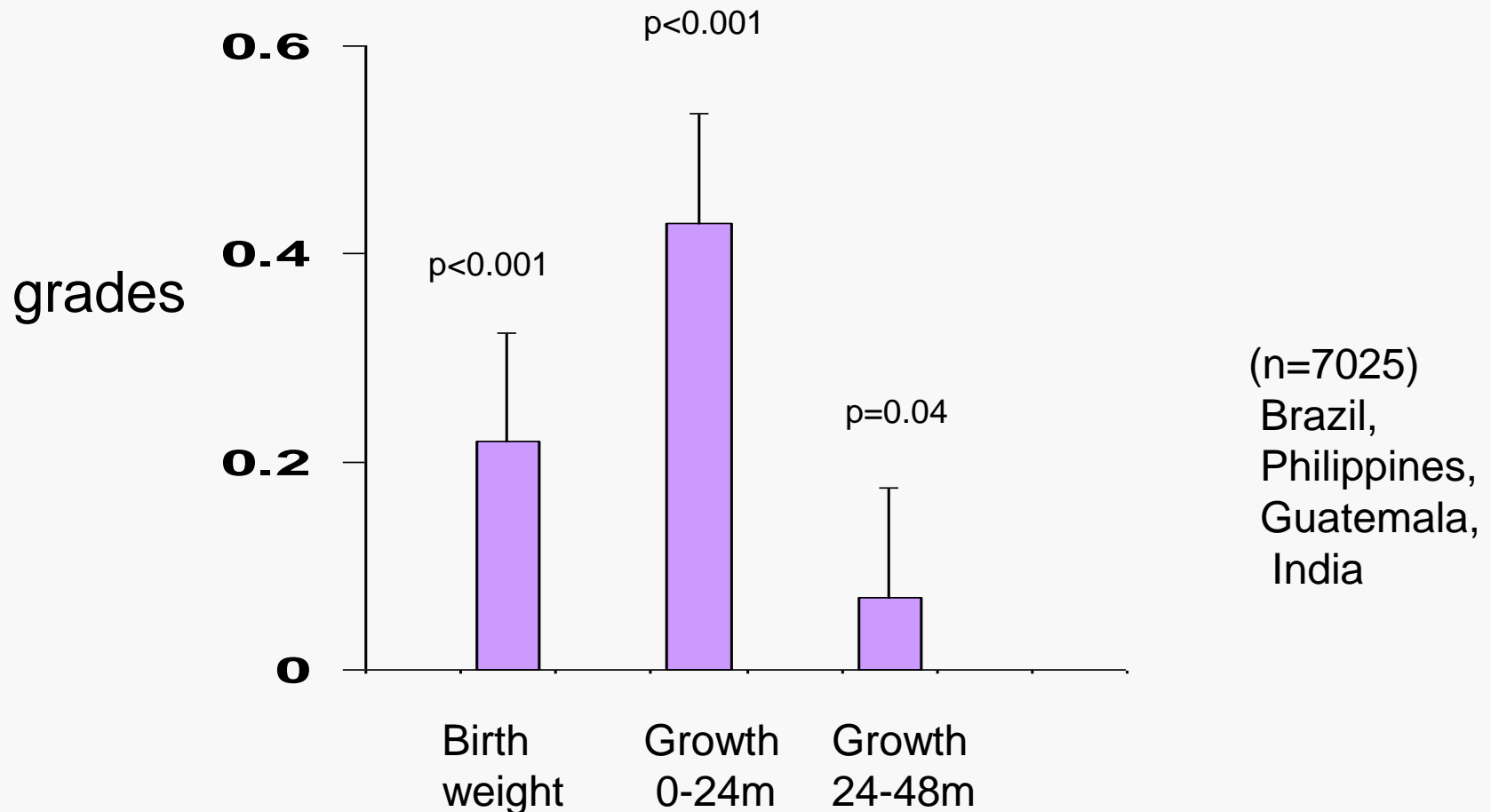
# Benefits from supplementation in Guatemala age 25-42years

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- Increased wage/hour (males)  
(supplement from birth to 36 months)
- Improved reading comprehension and reasoning (supplement from birth to 24 months)



**Timing:** Effect (SE) of 1 z-score of birth weight & growth in weight <4 years on **grades attained** in 4 cohorts, controlling for SES



# Conclusion from stunting

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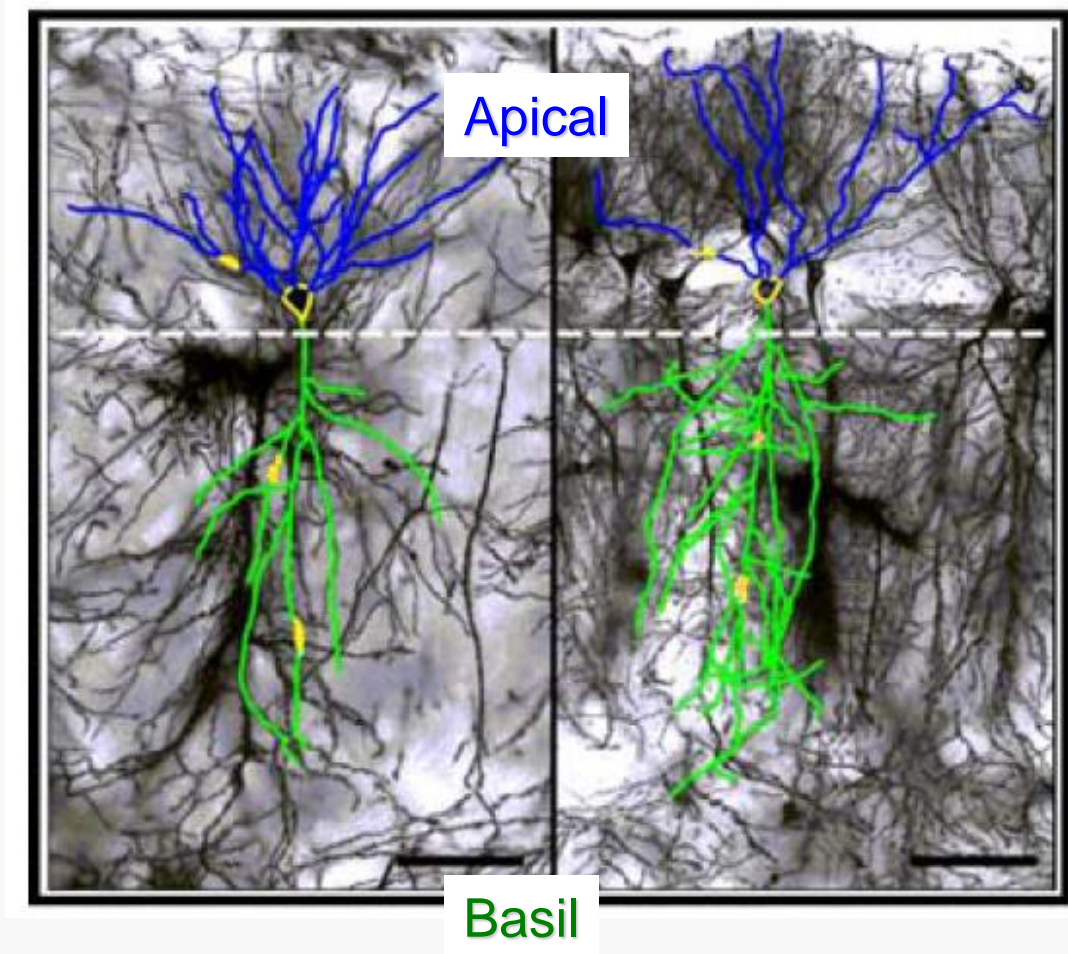
- Undernutrition contributes to the decline in development
- Most sensitive period 1st 24 months
- Some evidence of a sustained effect of supplementation
- Stunted children will not catch up with food alone

# Inadequate cognitive stimulation or learning opportunities



A biological insult

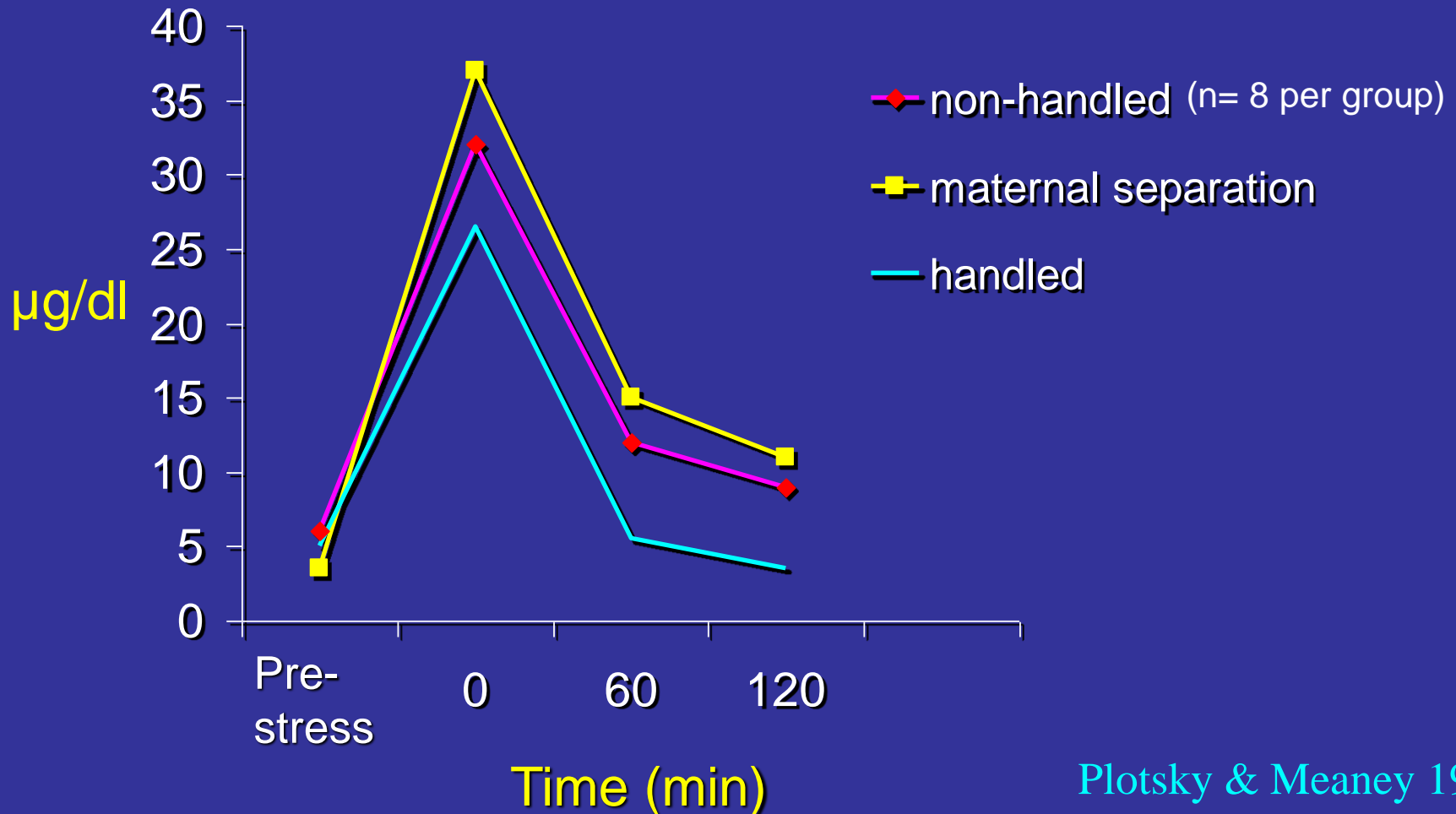
# Length of dendrites in hippocampus related to treatment in 1<sup>st</sup> postnatal week



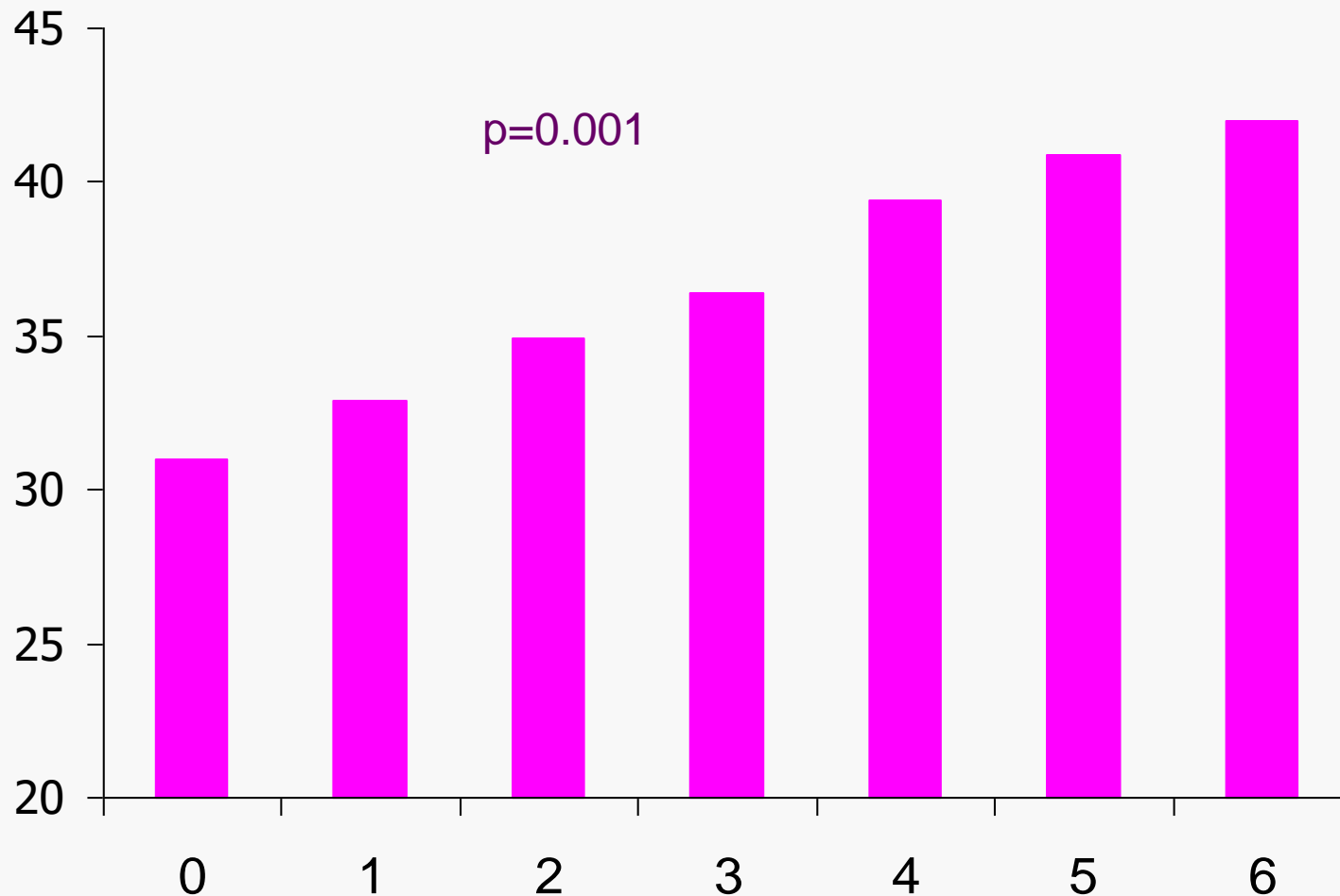
Low licking /grooming

High licking /grooming

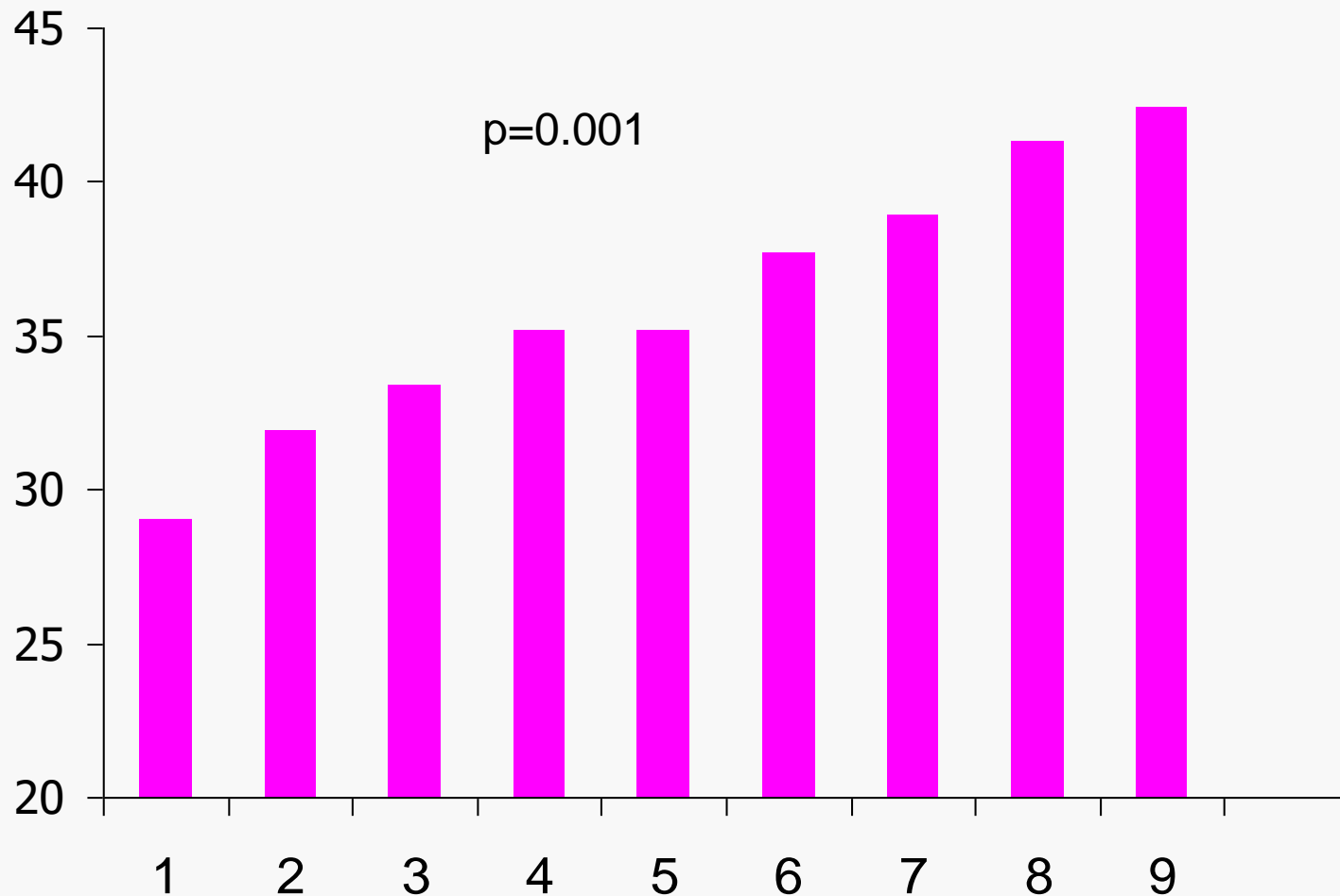
# Mean Corticosterone Levels Pre & Post Stress in Non-handled, Handled and Maternally-separated Rats



# Language comprehension score at 18 months by number of play activities (n=786)



# Language comprehension score at 18 months by number of play materials (UNICEF $n=786$ )





15 of 16 intervention studies providing cognitive stimulation show benefits to child development



Home visiting or centre based approaches

Effect size 0.5-1 SD

(Lancet child development series Paper 2)



- Focus on mother



- Paraprofessionals

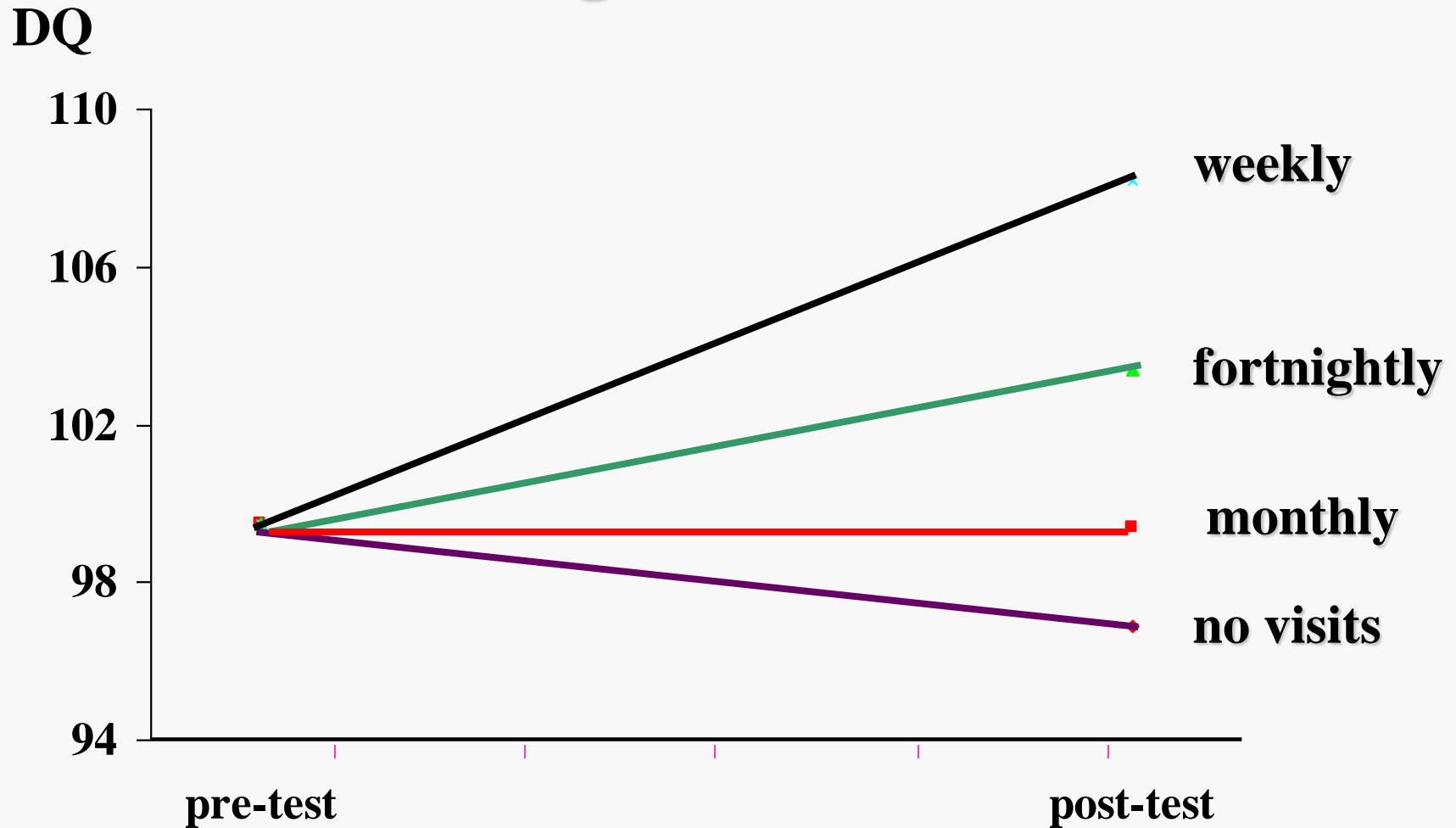




# Home made toys

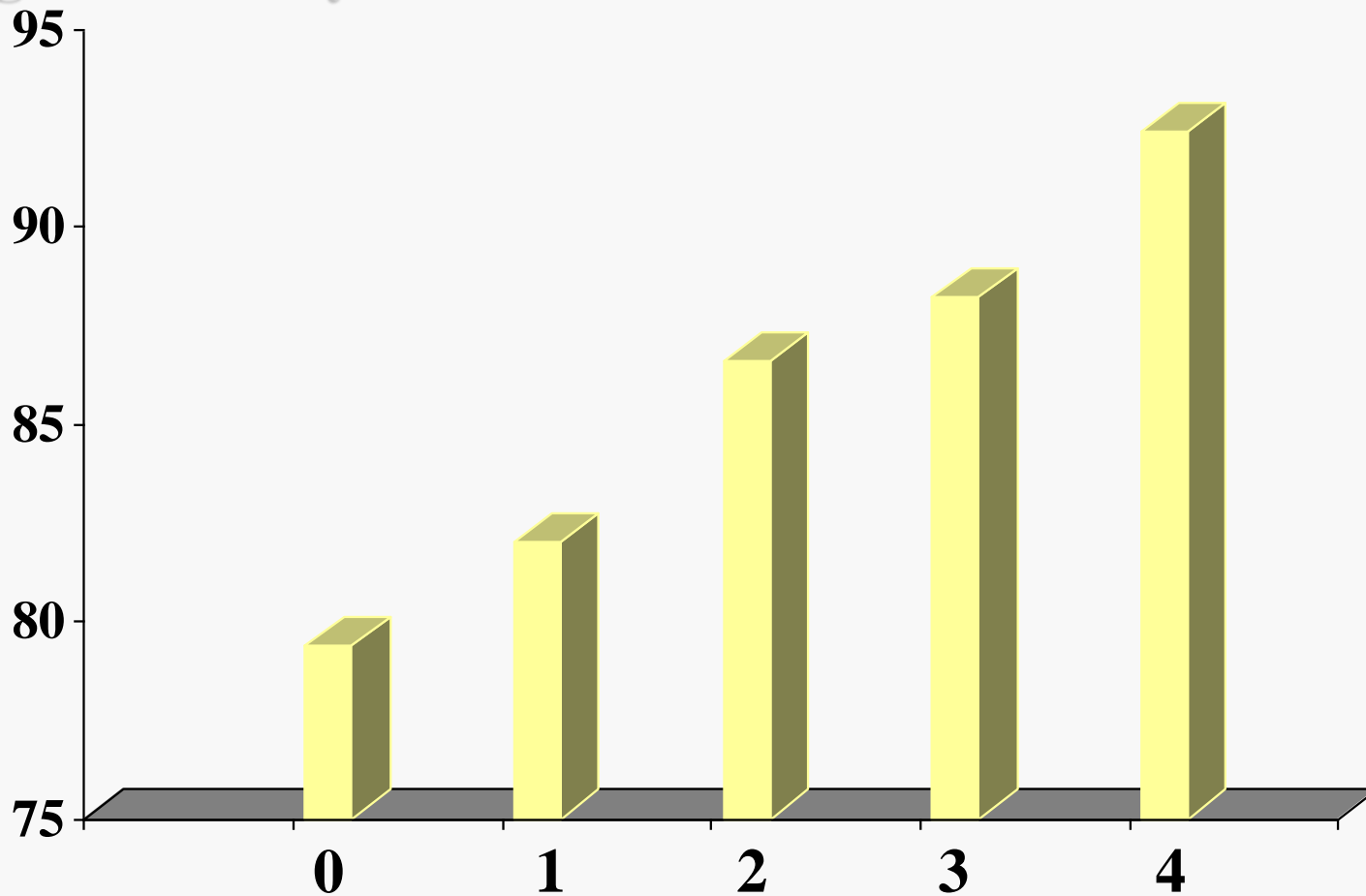


# Effects of visiting frequency in disadvantaged children: Jamaica



# Cognitive ability at 7 years by duration of intervention; Colombia

Cognitive ability



periods of intervention

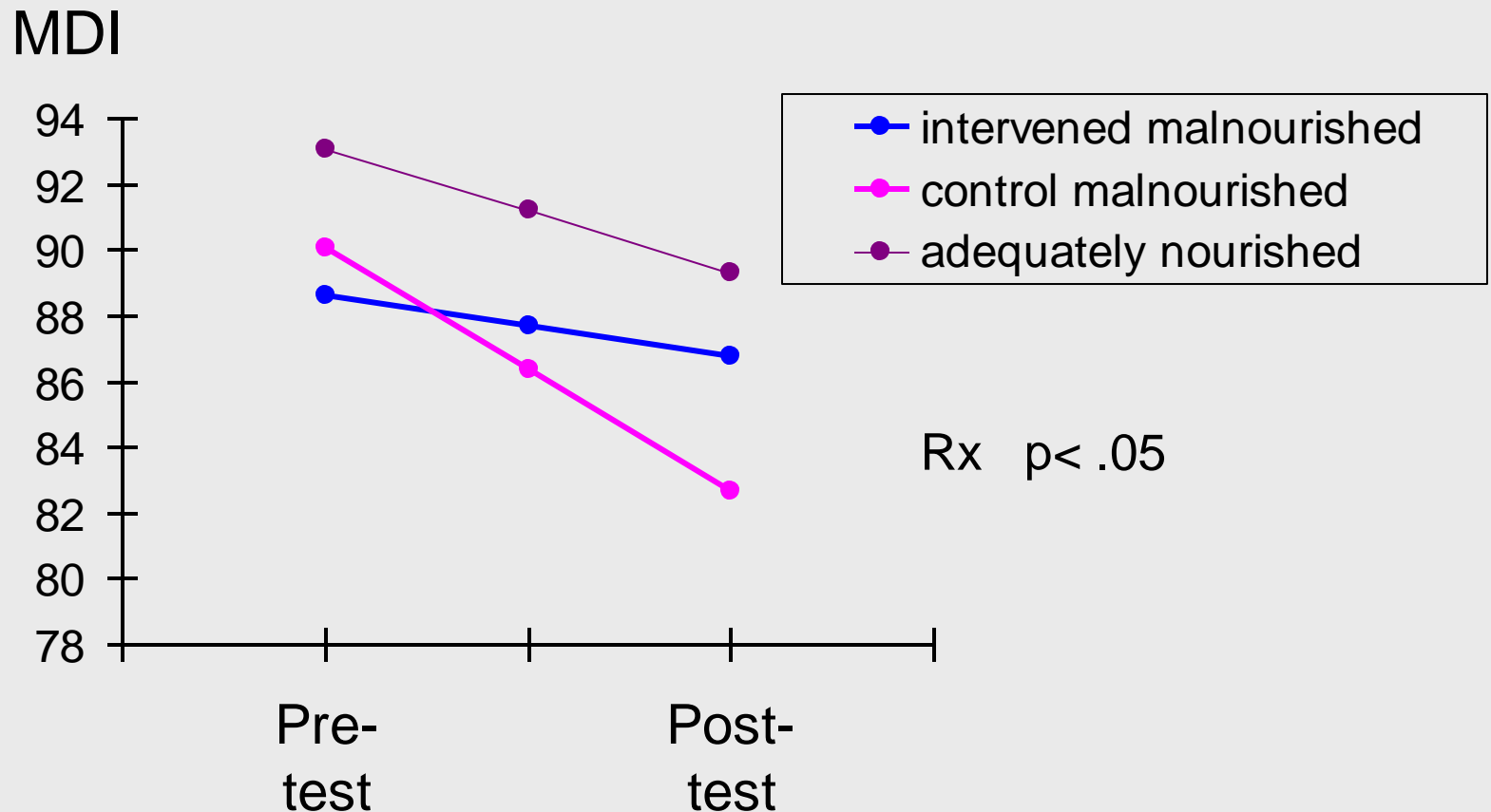
McKay et al, 1979

# RCT of 20 Community Nutrition Centres in Bangladesh (Hamadani et al, 2006)



# RCT of stimulation with malnourished Bangladeshi infants: Effect on mental development index (MDI)

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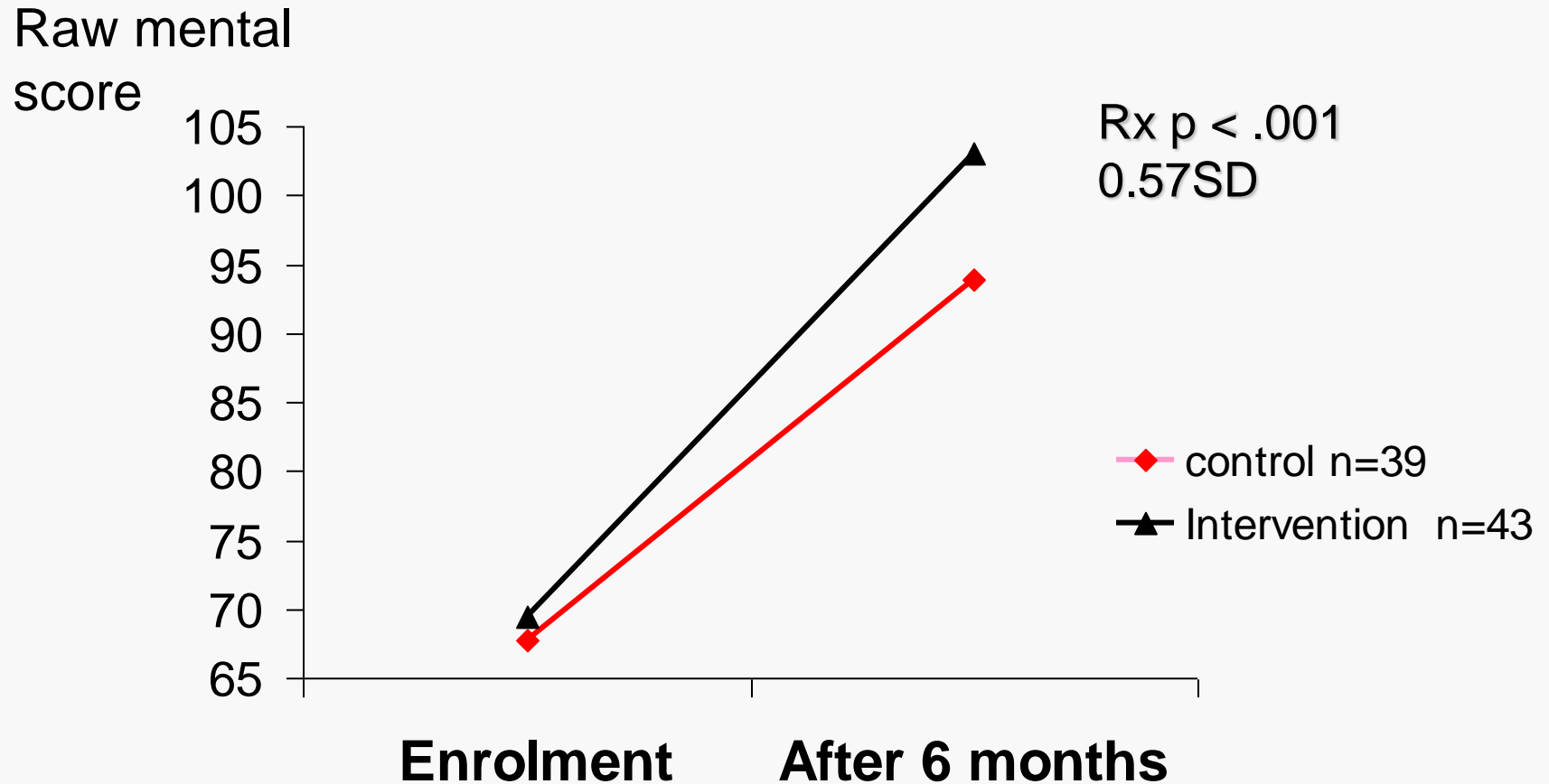
# Severely Malnourished Children in Hospital



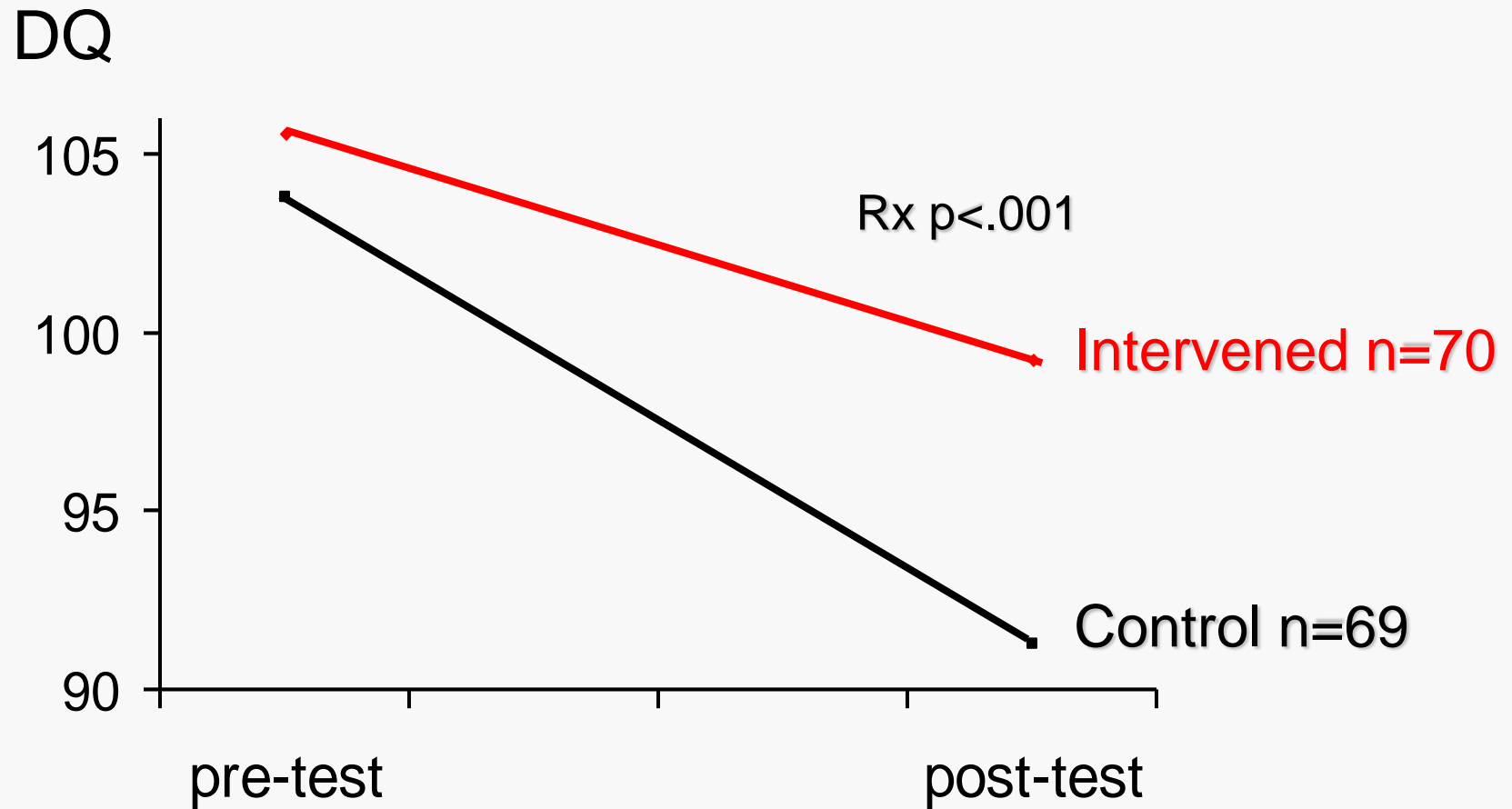


# Raw Mental Score at Enrolment & 6 Months After Leaving Hospital in Severely Malnourished Bangladeshi Children

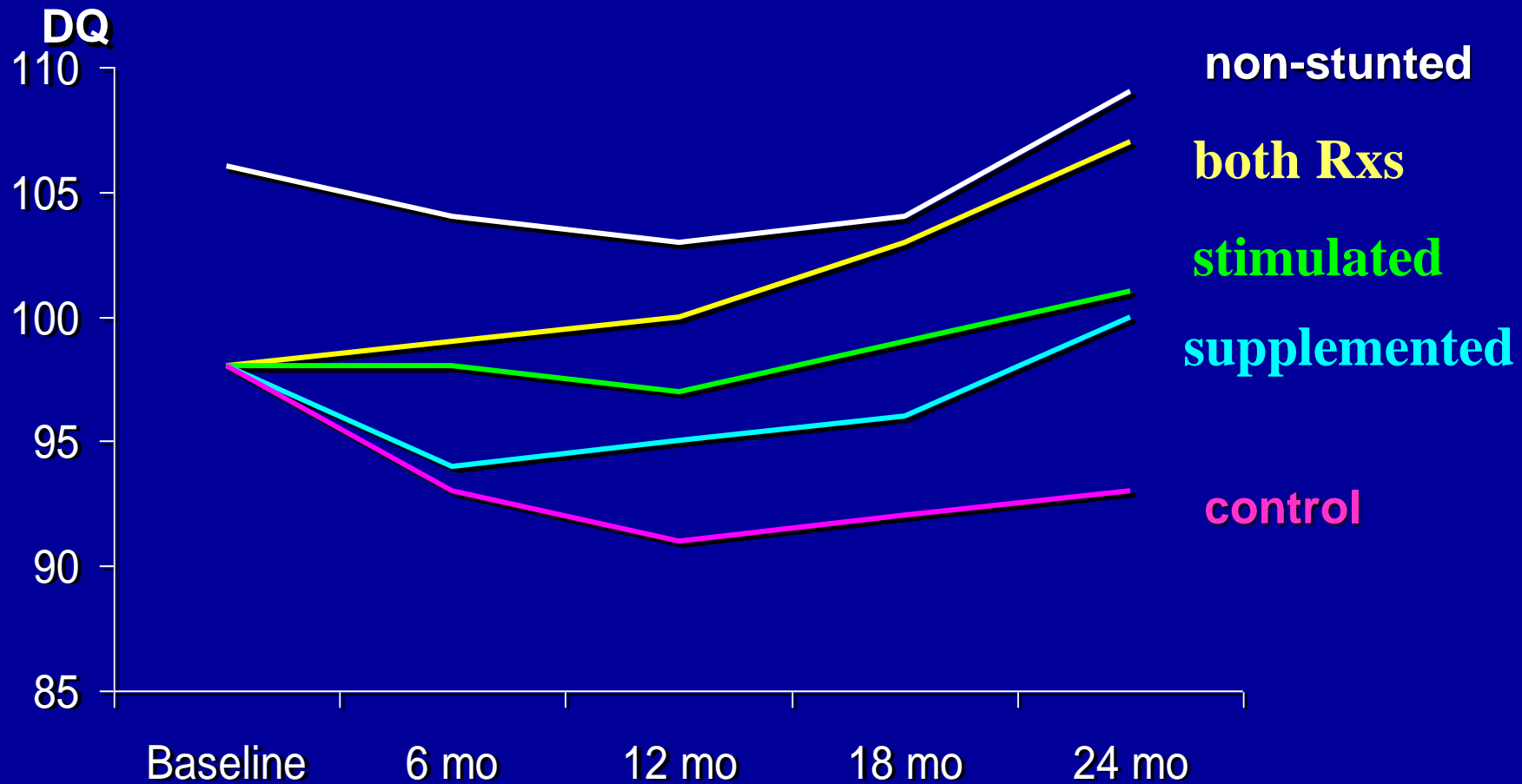
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# Primary Health Care: Effect of Intervention by PHC Staff on Children's Development Jamaica



# Integrated interventions: stunted Jamaican children aged 9-24mths



Grantham-McGregor et al, 1991

# Sustainable stimulation benefits at 17 & 21 years

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- Full IQ, verbal and performance IQ
- Reasoning, analogies, vocabulary,
- Reading comprehension & sentence completion
- Depression, anxiety, self esteem,
- Attention deficit, oppositional behavior
- Aggressive behaviour, social inhibition, general knowledge, grades attained, exams passed, depression

# Mothers' Benefits

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- Child development and child rearing knowledge ↑

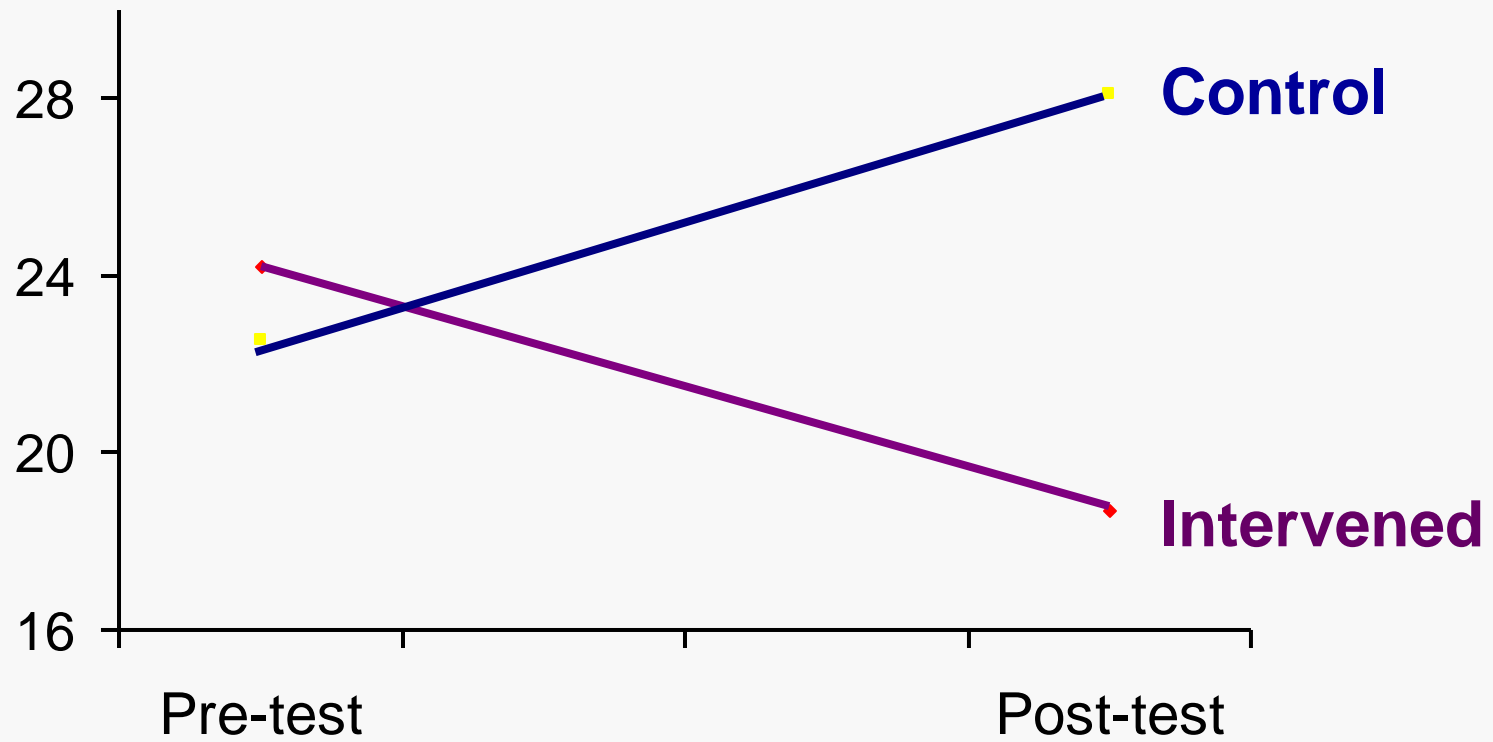
Stimulation provided in the home ↑

- Depression ↓

# Change in Maternal Depression With Intervention

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Depression

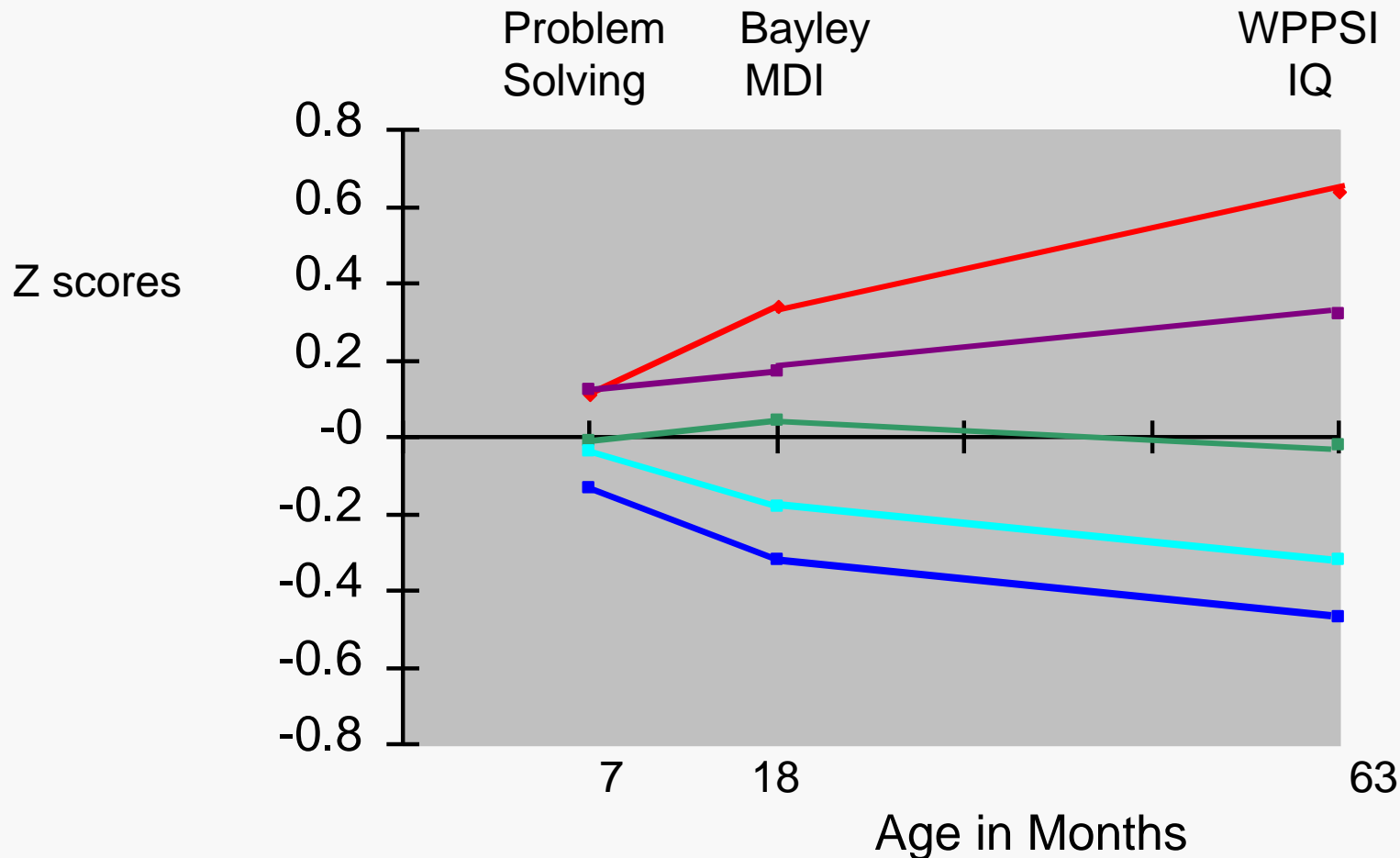


# Summary for Stimulation

- Nearly all trials have concurrent benefits
- Malnourished/LBW children can improve
- Benefits related to intensity and duration
- Can have sustained & comprehensive benefits
- Mothers benefit

# Timing of cognitive gap: Mental development by wealth quintiles at birth in 1,579 children in rural Bangladesh

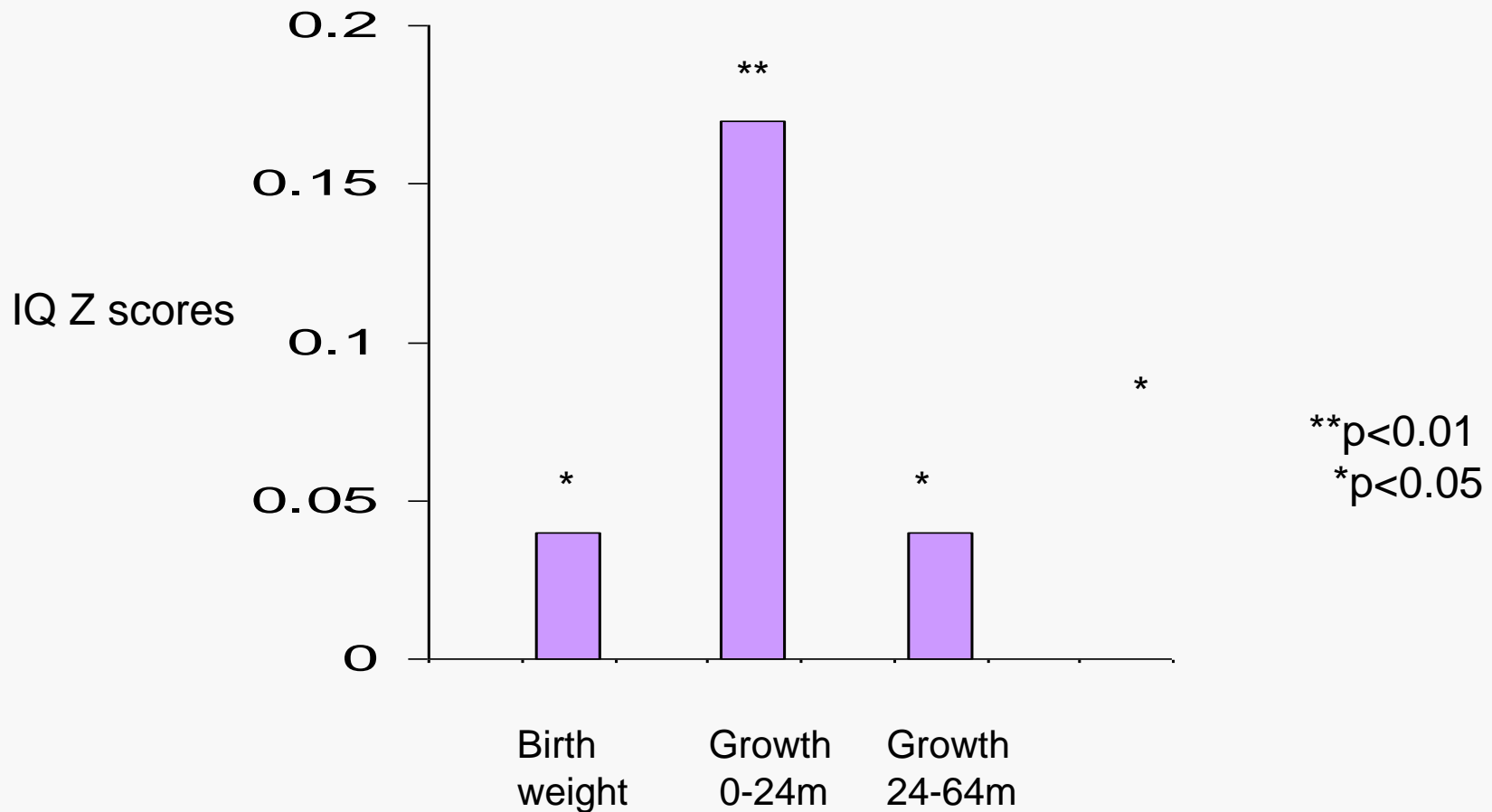
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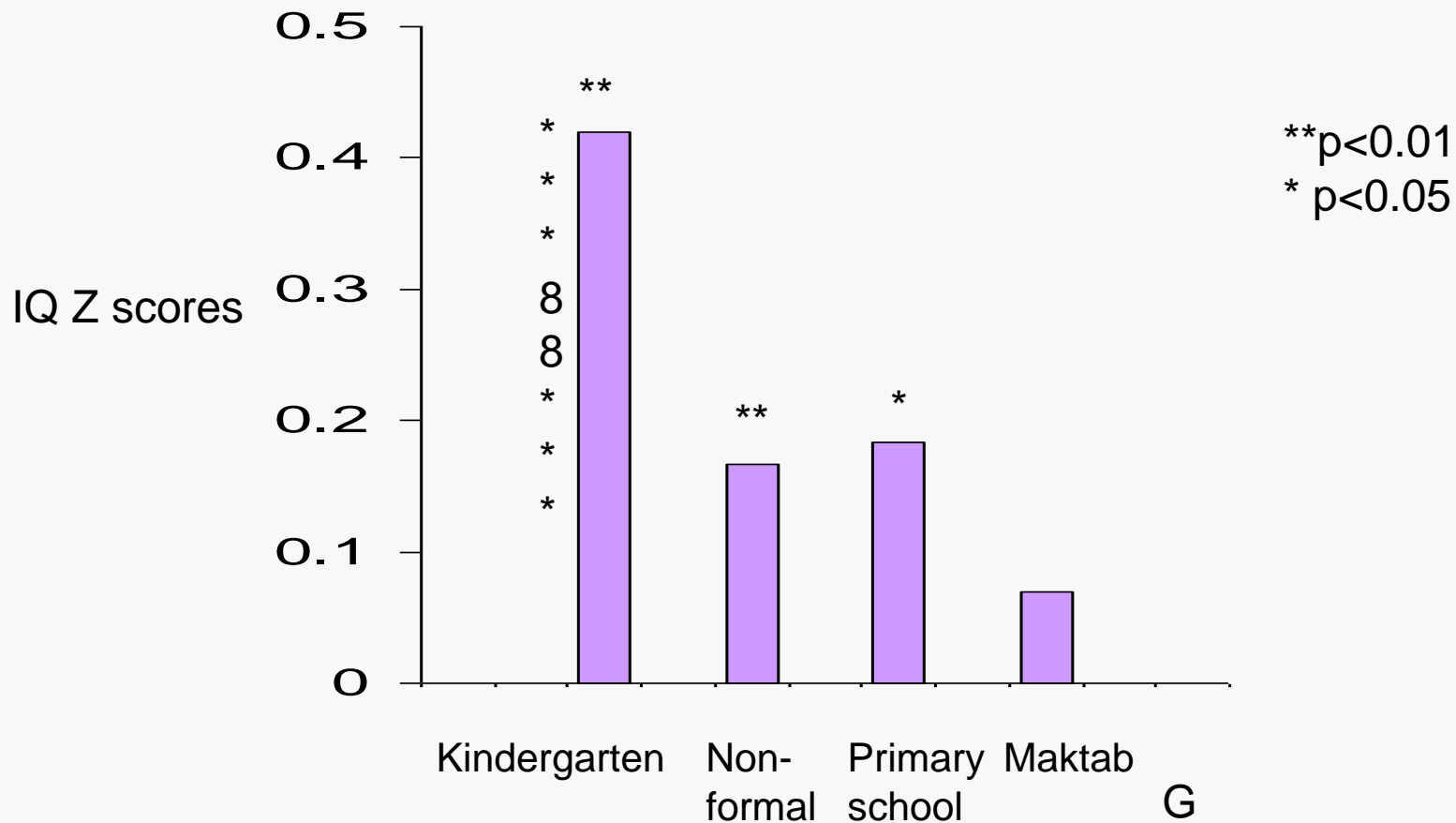
# Timing: Effect of 1 z-score of birth weight & growth in length on IQ at 5 years, controlling for SES

(n=1579)



# Timing: Effect of preschool on IQ at 5 years, (controlling for SES, nutritional status and Bayley scores at 18 months)

(n=1579)



# Implications for Future Policy

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- Urgent need to prevent enormous wastage in individual and national development
- Well evaluated projects **at scale** with long term follow up
- Explore ways of **integrating** stimulation with other services for <3 years

# Implications for Future Policy

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- health and nutrition services.
- cash transfer/ women's groups/ faith groups/microcredit groups
- Upgrade preschools

# The End



# Human Brain Development

