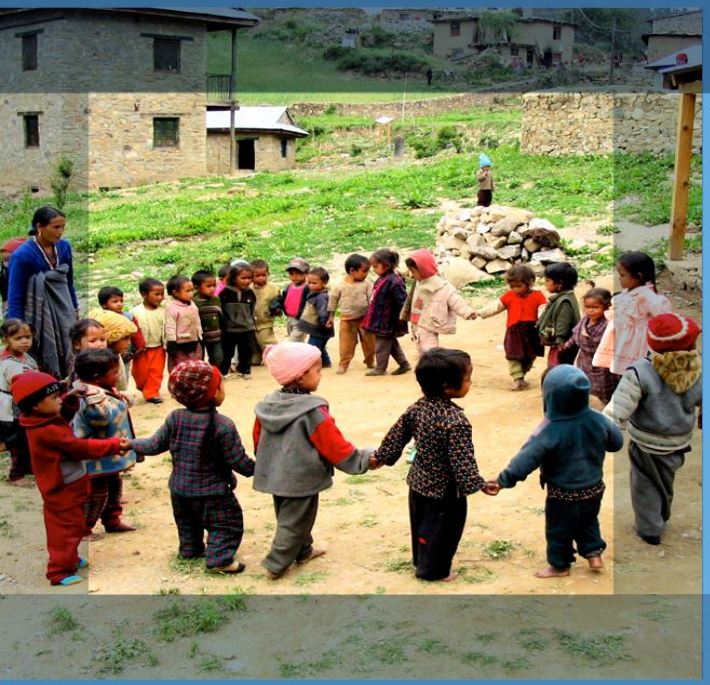

Evidence on the effects of interventions on early child development and later cognitive and educational outcomes

Palm Springs, CA February 12, 2014

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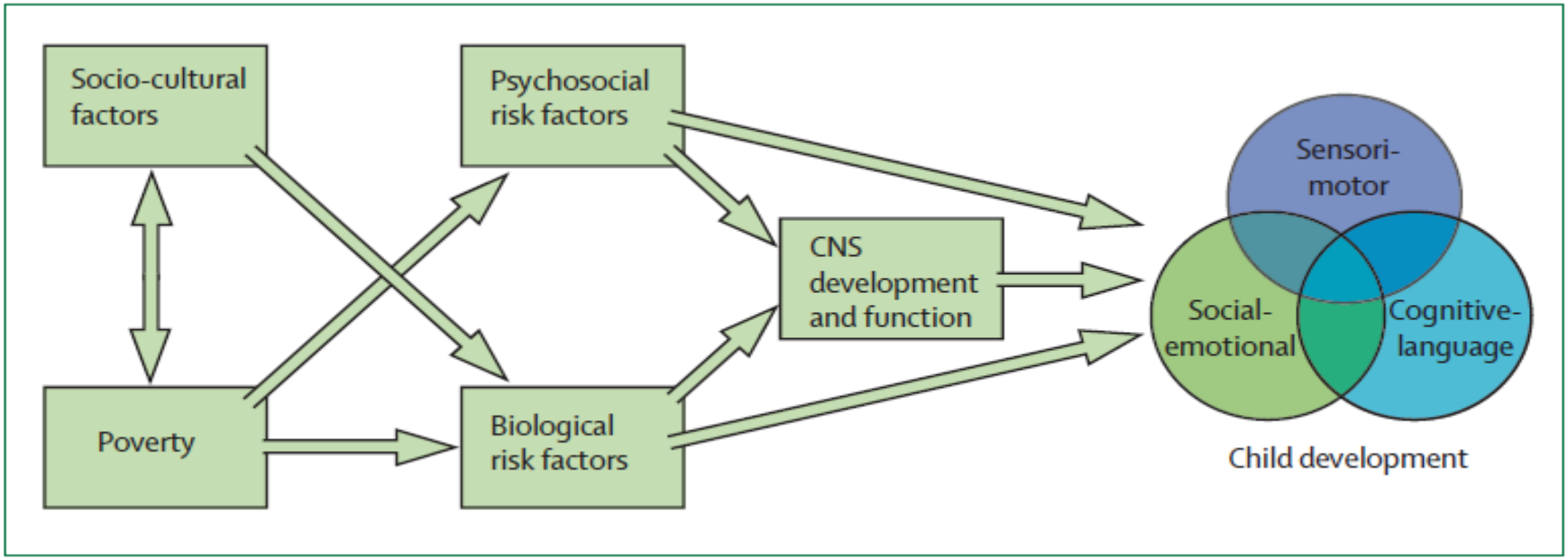
Domains of development to measure in 0-3 y.o.

- Domains of development:
  - Cognitive
  - Language
  - Motor
  - Executive function/self-regulatory
  - Social/emotional
- Domains are overlapping and mutually influencing
- Every effort should be made to include *multiple domains* when assessing children's development

Arguments for investing in under-3 year olds

- Critical timing of brain growth and development
- Risks to development start early and accumulate over time
- Effects of socio-economic status are present under three, and widen thereafter
- Nutrition, health and parenting interventions are effective in this age range
- Economic returns to early investment

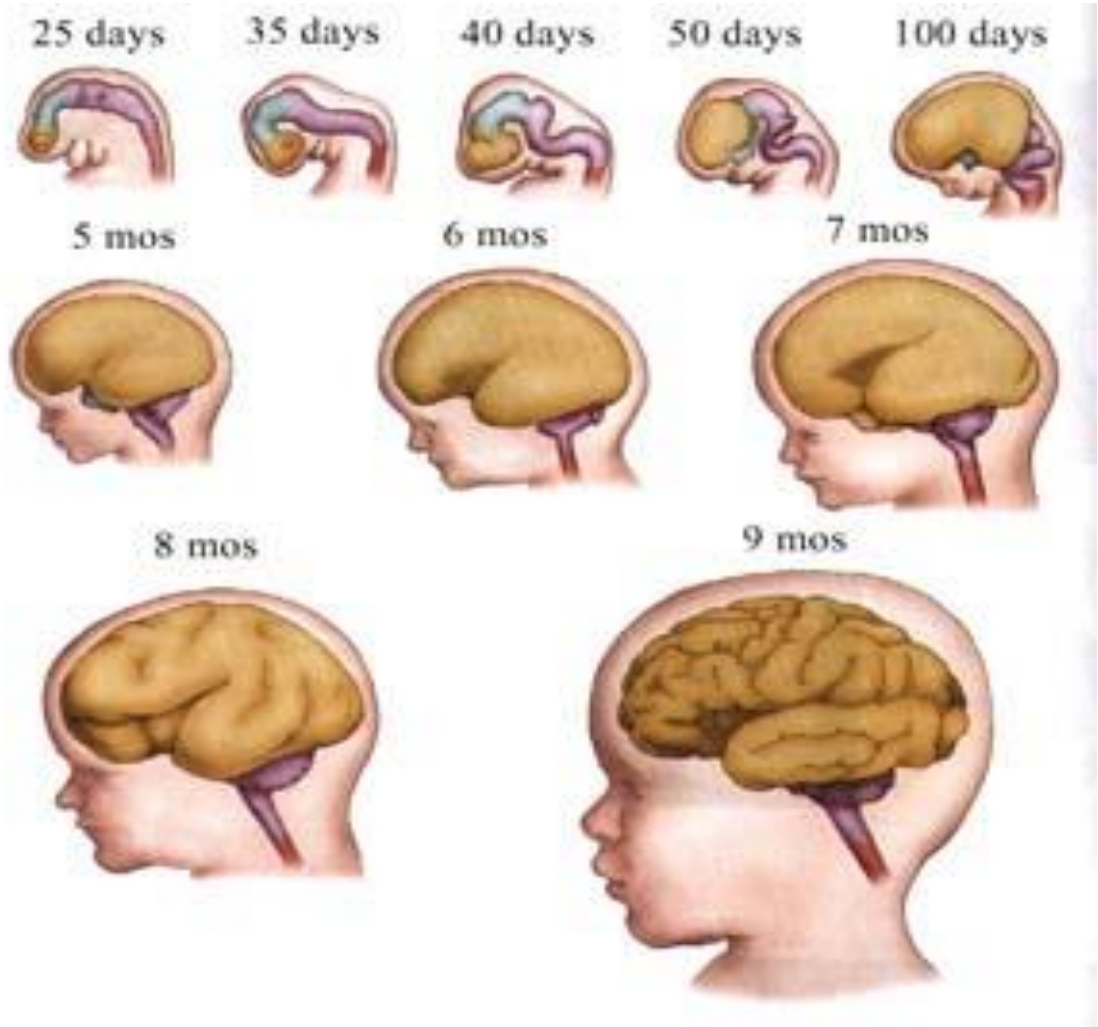
Multiple pathways: poverty to poor development



- Timing, dose and differential reactivity influence how exposure to risk translates into differences in brain function and structure
- Sensitive and critical periods in development

Walker et al., *Lancet* (2007)

90% of brain growth occurs by age 6

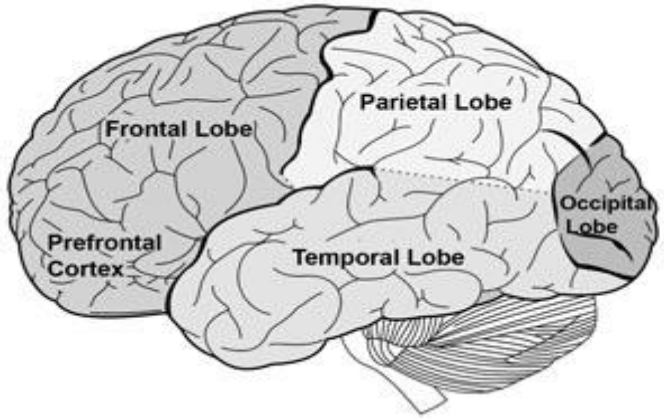


Brain Development

At birth: 25% of adult size

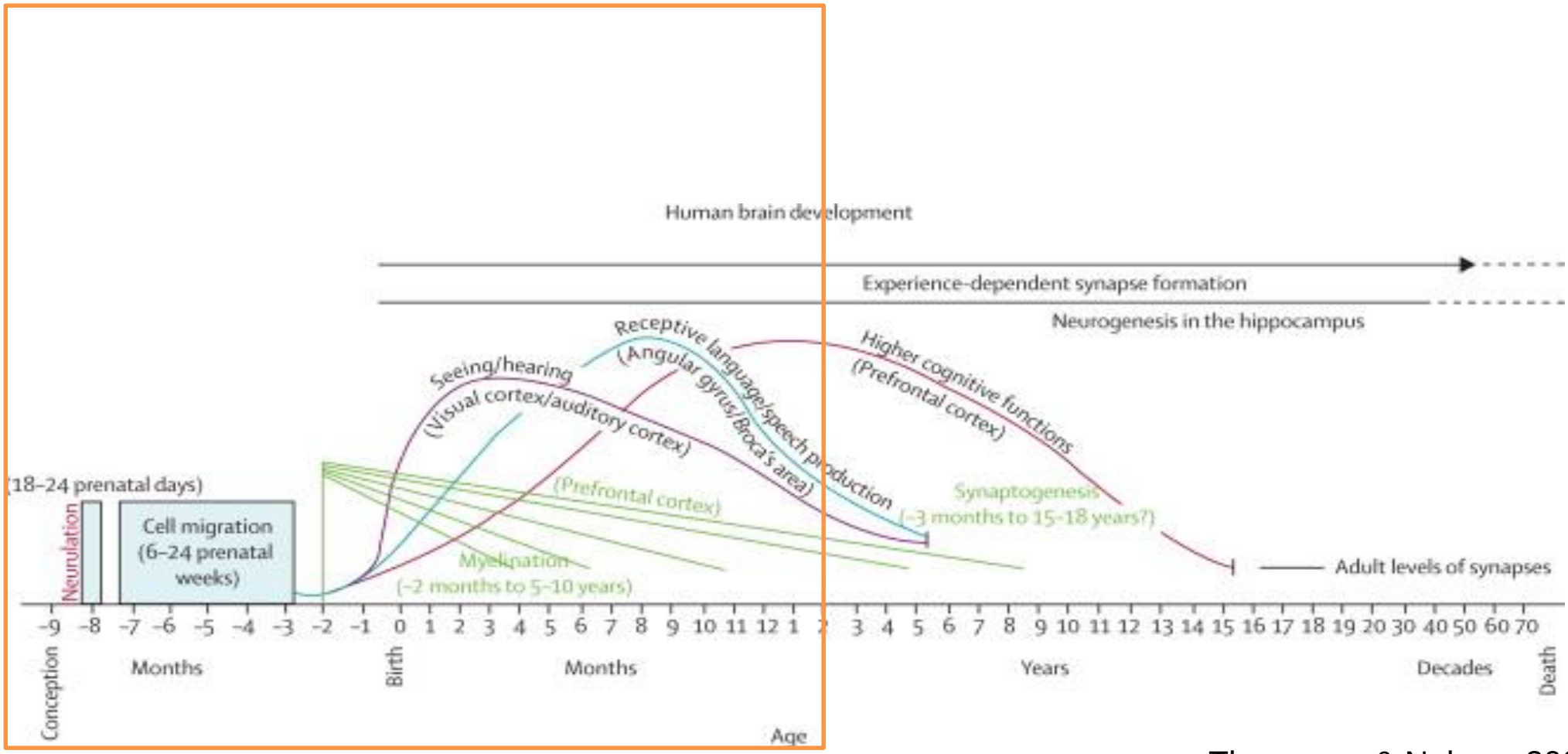
By age 2: 55 - 75% of adult size

By age 6: > 90% of adult size



Brain development in first 1000 days

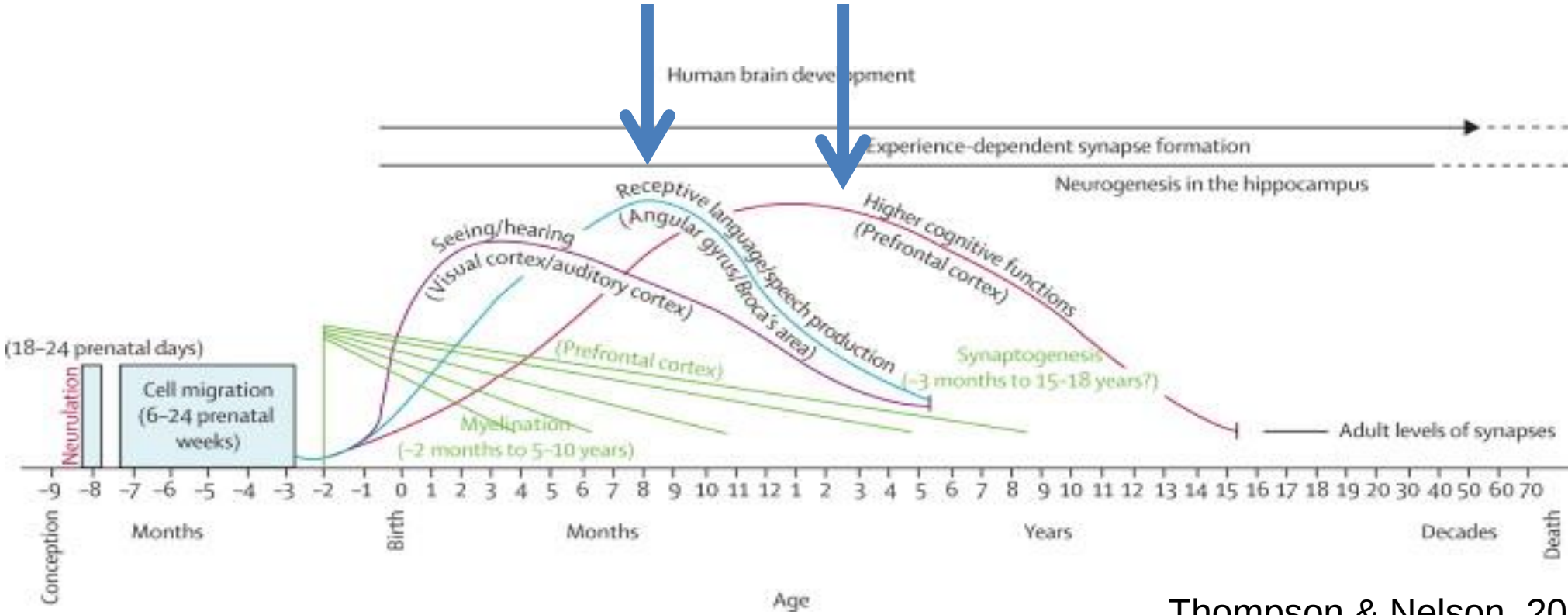
First 1000 days



Thompson & Nelson, 2001

Specific domains of developmental vulnerability

- Neurologic vulnerability in brain regions (Hackman & Farah, 2009)
- Language (perisylvian) and executive function (prefrontal) regions have a more protracted course of maturation (Farah et al., 2006; Kuhl & Rivera-Gaxiola, 2008; Mezzacappa, 2004; Noble et al., 2007; Noble, Norman, & Farah, 2005)



Thompson & Nelson, 2001

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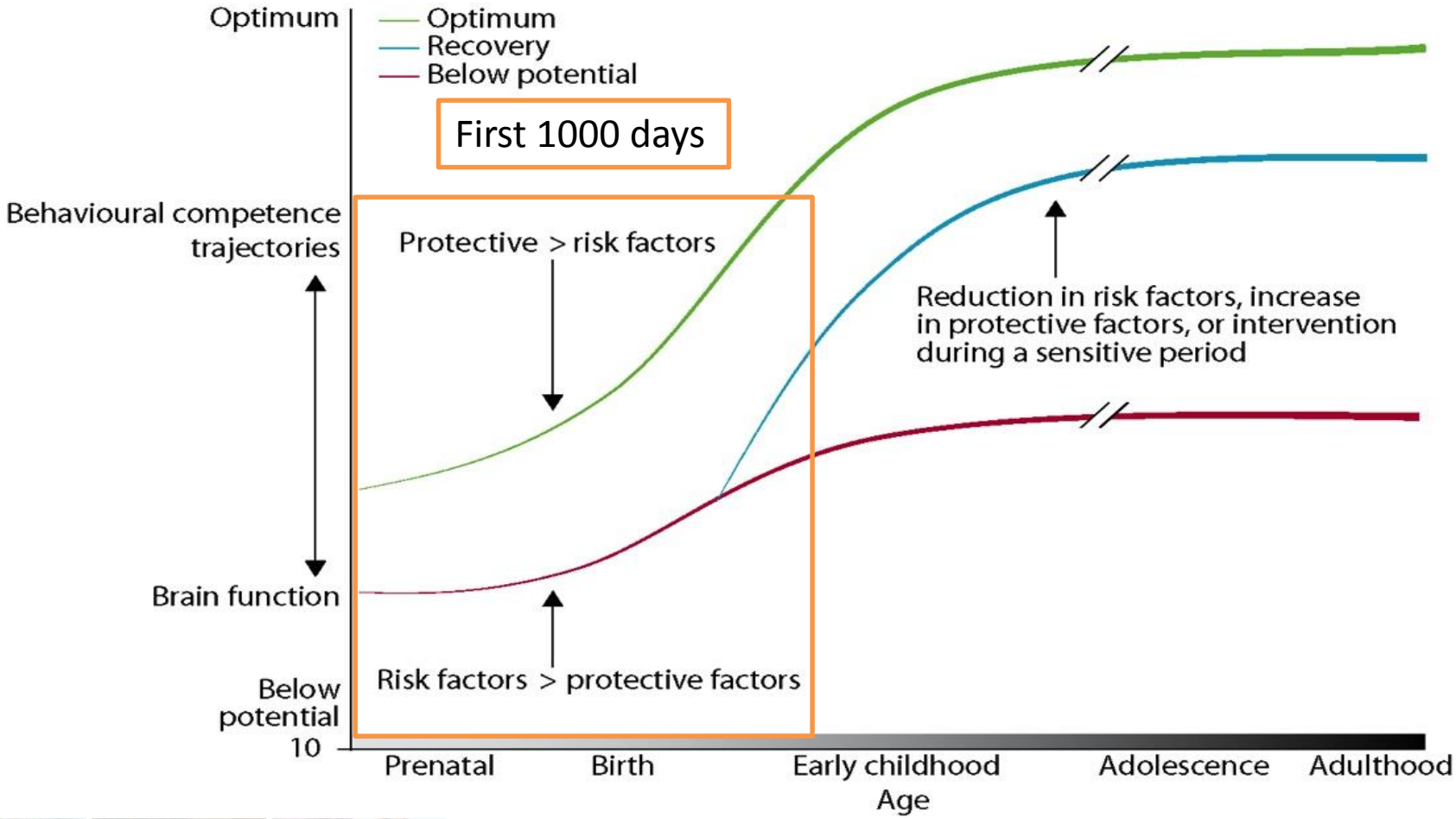
Wide array of risks that children are exposed to

- Poor housing, dangerous neighborhoods
- Lack of sanitation, clean water
- Larger family size, household crowding
- Less nutritious foods, malnutrition
- Exposure to infectious diseases, toxic metals, malaria
- Lack of access to schools and health care centers
- High levels of maternal depression

Grantham-McGregor et al. *Lancet* (2007)
Walker, Wachs et al. *Lancet* (2011)
Photo: Tricia Kariger

Risks start early and can get worse





Walker, Wachs et al., *Lancet* (2011)

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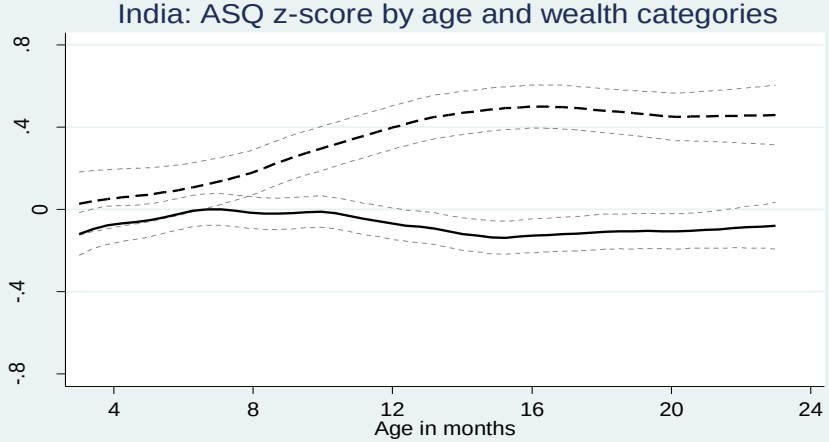
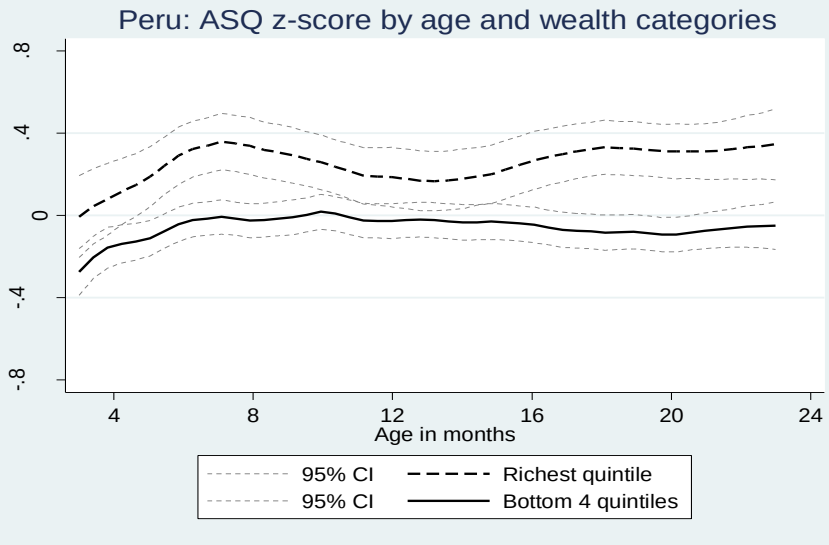
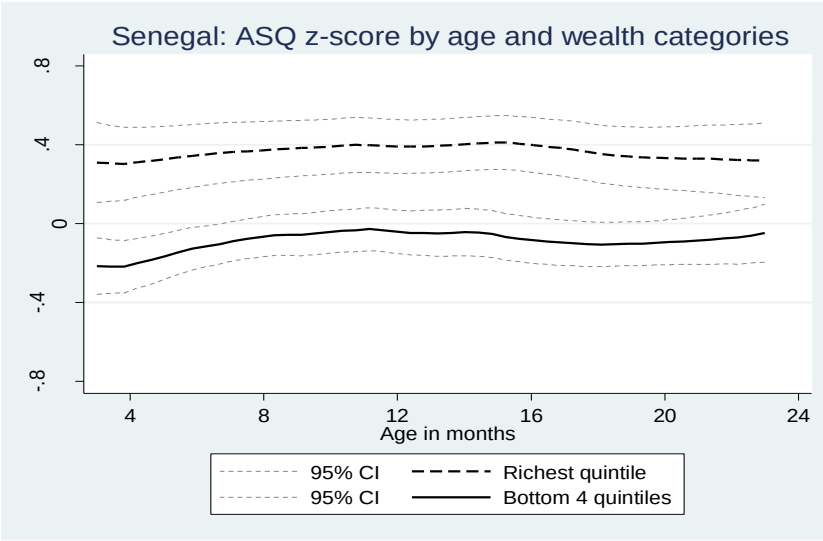
SES gradients in cognition <12 months old



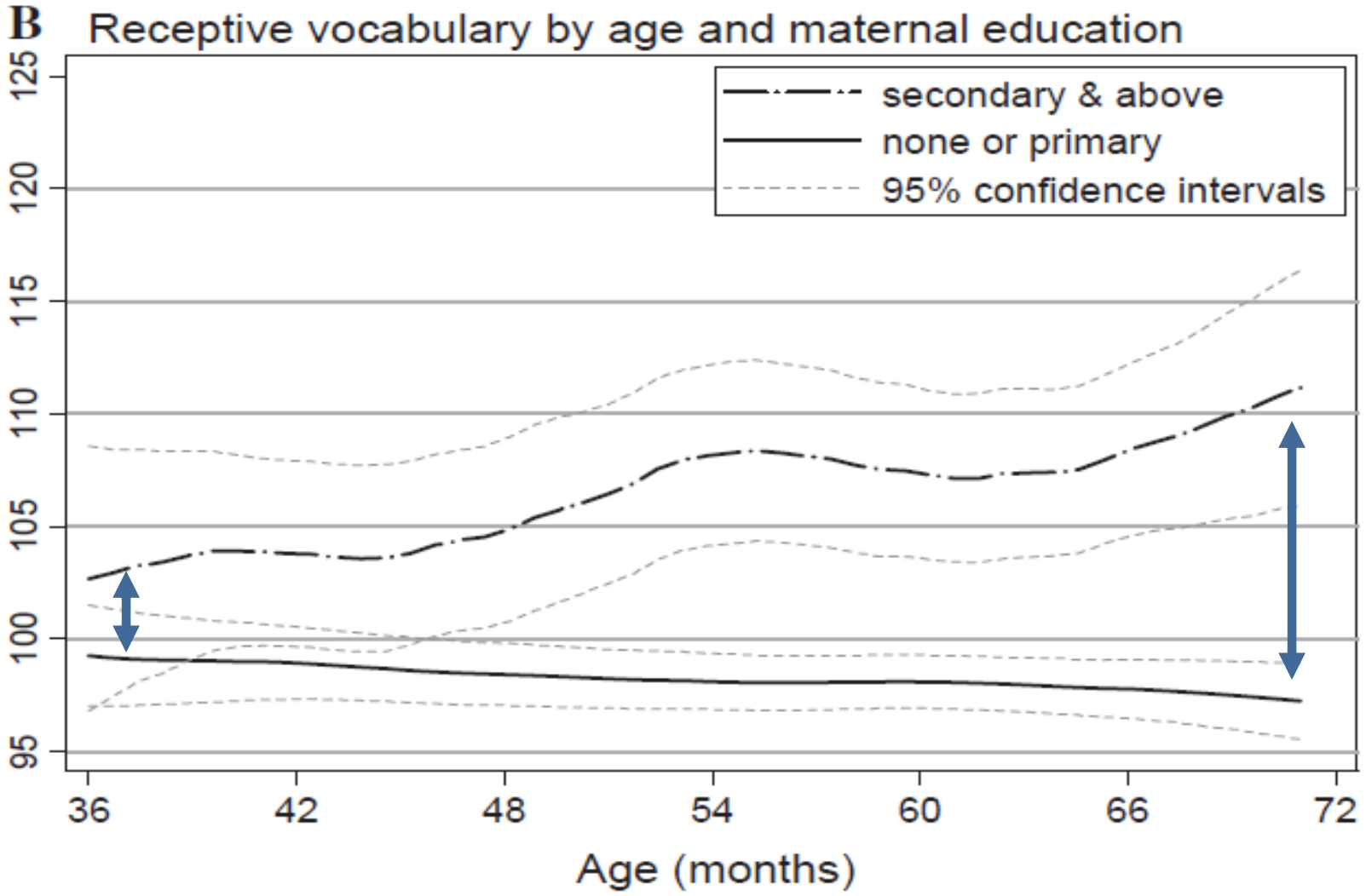




N=8727, children age 0-2, ASQ: Ages and Stages Questionnaire

Fernald, Kariger, Hidrobo & Gertler, *PNAS, 2012*

SES gradients increase with age



4 points

17 points

N=1282, children age 3-6 from rural regions in Madagascar

Fernald, Weber, Galasso, Ratsifandrihamanana, *Developmental Science (2011)*

SES differences in language scores

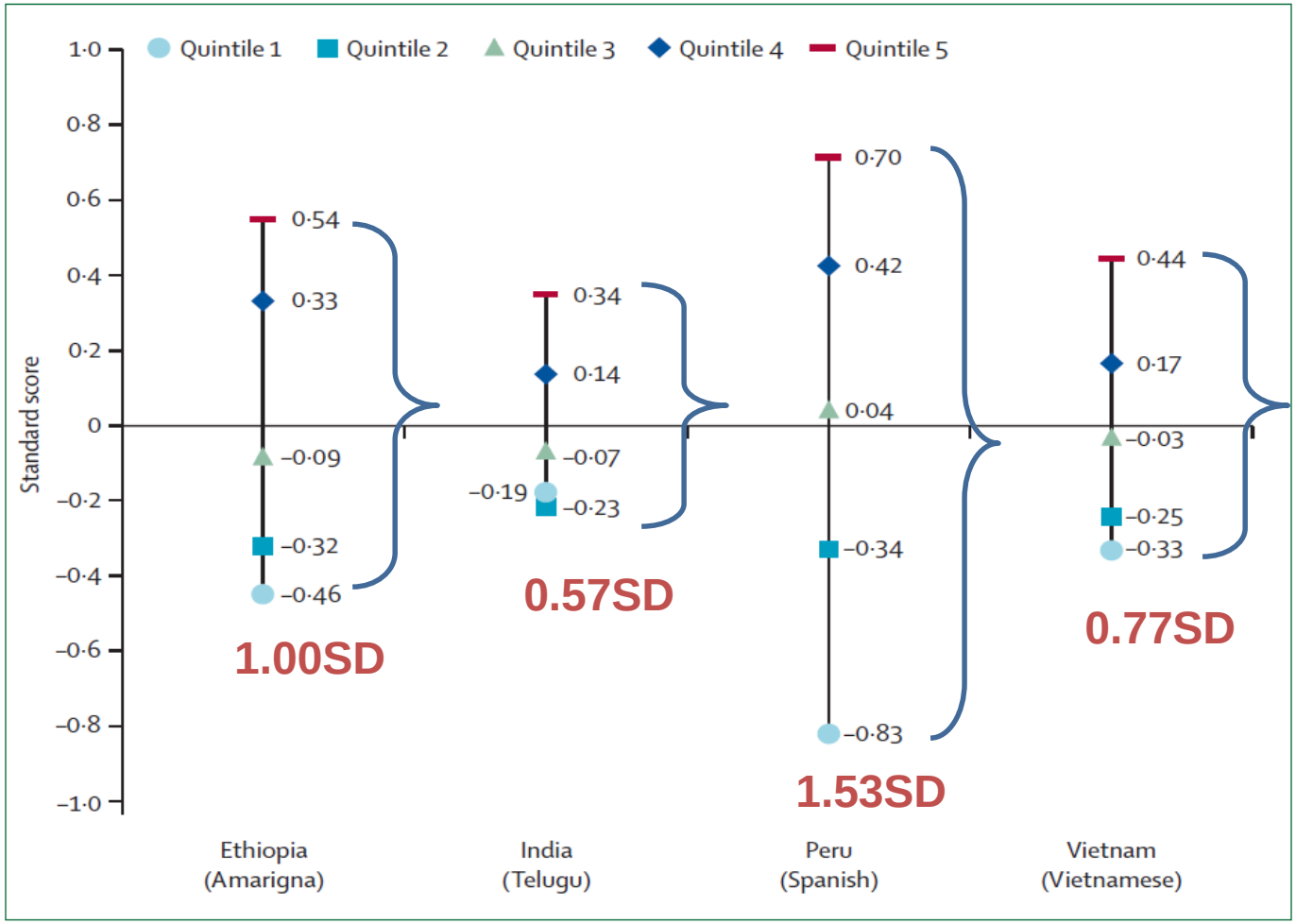


Figure 3: Peabody Picture Vocabulary Test[7] standard scores by country and quintile of expenditure
Data for children (aged 5–6 years) speaking the majority language of the region or country (in parentheses).

Lancet, 2011

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Interventions with best evidence for improving ECD

Risk: Undernutrition	Interventions
Severe acute malnutrition & stunting Extensive evidence for impact on development in early childhood. Predicts long term outcomes including IQ, educational achievement, mental health.	**Breastfeeding** - to promote growth and independent benefits for cognition **Improved complementary feeding** **Energy-protein (food) supplementation** for concurrent child development. Some evidence of long term benefits, if intervention begins early.

Walker, Wachs et al., *Lancet* (2011)

Interventions with best evidence for improving ECD

Risk: Micronutrient deficiencies	Interventions
Iodine: Major impact of severe deficiency; also effects from mild-moderate deficiency	**Iodine fortification programs:** good evidence of effectivenes
Iron deficiency anemia: Infants with IDA show developmental deficits and follow-up studies suggest continued deficits	**Iron supplementation**– inconsistent benefits for iron supplementation in early childhood (<3y), most benefits to motor development
Multiple micronutrient deficiencies	**Multiple micronutrient supplementation** – benefits to motor development, other domains inconsistent

Walker, Wachs et al., *Lancet* (2011)

Interventions with best evidence for improving ECD

Risk: Infection	Interventions
Malaria: Children < 5y at greatest risk of neurological effects including language and cognitive deficits. Repeated attacks have also been associated with poorer cognitive ability at school entry.	**Prevention** e.g. through increased access and use of bed nets. Chemoprophylaxis in early childhood associated with later educational benefits.
HIV: Infected children have lower developmental levels. Children affected by parental HIV increased exposure to other developmental risk factors.	**Prevention** of mother-child transmission. HAART may benefit development, few studies from LMIC.

Walker, Wachs et al., *Lancet* (2011)

Nutrition and health are essential, but…

Substantial gains in children's development require:

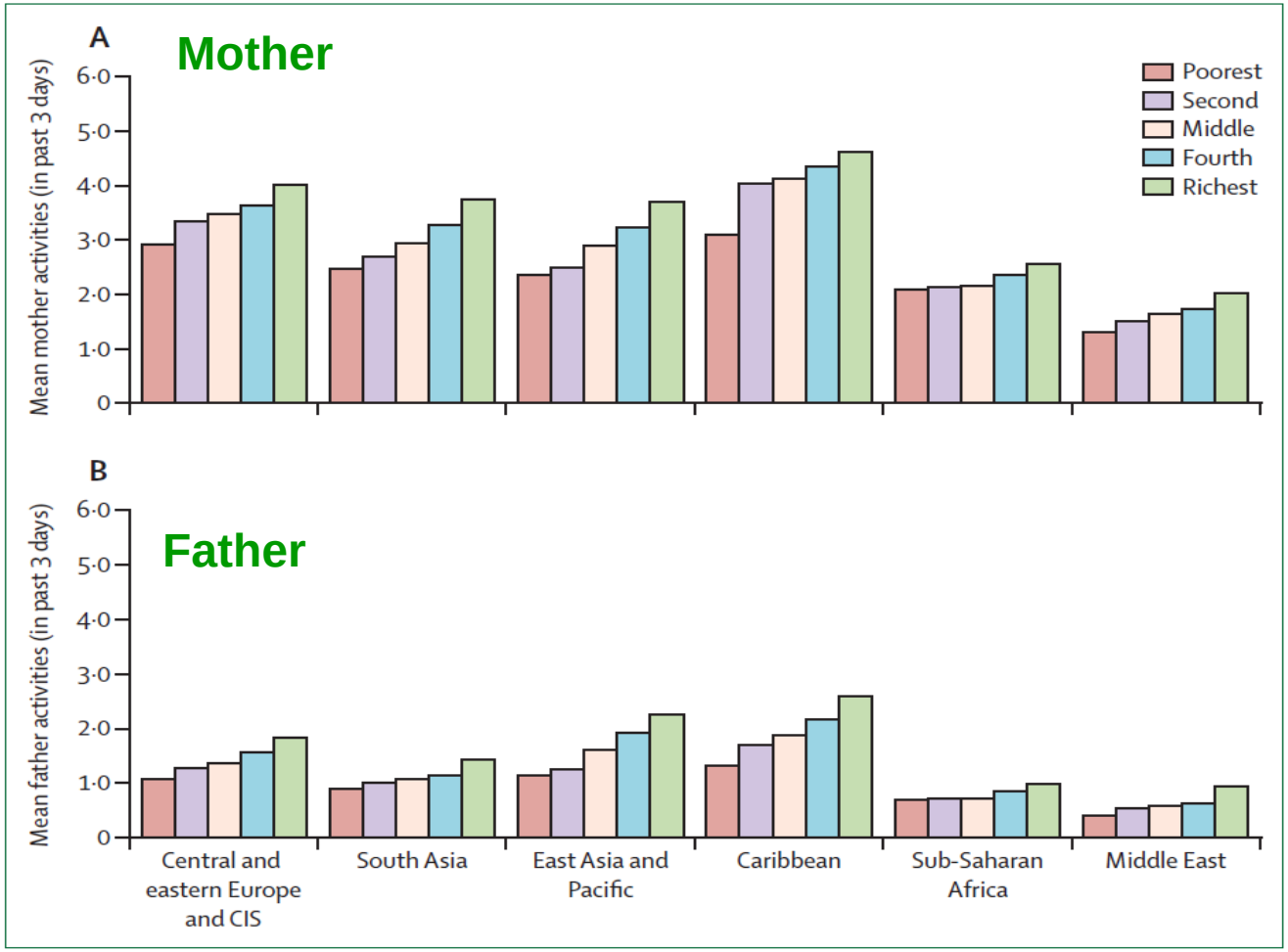
- Improvements in parenting, home stimulation and early education
- Increases in protective influences such as maternal education that reduce impact of risks
- Social protection including reductions in stressful experiences including maternal depression and exposure to violence

Parenting/early education

Risks	Interventions
Lack of quality caregiver-child interaction, lack of learning opportunities (stimulation)	Consistent evidence that parenting interventions delivered through home visits benefit development. Evidence for continued benefits to adulthood. Need for more evaluations of other delivery platforms and of programs at scale.
Lack of access to preschool education.	Increasing enrolment reduces disparities in schooling attainment. Improving quality increases cognitive and early educational scores

Engle, Fernald, Alderman et al. Lancet, 2011

SES differences in parent-child activities



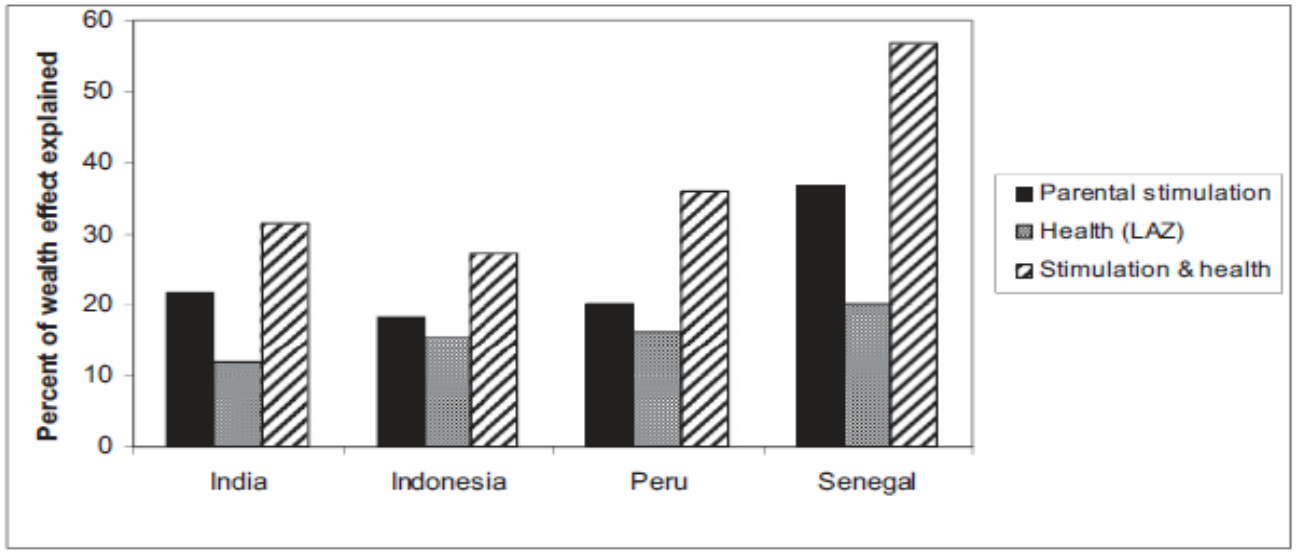
Only 1-3 activities with children in past 3 days for poorer income quintiles

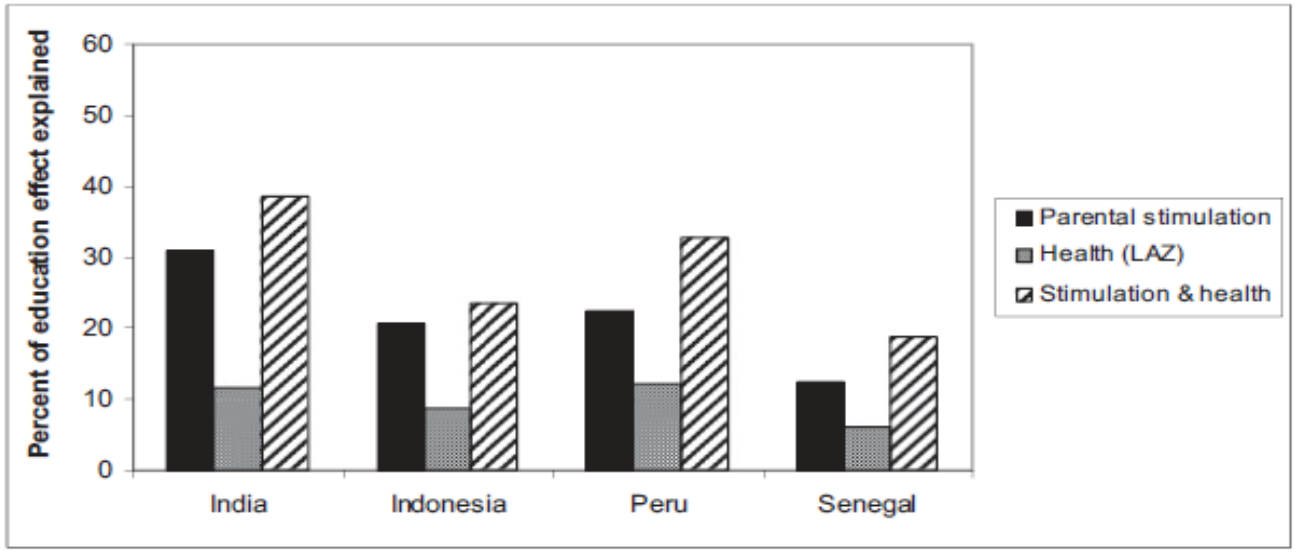
0-1 activities with children in past 3 days for poorer income quintiles

Figure 2: Mother's (A) and father's (B) total activities in the past 3 days by sampled countries within region and within-country wealth quintile for 38 countries

Engle, Fernald, Alderman et al. Lancet, 2011

Parental stimulation crucially important





Parental stimulation measured using Family Care Index. Includes questions about:

- Availability of books and play materials at home;
- Activities with parent or other adult including reading books, singing songs, telling stores, playing, teaching about letters, numbers and concepts;
- Outings that take child outside the home

N=8727, children age 0-2, ASQ: Ages and Stages Questionnaire

Fernald, Kariger, Hidrobo & Gertler, *PNAS, 2012*

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Estimating benefits of investing in early child development

- Used data from 73 countries (population ~=3 billion) to estimate long-term effects of one type of ECD intervention – preschool.
- Estimated association between schooling gap (between wealthiest and poorest quintile) and preschool enrollment 8-12 years earlier
- Calculated projected economic gain from decreasing gap through increasing preschool enrollment (as present value of added wage productivity)

Engle, Fernald, Alderman et al. Lancet, 2011

Benefit-to-cost calculation

Benefits due to increasing preschool enrollment: $4.7 to $33.7 billion USD, depending on model

	Actual values	Projected values with minimum preschool enrolment of 25%	Projected values with minimum preschool enrolment of 35%	Projected values with minimum preschool enrolment of 50%
PDV of lifetime earnings (3% discount rate) for one cohort (2008 US$ billions)	..	$10·64	$18·73	$33·72
PDV of lifetime earnings (6% discount rate) for one cohort ($ billions)	..	$4·73	$8·32	$14·97
Total costs due to increasing preschool enrolment ($ billions)	..	$0·74	$1·18	$1·92
Benefit-to-cost ratios				
3% discount rate	..	14·3	15·8	17·6
6% discount rate	..	6·4	7·0	7·8

Our sample consists of 73 countries with a population of about 3 billion with preschool data from 1998–2007. We dropped Bangladesh, Namibia, and Tanzania from our sample because of inconsistent statistics in the preschool enrolment rates. The schooling gap is the gap in median years of schooling between the wealthiest quintile and each of the other quintiles for individuals 15–19 years old.[95] The benefits due to increasing enrolment were calculated with estimates from an ordinary least squares (OLS) regression of average schooling gap on preschool enrolment from 8 to 12 years before the schooling gap statistic,[96] gross domestic product per capita, and Gini.[97] Estimates from OLS regression were used to simulate the schooling gap under three scenarios with preschool enrolment floors of 25%, 35%, and 50%. The economic benefit from decreasing the schooling gap through increasing preschool enrolment was calculated as the present discounted value (PDV) of added wage productivity under the assumption that earnings are zero for first 12 years after preschool and then are equal to yearly average earnings incremented by the average rates of return to schooling for the subsequent 45 years. For the benefit-to-cost ratio, we used the median cost per preschool student in 2004 from UNESCO data on 38 low-income and middle-income countries (US$77·50) adjusted to show the 2008 values ($88·34).

Table 3: **Analysis of benefits and costs of increasing preschool enrolments**

Engle, Fernald, Alderman et al. Lancet, 2011

Benefit-to-cost calculation

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Costs due to increasing preschool enrollment, $0.74-$1.92 bill ($88 per year for one child)

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Benefit-to-cost calculation

	Actual values	Projected values with minimum preschool enrolment of 25%	Projected values with minimum preschool enrolment of 35%	Projected values with minimum preschool enrolment of 50%
Mean preschool enrolment, 8–12 years before data for schooling gap	17·6%	30·6%	38·3%	51·1%
Total number of children aged 5 years enrolled, 8–12 years before data for schooling gap (millions)	11·4	19·8	24·8	33·1
Mean estim				
Benefits due				
PDV of life				
PDV of life				
Total costs d				
Benefit-to-cost ratios				
3% discount rate	..	14·3	15·8	17·6
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Benefit-to-cost ratio ranging from 6.4 to 17.6, depending on model specifications

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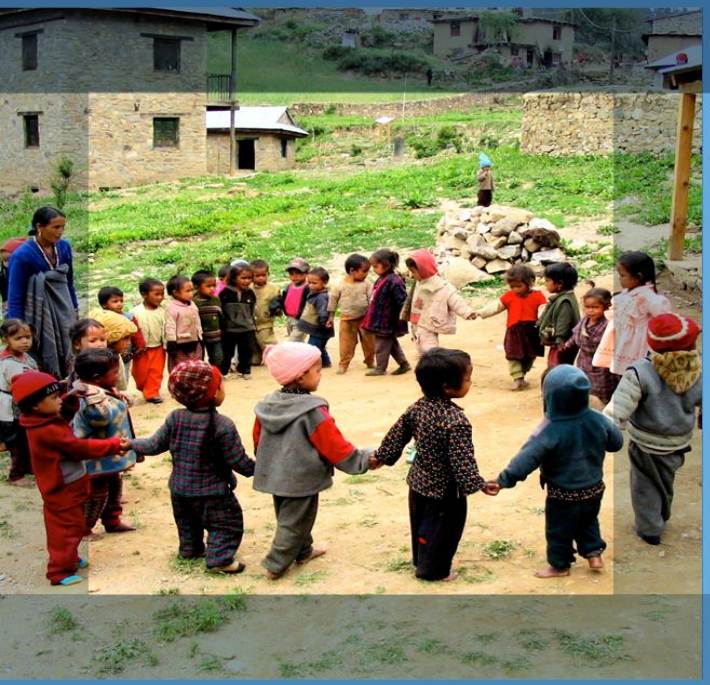
Summary: Benefit-to-cost ratio of 6.4 – 17.6

- Benefit-to-cost ratio from 6.4 to 17.6, depending on what percent of preschool children enrolled in each LAMI country (25% - 50%)
- Estimated increase in future earnings was calculated to be US $11 - 34 billion
- Conservative estimate – because only one early child development intervention
- Results robust to inclusion of height-for-age and mortality rate as a proxies for child health status

Engle, Fernald, Alderman et al. Lancet, 2011

Conclusions

- Preschool aged children are very vulnerable due to critical biological and brain processes occurring in this age range.
- Nutrition and health interventions can promote development but will be insufficient for substantial gains
- Children in this age range can benefit greatly from parenting and preschool interventions targeting cognitive, language and socio-emotional development, with sustained benefits
- There are significant “returns to investment” in early childhood as demonstrated by gains from increasing preschool enrolment.



Thank you!

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