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Socioeconomic Correlates of Early Child Development: Gradients from Six Countries in the East Asia-Pacific Region

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Abstract

This study examined socioeconomic gradients in different domains of early child development using data from the validation sample of the East Asia-Pacific Early Child Development Scales (EAP-ECDS). The Scales were administered to 7797 3- to 5- year-olds (3889 girls) from Cambodia, China, Mongolia, Papua New Guinea, Timor-Leste and Vanuatu and children's parents provided information about socioeconomic status (SES). Findings indicated that: (i) with the exception of Motor Development, all SES indicators predicted all domains of development; (ii) SES-development associations were largest for Cognitive Development, Socio-emotional Development, and Language and Emergent Literacy; (iii) wealth and maternal education were the best predictors of early child development; and (iv) significant SES-development associations were found in all countries except Cambodia.

Keywords: socioeconomic gradients, socioeconomic status, early child development, East Asia-Pacific, EAP-ECDS

Socioeconomic Correlates of Early Child Development:

Gradients from Six Countries in the East Asia-Pacific Region

Much of our knowledge about the relation between socioeconomic status (SES) and child development is from research conducted in high-income countries, although evidence from low- and middle- income countries (LMICs) is accumulating (Fernald, Kariger, Hidrobo, & Gertler, 2012; Lopez Boo, 2016). Research from high-income countries demonstrates that SES is positively associated with cognitive, language, and socio-emotional development (Bradley & Corwyn, 2002; Thomas, Forrester, & Ronald, 2013), and that SES differences in development persist as children mature (Reardon & Portilla, 2016), yet in LMICs most children are exposed to even greater risks of deprivation than children in high-income countries (Fernald et al., 2012). These include biological and environmental risks such as undernutrition, exposure to infectious diseases, and contaminated drinking water (Walker et al., 2007), and psychosocial risks such as inadequate cognitive stimulation and exposure to violence (Walker et al., 2011). Given these increased risks, and the fact that 82% of the world's children live in LMICs (UNESCO, 2015), understanding SES-development relations in these countries is of fundamental importance as a precursor to effective intervention.

In countries where most children have increased risks of deprivation and vulnerability to poverty, the variability of socioeconomic circumstances may be reduced and child outcomes might be assumed to be consistently low (Fernald, Weber, Galasso, & Ratsifandrihamanana, 2011). It may therefore be the case that, in some LMICs, SES gradients are either very small or non-existent because most children are in poverty and have poor developmental outcomes. In

such cases policies aimed at improving outcomes for the whole population may be more appropriate than those aimed at reducing disparities between different socioeconomic groups. However, extant research from LMICs suggests that, despite the different socioeconomic contexts compared to high-income countries, SES gradients may nevertheless be present. In a study of 3- to 6- year olds in Madagascar, Fernald et al. (2011) found that family wealth and maternal education were associated with several different measures of cognitive and language development, demonstrating SES-development relations even in a context of extreme poverty. Paxson and Schady (2007) found that both household wealth and parental education were associated with higher cognitive development scores in Ecuador; evidence from Chile, Colombia, Ecuador, Nicaragua, and Peru showed that SES was related to a measure of receptive language ability in each country (Schady et al., 2015); and data from the Young Lives study conducted in Ethiopia, India, Peru, and Vietnam have been used to demonstrate SES differences in vocabulary test scores (Engle et al., 2011; Lopez Boo, 2016). In addition, Fernald et al. (2012) found both household wealth and maternal education were associated with higher developmental scores in India, Indonesia, Peru, and Senegal; and Rubio-Codina, Attanasio, Meghir, Varela, and Grantham-McGregor (2015) found wealth differences in measures of cognitive and language ability in Bogota. However, there are as yet only a small number of studies examining SES and development in LMICs (Fernald et al., 2012) and, partly because of a lack of suitable data, there is little evidence of how SES-development relations differ between LMICs (Lopez Boo, 2016). A greater understanding of whether or not SES gradients are found consistently across different LMICs would guide policies aimed at alleviating disadvantage.

Areas in need of further research

Differences between domains. There is a scarcity of evidence from LMICs on how SES gradients differ across different domains of development (an exception is Rubio-Codina et al., 2015). Interventions targeted at young children in LMICs have typically focused on improving cognition (Rao, Yousafzai, & Ip, 2017), yet non-cognitive aspects of development such as socio-emotional skills have also been shown to be important for children's executive function, self-regulation and transition to school (Thompson & Raikes, 2007). Understanding the extent to which children's holistic development is related to SES would therefore help guide policies aimed at mitigating socioeconomic disadvantage. Studies from high income countries demonstrate that cognitive and verbal abilities tend to be particularly strongly associated with SES (Fernald, Marchman, & Weisleder, 2013), but links with socio-emotional wellbeing are less consistent (Bradley & Corwyn, 2002). Understanding whether or not the patterns found in high income countries are replicated across different LMICs would help determine whether the types of interventions used in high-income countries may also be effective in LMICs.

Measures of SES. SES is a concept that is typically understood as incorporating "economic status, measured by income; social status, measured by education; and work status, measured by occupation" (Dutton & Levine, 1989, p. 30). There is substantial variation between studies on how it is operationalized, with no consensus on whether it is best to use a composite SES measure or to use one or more individual indicators representing its different parts, and whether it has the same meaning for all ethnic and cultural groups (Bradley & Corwyn, 2002). Understanding whether and how SES-development relations vary depending on the aspect of SES in question could give some indication of the mechanisms that may be at work. For instance, SES and development may be related through wealth improving a child's access to

material resources (Currie, 2009), or through maternal vocabulary improving children's language development (Hoff, 2003). The highest levels of maternal education may have an especially large association with child outcomes (Boyle et al., 2006) and, given the lower levels of maternal education found in LMICs as compared to high-income countries, it is important to ascertain whether increases in more modest maternal education levels are also associated with better development. Understanding the relative importance of different aspects of SES for child development in LMICs would facilitate further research into the mechanisms at work and guide effective intervention.

The current study: relations between SES and child development

To address these research gaps, this study utilises data from six countries in the East Asia-Pacific region using the East Asia-Pacific Child Development Scales (EAP-ECDS) (Rao et al., 2014). First, it examines whether relations between SES and child development vary across different domains of development in these six LMICs. The EAP-ECDS provides data on seven domains - Cognitive Development; Socio-emotional Development; Motor Development; Language & Emergent Literacy; Health, Hygiene and Safety; Cultural Knowledge and Participation; and Approaches to Learning. Our hypothesis, based on findings from high-income countries, is that the largest SES-development associations will be with Cognitive Development and Language and Emergent Literacy.

Second, we consider how relations between SES and development vary depending on the type of SES indicator used. Following a common conception of SES as comprising three main elements (Dutton & Levine, 1989) we consider household wealth, maternal education, and

paternal occupation. Wealth is chosen rather than income in part due to data availability, and in part because wealth is less volatile and may measure longer-term SES (Hauser, 1994). We examine SES-development relations for the sample as a whole to determine which indicator is most strongly related to development in these six LMICs, and also examine SES-development relations across each of the six countries individually to ascertain whether this pattern is consistent or whether it varies by country.

Method

Sample

The EAP-ECDS were developed to assess the holistic development of children in the East Asia-Pacific region (Rao et al., 2014). Data come from a representative sample of 3,889 girls and 3,908 boys aged 3 to 5 years living in Cambodia, China, Mongolia, Papua New Guinea, Timor-Leste, and Vanuatu. The sampling plan for five of the six countries was developed with the relevant national statistics body, with the exception of China, for which the sample was drawn from five provinces with a wide variation in levels of economic development (Rao et al., 2018). Samples were therefore designed to be nationally representative, with the exception of China for which they were designed to be representative of five provinces only. Samples in each country were stratified by age, gender, and urban or rural residence, and were clustered by province (Rao et al., 2014). There were a total of 43 provinces, with 12 in Cambodia, 5 in China, 5 in Mongolia, 9 in Papua New Guinea, 6 in Timor-Leste, and 6 in Vanuatu. The EAP-ECDS were developed in 2010 and piloted during 2010 to 2012, and the data used in this study were collected as part of the validation study in 2013. Sampling of ethnic minority children was insufficiently representative and analyses are restricted to data from ethnic majority children.

Table 1 provides demographic information, and further information on the EAP-ECDS is provided in Supplementary Appendix A.

Measures

Early child development. There are 85 items across the 7 EAP-ECDS domains. Supplementary Table 1 shows that Cronbach's alpha scores demonstrated satisfactory internal consistency for each domain (Rao et al., 2014). Developmental scores were converted into month-of-age-adjusted z-scores to create measures that were comparable across children of different ages. This technique has been used elsewhere to analyze child development (e.g., Lopez Boo, 2016), and has been used to analyze EAP-ECDS data (Weber, Darmstadt, & Rao, 2017).

Socioeconomic status. Three measures of SES were used: household wealth; maternal education; and paternal occupation. The wealth indicator was derived from questions on asset ownership, based on the standardized questions used for the Multiple Indicator Cluster Survey (UNICEF, 2005). Following Filmer and Pritchett (2001), a composite variable was created by using the first component of a Principal Components Analysis (PCA) to determine weights for the asset variables. The PCA was run on the full set of all asset variables, and the first principal component rather than any of the others was used to determine the weights because it captures the largest amount of variance (Filmer & Pritchett, 2001). Techniques similar to this have been used extensively to create indicators representing household wealth (Schady et al., 2015). The indicator of maternal education was based on the mother's highest qualification over eight levels. The indicator of paternal occupation had nine different occupation levels (assumed to be ordinal) based on the International Labour Organisation ISCO-88 standard. The most common

occupation was skilled agriculture and fishing in Cambodia (36%), PNG (54%), Timor-Leste (51%), and Vanuatu (53%), manager or administrator in China (27%), and service or shop sales worker in Mongolia (33%). All SES indicators were standardized.

Control variables. Control variables used were the child's gender, country of residence, age category (in 6-month age groups), and urban or rural residence. A variable indicating the province in which the assessment was conducted was used as a level 2 variable to account for clustering in the sample design. Further details on measures can be found in the Supplementary Information.

Analyses Plan

First, means and standard deviations were calculated for each variable across each of the six countries. Variables included developmental domains, SES indicators, and country-level indicators. Pearson correlations between each of the SES variables were also calculated.

Second, hierarchical linear modeling (HLM) was used to analyze SES differences across the seven different developmental domains for all six countries combined. Multi-level models such as HLM are able to take into account and explore the structure of hierarchical populations (Bartholomew, Steele, Galbraith, & Moustaki, 2008). HLM is appropriate to analyze data from children sampled within specific areas of each country as it can account for potential similarities between children residing in the same area. In all HLM regressions 2 levels were used, with province as the level 2 variable.

Third, HLM was used to analyze the relative importance of different SES variables. The coefficients for wealth, maternal education and paternal occupation were examined within

models with only one SES variable. After this, the other two SES variables were added in turn to explore the extent to which SES-development associations using one SES variable were explained by the other variables.

Fourth, comparisons were made of how SES-development associations varied across each of the six countries. HLM regressions with interactions between country and each SES variable were used to examine SES-development associations for each country individually.

Missing values

As detailed in Supplementary Appendix A, missing values were found for several variables. Missingness for developmental domain scores ranged from n=69 (Cognitive Development) to n=428 (Cultural Knowledge and Participation). Regressions were used to test for associations with the key SES and developmental variables. Where an association was not found, the mean score for the province in question was used to impute missing values. Where missingness was associated with any of the key SES or developmental variables, missing variables were imputed based on means for the country, province, mother's education level, urban or rural residence, gender, country-specific wealth quintile, and six-month age category. Dummy variables for imputed values were included in all relevant analyses.

Results

Descriptive statistics

Table 1 shows the composition of the sample in each of the six countries, with means and standard deviations for child, household, and country-level variables.

Differences between developmental domains

Figure 1 shows SES-development associations for all countries combined across seven domains. The largest association was between wealth and Language and Emergent Literacy: a 1 SD increase in wealth was associated with an increase of more than 0.2 SD in Language and Emergent Literacy. There was also an association between wealth and Socio-emotional Development, with a larger coefficient (0.16) than for Cognitive Development (0.14). The association between maternal education and Cognitive Development (0.15) was larger than between maternal education and any other domain, although the association between maternal education and Language and Emergent Literacy was nearly as large (0.14). Where paternal occupation was used as the SES variable, the largest SES-development association was with Socio-emotional Development (0.08). Associations between SES and Motor Development were only significant for wealth.

Differences between SES indicators

Table 2 shows that the three SES variables were correlated with each other. Across the whole sample the largest correlation was between wealth and maternal education (0.69), but correlations varied between countries, with a correlation of only 0.19 between maternal education and paternal occupation in Vanuatu. Table 3 shows the associations between different SES variables and development, before and after controlling for each of the other SES variables. Before additional SES control variables were added, the association between developmental scores and wealth was largest (0.18 SD), followed by education (0.14), and then occupation (0.08). After each of the other SES variables were added to the model the magnitude of each

coefficient decreased. The coefficients of all three SES variables remained statistically significant even after controlling for each of the other variables.

Country similarities and differences

Table 4 compares SES-development associations across countries. Significant associations were found for all countries except Cambodia. Associations were largest in Mongolia, PNG, Timor-Leste, and Vanuatu where wealth was used as the SES variable, but the largest association overall was between maternal education and development in China (0.23 SD). In China, Mongolia, PNG, and Timor-Leste, significant associations were found between development and all three SES variables.

Discussion

This study examined SES gradients in early child development across six countries in the East Asia-Pacific region. It considered: (i) the magnitude of SES-development associations across different domains of development; (ii) how associations between SES and development varied depending on the measure of SES; and (iii) differences in SES-development associations across these six countries.

Key findings

SES and domains of development. The magnitude of SES-development associations varied depending on the SES variable and developmental domain in question. The association between household wealth and Language and Emergent Literacy was larger than with any other domain, and the association between maternal education and Cognitive Development was larger

than with any other domain. This is consistent with our hypothesis, and with findings from high income countries (Bradley & Corwyn, 2002; Thomas et al., 2013) which suggest that language and cognitive abilities have particularly large SES gradients. However, contrary to our hypothesis, the association between household wealth and Socio-emotional Development was larger than between household wealth and Cognitive Development, suggesting that large SES gradients in development are not confined to language and cognitive skills alone. Further, the consistency of associations between SES variables and different domains was striking: with the exception of Motor Development, significant SES-development associations were found for all domains. This suggests that, with the exception of motor skills, there are SES gradients in children's holistic development in these countries, which is consistent with existing research suggesting that different aspects of children's development are related (Bradley & Corwyn, 2002). For instance, non-cognitive aspects of development are important for children's self-regulation and transition to school (Thompson & Raikes, 2007), and self-regulation is highly influential for a range of children's developmental outcomes (McClelland et al., 2018).

Different SES indicators and development. Associations between SES and development were largest when household wealth was used as the SES variable, both across the sample as a whole and for four countries individually. Wealth and development could be related through an 'access to resources' mechanism (Currie, 2009) in these LMICs. Bradley and Corwyn (2002) highlight several ways through which resources and child outcomes could be related. These include nutrition, whereby an inadequate diet leads to poor health, weak protection against infection, negative impacts on brain growth, poor long-term memory, and depleted energy. Poor

quality housing may also play a role, either by exposing children to additional health risks (Guo & Harris, 2000) or by reducing intellectual and social well-being (Bradley & Caldwell, 1980).

However, children from low-SES households can face multiple disadvantages (McLoyd, 1998). Associations between maternal education and development were significant even after controlling for wealth, suggesting that several mechanisms may be underpinning SES gradients in child development. In China, associations between maternal education and development were larger than any other SES-development association. Maternal education has been linked to children's language development through exposure to different levels of vocabulary (Hoff, 2003), and the amount of time spent reading to children (Phillips & Shonkoff, 2000). Associations between paternal occupation and child development were significant but smaller in magnitude. This could be because occupational status has been linked to a variety of concepts also linked to wealth and education: financial capital, the status of a household's social networks, and parenting styles (Bradley & Corwyn, 2002). Alternatively it may be because how best to order different occupations into 'higher' and 'lower' levels of SES is contested (Grusky & Van Rompaey, 1992) so the concept is more difficult to measure than either wealth or education.

Implications

These findings have several key implications for child development. First, SES appears to predict scores across a wide range of domains of development. In these LMICs, SES was not only related to 'academic' competencies such as language and cognitive skills but predicted development holistically. Given that non-cognitive aspects of development have been shown to be important for executive function and the transition to school, interventions aimed at

alleviating disadvantage would need to target a wide range of competencies to be effective. Second, there was consistency between countries in SES-development associations, with significant associations in five of the six countries studied. These countries were from the same world region but were very different in many other ways, including in Gross National Income, culture, and geographical size. Given previous research in LMICs has also demonstrated SES gradients in child development, this suggests that links between SES and child development may be a common feature of many different LMICs. Third, the study shows that SES and development were related across a range of different SES indicators, with associations between wealth and development largest in four countries and the association between education and development largest in China. This highlights the importance of using diverse measurements for the multifaceted concept of SES, since it is difficult to predict which indicator will be most relevant in different LMICs.

This study has several limitations. First, cross-sectional data were used which limits the scope for understanding the potential mechanisms which may underpin SES-development associations. The findings presented show broad-brush associations between SES and development and are not intended to provide a detailed or nuanced understanding of how these concepts may be related. Further research using longitudinal data would perhaps be able to establish the mechanisms at work, and whether the SES-development associations found in this study continue over time as children mature. Second, interpretation of this study's results is limited by the exclusive use of direct assessment of child development. Further research using parent and teacher report, together with comparisons with direct assessment, could give further insights into SES gradients in early child development.

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Tables and Figures

Table 1

Demographic indicators and scores on the East Asia-Pacific Early Child Development Scales across six countries

	CAMBODIA			CHINA			MONGOLIA			PAPUA NEW GUINEA			TIMOR-LESTE			VANUATU		
	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD
Mean development score	1198	54.1	17.9	1623	67.0	16.0	1232	54.6	16.9	1778	39.9	18.9	1185	36.2	14.2	781	48.6	20.8
Cognitive Development	1198	41.8	19.1	1623	60.8	20.6	1232	41.5	19.3	1778	30.3	16.0	1185	31.6	14.8	781	39.4	20.8
Socio-emotional Development	1198	52.2	22.9	1623	64.6	20.0	1232	50.4	21.1	1778	36.9	21.8	1185	29.2	17.6	781	46.0	23.8
Motor Development	1198	65.1	16.7	1623	60.9	17.7	1232	63.6	19.5	1778	61.3	20.1	1185	57.5	19.4	781	68.5	22.5
Language & Emergent Literacy	1198	51.1	19.3	1623	70.6	18.1	1232	61.7	15.7	1778	39.2	17.9	1185	36.7	14.3	781	49.2	20.5
Health, Hygiene & Safety	1198	65.5	22.0	1623	77.4	15.3	1232	70.9	18.5	1778	49.6	24.5	1185	43.5	20.1	781	58.9	25.9
Cultural Knowledge & Particip.	1198	38.6	23.1	1623	64.2	21.0	1232	53.6	23.5	1778	40.9	21.3	1185	26.8	18.3	781	53.8	25.3
Approaches to Learning	1198	67.1	23.1	1623	71.8	21.7	1232	41.3	20.4	1778	36.9	21.4	1185	31.6	17.4	781	37.1	18.6
Wealth index	1198	-0.2	0.8	1623	1.1	0.5	1232	0.8	0.4	1778	-0.7	0.8	1185	-0.8	0.7	781	-0.6	0.6
Maternal education (8 levels)	1198	3.4	1.2	1623	5.7	1.2	1232	5.7	1.2	1778	3.2	1.2	1185	3.4	1.6	781	3.4	0.9
Paternal occupation (9 levels)	1198	2.9	2.1	1623	5.3	2.3	1232	3.5	2.6	1778	2.4	2.0	1185	2.6	2.3	781	2.5	2.0
Age in months	1198	53.8	10.4	1623	54.6	10.2	1232	53.7	9.9	1778	52.9	10.1	1185	53.2	10.2	781	54.6	9.7
Percentage girls	1198	50%		1623	50%		1232	50%		1778	51%		1185	50%		781	48%	
Percentage urban	1198	54%		1623	49%		1232	51%		1778	34%		1185	50%		781	11%	
Gross National Income per capita ($)		3095			13345			10449			2712			5371			2805	
Income Inequality: Q1 vs Q5		4.4			9.2			5			10.4			4.6			6.6	

Note: 7797 children participated in total. The range of each variable was as follows. Mean development score 4.1 to 95.8; Cognitive Development 1.9 to 98.1; Socio-emotional Development 2.6 to 100; Motor Development 6.7 to 100; Language & Emergent Literacy 1.6 to 100; Health, Hygiene & Safety 3.3 to 100; Cultural Knowledge & Participation 3.4 to 100; Approaches to Learning 4.0 to 100; Wealth index -1.8 to 1.8; Maternal education 1 to 8; Paternal occupation 0 to 8; Age in months 36.0 to 72.0; Percentage girls 48% to 51%; Percentage urban 11% to 54%.

Table 2

Correlations between socioeconomic variables

	Wealth-education	Wealth-occupation	Education-occupation
Whole sample	0.69	0.51	0.48
Cambodia	0.48	0.48	0.35
China	0.30	0.26	0.43
Mongolia	0.36	0.24	0.36
Papua New Guinea	0.44	0.39	0.29
Timor-Leste	0.42	0.50	0.31
Vanuatu	0.31	0.34	0.19

Note: n = 7797 (whole sample).

Table 3

Associations of wealth, education and occupation with development, with and without additional controls

	Wealth	Education	Occupation
Only this variable	0.178***	0.143***	0.079***
	(.126 - .229)	(0.084 - .201)	(.051 - .108)
With control: wealth		0.113***	0.055***
		(.057 - .168)	(.027 - .084)
With control: education	0.132***		0.052***
	(.093 - .171)		(.026 - .077)
With control: occupation	0.153***	0.124***	
	(.105 - .200)	(.067 - .181)	
With all controls	0.119***	0.102***	0.038**
	(.080 - .157)	(.048 - .157)	(.011 - .064)

Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; (95% CIs). n = 7797.

Table 4

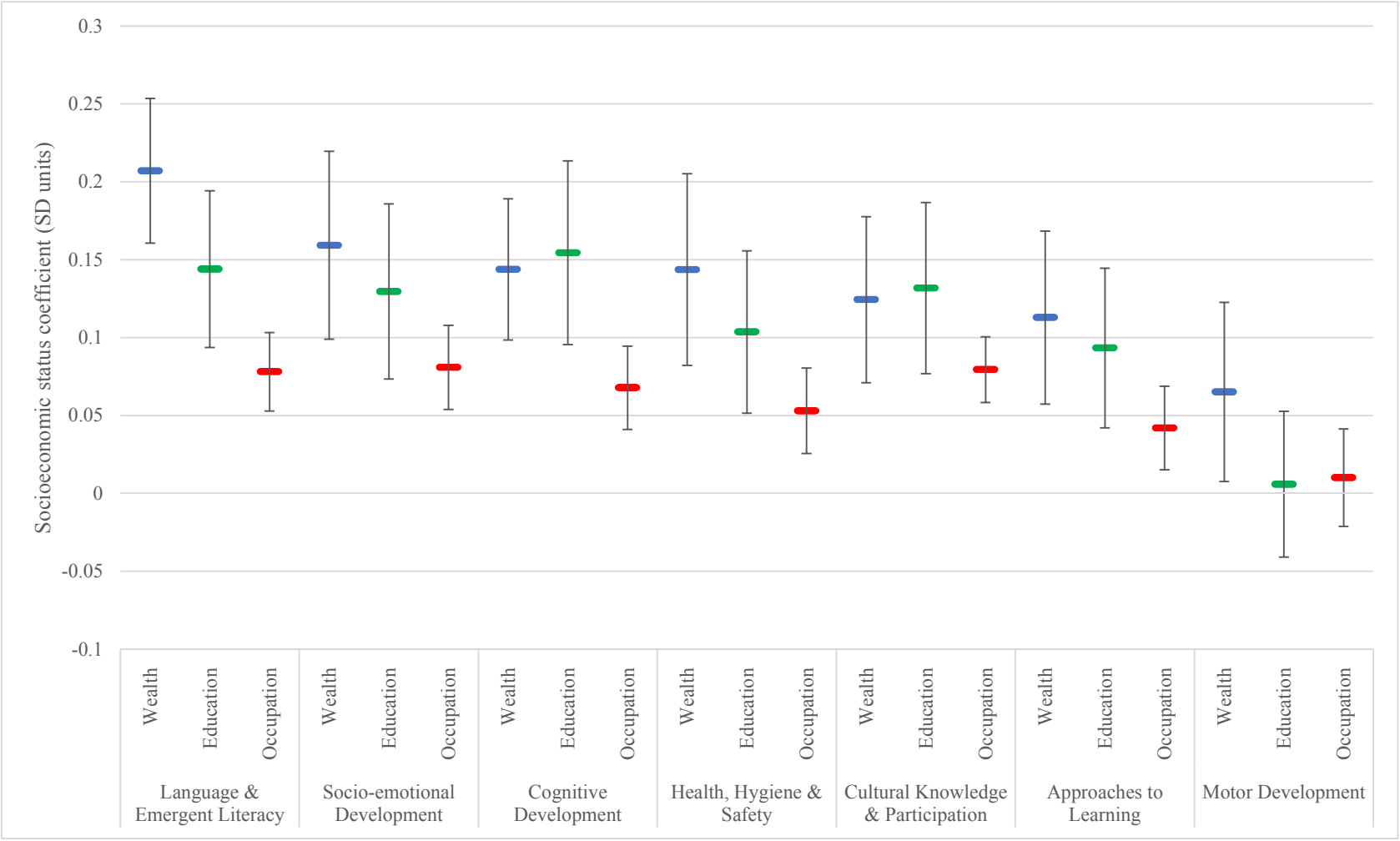
Associations between socioeconomic status and developmental scores for each country

	Wealth	Education	Occupation
Cambodia	0.090	0.055	-0.004
	(-.040 - .220)	(-.109 - .219)	(-.101 - .094)
China	0.148***	0.229***	0.136***
	(.102 - .194)	(.149 - .309)	(.082 - .191)
Mongolia	0.213***	0.207***	0.170***
	(.140 - .285)	(.118 - .296)	(.131 - .210)
Papua New Guinea	0.179***	0.165**	0.105***
	(.080 - .277)	(.045 - .284)	(.047 - .163)
Timor-Leste	0.121**	0.081**	0.068*
	(.043 - .199)	(.032 - .130)	(.002 - .134)
Vanuatu	0.066*	0.006	0.063
	(.002 - .129)	(-.076 - .087)	(-.001 - .127)

Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; (95% CIs). n = 7797.

Figure 1

Associations between socioeconomic status and z-scores across seven developmental domains



Note: Figure 1 shows coefficient estimates with 95% confidence intervals as error bars. n = 7797.

Supporting Information

Appendix A: Supplementary Information

Additional information on missing data

Missing values were found for urban or rural residence (n=13), father's occupation (n=605), mother's education (n=170), Cognitive Development (n=69), Socio-emotional Development (n=221), Motor Development (n=122), Language and Emergent Literacy (n=112), Health, Hygiene and Safety (n=215), Cultural Knowledge and Participation (n=428), Approaches to Learning (n=315), and the overall mean development score (n=204). Variables for wealth, gender, country and age had no missing values. Linear regressions were used to establish whether missingness was associated with any of the main SES or developmental variables, since associations could indicate a bias in results should missing values simply be excluded.

Missingness for maternal education and urban-rural residence was not significantly associated with any SES or developmental variables. Therefore, the mean maternal education score for the province in question was used where maternal education values were missing. Where urban-rural values were missing, the child was randomly allocated an urban or rural score with the probability of each being in proportion to the ratio of urban and rural cases in that province. However, missingness for paternal occupation was associated with household wealth, and missingness for several developmental z-scores was associated with maternal education, so these missing variables were imputed based on means for the country, province, mother's education level, urban or rural residence, gender, country-specific wealth quintile, and six-month age category.

In cases where this more specific mean could not be found, values were imputed based on means for country, province, maternal education, and age category only. In a small number of cases this second mean could also not be found (n=37 for father's occupation; n=12 for mean development scores; n=5 for Cognitive Development; n=9 for Socio-emotional Development; n=6 for Motor Development; n=7 for Language and Emergent Literacy; n=12 for Health, Hygiene and Safety; n=25 for both Cultural Knowledge and Participation and Approaches to Learning), so the mean for country, province and age category was used. To check the robustness of this technique values were imputed for non-missing data which yielded correlations between the imputed and the original variables of at least 0.8636.

Additional information on the EAP-ECDS

Prior to formal data collection, each assessor conducted tests in parallel with a supervisor. Inter-rater reliability between the assessor and supervisor was at least 85% before commencement of formal assessment, and reliability was regularly re-evaluated (Rao et al., 2014). Ethical approval was obtained from [blinded for review] Human Research Ethics Committee and informed consent was obtained from all parents of participating children.

Additional information on measures

Early child development. The EAP-ECDS has seven domains. Pilot studies resulted in 85 items being developed across these seven domains. Children were assessed in their local language by trained assessors (Rao et al*.,* 2018). Questionnaires and relevant assessment materials were translated into the local language and then back-translated to evaluate equivalence between English and the local language. Domains were shown to have satisfactory reliability (internal consistency), with Cronbach's alpha of 0.84 to 0.94 for all domains except Motor

Development, for which Cronbach's alpha was 0.70 to 0.77 (Rao et al., 2014). Full details can be found in Supplementary Table S1.

Since the EAP-ECDS were developed such that older children should have higher scores on average, developmental scores were converted into month-of-age-adjusted z-scores to create measures that were comparable across children of different ages. A score of 0 indicates an average score for a child of that age, whilst a score of 1 indicates being one standard deviation above average and -1 indicates being one standard deviation below average for that age. This technique has been used elsewhere to analyze child development (e.g., Lopez Boo, 2016), and has been used to analyze EAP-ECDS data (Weber, Darmstadt, & Rao, 2017). Z-scores allow comparison of children across the whole sample from all six countries.

Socio-economic status. Three measures of socio-economic status (SES) were used: household wealth; maternal education; and paternal occupation. The indicator of household wealth was derived from questions on asset ownership, such as whether the household has electricity, a radio, television, telephone, refrigerator, motorcycle, car, or boat, and whether a member of the household owns a dwelling, livestock or agricultural land. These questions follow the standardized questions used for the Multiple Indicator Cluster Survey (UNICEF, 2005). Following Filmer and Pritchett (2001), a composite variable was created based on the first component of a Principal Components Analysis (PCA) of the household wealth variables. Techniques similar to this have been used extensively to create indicators representing household wealth (Schady et al., 2015). The indicator of maternal education was based on the mother's highest qualification over eight levels: no formal education; preschool education; primary education; lower secondary; upper secondary; higher certificate, diploma or associate degree; bachelor's degree; or postgraduate. The indicator of paternal occupation was based on nine

different occupation levels (assumed to be ordinal) from the International Labour Organisation ISCO-88 standard. All SES indicators were standardized such that a score of 0 indicates mean wealth, and scores of 1 or -1 indicate one SD above or below the mean.

Control variables. Other control variables used were the child's gender, country of residence, age category (in 6-month age groups), and urban or rural residence. Although month-of-age-adjusted z-scores were used, the age control adjusts for any remaining confounding. A country control was used because the six countries have large differences in Human Development Index (HDI) scores and SES-development relations may differ across these countries. Early child development can vary by gender and SES can vary by urban or rural residence, so these control variables were added. A variable indicating the province in which the assessment was conducted was also used as a level 2 variable in order to account for clustering in the sample design.

Notes on Tables and Figures

Table 1. The table shows descriptive statistics for each of the key variables for each of the six countries separately. GNI and income inequality data are from: United Nations. (2016). *Human Development Report 2016: Human Development for Everyone.* New York: United Nations Development Programme.

Table 2. The table shows Pearson correlations between household wealth, maternal education, and paternal occupation, for the whole sample (pooled) and for each country individually.

Table 3. The table shows associations between three SES indicators and mean development scores from several different HLM regressions, controlling for age (in 6-month

categories), gender, country, urban-rural residence, and dummy variables for imputed values. The first row shows the association of that SES indicator with developmental scores. Subsequent rows show how the coefficient of that SES indicator changes once additional SES controls are added to the model. The final row shows the coefficient of that indicator once all three SES indicators are added. Significance at the 5%, 1% and 0.1% levels is shown by *, ** and ***. 95% confidence intervals are shown in brackets underneath the coefficients.

Table 4. The table shows associations between each of the three SES variables and developmental scores for each country individually.

Figure 1. The figure shows associations between SES and early child development over seven domains. SES is represented as wealth (blue), maternal education (green), and paternal occupation (red). Estimates represent the association for a 1 SD increase in SES on a child's month-of-age-adjusted developmental z-score.

Appendix B: Supplementary Tables and Figures

Supplementary Table 1

Cronbach's alpha scores for EAP-ECDS domains

Domain	Cambodia	China	Mongolia	PNG	Timor-Leste	Vanuatu
Cognitive development	0.94	0.94	0.93	0.91	0.88	0.94
Socio-emotional Development	0.93	0.91	0.92	0.93	0.89	0.94
Motor Development	0.70	0.74	0.75	0.77	0.72	0.75
Language and Emergent Literacy	0.94	0.93	0.92	0.93	0.89	0.95
Health, Hygiene, and Safety	0.91	0.84	0.87	0.93	0.87	0.94
Cultural Knowledge and Participation	0.91	0.89	0.91	0.92	0.89	0.94
Approaches to Learning	0.92	0.88	0.88	0.88	0.87	0.88

Note: The table summarises Cronbach's alpha scores for each domain in each of the six countries, based on Rao et al., (2014).