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Preschool attendance: a multilevel analysis of individual and community factors in 21 low and middle-income countries

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Abstract: This paper investigates how preschool attendance is shaped by individual and community factors for 71,806 children from 14,303 communities in 21 low-to middle-income countries using a multilevel analysis. We assess how these mechanisms vary by community and country wealth and the extent to which the variation of preschool attendance can be explained by the characteristics of children living in these communities. We find that of the total variation, 36% was attributable to communities and 12% to countries, with children's demographic and socioeconomic characteristics' explaining 23% of the between community variation. Community wealth and health are crucial determinants; in poor communities with high stunting rates, the chances of preschool attendance are at least halved. Our results suggest that the effect of community on preschool attendance is stronger in poorer countries with greater inequality between communities.

Keywords: preschool attendance; wealth heterogeneity; communities; stunting; contextual effects; multilevel; country income groups; DHS data.

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Máiréad Dunne is Professor of Sociology of Education at the University of Sussex and Director of the Centre for International Education. She engages in social and cultural studies of educational and social mobility. Her research has included studies of social class, gender, sexuality and ethnicity in policy and practice contexts in low-income countries as well as the UK. Her concerns are for reflexive research and theoretical development through contextually located and multi-perspectival explorations of educational policy, institutions and practices using mixed methods in approaches.

Benjamin Zeitlyn is a Lecturer in International Education and Development working at the University of Sussex. His research interests are in two principal areas: 1) he works on access to education and dropout, as a Research Fellow in CREATE and then on children who drop out of school in Ethiopia and on private secondary education in Malawi. 2) At the Sussex Centre for Migration Research, he has worked on transnational childhoods and identities, and migration and development. He is currently the qualitative theme leader in the Migrating Out of Poverty Research Programme Consortium. His doctoral work on British Bangladeshi children developed ideas of transnational social spaces and the experiences of children growing up in multicultural and transnational societies.

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1 Introduction

Early childhood is widely recognised as a vital period in which a child's foundations for success are laid. There is substantial empirical evidence of several positive effects of preschool education. Preschool is associated with enhancing school readiness and better school achievement (Currie, 2001; Heckman and Masterov, 2007; Lynch, 2005), increasing maternal employment (Blau and Currie, 2006; Berlinski et al., 2011), wage earning-potential as well as lower levels of high-risk behaviour (Naudeau et al., 2011). Although considerable progress has been made in the number of children enrolled in preschool in the last decade, more than half of young children remain excluded (UNESCO, 2012). To improve this situation, it is crucial to gain an understanding of the factors that drive preschool attendance.

There is a lack of evidence on these factors in developing countries. Recent research focuses on specific countries such as Berlinski et al. (2008) and Aguilar and Tansini (2012) in Uruguay, and Habibov (2012) in Central Asian countries. To fill this gap, this article examines the determinants of preschool attendance for 21 low and middle-income countries. Using large-scale quantitative analysis, we are able to disentangle how issues affecting preschool vary by country and wealth.

In addition, within each country, we include the community as a unit of analysis. Here, community refers to the local geographical context, drawing upon the

Demographic and Health Survey (DHS) ‘primary sampling unit’ (PSU). This allows us to add community characteristics (such as poverty and malnutrition levels) to individual characteristics influencing preschool attendance. To do so we follow a multilevel approach of two types. For the pooled model of all countries, we use a three-level analysis, where children (level 1) are nested within communities (level 2) which are nested within countries (level 3). For each country, a two-level analysis is conducted, with children nested within communities. We also perform a country income group analysis within a three-level framework to examine how individuals and community factors relate to a country’s wealth.

These different approaches allow us to investigate several important hypotheses. For instance, we are able to assess whether individual or community factors are more influential determinants of preschool attendance; we can explore variability of preschool attendance at different levels (across countries, income groups and communities) and whether this variation is reflective of the characteristics of children living in these communities. Moreover, we can examine whether and to what extent socioeconomic influences on preschool attendance are heterogeneous and vary by family wealth and community poverty. Moreover, we study double disadvantage, that is, we establish which countries and how many communities are likely to have low average preschool attendance coupled with strong wealth random effects. By following a multilevel framework we incorporate these elements into the large-scale study, providing relevant policy-based evidence.

2 Theoretical framework

Our model for preschool attendance is based on human capital theory where parents decide whether or not to send their children to preschool by weighing up future benefits (e.g., higher wages) against direct and indirect costs (e.g., travel costs, fees). The decision is also affected by the ability of the household to afford preschool and desire to attend (demand) and the availability of preschool places (supply). These factors operate at the individual/household level, community level and the regional or national level (see Huisman and Smits, 2009; Longwe and Smits, 2012).

At the individual level, poorer families face higher costs in terms of the proportion of household income they must commit for preschool. Less well-educated parents are less likely to value preschool for their children (Buchmann, 2000). Poor families are more likely to show evidence of poor family planning (young mothers, large number of children), which puts pressure on scarce family resources and therefore decreases education participation of any type (Webbink et al., 2012). At the community level, educational infrastructure, safety, distance and labour market opportunities are also central (Ersado, 2005). Fewer labour prospects and low quality schools may make parents reluctant to invest in preschool. The nutritional health of communities is critical too. Poor nutrition in early childhood irreversibly impedes cognitive development and lowers preschool enrolment (Grantham-McGregor et al., 2007; Vegas and Santibáñez, 2010). National policies may favour some communities by expanding preschool supply and teacher deployment within already wealthy communities. Moreover, many factors will influence each other across levels. For example, a poor family are likely to live in a poor community, which, if it has poor educational facilities and malnutrition, will compound the negative effect of the household’s poverty on preschool attendance.

3 Data and methods

3.1 Variables

This study is based on 21 DHSs from low, lower middle and upper middle-income countries' groups between 2005 and 2011 (Measure DHS, 2013a). Countries are grouped by level of gross national income (GNI) per capita according to the World Bank income classification (World Bank, 2012). The standardised multistage sampling procedure of the DHS has the double advantage of providing nationally representative samples that are also comparable across countries (Measure DHS, 2013b).

The key unit of analysis used in the multilevel model is the 'community', a small contiguous area known as a cluster or PSU in DHS surveys. DHS data for comparative (multilevel) analysis on how community characteristics affect specific outcomes has mainly been used in studies of health (Adekanmbi et al., 2013; Corsi et al., 2012; Uchudi, 2012; Uthman, 2010). By contrast, for education measures and especially for preschool attendance, evidence related to community is non-existent.

Table 1 DHS countries, year, sample size, communities and mean preschool attendance

Country	Year	Sample size	Communities	Preschool attendance	
				Mean	SD
Low					
Cambodia	2010	4,673	610	0.186	0.389
Malawi	2010	6,791	843	0.081	0.272
Nepal	2011	1,525	281	0.487	0.5
Niger	2006	4,519	341	0.049	0.216
Rwanda	2010	4,818	492	0.24	0.427
Sierra Leone	2008	2,847	353	0.087	0.282
Tanzania	2010	2,839	463	0.309	0.462
Uganda	2011	3,892	403	0.405	0.491
Zimbabwe	2010	1,530	377	0.441	0.497
Lower middle					
Albania	2008	1,151	396	0.552	0.498
Bolivia	2008	4,672	966	0.374	0.484
Cameroon	2011	4,426	574	0.155	0.362
Egypt	2008	3,908	1,131	0.288	0.453
Ghana	2008	3,530	411	0.473	0.499
Guyana	2009	905	290	0.399	0.49
Moldova	2005	1,258	376	0.741	0.438
Nigeria	2008	6,758	863	0.215	0.411
Upper middle					
Azerbaijan	2006	854	287	0.116	0.32
Colombia	2010	7,100	3,380	0.362	0.481
Dominican Republic	2007	3,081	1,216	0.573	0.495
Maldives	2009	729	250	0.904	0.295
Total		71,806	14,303	0.287	0.452

Table 1 describes countries/years used in the analysis as well as the number of communities with the observed mean of preschool attendance. The population under study is children of preschool age.¹ This yields a pooled sample of 21 countries with 71,806 observations distributed across 14,303 communities and with a mean for the dependent variable ‘preschool attendance’ of 28.7%. The number of level 1 observations per community for the pooled sample is around five. This varies between 2.1 and 13.3 children per community across countries, which are well above than what is required to obtain corrected point and interval estimates for the model’s parameters, particularly considering the large level 2 numbers of communities in the sample (Bell et al., 2010).

Following previous studies (e.g., Aguilar and Tansini, 2012; Berlinski et al., 2008; Huisman and Smits, 2009; Longwe and Smits, 2012), we included individual demographic variables such as family composition, birth order and socioeconomic covariates such as wealth, mother’s employment and parental education. At the community level, variables included were place of residence, aggregate community poverty (proportion of household in the bottom two wealth quintiles), community nutritional health (average stunting rate) and average community parental education as well as regional countries’ dummies. Table 2 shows descriptive statistics of all these variables.

Table 2 Sample descriptive statistics (pooled sample)

<i>Variable</i>	<i>Definition</i>	<i>Mean</i>	<i>SD</i>
<i>Level 1 (individual/household)</i>			
Demographic factors:			
Male	Equals to 1 if gender is male and 0 for female.	0.51	
Number of children under five years old		1.87	1.05
Number of children of primary school age in the household		1.22	1.22
Head of household – male	Equals to 1 if household head is male, 0 otherwise.	0.79	
Birth order of child – first	Equals to 1 if child’s birth is first, 0 otherwise.	0.24	
Birth order of child – second or third	Equals to 1 if child’s birth is second or third, 0 otherwise.	0.38	
Mother age at birth – less than 18 years old	Equals to 1 if mother age at birth was less than 18, 0 otherwise.	0.32	
Socioeconomic factors:			
Mother education – at least some secondary	Equals to 1 if mother attended secondary or more, 0 otherwise.	0.33	
Father education – at least some secondary	Equals to 1 if father attended secondary or more, 0 otherwise.	0.39	
Wealth (mean centred)	1 = poorest, 2 = poor, 3 = middle, 4 = rich, 5 = richest.	2.68	1.40
Mother employed	Equals to 1 if mother is currently working, 0 otherwise.	0.59	

Table 2 Sample descriptive statistics (pooled sample) (continued)

<i>Variable</i>	<i>Definition</i>	<i>Mean</i>	<i>SD</i>
<i>Level 2 (community)</i>			
Urban residence	Equals to 1 if community is urban, 0 otherwise.	0.31	
Community stunting	Average stunting rate.	0.29	0.24
Community poverty	Average proportion of households in the bottom two wealth quintiles.	0.50	0.38
Community parent's education: at least some secondary	Average proportion of parental education (some secondary or more).	0.36	0.39
Outcome: preschool attendance		0.29	0.45

3.2 Multilevel analysis

For the pooled sample model we use a multilevel logit with a three-level hierarchical structure where n children of preschool age are nested within J communities, which are nested within K countries. The binary dependent variable y_{ijk} is equal to 1 if the child i ($i = 1, \dots, n$) in community j ($j = 1, \dots, J$) in country k ($k = 1, \dots, K$) is attending preschool and 0 otherwise. Demographic and socioeconomics variables at the individual level are denoted by X_{ijk} and variables at the community level by Z_{jk} . The error term at the individual level is e_{ijk} , μ_{jk} for level 2 and ν_k for level 3. The three level random intercept logistic regression model (RIM) is defined as:

$$\log \left\{ \frac{\pi_{ijk}}{1 - \pi_{ijk}} \right\} = \beta_{000} + \sum_p \beta_{p00} X_{pijk} + \sum_q \gamma_{00q} Z_{qjk} + \mu_{jk} + \nu_k \quad (1)$$

Additionally, we allow for random effects on the community slope of wealth and on the country slope of community poverty:

$$\log \left\{ \frac{\pi_{ijk}}{1 - \pi_{ijk}} \right\} = \beta_{000} + \sum_p \beta_{p00} X_{pijk} + \sum_q \gamma_{00q} Z_{qjk} + \mu_{pj} X_{pjk} + \mu_{0jk} + \nu_{qk} Z_{qjk} + \nu_k \quad (2)$$

The intra-class correlation coefficient (ICC) at the community and country levels is calculated as:

$$\rho_{\text{community}} = \frac{\sigma_{\mu}^2}{\sigma_{\mu}^2 + \sigma_{\nu}^2 + \sigma_{\varepsilon}^2} \quad (3)$$

$$\rho_{\text{country}} = \frac{\sigma_{\nu}^2}{\sigma_{\mu}^2 + \sigma_{\nu}^2 + \sigma_{\varepsilon}^2}$$

where σ_{ε}^2 is the variance of level 1 (children) which is equal to $\pi^2/3$ ($\cong 3.29$), σ_{μ}^2 is the variance of level 2 (community) and σ_{ν}^2 is the variance of level 3 (country). We rely on this definition as we are interested in a decomposition of the variance across levels and

how much variance is explained at each level (Hox, 2010). An alternative is to add both the community and country variance on the numerator, which yields the ICC for children in the same country [see Rabe-Hesketh and Skrondal (2012, p.876) for details].

We first estimate a null model and then sequentially control for individual and community covariates. Then, we assess how much of the preschool attendance variation is explained by characteristics of individuals and communities individually, as well as to test for heterogeneity and the effects of community socioeconomic characteristics. We repeat the same analysis by country income groups. For the country specific results we follow the same estimation procedure for a two-level hierarchical structure. We rely on three indicators of variation partition: the ICC, as well as the median odds ratio (MOR) and the interval odds ratio (IOR) which accounts for the dependence of the within children variation of the chosen covariates (Larsen and Merlo, 2005). These indicators are defined as:

$$\begin{aligned}\rho'_{community} &= \frac{\sigma_{\mu'}^2}{\sigma_{\mu'}^2 + \sigma_{\varepsilon}^2} \\ MOR &= \exp\left\{\sqrt{2 \times \sigma_{\mu'}^2} \times \Phi^{-1}(0.75)\right\} \\ IOR_{lower} &= \exp\left\{\gamma_{1jk} \times (Z_{1jk}) \sqrt{2 \times \sigma_{\mu'}^2} \times \Phi^{-1}(0.10)\right\} \\ IOR_{upper} &= \exp\left\{\gamma_{1jk} \times (Z_{1jk}) \sqrt{2 \times \sigma_{\mu'}^2} \times \Phi^{-1}(0.90)\right\}\end{aligned}\tag{4}$$

where $\sigma_{\mu'}^2$ is level's 2 variance and σ_{ε}^2 level 1's variance ($= \pi^2/3$), and $\Phi(\cdot)$ is the standardised cumulative normal distribution, $\Phi^{-1}(0.75)$ is the 75th percentile, $\Phi^{-1}(0.10)$ is the tenth percentile, $\Phi^{-1}(0.90)$ the 90th percentile, and γ_{1jk} and Z_{1jk} are the coefficient and dummy for community poverty. The MOR quantifies the variation between communities by comparing two children from two randomly chosen, different communities. The IOR is a quantification of the proportion community variation explained by community poverty. Estimations were carried out using the `gllamm` routine of STATA (Rabe-Hesketh and Skrondal, 2012).

4 Results

4.1 Pooled sample

Figure 1 shows the community and country variance of preschool attendance for the null model and by controlling for level 1 and 2 covariates. Two findings emerge from this figure. First, between-community variation of preschool attendance is much larger than variation between-countries (nearly twice as large). In the null model without controls, the ICC or proportion of the variance attributed to community level factors is 36% and the ICC for country level factors is 12%. Second, while individual factors account for most of the preschool attendance variation between communities, factors at the community level explain most variation at the country level. In the individual-adjusted model, individual differences account for 32% of the level 2 variance reduction and only for 2% of the level 3 variance, whereas the opposite occurs in the full model: community factors account for 14% of the level 2 variance and 37% of the level 3 variance.

Figure 1 Variation in preschool attendance attributed to communities and countries in models with demographic and socioeconomic (individual) and community characteristics (see online version for colours)

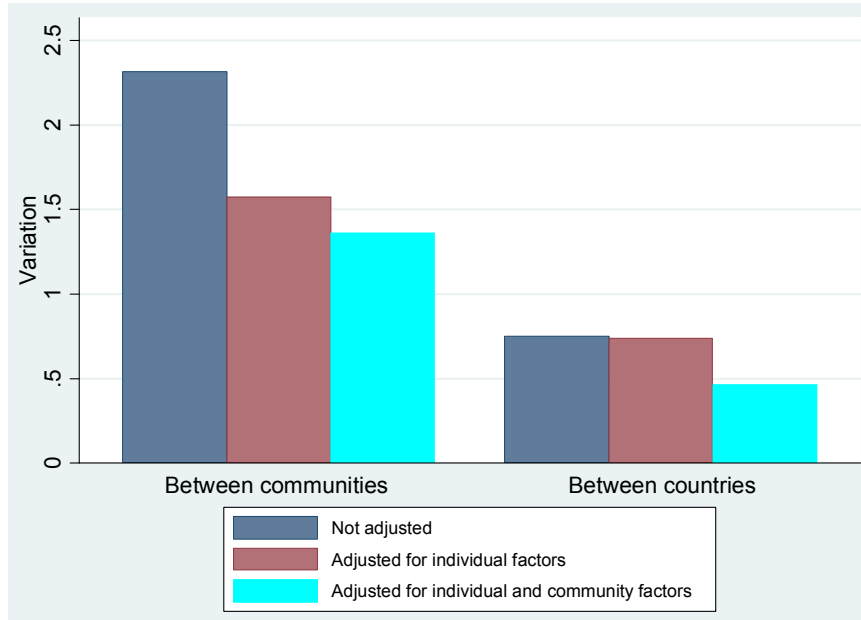


Table 3 contains estimations of the determinants of preschool attendance at the individual level (Model 2) and at the individual and community level (Model 3). We first test an empty model with 3 levels against a 2 level structure for the pooled sample. The model with individuals, communities and country level is accepted, which is reflected in a statistically significant inter-country variance ($\sigma_{v_0}^2$) for Models 1 to 3. The country and community variance are jointly significant after controlling for covariates in Models 2 and 3 [p-values for var (Cons) for both levels 2 and 3 are less than 1%]. Thus, variation on preschool attendance for all countries is simultaneously attributed to unobserved heterogeneity at the community and country levels, after accounting for individual/household and community characteristics.

In Model 3, we allow for random effects on wealth and community poverty, exploring the heterogeneity in the variation of preschool attendance both by socioeconomic status at the community and country level. The variance-covariance matrix adds to the intercept variances of Model 2, the terms for the variance of the slope of wealth ($\sigma_{\mu_1}^2$) and community poverty ($\sigma_{v_1}^2$) as well as the two covariances with the intercept ($\sigma_{\mu_0_1}$ and $\sigma_{v_0_1}$). We find that both wealth slopes vary between communities and communal poverty slopes vary between countries (LR $\chi^2(2) = 869.93$, p-value = 0.00). The large variability of community poverty, which nearly duplicates the country intercept (i.e., $\sigma_{v_1}^2 = 0.82$ and $\sigma_{v_0}^2 = 0.46$), indicates that poverty has an effect on preschool attendance chances beyond a country's specific characteristics. In addition, the large correlation between the random intercept and wealth slopes ($r = -0.54$, p-value = 0.00) implies that communities that have above-average preschool attendance tend to have below average effects on household wealth.

Table 3 Determinants of preschool attendance for pooled model

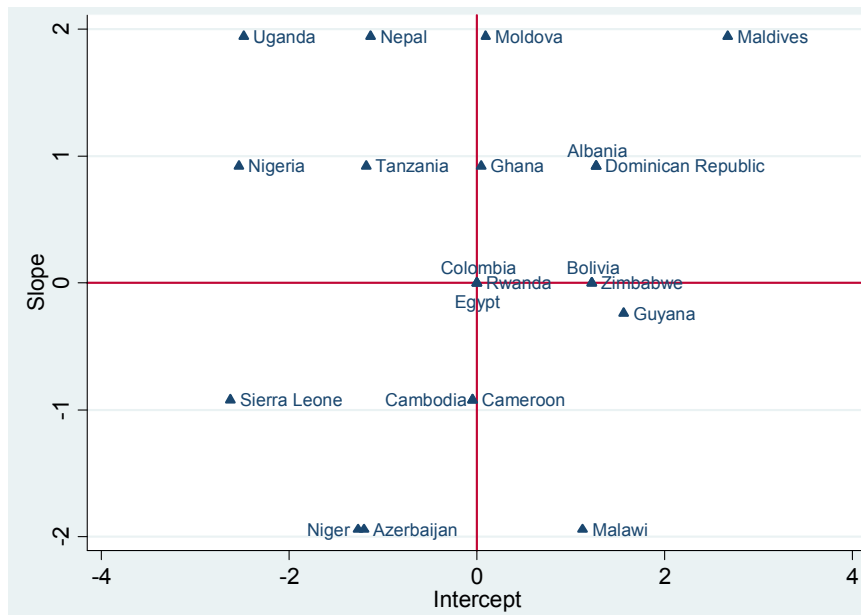
	Model 1 empty	Model 2 individual	Model 3 individual and community
Individual-level variables			
Male		0.949	0.955
No. children under five years old		0.922	0.913
No. children primary school age		0.881	0.880
Male household head		0.917	0.929
Birth order first		1.133	1.226
Birth order second/third		1.084	1.107
Mother aged less than 18 at birth		0.870	0.916
Mother education – at least secondary		1.131	1.088
Father education – at least secondary		1.124	1.039
Wealth		1.718	1.570
Mother employed		1.131	1.157
Communities-level variables			
Urban residence			1.1502
Health			0.5678
Poverty			0.6868
Parents education – at least secondary			1.6773
Constant		0.730	0.3974
Random part			
Level 2 – communities			
$Var(cons) = \sigma_{\mu_0}^2$	2.314	(0.059)***	1.359
$Cov(cons, wealth) = \sigma_{\mu_0}$			-0.187
$Var(wealth) = \sigma_{\mu_1}^2$			0.088
Level 3 – countries			
$Var(cons) = \sigma_{\nu_0}^2$	0.751	(0.024)***	0.463
$Cov(cons, poverty) = \sigma_{\nu_0}$			0.023
$Var(poverty) = \sigma_{\nu_1}^2$			0.817
ICC (community)	0.364		0.266
ICC (country)	0.118		0.091
Log-likelihood	-34,355	-31,791	
N	71,806	71,806	71,806

Notes: *p < 0.10, **p < 0.05, ***p < 0.01; odd ratios and standard errors in parentheses are reported.

We now turn to the estimated covariates. On the one hand, individual socioeconomic factors have larger impacts than individual demographic factors. Household wealth and mother being employed have odds ratios of 1.57 and 1.16, respectively. A child in a rich family had nearly three times the chance of attending preschool than a child from a household with average wealth.² Apart from the variable ‘child birth order-first’, which has an odd ratio of 1.22, the remaining demographic variables have smaller effects than socioeconomic variables. This is expected, as poverty is both a cause and an effect of poor family planning.

Characteristics of the community where children live are also crucial determinants of preschool attendance. We accept the presence of community effects (LR $\chi^2(4) = 304.98$, p-value = 0.00). Community poverty and parental education have odds ratios of 0.69 and 1.68, larger than their individual level counterparts, indicating that community level factors were more influential than individual level factors. Community stunting rate has an odd ratio of 0.56. As undernutrition is associated with poor cognitive development, late entry into school, fewer years of schooling and reduced productivity (Crookston et al., 2011), children living in communities with larger stunting rates are less likely to be attending preschool. The large negative association between community stunting and preschool attendance supports the argument that early childhood development dimensions (health, nutrition and education) are strongly inter-related.

Figure 2 Countries’ intercept and community poverty random effects for pooled model (see online version for colours)



By simultaneously plotting the random effects of the intercept and community poverty at the country level, disadvantaged countries with both low preschool attendance and large effects of poverty on preschool attendance can be identified. This information is provided in Figure 2. Within the wide variation of specific country effects and communal poverty, three broad groups can be pinned down in terms of disadvantage. First, there are four

countries falling into the double disadvantaged group (top left quadrant), with three of those being low-income countries (only Nigeria is from the lower middle-income group). Second, upper middle-income countries are in the origin (with roughly zero variability) or in the top right quadrant, with above average preschool attendance but some effect of community wealth. Third, the lower middle-income group is heterogeneous, the random intercept is similar but community poverty effects are influential.

4.2 By income group

Table 4 displays estimates by income group. As far as the fixed part of the model is concerned, wealth is an important determinant for all three income groups, however, its contextual effect is only significant in low and lower middle-income countries (odds ratio of 0.48 and 0.41 for community poverty and of 1.2 but not significant for the richer countries' group). While low preschool attendance is prevalent in low-income countries, community health estimates contain an interesting finding. The effect in lower middle-income countries (odds = 0.38) is twice as large than in the poorest countries (odds = 0.81). This indicates that it may be possible to increase preschool attendance in lower middle-income countries by improving the nutritional status of certain communities.

The random part of Table 4 shows that there is heterogeneity in the variation of preschool attendance at different levels of wealth regardless of the level of income of a country. The random effect of wealth, however, is smaller for low-income countries ($\sigma^2 = 0.103$) than in lower middle-income countries ($\sigma^2 = 0.235$). Low-income countries are a more homogenous in terms of income effects while lower middle-income countries are more diverse.

The covariance between the random intercept and wealth, which relates average attendance with its wealth gradient, is negative within the three groups (i.e., wealth effect on preschool attendance is strong where the average probability to attend preschool is small). But this covariance term has more influence in the low-income group. In particular, the correlation r is equal to 0.67 in the low-income group, $r = 0.33$ in lower middle group and $r = 0.51$ in the upper middle group, so the widest variation between countries occurs in the low-income group (see Figure 3). This may suggest that for the poorest children from low-income countries preschool attendance is a matter of a lack of supply and, for children in upper middle-income countries, wealth is an issue in some countries but not others. On the contrary, for lower middle and upper middle-income countries, wealth slopes are rather constant across wealth quintiles.

4.2 Individual countries

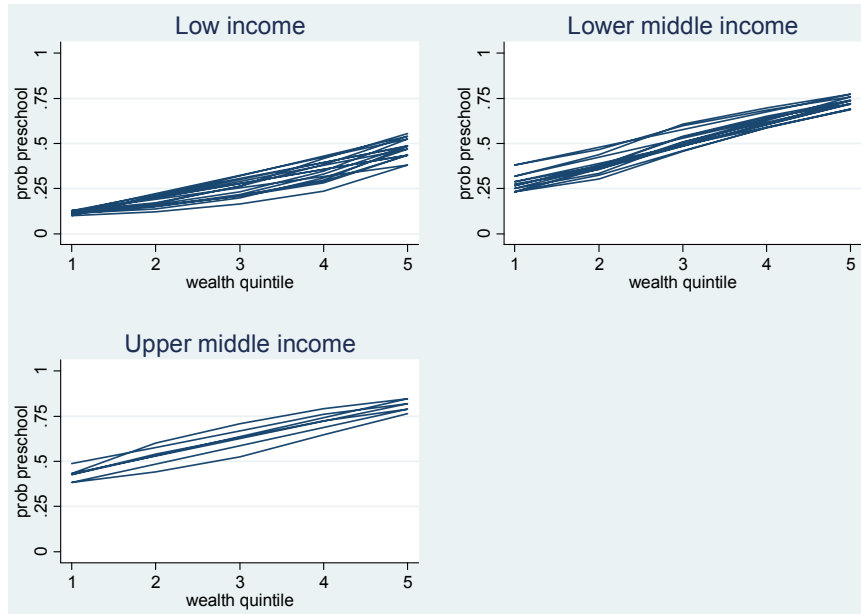
This section presents results under a two-level structure. Community variation is displayed in Figure 4. Information on the variation attributed to each level, individual and community socioeconomic estimates³ as well as the results for the tests on the random effect of wealth and for the joint effect of level 2 covariates, are presented in Tables 5a and 5b.

Table 4 Wealth and community factors of preschool attendance and random effects by income group

	<i>Model 4 – low income group</i>	<i>Model 4 – lower middle-income group</i>	<i>Model 4 – upper middle-income group</i>
Wealth	1.631 (0.038)***	1.61 (0.044)***	1.548 (0.063)***
Communities-level variables			
Urban residence	1.343 (0.099)***	0.599 (0.043)***	1.657 (0.140)***
Health	0.81 (0.097)*	0.377 (0.046)***	0.580 (0.108)***
Poverty	0.483 (0.060)***	0.413 (0.0462)***	1.200 (0.146)
Parents education – at least secondary	1.547 (0.158)***	1.641 (0.131)***	1.872 (0.241)***
Random part			
Level 2 – communities			
$Var(cons) = \sigma_{\mu_0}^2$	1.47 (0.077)***	1.395 (0.083)***	1.302 (0.139)***
$Cov(cons, wealth) = \sigma_{\mu_0}$	-0.26 (0.030)***	-0.187 (0.035)***	-0.236 (0.053)***
$Var(wealth) = \sigma_{\mu_0}^2$	0.103 (0.023)***	0.235 (0.040)***	0.165 (0.062)***
Level 3 – countries			
$Var(cons) = \sigma_{\nu_0}^2$	0.27 (0.015)***	0.277 (0.024)***	1.344 (0.094)***
ICC (community)	0.292	0.281	0.219
ICC (country)	0.054	0.056	0.226
Log-likelihood	-1,2274	-12,685	-6,359
N	33,434	26,608	11,764

Notes: *p < 0.10, **p < 0.05, ***p < 0.01; odd ratios and standard errors in parentheses are reported; specification includes same covariates as in Table 3.

Figure 3 Country income groups' predicted probability of attending preschool by household wealth (see online version for colours)



Preschool attendance is far from homogenous and varies considerably between countries (see Figure 4). For instance, Nigeria, Sierra Leone, Niger and Nepal have large between-community variances above four and, at the other end of the scale; there are countries such as Dominican Republic, Bolivia, Zimbabwe and Guyana with level 2 variances below one. Furthermore, the reduction of 40%⁴ in the between-community variation when controlling for individual and community characteristics illustrates how important mechanisms operating at the individual and community levels are in determining the within-country distribution of preschool attendance. Of the countries with a considerable level 2 variance, the ICC reductions are of 67% in Albania, 59% in Uganda, Niger 53%, Cameroon 52%, and 49% in Nigeria (see Table 5a).

A comparison of the MOR between the null and full model further support this. When considering two randomly chosen children with the same covariates from two different clusters and conduct the hypothetical experiment of calculating the odds ratio of a child with a high propensity to attend preschool versus a child with a low propensity, we can see that odds ratio are reduced around 50%–70% in various countries (i.e., Nepal, Niger, Nigeria, Sierra Leone, Uganda). Nonetheless, MORs in the full model are still high (above two in most countries), suggesting a substantial community heterogeneity. The IOR shows where the odds ratio from a poor community and a rich-community lies for 80% of the cases of children with the same covariates. Two things are notable across countries' IOR intervals. First, the interval contains one and so poverty alone, beyond all other controls, does not account for a substantial amount of community heterogeneity. Second, intervals are quite broad, reflecting a large amount variation still unexplained, though in some countries, the poverty effect is relatively high with respect to community effect. For example, in Nigeria and Cameroon, the upper limit of the IOR is lower than

the MOR, indicating a clear impact of the level of community wealth on preschool heterogeneity.

Figure 4 Countries' community variance for preschool attendance (see online version for colours)

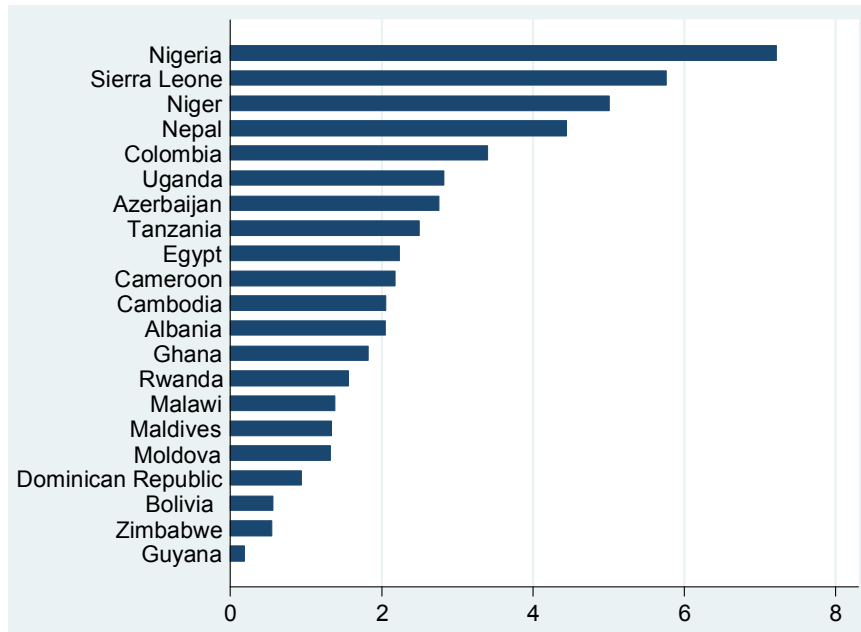


Table 5a Individual country estimations: ICC, MOR and IOR

Country	Year	ICC		MOR		IOR	
		Null model	Full model	Null model	Full model	10th percentile	90th percentile
Low							
Cambodia	2010	0.385	0.265	3.93	2.83	0.12	6.12
Malawi	2010	0.296	0.266	3.07	2.83	0.13	7.01
Nepal	2011	0.575	0.335	7.48	3.41	0.03	3.39
Niger	2006	0.604	0.282	8.46	2.96	0.16	10.03
Rwanda	2010	0.322	0.253	3.29	2.74	0.05	2.37
Sierra Leone	2008	0.637	0.401	9.88	4.12	0.02	4.56
Tanzania	2010	0.432	0.360	4.52	3.66	0.02	2.94
Uganda	2011	0.462	0.188	4.98	2.30	0.11	2.58
Zimbabwe	2010	0.143	0.088	2.03	1.71	0.79	6.07

Notes: Full model specification includes levels 1 and 2 factors as in Table 3 as well as regional dummies, plus random effect of wealth. IORs are calculated for the full model.

Table 5a Individual country estimations: ICC, MOR and IOR (continued)

Country	Year	ICC		MOR		IOR	
		Null model	Full model	Null model	Full model	10th percentile	90th percentile
Lower middle							
Albania	2008	0.383	0.127	3.91	1.93	0.40	4.94
Bolivia	2008	0.146	0.040	2.05	1.42	0.56	2.13
Cameroon	2011	0.399	0.192	4.10	2.32	0.05	1.34
Egypt	2008	0.405	0.267	4.17	2.84	0.06	3.42
Ghana	2008	0.357	0.186	3.63	2.28	0.19	4.28
Guyana	2009	0.053	0.024	1.51	1.31	0.51	1.42
Moldova	2005	0.287	0.259	3.00	2.78	0.07	3.21
Nigeria	2008	0.687	0.353	12.96	3.59	0.02	2.27
Upper middle							
Azerbaijan	2006	0.456	0.303	4.87	3.13	0.01	0.78
Colombia	2010	0.508	0.264	5.80	2.82	0.23	11.90
Dominican Republic	2007	0.222	0.154	2.52	2.09	0.21	3.45
Maldives	2009	0.290	0.305	3.02	3.15	0.17	12.97

Notes: Full model specification includes levels 1 and 2 factors as in Table 3 as well as regional dummies, plus random effect of wealth. IORs are calculated for the full model.

Table 5b Individual country estimations: determinants and tests

Country	Year	Individual covariates		Community covariates			Random effect of wealth	Contextual effects
		Mother education (high)	Wealth	Urban	Health	Poverty		
Low								
Cambodia	2010	1.12	1.57***	1.54**	0.99	0.85	Yes	Yes
Malawi	2010	0.90	1.2***	1.52**	1.03	0.97	Yes	Yes
Nepal	2011	1.58**	1.88***	0.84	0.79	0.33**	No	Yes
Niger	2006	1.04	2.91***	0.89	0.10***	1.28	Yes	Yes
Rwanda	2010	1.19*	1.56***	1.06	0.92	0.35***	Yes	Yes
Sierra Leone	2008	1.1	3.17***	2.56***	1.04	0.31*	Yes	Yes
Tanzania	2010	1.23*	1.73***	1.21	1.39	0.25***	Yes	Yes
Uganda	2011	1.48***	1.67***	1.76***	0.64*	0.53*	Yes	Yes
Zimbabwe	2010	1.13	1.34***	1.45	0.45	2.19**	Yes	Yes

Notes: Full model specification includes levels 1 and 2 factors as in Table 3 as well as regional dummies, plus random effect of wealth. Odds ratios significant at 10% (*), at 5% (**) and at 1% (***). LR tests of random effects of wealth and the joint effect of level 2 covariates significance level is 5%.

Table 5b Individual country estimations: determinants and tests (continued)

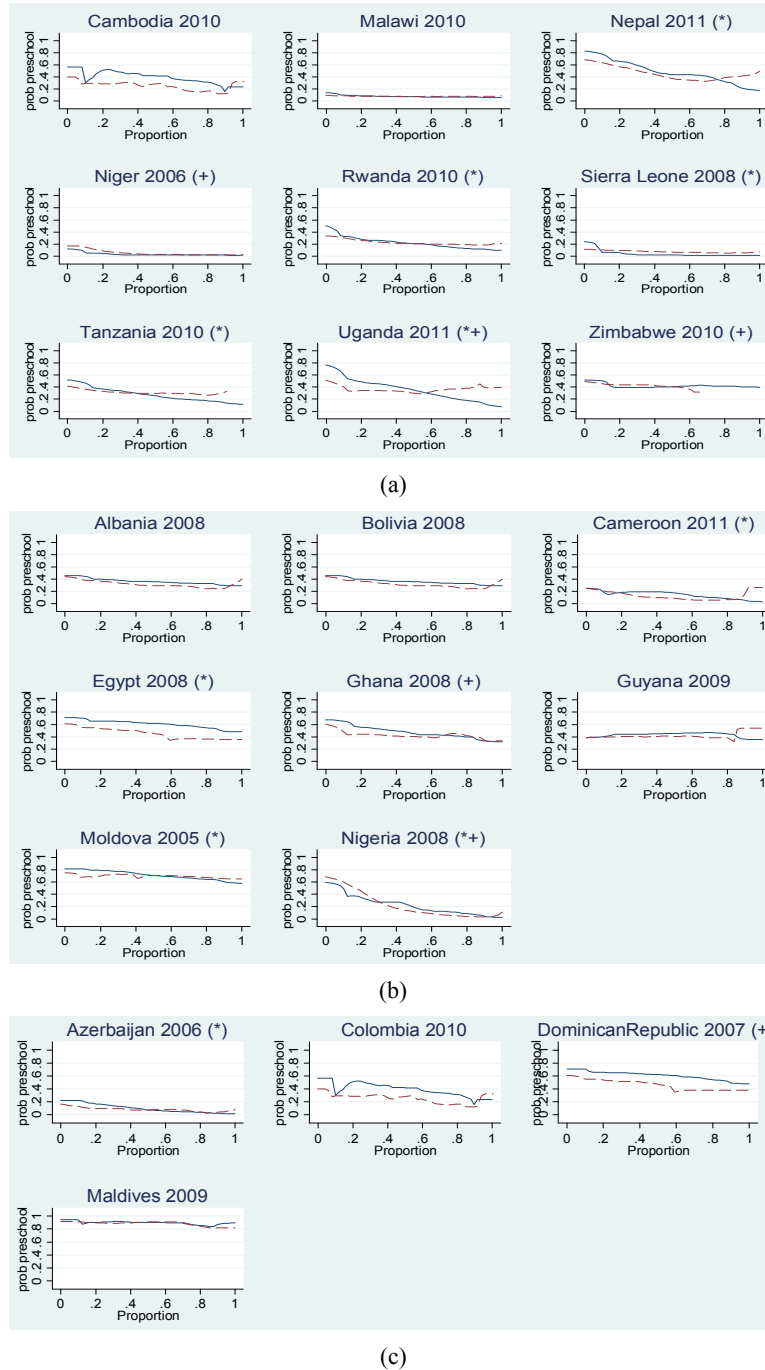
Country	Year	Individual covariates		Community covariates			Random effect of wealth	Contextual effects
		Mother education (high)	Wealth	Urban	Health	Poverty		
Lower middle								
Albania	2008	1.50**	1.37**	1.74*	0.62	1.41	Yes	Yes
Bolivia	2008	1.33***	1.37***	0.70**	0.78	1.09	Yes	Yes
Cameroon	2011	1.05	1.38***	0.64**	0.66	0.27***	Yes	Yes
Egypt	2008	1.33**	1.49***	4.58**	0.7	0.47***	Yes	Yes
Ghana	2008	1.14*	1.80***	0.78	0.49**	0.89	Yes	Yes
Guyana	2009	1.04	1.03	0.72	1.96	0.85	No	No
Moldova	2005	2.87	1.26**	0.99	0.73	0.46*	No	Yes
Nigeria	2008	0.99	2.35***	1.04	0.24***	0.20***	Yes	Yes
Upper middle								
Azerbaijan	2006	1.26	1.08	2.80**	0.35	0.09***	No	Yes
Colombia	2010	1.45***	1.71***	1.71***	0.88	1.66***	Yes	Yes
Dominican Republic	2007	1.20**	1.31***	0.98	0.46*	0.85	Yes	Yes
Maldives	2009	0.66**	1.41	2.64	0.68	1.47	No	Yes

Notes: Full model specification includes levels 1 and 2 factors as in Table 3 as well as regional dummies, plus random effect of wealth. Odds ratios significant at 10% (*), at 5% (**) and at 1% (***). LR tests of random effects of wealth and the joint effect of level 2 covariates significance level is 5%.

Household wealth is a key individual level determinant in 18 countries (in only three countries it is not statistically significant). Wealth effects are larger for low-income countries than in lower middle-income countries. In Sierra Leone, Niger and Nepal, low-income countries, the estimated odd ratios for wealth are 3.17, 2.91 and 1.88, respectively. In addition, substantial heterogeneity is observed for differences in preschool attendance by household wealth. Tests on the random effect of wealth slopes confirm the pooled sample results: wealth effects vary across communities in 16 countries.

Of the level 2 covariates, community poverty is influential; it is statistically significant in ten countries with average odds of 0.33. The level of malnutrition in a community, with odds ratio varying between 0.1 and 0.64, also has a large effect. Children living in urban areas are more likely to be attending preschool (odds ratios are over 1.5 in eight countries). High levels of community poverty and malnutrition severely diminish the chances of children attending preschool. This is illustrated in Figure 5 by plotting community poverty and health gradients on preschool attendance. In Nigeria, for instance, when the proportion of poor households and stunting rate increases from 10% to 60%, the probability of preschool attendance is reduced from 60% to 15%. Likewise, in Uganda, the chances of a child attending preschool are reduced by 35% and 15% by a 50% increase in the rate of poverty and stunting respectively.

Figure 5 Predicted probability of attending preschool by community poverty and community health for individual countries, (a) low income (b) low middle income (c) upper middle income (see online version for colours)



Notes: (*) Community poverty significant at 10%; (+) community health significant at 10%. The blue line represent poverty and the red dotted line stunting.

5 Discussion

This study investigated the role played by individual and community level factors as determinants of preschool attendance using a large representative sample from 21 countries of different income levels. To our knowledge, this is the first comprehensive multilevel study that examines the influence that demographic, socioeconomic as well as communal poverty and malnutrition have on preschool attendance in a wide range of countries. The study, nevertheless, has some limitations such as the problem of the measurement error of wealth and that our preschool measure does not capture utilisation or quality (see Habibov, 2012). Another important limitation is that because to the cross sectional nature of the data, findings should be interpreted with caution. For instance, the relationship between preschool attendance and community poverty could work in the other direction where constraints on preschool supply maybe due to a lack of incentive of providers to enter deprived areas rather than to a constrained demand driven by low community wealth. Indeed, strong causality arguments would require a panel data structure.

5.1 Main findings

The study's results can be summarised in four key findings. First, between-community variation of preschool attendance is much larger than variation between-countries, with individual characteristics accounting for the majority of the variation between communities and community factors associated to inter-country differences. Second, socioeconomic as well as health factors are the most important barriers to preschool attendance. Household wealth has a stronger impact than individual demographic factors. Community poverty and malnutrition are strongly negatively associated with preschool attendance. This strong association, however, is found in both the pooled model and most individual countries, while there are differential effects by income group. For instance, the contextual effect of poverty is only significant in poorer countries. Third, socioeconomic impacts are substantially heterogeneous at the country and community levels. Fourth, most countries tend to have a number of disadvantaged communities with low access and strong effects of household wealth. All of these findings remain unchanged after controlling for socioeconomic and demographic characteristics. We discuss each finding's implication below.

The large magnitude of community variation (ICC of 28% of the total variance in full model) suggests that preschool attendance is influenced by community level factors rather than at country level, and heavily influenced by the composition of the children and households living within those communities. Contextual factors (e.g., community poverty and community health), on the other hand, are predominantly associated with inter-county differences in preschool attendance.

These factors are community-specific within a country, but will also operate differently across countries given the macro context and level of wealth of the country, adding to the overall inter-community difference. In poor countries where access is an issue, poverty would play a key role, while it won't in wealthier countries because of a more even supply of preschools. The level of poverty, together with urbanisation⁵ and health constraints within a community, therefore helps to explain those inter-country differences in preschool attendance. The remarkable range of community variation on

preschool attendance (from 7.2 in Nigeria to 0.18 in Guyana) indicates the relative importance of local community characteristics. In short, local residential context matters.

Inequality in preschool attendance is particularly pronounced in disadvantaged communities where children are exposed to multiple risk factors such as poor sanitation, malnutrition; low parental education, lack of stimulation and access to quality preschool (Naudeau et al., 2011). These children have the double disadvantage of household and community level factors. Malnutrition leads to problems such as stunting, which delays cognitive development and reduces preschool enrolment (Glewwe et al., 2001; Grantham-McGregor et al., 2007; Vegas and Santibáñez, 2010). Communities where the majority of households are poor are often additionally disadvantaged by having inadequate health and education facilities, and families with poor maternal health, and poorly educated parents facing financial constraints. Stunting and poverty are indicators of deprivation because they represent multiple biological and psychosocial risks (Engle et al., 2011; Walker et al., 2007). We found that poverty and stunting are deeply inter-connected and associated with low preschool attendance.⁶ As shown by our results, in ten countries the odds ratios of poverty are between 9% and 53%. Poverty in low and lower middle-income countries has odds ratios of 48% and 41%, respectively.

There is also a significant variation in preschool attendance at different levels of wealth and poverty. Wealth slopes vary between communities and communal poverty slopes vary between countries. Our findings show that wealth random effects are substantial for most countries and, at the same time, there is a large random effect for poverty (in the pooled model the variance of poverty is equal to 0.82 while for wealth is of 0.09). This points toward the important role that country and community conditions play in the variability of the association between wealth and poverty and preschool attendance. In poor communities, because of a lack of resources, financial constraints, more dispersed schools, nutritional problems and safety concerns, only the better off children will make it into preschool (World Bank, 2013). This will yield steep wealth gradients in those poor communities.

Equally, poverty effects vary significantly across countries. In high-income countries, wide coverage and policies to reach children living in poor communities will reduce the effect that poverty has on the chances of attending preschool (Paxson and Schady, 2010; Walker et al., 2011). Therefore, poverty gradients are smaller and more homogenous across communities. Conversely, in low-income countries, community poverty widens the inequality effect of family wealth. This is reflected in our findings by a larger negative covariance between the random intercept and wealth for the low-income group ($= -0.26$) as compared to the lower middle ($= -0.18$) and upper middle-income groups ($= -0.23$).

Country global estimates, however, may mask how the extent of inequality is distributed in a given country. Multilevel modelling allowed us to identify how many communities within a country are doubly disadvantaged by having low preschool attendance combined with strong effects of household wealth. We find that in countries such as Uganda and Nigeria between 40 to 50% of their communities present the problem of double disadvantage, that is, they have random effects for the intercept below zero and positive for the slope of wealth. Not surprisingly, in these countries the joint effects of poverty and malnutrition are acute (odds ratio of 53% for poverty and 64% for stunting in Uganda and 20% and 24% in Nigeria).

5.2 Policy implications

Investing in preschool education offers long-lasting and large returns for society in general (e.g., better education outcomes upon primary school entry, increased wage-earning potential) and can also address early gaps in opportunity (Alderman and Vegas, 2011; Aguilar and Tansini, 2012). Yet, we find that large within-country inequalities are reducing the future returns of preschool education of many children: 6,350 communities (or 44% of the total number of communities of the 21 countries) suffer from low attendance and strong wealth impacts. The study identifies three key features for policies aimed at reducing the extent of this inequality: widening access, empowering communities and a dual attention to poverty and malnutrition.

Extending the coverage of preschool is vital. Less than half of young people get access to preschool education (UNESCO, 2012). By expanding the access of quality preschool provision, the marginalised will benefit the most and thus the prospect of inequalities in social and economic outcomes in adulthood will be narrowed. For the low-income countries in the sample, the preschool attendance rate is just 25%. Expansion should be primarily targeted towards poor rural areas with low levels of adult education. In low income countries, for instance, we find that the chances of a child attending preschool is 34% larger in urban communities and twice as large in non-poor communities. Targeting those areas could counterbalance wealth and residence effects. There is positive policy evidence on the benefits of expanding preschool in rural communities. In Guatemala, a low income country, a large-scale preschool expansion between 1998 and 2005 in rural areas, where large segments of the indigenous population live in, led to increase in progression and attendance at later grades (Bastos et al., 2012).

Widening access alone is insufficient and it should be accompanied by community-level policies. The paper's findings support this. Community accounts for 27% of the variation in preschool attendance beyond controls by individual and community characteristics. Variation between communities is larger than between countries. Community factors explain why some countries have a higher dispersion in preschool attendance than others; accounting for 37% of the country variance. In the poorest countries, community level factors account for more than half of the preschool attendance variation. The amount and distribution of resources in a community has an impact on dispersion of wealth gradients and hence on inequality. Therefore, by changing local conditions through community policies in these countries (e.g., improving school facilities and raising quality and safety in a community) a great deal can be achieved. Examples of this are the encouraging effects of community-based programs such as *Hogares Comunitarios de Bienestar* in Colombia (Attanasio et al., 2010; Bernal and Fernández, 2013) and the centre-based community driven preschool model in rural areas of the Gaza Province of Mozambique implemented in 2008 by Save the Children (Martinez et al., 2012).

Lifting households out of poverty can have far reaching impacts in low-income countries. Children living in poor communities in Tanzania and Nepal, for instance, have just 25–33% chance of attending preschool. By targeting worse-off households a living in poor communities through financial transfer mechanisms, the benefits of preschool can be extended to the under-privileged. Conditional cash transfers (CCT), which help parents to defray the cost of preschool, increased attendance by 35% in poor rural areas of China (Wong et al., 2013) and have shown some fruitful effects in Ghana (i.e., Livelihood Empowerment Against Poverty, LEAP) and a pilot CCT program in

Burkina Faso (Akresh et al., 2013). Although in Africa, large costs, political will, and capacity building are still key barriers for implementation.

Moreover, preschool policies should include, alongside pedagogic and poverty-alleviation measures, a nutrition intervention component for early childhood. Improving a child's health is the first step for lower middle-income countries. For instance, we found that, in Nigeria, a 50% reduction in stunting is associated with a 15% increase in preschool attendance. Nutritional interventions like school feeding programs for the higher risk groups (such as children born to less well-educated mothers), subsidised food for mothers and infants and free health care should be central policy objectives for lower middle-income countries, which is in line with the widespread application of CCT programs in Latin America.

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Notes

- 1 The education system information for each country is based on International Standard Classification of Education (ISCED). We also age adjusted each survey to account for any disparity on the time of the fieldwork and the schooling period of each country.
- 2 With $\hat{\beta}$ for wealth equal to 0.45, the odds of a richest child being enrolled at preschool is calculated as $\exp((5 - 2.68) \times (0.45)) = 2.85$.
- 3 Additional results from the demographic variables and family composition for each country are available from the authors upon request.
- 4 The average ICC for the null model is 0.37, but for the fully adjusted model it is 0.23.
- 5 In less urbanised countries access to preschool may be less as preschools are often situated in cities.
- 6 In the pooled model the estimated odds ratio for poverty is equal to 0.67, while stunting has an even larger impact with an odd ratio of 0.59.