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Socioeconomic gradients in child development in very young children: Evidence from India, Indonesia, Peru, and Senegal

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Gradients across socio-economic position exist for many measures of children's health and development in higher-income countries. These associations may not be consistent, however, among the millions of children living in lower- and middle-income countries. Our objective was to examine child development and growth in young children across socio-economic position in four developing countries. We used cross-sectional surveys, child development assessments, measures of length (LAZ), and home stimulation (Family Care Index) of children in India, Indonesia, Peru, and Senegal. The Extended Ages and Stages Questionnaire (EASQ) was administered to parents of all children ages 3–23 mo in the household (*n* =8,727), and length measurements were taken for all children 0–23 mo (*n* = 11,102). Household wealth and maternal education contributed significantly and independently to the variance in EASQ and LAZ scores in all countries, while controlling for child's age and sex, mother's age and marital status, and household size. Being in the fifth wealth quintile in comparison with the first quintile was associated with significantly higher EASQ scores (0.27 to 0.48 of a standardized score) and higher LAZ scores (0.37 to 0.65 of a standardized score) in each country, while controlling for maternal education and covariates. Wealth and education gradients increased over the first two years in most countries for both EASQ and LAZ scores, with larger gradients seen in 16–23-mo-olds than in 0–7mo-olds. Mediation analyses revealed that parental home stimulation activities and LAZ were significant mediating variables and explained up to 50% of the wealth effects on the EASQ.

income inequality | low-income countries | poverty

Living with low socioeconomic position (SEP) is a critically important risk factor for poor child health, and it has negative consequences for a wide range of other outcomes. Studies in the United States have shown consistent SEP gradients for child health outcomes, including asthma, headaches, ear infections, and diabetes (cf. refs. 1–6). Disparities are present even in European countries, where smaller disparities in income exist (7), and these early differences can persist into adolescence and adulthood (8–10). Several studies have found that differences between children from rich and poor households increase with age (11, 12), but others have found no differences across age (1, 7).

Significant effects of social position have also been found for child behavior, language, memory, and executive function in infancy and childhood and across the lifespan (2, 13–16). Gradients are present in older children from the United States and The Netherlands relating to behavior problems (8- to 16-y-old children) (17) and cognitive performance (14-y-old) (18). Studies examining data from multiple higher-income countries suggest that countries with better social policies (e.g., a long history of welfare state regimes) have flatter gradients in reading skill among 15-y-old children (19).

The extensive and negative consequences of poverty on children are caused not just by the lack of household economic resources or parental education but also by a wide range of risk factors and exposures associated with poverty; these factors include poor housing, dangerous neighborhoods, household crowding, pollution, less stimulating learning environments, and less responsive parenting (2, 13–15, 20–23). These interrelated and mutually reinforcing factors also include quality of parental care, family dynamics, and environmental characteristics (3, 24–26). Children suffer not just from this wide range of detrimental factors that they experience at any point in time, but also because they are exposed to a greater total number of these factors cumulatively across the course of their lives (3, 18). Low SEP contributes directly to poor outcomes through these risk factors and poor child outcomes negatively feed back to affect future SEP in a continually interactive and dynamic process (27).

In low- or middle-income countries, most children live in conditions of even greater financial deprivation than poor children in higher-income countries. They are exposed to a lack of sanitation facilities and clean water, larger family size, lack of access to schools and healthcare centers, less nutritious foods, micronutrient deficiencies, and exposure to infectious diseases and toxic metals (25, 28, 29). In such settings with multiple sources of deprivation, the negative consequences of poverty are more severe, causing hundreds of millions of very young children in low- and middle-income countries to suffer from suboptimal development (30).

In one review of data from several lower- and middle-income countries, there was a consistent gradient in SEP for mortality (31). In a study in Mozambique, there was a clear gradient in child mortality for children 0–10 y, but the gradient was only for fathers' education (not mothers' education) (32). A study using data from Indonesia examined subjective and objective health measures and found a consistent income–health gradient among children 0–14 y (33), with no evidence that the associations between income and health increased as children aged. Several studies have examined patterns of linear growth among children in low- or middle-income countries, and they have shown that children living in conditions of poverty suffer from delayed growth and increased risk of growth faltering (cf. refs. 34 and 35). As a consequence of this trend, the World Health Organization's most recent growth standards were designed to be an international reference standard, representing the optimal growth potential of healthy breastfed children, and

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they have highlighted the finding that most linear growth retardation occurs before the age of 2 y (36).

Despite the compelling evidence connecting low social or economic position and decrements in child development in higher-income countries, we were only able to identify a small number of studies examining gradients in child cognitive or language development from lower- or middle-income countries. One analysis of receptive language performance among children 4–6 y from Ethiopia, India, Peru, and Vietnam using data from the Young Lives Study (37) compared language scores of children living in households in the highest-income quintile with scores of children living in households in the lowest income-quintile. The differences in standardized scores between top and bottom quintiles ranged from 0.57 SD in India to 1.53 SD in Peru (38). Another study from Ecuador showed that preschool-age children from the wealthiest or most educated families had higher receptive language scores than children from the poorest or least educated homes (39). In a large nationally representative sample of children in Madagascar, children with mothers who had secondary education or that were from families in the top wealth quintile performed better across a wide range of cognitive and language tests than children with mothers who had less education or that were from families with fewer resources (40). The mean difference in scores doubled between the ages of 3 and 6 y, and the biggest differences between groups were in the specific areas of language and sustained attention.

The primary objective of this paper was to examine socioeconomic gradients for a comprehensive measure of early child development across samples of very young children from four low- or middle-income countries: India, Indonesia, Peru, and Senegal. The data used for these analyses were from baseline surveys of households in community-randomized water and sanitation trials and were collected from 2008 to 2009. Our objective was to extend the existing literature by examining data from large samples of children under 2 y in multiple countries using length-for-age z score (LAZ) and a measure of child development [the Extended Ages and Stages Questionnaire (EASQ)], which includes domains relating to communication, gross motor skills, and personal/social development. For the analyses described below, we converted total EASQ scores to age-adjusted z scores using country- and age category-specific means and SDs. We used two primary measures of SEP in our analyses: maternal educational attainment and household wealth index; we also incorporated measures of home stimulation to examine mechanisms by which SEP could affect child outcomes. Using a combination of parametric and nonparametric analyses to examine the associations between family SEP and child development in over 8,000 children, we broaden the existing literature by including children who are much younger (3–23 mo) than the children who had been included in previous studies set in low- and middle-income countries.

Results

SEP Gradients in Child Development Outcomes. Descriptive statistics for children from each country are presented in Table 1. Maternal education and wealth both contributed significantly and independently to the variance in EASQ (Table 2) and LAZ (Table 3)

Table 1. Descriptive statistics by country

	India		Indonesia		Peru		Senegal		Total	
	Mean (SD) or percent	*N*	Mean (SD) or percent	*N*	Mean (SD) or percent	*N*	Mean (SD) or percent	*N*	Mean (SD) or percent	*N*
Mother's schooling (y)	4.7 (4.7)	4,158	8.1 (3.3)	2,029	7.4 (4.0)	3,654			6.4 (4.4)	9,841
Mother is married	98%	4,164	98%	2,049	26%	3,659	95%	2,132	0.8 (0.4)	12,004
Mother's age (y)	24.9 (5.0)	4,172	28.0 (6.5)	2,049	28.1 (8.1)	3,662	28.5 (7.2)	2,137	27.1 (6.9)	12,020
Wealth index*	0 (2.7)	4,195	0 (2.0)	2,098	0.1 (2.4)	3,699	−0.1 (2.5)	2,169	0.02 (2.5)	12,161
Household size (number of people)	6.7 (2.6)	4,203	4.6 (1.3)	2,098	5.6 (1.9)	3,702	14.1 (7.5)	2,174	7.3 (4.9)	12,177
Child's age (mo)	11.3 (6.6)	4,203	11.4 (6.3)	2,098	11.4 (6.9)	3,702	11.5 (6.8)	2,174	11.4 (6.7)	12,177
Child is male	52%	4,202	51%	2,098	51%	3,702	52%	2,174	50%	12,176
Length-for-age (LAZ) score	−1.6 (2.0)	3,512	−0.9 (1.4)	2,088	−1.4 (1.2)	3,594	−0.6 (1.3)	1,908	−1.2 (1.6)	11,102
Weight-for-length z score	−1.0 (1.6)	3,328	−0.4 (1.3)	2,070	0.4 (1.2)	3,583	−0.5 (1.2)	1,983	−0.4 (1.5)	10,964
Total Extended Ages and Stages Questionnaire (EASQ) score†	554.7 (250.2)	2,975	578.1 (227.5)	1,690	603.7 (222.1)	2,845	547.5 (214.1)	1,217	574.2 (233.1)	8,727
Gross National Income (GNI) per capita (2010)‡	$1,340		$2,580		$4,710		$1,050			
Life expectancy at birth (y)‡	65		69		74		59			
Prevalence of stunting among children (%)‡§	48		37		24		19			
Prevalence of wasting among children (%)‡¶	20		14		1		9			
Adult literacy rate (%)‡	63		92		90		50			
Human Development Index (rank)‖	134		124		80		155			
Under 5 y mortality rate‡	63		35		19		75			

*Wealth index was constructed using principle components analysis. Variables used to construct the wealth index were asset indicators and household indicators and varied by country.

†Maximum total EASQ score is 980 for India, Indonesia, and Peru and 890 for Senegal.

‡Data from United Nations Children's Fund (UNICEF) State of the World's Children 2012 report (72).

§Moderate and severe stunting defined as percentage of children ages 0–59 mo below −2 SDs from median length for age/height for age of the World Health Organization Child Growth Standards.

¶Moderate and severe wasting defined as percentage of children ages 0–59 mo below −2 SDs from median weight for length/weight for height of the World Health Organization Child Growth Standards.

‖Data from United Nations Development Programme (UNDP) International Human Development Index (73).

Table 2. **Effect of household wealth and maternal education on child development (EASQ) *z* score adjusted for covariates**

	India	Indonesia	Peru	Senegal
Wealth				
First wealth quintile (reference group)				
Second wealth quintile	0.06 (0.06)	0.22 (0.08)*	0.05 (0.08)	0.13 (0.12)
Third wealth quintile	0.30 (0.07)*	0.34 (0.09)*	0.11 (0.07)	0.10 (0.14)
Fourth wealth quintile	0.28 (0.08)*	0.38 (0.09)*	0.18 (0.08)†	0.07 (0.17)
Fifth wealth quintile	0.48 (0.07)*	0.34 (0.10)*	0.27 (0.09)*	0.38 (0.19)†
Maternal education				
No schooling (reference group)				
1–5 y of schooling	0.04 (0.05)	0.20 (0.21)	0.20 (0.10)†	
6 y of schooling	0.20 (0.13)	0.20 (0.18)	0.25 (0.11)†	
7–9 y of schooling	0.18 (0.06)*	0.20 (0.19)	0.42 (0.11)*	
>9 y of schooling	0.26 (0.07)*	0.34 (0.19)‡	0.48 (0.10)*	
Some schooling				0.15 (0.07)†
Covariates				
Child is male	−0.08 (0.04)†	−0.18 (0.05)*	−0.06 (0.04)‡	−0.06 (0.06)
Mother is married	−0.13 (0.12)	−0.28 (0.18)	0.01 (0.05)	0.01 (0.12)
Mother's age (y)	0 (0)	−0.01 (0)†	0 (0)	0 (0)
Household size	0 (0.01)	0.03 (0.02)	0 (0.01)	−0.01 (0)
Constant	−0.72 (0.19)*	−1.12 (0.31)*	−0.95 (0.16)*	−0.70 (0.33)†
Observations	2,942	1,631	2,805	1,182
R^2	0.189	0.247	0.229	0.208
F test: Wealth indicators§	<0.001	<0.001	0.03	0.06
F test: Education indicators¶	0.003	0.20	<0.001	—

Robust SEs clustered at the village in parentheses. All specifications contain children's age in month indicators and village indicators.
*$P < 0.01$.
†$P < 0.05$.
‡$P < 0.10$.
§Gives the *P* value on a test of joint significance of the wealth categories.
¶Gives the *P* value on a test of joint significance of the education categories.

scores in all four countries while controlling for child age, sex, mother's marital status and age, household size, and village. Being in the fifth wealth quintile compared with the first quintile conferred a significant advantage to EASQ scores (ranging from 0.27 to 0.48 of a standardized score) and LAZ scores (0.37–0.65 of a standardized score) in all countries, while controlling for maternal education; being in the fourth wealth quintile was also associated with benefits for EASQ in three of four countries and LAZ in all countries. Although there were some benefits evident for being in the second or third quintiles for both EASQ and LAZ, the significance of these findings was not consistent.

Similarly, having a mother in the highest category of education (>9 y) compared with having a mother with no formal education was also associated with significantly better performance on the EASQ (0.26–0.48 of a standardized score) in India, Indonesia, and Peru while controlling for household wealth; these results were also consistent for Senegal, where a slightly different measure of maternal education was used. For LAZ, there was a significant benefit to having a mother with higher education for India (0.32 standard score) and Peru (0.50 standard score) but no significant benefit for Indonesia or Senegal.

SEP Gradients Across the First 2 y of Life. Children from households in the highest wealth quintile or children with mothers who had more than 9 y of schooling had significantly higher EASQ *z* scores than children in the bottom four wealth quintiles or children with mothers who had 9 y or less of schooling, and these differences increased with age for India, Indonesia, and Peru (Fig. 1). Similarly, children from the highest wealth or education categories had significantly higher LAZ scores than children from the bottom wealth or education categories, and these differences increased with age in all four countries (Fig. 2).

The divergent patterns seen graphically of wealth and maternal education gradients across EASQ and LAZ scores were confirmed in a multivariate regression framework, with significant age by wealth and age by education interaction terms (Table S1). Specifically, the effect of being in the top wealth quintile on the EASQ *z* scores was 0.4–0.5 SD larger for children 16–23 mo than children 0–7 mo in India and Indonesia; there were no significant age by wealth interactions in Peru or Senegal. The maternal education gradient significantly increased with age in India and Peru, where the effect of having a mother with more than 9 y of schooling on EASQ *z* scores was 0.2–0.7 SD larger for children 16–23 mo than children 0–7 mo.

Wealth and education gradients also increased with age for linear growth outcomes (Table S2). The effect on LAZ scores of being in the top wealth quintile was 0.3–0.6 SD larger for children 16–23 mo than children 0–7 mo for all four countries. The effects of the education gradient were evident in three of four countries, where the effect on LAZ scores of having a mother with more schooling was 0.2–0.7 SD larger for children 16–23 mo than children 0–7 mo. In these three countries, there were also beneficial effects on growth for children 8–15 mo compared with children 0–7 mo (0.2–0.6 SD).

SEP Gradients in Household Support for Learning (Family Care Index). Compared with children in the lowest wealth quintile, children living in households in the highest wealth quintile were more likely to play with toys, more likely to own a children's book, and more likely to have engaged in stimulating activities with an adult in the past 3 d (Table S3). These results were also consistent when examining differences between the highest and lowest groups in terms of educational attainment. The proportion of the total wealth effect that was mediated by parental home stimulation activities ranged from 18% in Indonesia to 37% in Senegal, and the

Table 3. Effect of household wealth and maternal education on length-for-age z-score (LAZ) adjusted for covariates

	India	Indonesia	Peru	Senegal
Wealth				
First wealth quintile (reference group)				
Second wealth quintile	0.03 (0.12)	0.19 (0.10)*	0.13 (0.07)†	0.10 (0.10)
Third wealth quintile	0.20 (0.12)*	0.17 (0.10)	0.06 (0.07)	0.36 (0.12)‡
Fourth wealth quintile	0.34 (0.14)†	0.34 (0.11)‡	0.26 (0.07)‡	0.40 (0.15)†
Fifth wealth quintile	0.65 (0.16)‡	0.40 (0.12)‡	0.37 (0.10)‡	0.43 (0.17)†
Maternal education				
No schooling (reference group)				
1–5 y of schooling	0.10 (0.09)	0.03 (0.22)	0.15 (0.11)	
6 y of schooling	0.14 (0.18)	0.07 (0.21)	0.33 (0.11)‡	
7–9 y of schooling	0.25 (0.09)‡	0.06 (0.19)	0.45 (0.11)‡	
>9 y of schooling	0.32 (0.11)‡	0.19 (0.21)	0.50 (0.11)‡	
Some schooling				−0.04 (0.08)
Covariates				
Child is male	−0.18 (0.06)‡	−0.10 (0.06)	−0.20 (0.04)‡	−0.11 (0.06)*
Mother is married	−0.45 (0.21)†	−0.11 (0.21)	0.05 (0.05)	0.11 (0.14)
Mother's age (y)	0.01 (0.01)	0 (0)	0 (0)	0 (0)
Household size	−0.01 (0.01)	0.02 (0.02)	−0.02 (0.01)*	0 (0.01)
Constant	−1.22 (0.4)‡	0.33 (0.39)	−0.85 (0.20)‡	0.05 (0.31)
Observations	3,474	2,019	3,543	1,852
R^2	0.287	0.336	0.258	0.219
F test: Wealth indicators§	<0.001	0.006	<0.001	0.02
F test: Education indicators¶	0.03	0.59	<0.001	—

Robust SEs clustered at the village in parentheses. All specifications contain children's age in month indicators and village indicators.
*$P < 0.10$.
†$P < 0.05$.
‡$P < 0.01$.
§Gives the *P* value on a test of joint significance of the wealth categories.
¶Gives the *P* value on a test of joint significance of the education categories.

proportion of the total education effect explained ranged from 12% in Senegal to 31% in India (Fig. S1). When LAZ was added to the analyses as a mediating variable, the percent of the wealth effect explained by the combination of home stimulation and LAZ ranged from 27% in Indonesia to 57% in Senegal; the percentage explained by home stimulation and LAZ for the education effect ranged from 19% in Senegal to 39% in India (Tables S4, S5, and S6).

Discussion

In four low- or middle-income countries, children under 2 y from the wealthiest households had higher developmental (EASQ) scores and better growth (LAZ) than children from the poorest households while controlling for maternal education and relevant covariates. Similarly, having a mother in the highest category of education was also associated with significantly better performance on the EASQ in three of four countries while controlling for household wealth and relevant covariates.

There was evidence that the effects of the wealth and maternal education gradients on EASQ scores increased with child age in India, Indonesia, and Peru. Cross-sectional and longitudinal studies in the United States using neuroimaging techniques have documented that the cortical regions that require larger cognitive control, such as selective attention tasks (41), and regions that require responding to complex environmental stimuli, such as language (42), are the regions with activity that increases with age, suggesting an explanation for how gradients may change with age. In contrast to what we expected, the differences between children living in Senegal (and to some extent, Peru) in households with greater wealth or education seemed to be already present at 4 mo; the differences in scores between the highest and lowest wealth or education groups stayed fairly constant across the 4–24 mo age range.

Wealth and maternal education gradient effects on LAZ scores also became more pronounced with age in all countries. These findings reflect typical growth patterns of young children in low-income countries, where stunting (linear growth retardation caused by undernutrition) is prevalent (36). In these circumstances, growth faltering begins in the first few months of life, and the prevalence of stunting generally peaks at around 2 y of age before leveling off (43). Although stunting has multiple causes, including inappropriate feeding with unsafe or nutrient-poor foods and high diarrheal infection (44), the synergistic and interactive associations between undernutrition and diarrheal infection (e.g., malnourished babies are vulnerable to infection and babies with diarrhea are prone to malnutrition) (45) are likely to play a major role in the stunting rates seen in low-income countries (46). Access to better quality foods may reduce the loss in growth typically found in children growing up in impoverished populations (47). We may have captured a stronger SEP effect on length in the older children, because they have had more opportunity to experience chronic undernutrition and accumulate a greater length/height deficit.

We showed that parental home stimulation variables, as measured by the Family Care Index, explained about 20–35% of the total wealth effect and 15–50% of the education effect on child development outcomes. When we used LAZ scores as a proxy measure for health, we found that LAZ explained a much smaller fraction of the wealth and education gradients than parental stimulation. When parental home stimulation and LAZ scores were included together, however, they explained from one-third to one-half of the wealth and education gradients. These findings fit into a broader literature showing associations between home stimulation and child development outcomes from countries around the world (48).

A growing area of research directly examines brain structure and functioning in relation to SEP (49, 50). Conditions associated with poverty, such as low birth weight, stress-induced hormonal changes during pregnancy, and postnatal exposure to environmental stressors, have been hypothesized to be possible mecha-

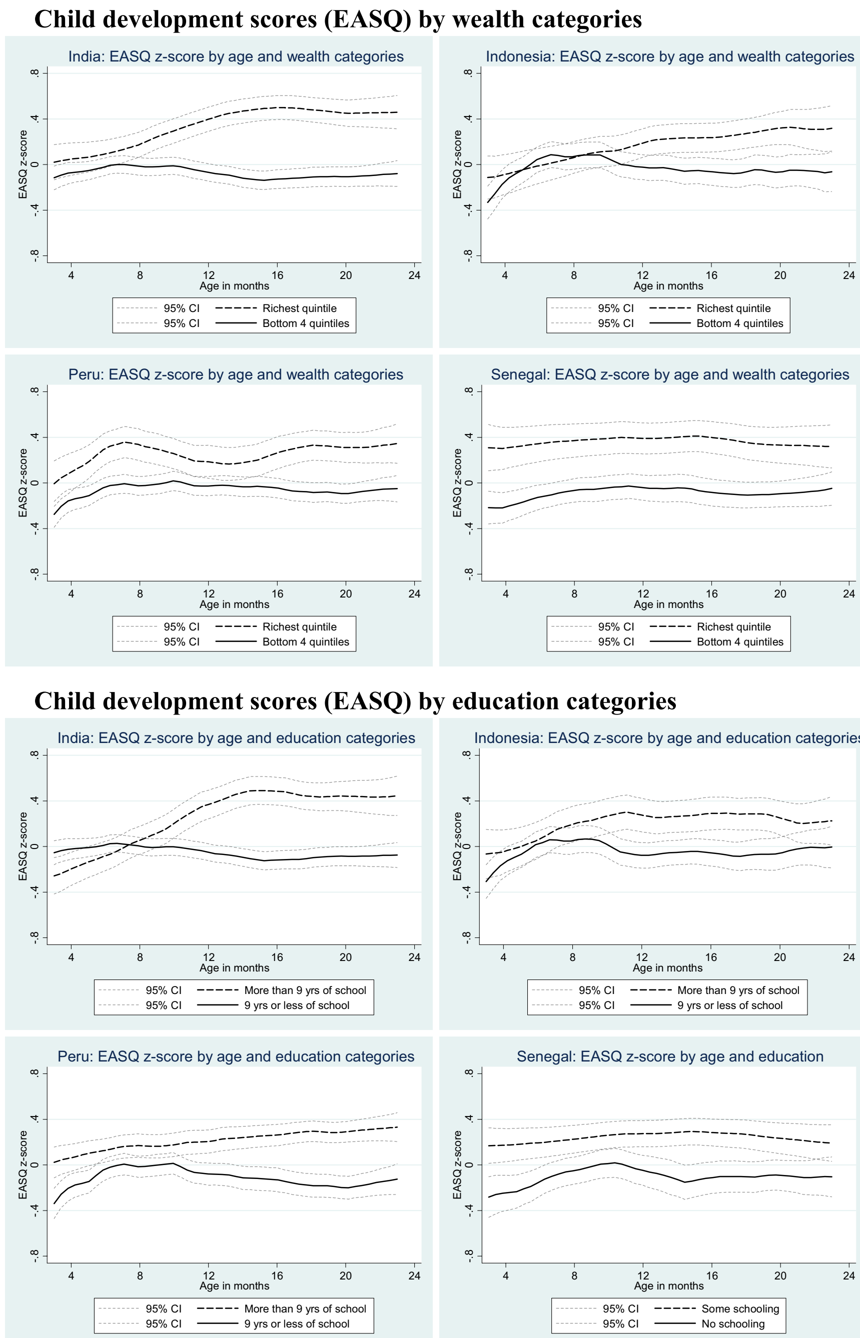

Fig. 1. Estimates of wealth and education gradients across child development score (Extended Ages and Stages Questionnaire [EASQ]).

nisms for variations in brain activity (51, 52) and structure (53). Some abilities—such as language, attention, inhibition, and working memory—that engage areas of the brain that continue to grow beyond infancy seem to be particularly susceptible to the detrimental effects of growing up in low-resource homes (54, 55). Children's neuronal activity when responding to language and executive function tasks (e.g., working memory and attention) differs by SEP (56), even during infancy (57). Children and adolescents from low-income homes have also been shown to have less hippocampal gray matter than children from higher-income families (53). Because the hippocampus is involved with both emotional and cognitive functioning, SEP differences in this structure may contribute to the lower developmental scores observed in poorer children. The inclusion of ability-specific test protocols related to poverty (e.g., language development and executive function) in large, international studies may help elucidate the associations between SEP and cognitive functioning.

A major limitation of our analyses is that we do not have extensive economic, cultural, political, or historical information about any of the countries where the study occurred, and thus, we are unable to comment on any country-related issues that may explain our findings; future research may be informed by the collection and use of more detailed country-level data. Another limitation of the current study is that we are not able to say specifically what areas of development are affected most greatly by poverty, because our measure of child development, the EASQ, is a composite of many

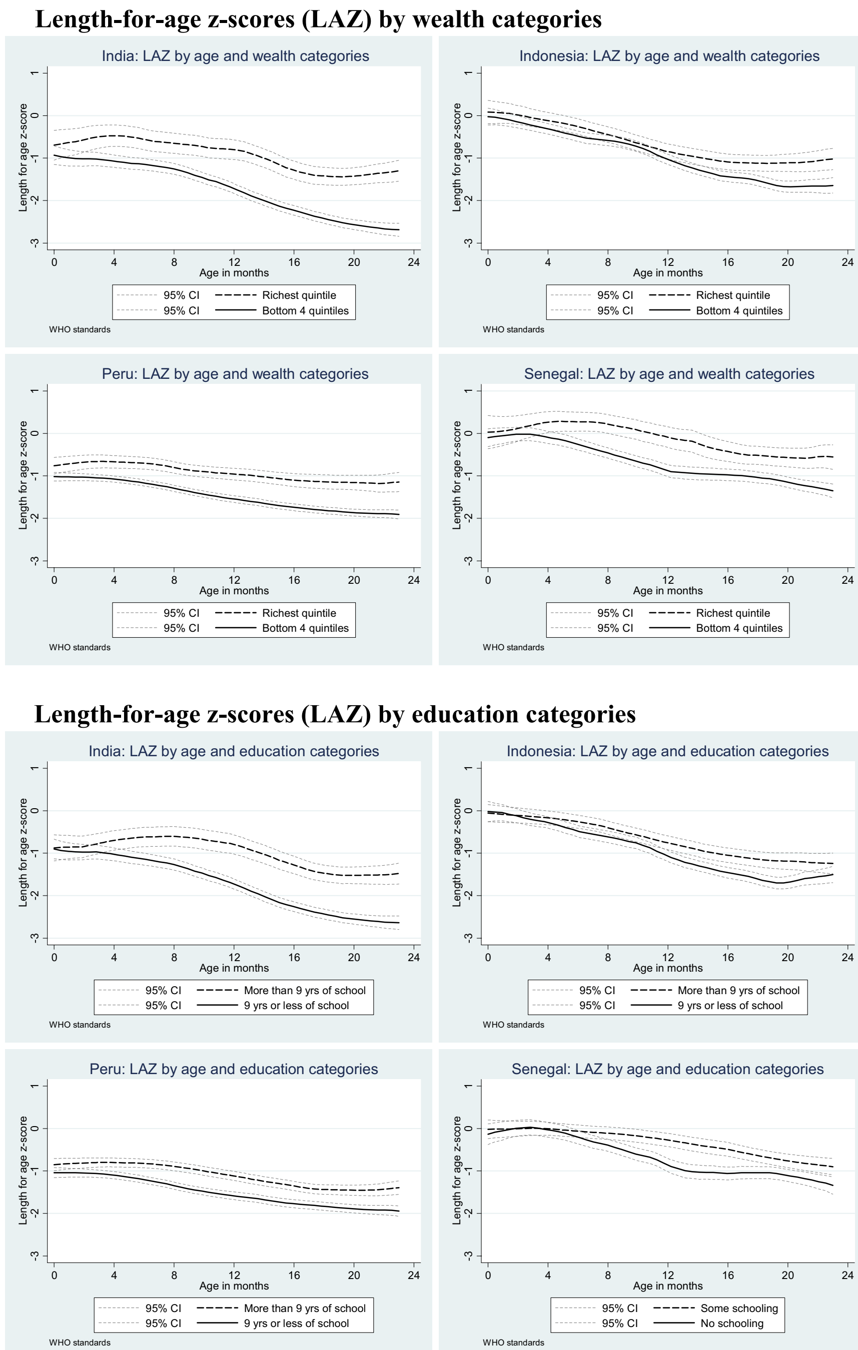

Fig. 2. Estimates of wealth and education gradients across LAZ scores.

domains. Finally, our measures were all obtained concurrently, and thus, we cannot make claims about causality when discussing mechanistic pathways connecting SEP and child outcomes; future analyses using longitudinal data could shed light on the specific mechanisms at play.

Findings from the present study support the notion that inequities in child wellbeing because of poverty must be addressed early in life (38, 58). The American Association of Pediatrics recently issued a statement about the long-lasting effects of childhood poverty on health and development, with recommendations for providing a broad range of services or interventions to support children and families living in impoverished homes (59). Evidence from nutrition (36, 45) and early childhood research suggests that intervening before (rather than during) the preschool years is more effective for preventing some of the health and developmental deficits associated with poverty (38). In addition to the growing literature highlighting the importance of early intervention (60), there is also a strong economic argument for intervening as early as possible, preferably during the prenatal period (61). Our findings also point to the critical importance of larger-scale structural and economic interventions that could enable greater participation in formal schooling and the labor force, which would then allow parents to provide a better environment for their children through improvements in the home or purchase of and appropriate use of goods that influence child growth and development (22, 62).

Materials and Methods

Data. Data were collected through research conducted by the World Bank's Water and Sanitation Program's Global Scaling Up Sanitation and Handwashing Projects. The study was conducted across a large number of rural sampling clusters (usually villages) from each country: 160 (India), 160 (Indonesia), 211 (Peru), and 110 (Senegal). Within these rural villages, households were randomly sampled from a list of all households with at least one child <24 mo (63).

Measures of Child Development. ***EASQ.*** Three subdomains of the EASQ were administered to children ages 3–23 mo: communication, gross motor, and personal/social. The EASQ was adapted from the original Ages and Stages Questionnaire (64). The adaptation of the EASQ is described in *SI Text*. Modifications to items were made as necessary in each country; for example, an item asking about the use of forks was dropped during piloting because of low response rates across all countries. Other items were adapted to better fit the local context (e.g., references to specific items of clothing, foods, furniture, or baby games were changed as necessary). After calculating the total EASQ scores with the eligible questions for each domain, internally age-adjusted z scores were calculated using country and age category-specific means and SDs. In addition, an overall EASQ score was calculated that summed up the scores in each domain and converted the total EASQ score to age-adjusted z scores. Cronbach's α-values for EASQ scores overall were adequate, with most values (per age group, country, and domain) near 0.6 or above.

Length. In all four countries, children had their length measured using standard measurement techniques (65). Children's lengths were then converted to age- and sex-adjusted z scores using the 2006 World Health Organization Child Growth standards (66). Children's z scores were converted to missing if they were less than −6 or greater than 6 SDs away from the reference population (this conversion to missing occurred for ∼2% of cases).

Household-Level Measures. ***Socioeconomic variables.*** We used two primary measures of SEP in this analysis: maternal educational attainment and household wealth index. Maternal educational attainment was assessed by calculating the years of formal schooling that the mother had completed. For countries with data on formal years of schooling (India, Indonesia, and Peru), the following five education categories were created: no schooling, less than 6 y of schooling, 6 y of schooling, 7–9 y of schooling, and more than 9 y of schooling. For Senegal, information on whether the mother had ever attended school was available. For constructing the wealth index, the principle components analysis aggregated wealth-related variables into a single index that could be used to establish differences in household wealth (67). Variables included in the wealth index are indicators related to household infrastructure (roof, wall, floor, rooms, electricity, etc.) and assets. Given the differences in survey questions across countries, the exact infrastructure and asset indicators varied by country. The first principle component was retained to calculate the wealth index, because it captures the most common variation among the variables and is an adequate measure for wealth (68). The reliability of an asset index to yield household rankings in wealth was established for the demographic and health surveys (DHS) and validated with rankings using household expenditures (69). For each country, the household wealth index was sorted, and wealth quintiles were created.

Household support for learning (Family Care Index). Home stimulation for cognitive and language development was measured with the Family Care Index items developed for use in the United Nations Children's Fund (UNICEF) Multiple Indicator Cluster Survey (MICS) (70). These items assess the availability of books and play materials along with the occurrence of different activities between an adult and a child, including reading books, singing songs, telling stories, playing, teaching about letters, numbers, and concepts, and going on outings that take the child outside the home. The measure has been shown to vary by SEP category in a variety of countries and has been predictive of child development outcomes (48, 70, 71). For the mediation analysis, a "home stimulation" index was created by summing up the dichotomous Family Care indicators.

Statistical Analysis. Children included in the EASQ analyses ($n = 8,727$) were children who were in the eligible age range (from 3 mo, 16 d to 23 mo, 31 d) who had not been more than 3 wk premature, had no disability, and had completed the survey. For length measurements, children used in the analyses ($n = 11,102$) were children ages 0–23 mo who had z scores within 6 SDs of the reference population.

Our statistical analysis proceeded as follows. (*i*) We first examined the association between children's development outcomes and socioeconomic gradients. (*ii*) We then investigated whether this association changed with age and particularly, whether the gap in child outcomes between the highest wealth (or education) and lowest wealth (or education) categories would widen across the age range. (*iii*) Finally, we conducted a mediation analysis to explore whether the Family Care Index or LAZ mediated the wealth and education effects on EASQ.

In the first stage, we conducted country-specific regressions of children's EASQ z scores or LAZ scores on wealth quintiles and maternal education categories, controlling for a child's age and sex, mother's age and marital status, and household size. To account for differences across villages, all regressions included a set of village fixed effects. Therefore, the coefficients for each wealth (or education) category represent the mean difference in z scores of the specific wealth (or education) category from the omitted group (which is the lowest wealth quintile or mothers with no schooling) for households living in the same villages. In other words, the coefficient in front of the fifth wealth quintile indicator represents the mean difference in scores of children in the lowest wealth quintile and the richest quintile. To test the joint significance of the wealth categories and education categories, we performed Wald tests in STATA 11.

In the second stage, we conducted both a nonparametric analysis using a local polynomial smoothing routine and a semiparametric analysis using ordinary least squares. The local polynomial smoothing routine conducted in STATA 11 performed a kernel-weighted local polynomial regression of total EASQ z scores or LAZ scores as a function of children's age and graphed the smoothed values with a 95% confidence interval. To examine whether SEP gradients widen with age, the local polynomial smoothing routine was performed and compared those children in the top wealth or education categories with those children in the bottom wealth or education categories. Given that the improvements in outcomes are not stepwise with the increase in gradients for all countries, we grouped the bottom four quintiles and compared them to the richest quintile. Similarly, we grouped children with mothers who had 9 y or less of schooling and compared them with children with mothers who had more than 9 y of schooling (for India, Indonesia, and Peru). For Senegal, we compared outcomes of children with mothers who had no schooling with children with mothers who had some schooling.

In addition to the nonparametric analyses, we conducted a semiparametric analysis to investigate whether the disparities in child development outcomes across SEP gradients increased with age. Specifically, for each country, we conducted regressions of EASQ z scores or LAZ scores on indicators for wealth (or mother's education), indicators for age, and the interaction of wealth (or education) and age indicators. In line with the nonparametric analysis, the indicator for wealth equaled one if the household was in the top wealth quintile, and the indicator for education equaled one if the mother had more than 9 y of schooling (for India, Indonesia, and Peru) or if the mother had some schooling (for Senegal). To minimize the number of interactions and more clearly see the difference of socioeconomic gradients across younger and older children, we grouped children into three age categories: younger (0–7 mo), middle (8–15 mo), and older (16–23 mo). Results, however, were robust to using different age categorizations or linear age interaction. The coefficients for the interactions of wealth and age indicate whether the impact on child outcomes of being in the top socioeconomic gradient changes with age.

Mediation analyses of the Family Care Index and LAZ were conducted by examining whether (*i*) the Family Index and/or LAZ were significantly associated with wealth and education gradients, (*ii*) the Family Care Index and/or LAZ were significantly associated with EASQ, and (*iii*) the associations between wealth and education gradients and EASQ were attenuated by the introduction of the Family Care Index and/or LAZ into the model. The proportion of the effect that was mediated by the Family Care Index and/or LAZ was then calculated as a percent change of the wealth or education effect when the Family Care Index and/or LAZ was added to the model.

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