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SPECIAL ISSUE: GLOBAL CHALLENGES AND NEW DIRECTIONS IN EARLY YEARS INTERVENTION RESEARCH

A slippery slope: early learning and equity in rural India

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ABSTRACT

There is near consensus that early childhood education and care (ECEC) is essential to children's early development. A common corollary is that early learning will be pivotal to helping redress inequities in educational outcomes. We examine whether this is true among rural communities in the Indian states of Assam, Rajasthan, and Telangana. Specifically, we assess whether learning gains for the most disadvantaged are retained in comparison to more advantaged children who had lower initial learning levels. We find that lower-achieving, more advantaged children (as measured by mother's education) soon overtake higher-achieving but less advantaged children. In contrast, higher-achieving girls remain ahead of lower-achieving boys in Assam and Telangana, although they are caught up in Rajasthan. Given the differing patterns across the states, we explore the extent to which these may be shaped by their respective social and policy contexts.

KEYWORDS

Early years education; ECEC; equity; India; Assam; Rajasthan; Telangana

1. Introduction

One of the most universal trends in education is that children from more disadvantaged backgrounds are less likely to reach functional literacy and numeracy (The International Commission on Financing Global Education Opportunity, 2017; World Bank, 2018). While predictors of disparities are numerous, common determinants of educational opportunities include household wealth (Deininger, 2003; Kadzamira & Rose, 2003; Lewin & Sabates, 2012; Spaull & Kotze, 2015), parental education (Aslam & Kingdon, 2012b; Chudgar, 2009; Chudgar & Shafiq, 2010), child sex (Aslam & Kingdon, 2012a; DeJaeghere et al., 2013; Dercon & Singh, 2013), disability (Mitra et al., 2013; Singal et al., 2018), and region (Ghosh, 2011; Rose et al., 2016).

Global education policy debates have increasingly focused on the early years of formal schooling as a means to improve learning outcomes, both in the aggregate (via improvements for all) and in reducing disparities (via giving greater attention to more disadvantaged groups). This trend has been formalised in UNESCO's Sustainable Development Goals, which specify 'free, equitable and quality' primary education (target 4.1) and the even earlier stage of universal 'quality early childhood development, care and pre-primary education' (target 4.2).

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A sound logic underlies this focus: the early-childhood years are a crucial period for cognitive development (Kohlberg, 1968; Ramey & Ramey, 1998; Young & Richardson, 2007), meaning that additional learning during this time can have long-lasting effects on development over the lifespan (Campbell et al., 2001; Shore, 1997; Yoshikawa et al., 2013). According to the logic of human capital, investments in early childhood development can thus offer a better rate of return on investment than later educational stages by accruing, in essence, more compound interest over the lifespan (Gertler et al., 2014; Heckman, 2006; Heckman et al., 2010). And since disparities in cognitive functioning are apparent between poorer and wealthier children at the earliest ages (Cunha et al., 2010; Dearden et al., 2010; Feinstein, 2003; Von Stumm & Plomin, 2015), earlier investments seem essential to preventing, or at least reducing, inequitable outcomes across the lifespan.

There now exist numerous studies demonstrating the efficacy of high-quality early childhood education and care (ECEC) across a range of low- and middle-income countries (LMICs; Britto et al., 2017; Luoto et al., 2021; Maldonado-Carreño et al., 2022; Rao et al., 2013; Richter et al., 2021). Much of this evidence though comprises evaluations of recently designed and launched interventions, rather than the pre-existing programmes accessed by most families. Another caveat is that the short timeframe of many such evaluations risk overlooking fadeout effects. After reviewing early year intervention programmes across 7 LMICs, Jeong et al. (2021) found significant immediate gains in children's cognitive and behavioural development but they were only sustained up to three years. This corroborates findings from the US, where Bailey et al. (2017) found diminishing long-term impacts across 67 early childhood interventions between 1960 and 2007.

Thus, in order to assess and understand the role of ECEC in educational outcomes and equity, it is important to analyse current conditions as experienced by many families on the ground, in the absence of specific intervention programmes. Beyond experimental evaluations of specific ECEC programmes, a range of studies has shown the importance of studying how parents and children navigate the opportunities available to them over time (Alcott et al. 2020, Sriprakash et al., 2020). This is especially true in LMICs, where resource constraints may make changing the status quo for the most disadvantaged families even more difficult.

This is the area to which this study contributes. We explore the intersection of learning and disadvantage during the early years (ages 4 to 8) for a cohort of children in rural India. Namely, we assess whether learning gains for the most disadvantaged are retained relative to more advantaged and explore the extent to which patterns may be shaped by the distinctive social and policy contexts of each of the three states upon which we focus: Assam, Rajasthan, and Telangana. Our analysis shows that children with less formally educated mothers are overtaken by lower-achieving children with more educated mothers. Higher-achieving girls remain ahead of lower-achieving boys in Assam and Telangana but are caught up in Rajasthan. Grade progression and school type mediate almost all trajectories, indicating that they correlate strongly with learning opportunities during the early years.

1.1 Early-years education in India

The degree of learning inequalities in India is stark. Among the most frequently cited educational statistics are the ASER Centre[1] survey's finding that, for over a decade, only around half of Grade 5 children in rural India can read a passage from a Grade 2 textbook (ASER Centre, 2007, 2012, 2019). Disaggregating these data shows an even greater cause for concern among more disadvantaged children (Jain, 2019): in government schools, those from the poorest household quartile are over twice as likely as those from the wealthiest to be unable to read that same passage (Alcott & Rose, 2015). The prevalence of learning disparities is further corroborated by a range of studies (for example, Aslam & Atherton, 2016; Borooah, 2012; Chudgar & Quin, 2012; Dercon & Singh, 2013; Muralidharan & Sheth, 2016; Singh, 2015). That said, it is important to recognise that, in a country as diverse as India, patterns vary considerably across states, with those in the north typically showing larger disparities than those in the south (Alcott & Rose, 2017; Bhattacharjea et al., 2011; Ghosh, 2011).

The claim that early development begets greater learning in the long run may be especially pertinent in India. In 2009, the national government enacted the no-detention policy, which requires children to move to the next school grade each academic year, regardless of their learning progress. Through the Right to Education Act, a key policy requirement of schoolteachers is that they complete the curriculum within each academic year, regardless of their pupils' learning progress. The combination of these two policies means that, from the outset of primary school, each child is expected to move through a series of grade-specific curricula irrespective of whether her own progress keeps pace with the increasing difficulty of this content.

The obvious concern, that many children could be left behind by an 'overly accelerated' curriculum (Pritchett & Beatty, 2015), has been confirmed empirically (ASER Centre, 2015; Educational Initiatives, 2010): when children in Grade 3 were assessed with literacy tests designed for Grade 1 children, only 51% passed, suggesting that half of children were two grades behind in their learning. Among those children who have fallen behind curricular expectations, only a tenth catch back up to the expected grade level during the following school year (Bhattacharjea et al., 2011).

This slow progress intersects with inequality. In their work on a cohort study in Andhra Pradesh and Telangana, Rolleston et al. (2014) find clear socioeconomic gaps in vocabulary as early as age 5, with these gaps carrying through to later cognitive assessments at ages 8, 12, and 15. Focusing on a single learning outcome, the ability to perform a two-digit subtraction with borrowing (e.g. '45–18'), Alcott and Rose (2017) find large socioeconomic gaps across rural India from the earliest school grades.

We know then that disparities grow early on, but it is less clear whether these disparities can be rectified by the most disadvantaged learning more at an early age. Unlike many LMICs (Black et al., 2016), India has very high levels of ECEC provision (Kaul et al., 2017; Rao & Kaul, 2018). This scale of provision comes primarily through the national government's Integrated Child Development Services (ICDS) programme, now in its fifth decade, and the more recent growth in private ECE provision, with 23% of rural four-year-olds attending a private preschool (ASER Centre, 2020). In India then, unlike many other LMICs, the most pertinent question is not whether children have access to some form of ECEC, but whether the ECEC that they access has any benefit.

A range of studies (Kaul et al., 2017; Rao, 2010; Singh & Mukherjee, 2019) suggests that much of the preschool provision across India is far removed from the developmentally appropriate practices championed in both national (National Policy on Education) and global education policy (Sustainable Development Goal 4.2) and research (Britto et al., 2017; Yoshikawa et al., 2013). Instead, government *anganwadis* ('courtyard shelters', i.e. the centres established through ICDS) have been criticised for the near-complete absence of learning activities (Kaul et al., 2017; Swaminathan, 1998), whereas private preschools are typified as offering strict discipline and textbook-based learning in a 'downward extension' of the primary school system (Alcott, Bhattacharjea et al. 2020, Kaul et al., 2017; Sriprakash et al., 2020; Streuli et al., 2011).

Nonetheless, there is evidence that these forms of ECEC may benefit development even if they fall short of Western norms of provision. Using propensity score matching methods with the India Human Development Survey, Vikram and Chindarkar (2020) find that ICDS provision improved girls' later reading and arithmetic outcomes, although it had no impact on boys. Unsurprisingly, the programme's impact appears to be mediated by the quality of provision: working from an admittedly small sample, Rao (2010) finds that more motivated and qualified *anganwadi* staff were associated with better developmental outcomes for attending children. Children at private preschools tend to have stronger cognitive, numeracy and literacy outcomes than do those at *anganwadi* centres (Wadhwa et al., 2019), but establishing the causality of this relationship is difficult given that attending children tend to come from relatively privileged backgrounds (Ghosh & Dey, 2020; Sriprakash et al., 2020). Nonetheless, Singh and Mukherjee's (2019) use of propensity score matching indicates that, even after accounting for a range of measurable forms of background advantage, private preschools improved children's learning outcomes.

While more universal debates have championed ECEC as a vehicle for lessening inequalities, the variability in provision across India means that it may just as likely exacerbate gaps between the more and the less advantaged. In rural areas, private preschools are far more likely to be found in villages with more developed infrastructure (Ramanujan & Dave, 2019). Studies from across India show that, in a given village, those most likely to be attending private preschools come from relatively advantaged households, with disparities apparent by parental education (Ghosh, 2019; Singh & Mukherjee, 2019), wealth (Singh & Mukherjee, 2016; Woodhead et al., 2009), and caste (Härmä, 2009; Kaul & Sankar, 2009; Sriprakash et al., 2020).

1.2 Focus of this study

Early cognitive development during the ECEC years has often been presented as essential not only to ensuring later learning but also to helping the most disadvantaged children close the gap. But, as in many countries, the unequal nature of ECEC provision in India provides just one of many reasons that those disadvantaged children making early progress may struggle to consolidate and maintain their progress. We thus aim to contribute to the research literature by exploring whether, in the early years, disadvantaged but initially higher-achieving children stay ahead of initially lower-achieving but more advantaged children. To do this, we address the following questions:

(1) Across rural populations in three Indian states *(Assam, Rajasthan, and Telangana)*, do typically disadvantaged *(namely, by (i) mother's education and (ii) child sex)* but higher-achieving children stay ahead of lower-achieving but more advantaged children?
(2) To what extent can these patterns be explained by children's caste?
(3) Controlling for caste, to what extent can these patterns be explained by children progressing at different rates through the school years *(i.e. being in different ECEC or primary school grades)* and attending different types of ECEC and schools *(namely, private versus government schools)*?

2. Data sample

To answer these questions, we undertake quantitative analysis of data from the India Early Childhood Education Impact (IECEI) study. IECEI followed a cohort of children in the states of Assam, Rajasthan, and Telangana between ages 4 and 8 (from September 2011 to December 2015). Children were sampled from two rural districts in each of the three states, with a total sample of 11,828 children in the first of the study's 13 waves.

As with almost all longitudinal studies (Allison, 2002), IECEI is prone to sample attrition. Given our focus on children's academic development over time, we focus on the subset of children who completed all five rounds of assessment together with full information on their sociodemographic and school factors (n = 5,950), which represents 65% of those who were surveyed in the first wave. Attrition occurred primarily because enumerators could not locate a child during a particular wave, either because the child was out of the village on the day of the survey or, in some cases, because the family had migrated from the village for a season. By definition, it is not possible to know whether our sample of 5,950 and all those participating in the initial wave differed on unobservable characteristics. However, analysis on observable characteristics suggests at least a reasonable degree of comparability between the groups: there was no statistically significant difference (at the 0.05 level) between the two samples in either caste or household wealth, indicating that children from marginalised economic and social backgrounds were not more likely to have been left out across survey waves.

Our analysis focuses on two key factors: disadvantage (namely, by mother's education and child sex) and achievement. Both measures of disadvantage are collected in survey wave one. For mother's education, we bifurcate the sample between those whose mother completed school Grade 5 – i.e. completed the lower-primary school level – and those whose mother did not. Child sex is reported by the child's mother.

For school-level factors, we account for children's school grade, i.e. ECEC and primary school grades, and provision type. Provision type is categorised as either private school or government school, with the latter including government primary schools, *anganwadis* and *ka-shrenis* (government ECEC centres specific to Assam). There was no information on school fees, meaning we were unable to distinguish between low-fee and more expensive private schools.

Achievement was assessed during five of the study's survey waves, each 12 months apart, from 2011 (average child age 4) to 2015 (average child age 8). The first two assessments used the School Readiness Instrument (SRI), which focused on children's cognitive, pre-literacy, and pre-numeracy abilities. SRI was initially developed by the

Table 1. Sample descriptive statistics, by state.

	Rajasthan Mean (SD)	Assam Mean (SD)	Telangana Mean (SD)
Mother has completed Grade 5	37%	54%	44%
Male	53%	48%	52%
Caste grouping			
Scheduled castes	17%	9%	26%
Scheduled tribes	10%	10%	10%
Other backward class	59%	40%	60%
General category	13%	41%	4%
None/don't know	1%	0%	0%
Assessment score			
SRI at age 4	19% (15%)	31% (18%)	30% (18%)
SRI at age 5	30% (15%)	39% (18%)	37% (16%)
EGA at age 6	41% (28%)	48% (23%)	55% (21%)
EGA at age 7	46% (25%)	47% (24%)	57% (20%)
EGA at age 8	56% (25%)	53% (23%)	68% (18%)
Proportion of children with score zero			
SRI at age 4	17%	5%	10%
SRI at age 5	4%	2%	2%
EGA at age 6	1%	1%	0%
EGA at age 7	1%	0%	0%
EGA at age 8	0%	0%	0%
n =	*2,725*	*1,671*	*1,554*

World Bank and subsequently adapted by IECEI researchers for the context of India (for example, in administration procedures and pictures used in some tools). The third, fourth, and fifth assessments used the Early Grade Assessment (EGA). Developed by ASER Centre in collaboration with Ambedkar University's Centre for Early Childhood Education and Development, EGA focuses on the three domains of cognitive (e.g. logical reasoning), emergent literacy (e.g. word recognition) and emergent numeracy (e.g. addition and subtraction). Since the EGA rounds were spaced at one-year intervals, each round incorporated some items at a higher level of difficulty than the previous round.

Table 1 shows summary statistics for the sample, by state, across our key variables of analysis. Assam has the highest proportion of mothers educated beyond fifth grade, at 54%, compared to 44% in Telangana and 37% in Rajasthan. The boy/girl ratio is close to 50:50 in each state. Regarding achievement, sampled children in Assam and Telangana performed markedly better than those in Rajasthan between ages 4 and 6. At age 4, 17% of children in Rajasthan left-censored, i.e. scored zero on the assessment, in contrast to 5% in Assam and 10% in Telangana. At ages 7 and 8, children in Telangana performed best among the three states, while those in Assam and Rajasthan were far closer to one another.

We further explored children's achievement scores by age, school type and early childhood education and care (ECEC)/primary school in Table 2. Around 60% of children attended private school in Rajasthan every single year between ages 4 and 8, compared to 40% of children in Telangana. In Assam though, only 8% of children attended private institutions at age 4, rising to 19% at age 5 and 30% between ages 6 and 8.

Children's progression through the school levels also varies between the states. By age 6, when children are expected to be in primary school, 92% of those in Rajasthan's government institutions were but 40% of children in private institutions were still in ECEC. In contrast, in Assam, the ECEC: primary school ratio was almost the same for government and private schools between ages 4 and 8. That is, more than 90% of children

Table 2. Sample descriptive statistics, by age, school type, ECEC/primary school, and state.

	Attending government school			Attending private/other school		
	ECEC	Primary	Both	ECEC	Primary	Both
Rajasthan						
Age 4[2]						
SRI percentage score (Mean and SD)			17% (14%)			23% (15%)
Proportion of children			41%			59%
Age 5						
SRI percentage score (Mean and SD)	21% (10%)	28% (13%)	26% (12%)	34% (14%)	37% (15%)	35% (15%)
Proportion of children	25%	75%	42%	68%	32%	58%
Age 6						
EGA percentage score (Mean and SD)	17% (12%)	33% (19%)	32% (19%)	43% (21%)	54% (21%)	50% (22%)
Proportion of children	8%	92%	41%	40%	60%	59%
Age 7						
EGA percentage score (Mean and SD)	15% (13%)	35% (22%)	34% (22%)	37% (22%)	59% (21%)	55% (23%)
Proportion of children	1%	99%	39%	17%	83%	61%
Age 8						
EGA percentage score (Mean and SD)	–	44% (24%)	44% (24%)	40% (19%)	67% (19%)	65% (20%)
Proportion of children	0%	100%	41%	6%	94%	59%
Assam						
Age 4						
Mean and SD SRI percentage score			30% (18%)			42% (20%)
Proportion of children			92%			8%
Age 5						
Mean and SD SRI percentage score	36% (16%)	50% (20%)	37% (17%)	50% (18%)	51% (18%)	50% (18%)
Proportion of children	92%	8%	81%	94%	6%	19%
Age 6						
Mean and SD EGA percentage score	35% (19%)	55% (21%)	44% (22%)	54% (22%)	59% (24%)	57% (23%)
Proportion of children	53%	47%	72%	45%	55%	28%
Age 7						
Mean and SD EGA percentage score	18% (13%)	48% (22%)	43% (23%)	46% (18%)	58% (21%)	57% (21%)
Proportion of children	16%	84%	68%	13%	87%	32%
Age 8						
Mean and SD EGA percentage score	14% (11%)	50% (21%)	49% (22%)	44% (22%)	64% (21%)	63% (21%)
Proportion of children	3%	97%	67%	3%	97%	33%
Telangana						
Age 4						
Mean and SD SRI percentage score			26% (17%)			34% (20%)
Proportion of children			62%			38%
Age 5						
Mean and SD SRI percentage score	27% (15%)	39% (16%)	36% (17%)	39% (15%)	44% (18%)	39% (16%)
Proportion of children	28%	72%	56%	93%	6%	44%
Age 6						
Mean and SD EGA percentage score	26% (19%)	54% (21%)	53% (22%)	51% (18%)	67% (17%)	57% (19%)
Proportion of children	2%	98%	57%	61%	39%	43%
Age 7						
Mean and SD EGA percentage score	–	58% (21%)	58% (21%)	37% (18%)	61% (17%)	56% (20%)
Proportion of children	0	100%	58%	19%	81%	42%
Age 8						
Mean and SD EGA percentage score	–	66% (19%)	66% (19%)	48% (17%)	71% (14%)	70% (15%)
Proportion of children	0	100%	59%	5%	95%	41%

were attending ECEC at age 5 in both school types. By age 7 and 8, most children in both government and private schools participated in Grade 1 and above. Telangana presents another story: at age 6, 98% of children in government provision had started primary school compared to 39% among those in private provision. By age 7, all children in government schools were participating in Grade 1 and above, but there were still 19% of children in private provision attending ECEC.

3. Empirical approach

For our analysis, it is essential to account for the regression to the mean effect (RTME). This is because we focus on children with either notably high or notably low initial performance, and these two groups are likely to perform closer to the average on any subsequent assessment (i.e. regress to the mean). A failure to account for RTME risks exaggerating the degree of inequality between groups over time due to initial measurement error (Galton, 1886).

To avoid this pitfall, it is necessary to have two sets of scores at the initial time point (Jerrim & Vignoles, 2013), so that one set of scores can be used to classify children into ability groups and the other set as the observations for time one. Fortunately, one of the great strengths of the IECEI data is that it has two sets of achievement scores at equivalent level at the initial survey wave. It thus provides an opportunity to reduce regression-to-the-mean effects and is, as far as we know, the first to do so for a LMIC context.

In Appendix A (Table A1) we explain in detail the methods that we use to minimise RTME in our analysis. To summarise here, The World Bank in India research team (World Bank, 2009) applied principal component analyses on the SRI instruments, generating a single construct. This suggests that, at ages 4 and 5, children's cognitive, language and numeracy skills are strongly interconnected and almost indistinguishable, which is corroborated by research demonstrating their parallel development (Purpura et al., 2011, 2019). This alignment serves as our basis for generating two subgroups from the age 4 SRI to reduce regression to the mean effects. Thus, unlike previous studies, which used scores of two different developmental areas to categorise initial achievement and track learning progressions (Crawford et al., 2017; Jerrim & Vignoles, 2011), we grouped our baseline assessments based on item difficulty. We also tried other groupings but found very similar patterns, i.e. there were no significant differences in either the timings of intersections or the directions of learning trajectories. After controlling for these relative effects through regression analyses on every round of assessment, we extract the residuals from these regressions, and they become the revised achievement scores reflecting children's abilities. More information can be found in Appendix B.

For our first research question, we use these new scores to define three initial achievement groups – low, average, and high – based on children's achievement scores in the first assessment, the SRI when children were at age 4. We then standardise achievement scores obtained at age 5, 6, 7 and 8 into a percentile ranking. That is, by comparing each child's score at each timepoint to those of their peers, we give them a new ranking number between 1 and 100. By averaging the percentile ranking of children defined by their initial achievement group, we can observe the academic trajectory, in terms of percentile position, in every round of assessment for each group and compare these for more and less advantaged groups of children. In addition, we control for relative age effects by categorising children into younger (bottom 25% in age), mean-age band (25% to 75% in age) and older (top 25% in age) cohort. To test for statistical difference between group averages, we used 95% confidence intervals to examine any overlapping between mean estimates.

For our second research question, we add a categorical dummy variable to control for children's caste grouping (Table 1 shows the groupings used). After extracting newly revised achievement scores through regression analyses controlling for both age and

caste, we plot the trajectories of least and most advantaged groups. For our third research question, we further controlled for school types (i.e. government vs private/other) and school grades (i.e. ECEC or primary school). Similar procedures were adopted to extract residuals from these regressions and extract newly revised achievement scores between ages 4 and 8. We used these two factors to minimise the score inflation effect brought by schools.

4. Analysis

4.1 Assam

4.1.1 Mother's education

Our analysis for Assam is shown in Figure 1 (for the full regression models underlying this figure, see Appendix Tables B1–B3). In this and all subsequent figures, models (a), (b), and (c) correspond, respectively, to our first, second, and third research questions.

Model 1a compares learning trajectories for children according to their mother's education level and their initial assessment performance. Our two groups of interest are (a) those with low mother's education and high assessment performance (solid grey line, n = 194) and (b) those with high mother's education and low assessment performance (solid black line, n = 271). These two lines intersect at age 5, and then diverge after age 6, the age at which children are expected to begin primary school. In other words, relative learning gains among disadvantaged children do not seem to hold: the groups are performing similarly on learning assessments within two years and those from the more advantaged homes (in terms of mother's education level) overtook those from less advantaged homes.

Model 1b compares children on the same parameters (mother's education and initial assessment performance) but now controls for caste (research question 2). The patterns from model 1a still hold, i.e. regardless of children's caste backgrounds, by age 7, initially higher-achieving children whose mothers did not complete Grade 5 were overtaken by

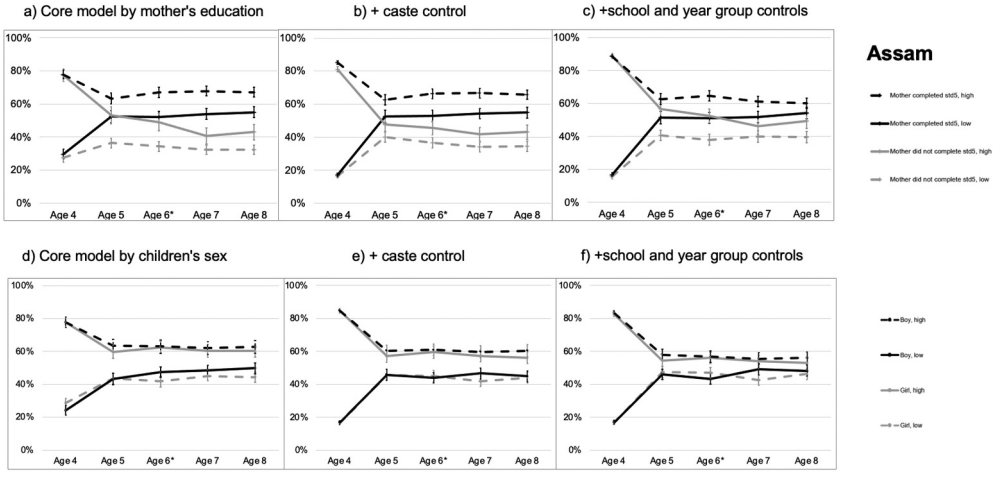

Figure 1. Learning trajectories, Assam.

their initially lower-achieving peers whose mother did complete Grade 5. This suggests that caste background does not exacerbate the learning disparities between the more and less advantaged groups.

On top of model 1b, model 1c further controlled for both school grade (i.e. ECEC or primary school) and whether the child was attending a government or a private school (research question 3). The solid grey and solid black lines continue to intersect between ages 7 and 8. In other words, school-level influence is especially significant on children's learning trajectories between ages 7 and 8, enabling initially low-achieving group to take over the initially high-achieving group.

4.1.2 Sex

The pattern is very different though for learning trajectories according to child sex. In model 1d, girls with strong initial assessment performance (solid grey line, n = 289) continue to outperform boys with lower initial performance (solid black line, n = 271) across all the years. This pattern also holds when controlling for caste in model 1e. When controlling for school year and school type (model 1f), the gap between these groups continues across the waves but is statistically significant (at the .05 level) at ages 5 and 6 but not thereafter. In other words, sex differences in grade progression and school type seem to play some role in advantaging boys, but not enough to fully reverse the gap for high-achieving girls. Assam then shows high inequity according to mothers' education levels but reasonable equity according to child sex.

4.2 Rajasthan

4.2.1 Mother's education

In comparison to Assam, Rajasthan shows stronger levels of inequity (Figure 2 –for the full regression models underlying this figure, see Appendix Tables B4–B6. Regarding household education, those with low mother's education and high assessment performance

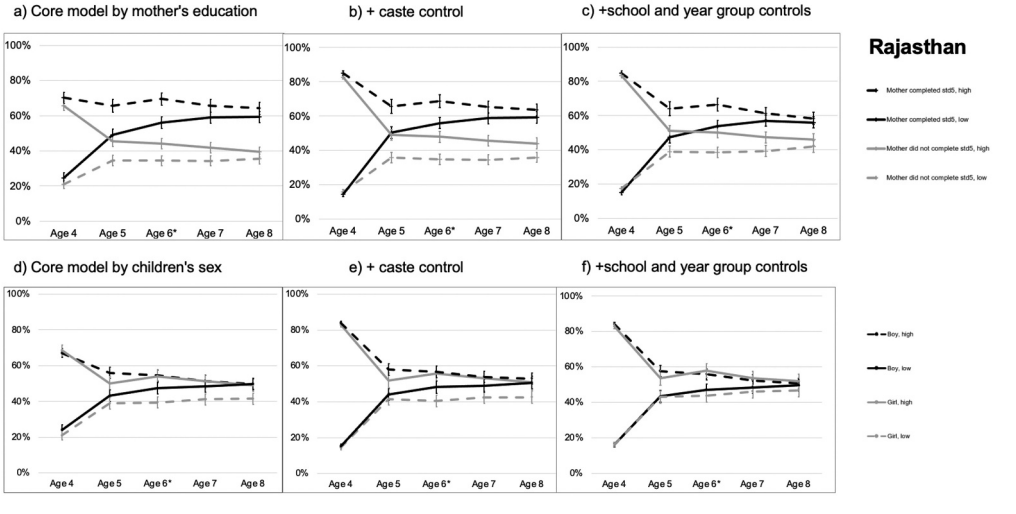

Figure 2. Learning trajectories, Rajasthan.

(solid grey line, n = 479) were caught up by their initially lower-achieving peers with higher mother's education (solid black line, n = 329) within one year and then overtaken in the ensuing assessments (model 2a). Compared to Assam, the extent of the eventual inequality is greater, with the averages for the two groups in the final assessment year falling 20 percentile points apart. The pattern still holds after controlling for caste in model 2b, which again suggests that this learning disparity could be primarily affected by mother's education level. After controlling for both school year group and school type (model 2c), we saw initially higher-achieving children whose mother did not complete Grade 5 were able to maintain their initial academic advantages up to age 6.

This suggests that, in Rajasthan, mother's education level (completed Grade 5 or not) had significant associations with both children's progress through the school year groups and the types (i.e. private, government and other) of schools their children attended. This was confirmed by Spearman correlations and chi-square tests. In other words, children with higher levels of mother's education appear to gain advantages in learning progress through attending different types of schools (namely, private providers), enabling even the lower achievers in this group to overtake high-achieving, less advantaged peers.

4.2.2 Sex

In Rajasthan, girls with relatively high initial achievement (n = 316) continue to perform better than initially lower-achieving boys (n = 430). As shown in model 2d, the two groups quickly converge and remain statistically indistinguishable at the following assessments. While initially lower-achieving boys quickly perform similarly to higher-achieving girls (and boys, too), lower-achieving girls (dotted grey line) appear to fall behind. The overall pattern of convergence remains markedly similar after controlling for caste in model 2e. However, after accounting for school grade and school type in model 2f, we found that higher-achieving girls stayed ahead of lower-achieving boys till age 6, whereas lower-achieving boys had indistinguishable achievement scores from lower-achieving girls. Altogether, this suggests that initially lower-achieving boys benefited from school grade and school type, overtaking initially lower-achieving girls and reducing the gap between them and initially higher-achieving girls.

4.3 Telangana

4.3.1 Mother's education

In comparison to the other states, Telangana (Figure 3 – for the full regression models underlying this figure, see Appendix Tables B7–B9) appears to show less extreme inequity by maternal education. Much as in Assam and Rajasthan, the solid grey (n = 256) and solid black (n = 193) lines already converge by the second assessment (model 3a). However, in contrast to the other states, in Telangana the relatively advantaged group does not then overtake the less advantaged group. When controlling for caste, school grade and school type, the groups remain even more closely matched (model 3b and model 3c). It is worth noting though that adding for these controls lessens the gap between advantaged high-achievers and disadvantaged low achievers between model 3b and model 3c, suggesting that part of the disparity between these groups is attributable to grade progression and school type, not caste.

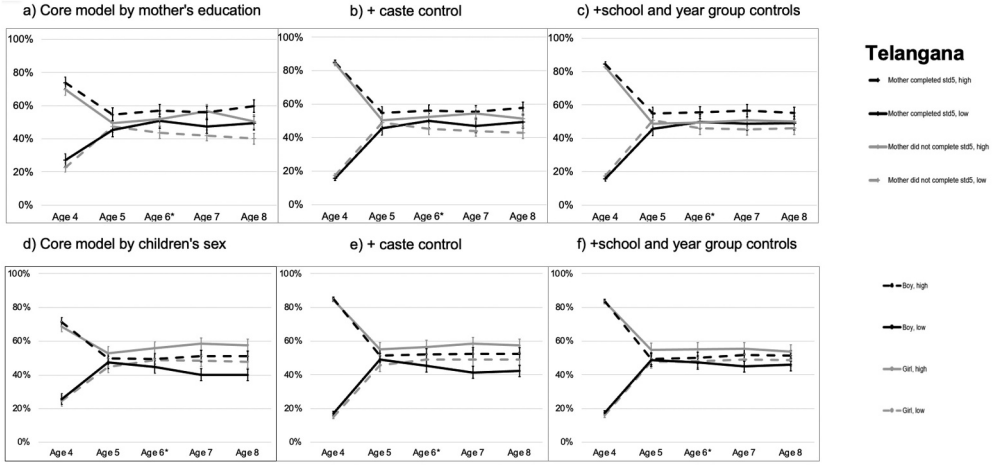

Figure 3. Learning trajectories, Telangana.

4.3.2 Sex

Learning trajectories by sex in Telangana (model 3d) are more comparable to Assam than to Rajasthan, i.e. they are relatively equitable in that higher-achieving girls (solid grey line – n = 196) stay ahead of lower-achieving boys (solid black line – n = 235). Once again, controlling for caste, school grade and school type lessens the gaps between lines, indicating their correlation with ongoing learning.

5. Discussion

Learning disparities have been widely researched in the Indian context, but there is limited evidence on the timing of when high-achieving but disadvantaged children lose their initial progress. We show that the convergence/outperformance in learning trajectories between more and less advantaged children occurs very early on in the preschool and primary school years. This could provide insights for policy makers with regards to the effectiveness of ECE programmes, i.e. whether they can help the least privileged children who show early ability to maintain their strong initial learning trajectories. One perspective is that, as currently constructed, they cannot. However, we think that the degree of difference in patterns across the three states support a more nuanced interpretation.

5.1 Telangana: greatest equality

Among the three states, Telangana shows the greatest degree of equality in learning. That is, there were no significant learning inequalities (at the 95% level) between (initially high-achieving) girls and (initially low-achieving) boys. And even though learning trajectories gradually converged between the initially highest-achieving and initially lowest-achieving children, mother's education level did not create significant disparities in learning before and after controlling for caste and school-level factors.

This may suggest that government-provided ECE programmes in Telangana not only helped minimise the initial attainment gaps but also enabled the least privileged children to maintain the same levels of learning as their more privileged peers over time. As reflected in Table 2, by age 6, almost all children in government schools were attending primary schools, which suggests that their progress was not lacking. This corroborates research by Kaul et al. (2017), who claim that the quality of *anganwadis* in Telangana is better than in Assam or Rajasthan, as indicated by more flexible classroom organisation, multiple individual and group activities in each session, and a larger proportion of time dedicated towards play-based learning.

5.2 Assam: school type and grade matter more than mothers' education level

In terms of learning inequalities, Assam falls between Rajasthan and Telangana. Regardless of sex, the initially highest-achieving children were able to maintain their level of progress over time. However, for children within the same school type and the same grade, those with the initially lowest achievement managed to catch up within three years. This suggests that school-level influence started to create significant disparities in learning after age 6, when half of children in Assam entered primary school as shown in Table 2.

Similarly, the initially lowest-achieving children with more educated mothers managed to outperform high-achieving but disadvantaged peers after age 6. However, the additional control for school type and grade led to indistinguishable children's learning trajectories. As shown in Table 2, the ratio between ECEC and primary school at every single timepoint was almost the same in both government and private schools. This indicates that disparities in the type of school attended (private or government) primarily drove learning disparities after age 6. We argue then that mother's education had a less significant impact than school type in Assam. This could be explained by Assam's higher literacy rate among females (67%) in comparison to Telangana and Rajasthan (both below 60%), despite Assam being the least affluent among the three states (Kaul et al., 2017).

Seen another way, despite being overtaken later on, high-achieving children from the least privileged backgrounds were able to maintain their initial strong learning trajectories until age 6. This may indicate the effectiveness of government-provided ECEC since only 7% of total preschools in Assam were private, in contrast to 40% in Rajasthan. In addition, children in Assam had longer exposure to preschools compared to their peers in Rajasthan and Telangana.

5.3 Rajasthan: mother's education level matters more than school type and grade

Rajasthan had the largest learning disparities. The school types and grades not only further disadvantaged girls with the initial lowest achievement, but also enabled children whose mothers completed Grade 5 to outperform their better-achieving peers by age 5. Within the same school type and grade, we observed the initially lowest-achieving children whose mothers completed Grade 5 continuing to outperform their initially higher-achieving peers whose mothers did not complete Grade 5. That is, both school type and mothers' education exacerbated learning disparities in Rajasthan, albeit with mother's education having a more notable impact.

The results are not surprising given that Rajasthan has the highest levels of inequality in several domains: in comparison to Assam and Telangana, it has the greatest number of preschools but also the largest proportion (around 33%) of 4-year-olds not participating in any types of ECEC (Kaul et al., 2017). For those who do participate, private provision is often preferred over government *anganwadis*, where more than 50% of children participated in private schools in every round of assessment. This is because parents tend to have greater concerns over the poor quality of infrastructures and lack of 'useful learning activities' (Alcott, Battacharjea et al., 2020; Ramanujan & Dave, 2019). Private provision further exacerbates learning disparities as it prioritises formal learning, thus enabling their students to have better academic attainment (Kaul et al., 2017). Unlike in Assam and Telangana, higher mothers' education levels outweighed initial achievement even when controlling for school type and grade. That is, when receiving similar levels of teaching and other school materials, more educated mothers grant their children opportunities that not only eradicate initial attainment gaps but also facilitate long-term learning.

6. Implications

Our research has identified important patterns across the three states: greater equality by child sex in Assam and Telangana but not in Rajasthan; little additional exacerbating influence of caste; and that school type, grade, and mothers' education levels exacerbate learning disparities in all three. By exploring the exact time point for convergence/outperformance in learning trajectories, we find that government ECEC programmes have probably played some role in promoting learning equality in Telangana and Assam. Even though our research design does not imply causal relations, we argue that the current results are in line with previous findings and add to existing knowledge on the effectiveness of ECEC provision in rural India.

First, Telangana has the greatest degree of learning equality, which could be primarily due to the high-quality government ECEC provision. Second, the wide participation and longer exposure to government ECEC provision in Assam seemed to enable the least privileged children to maintain their initial advantage during but not beyond preschool, suggesting that differences between private and government primary schools are exacerbating inequalities. Finally, even though Rajasthan is known for its widespread private educational provision, we identified mothers' education levels as further exacerbating learning disparities that cannot be simply solved by reducing structural inequalities between private and government schools.

India's new National Education Policy (NEP) of 2020 offers an important opportunity for reflection. One of the NEP's most urgent policy priorities is to universalise preschool education that can ensure foundational literacy and numeracy for all. In the current study, Telangana, the strongest performing of the three states, had more diverse learning activities in government ECEC programmes, including play-based learning. Such activities are widely held to facilitate the development of age-appropriate competencies (Whitebread et al., 2019) and, incorporated into primary curricula, is shown in other contexts to support autonomy, self-motivation, and reflection (Briggs & Hansen, 2012). Telangana's example thus indicates that play-based learning should prove a core element of the NEP's ECEC programming and could possibly be extended to primary education.

Mass participation in government-provided ECEC and relatively 'delayed' participation in primary school in Assam helped children to experience longer exposure to preschool. This supports Kumar and Choudhury's (2021) that longer duration of preschool can sometimes minimise the learning gap between private and government schools. While government-provided ECEC was more popular in Assam and Telangana (as shown in Table 2), parents in Rajasthan still preferred private provision and encouraged their children to progress to primary school earlier, which seems to exacerbate learning inequalities. As discussed earlier, this is often linked to a desire for strict discipline and textbook-based learning of more 'formal' schooling, the antithesis of more play-based approaches. Thus, parental choice, combined with the current pressures on teachers to focus on and complete the year's textbook and curriculum, at the cost of addressing the mismatch between academic standards and student learning levels (Banerji, 2000; Muralidharan & Singh, 2021; Pritchett & Beatty, 2015), are important barriers that policy and curriculum designers will need to navigate. Textbooks could be adapted to support and encourage such forms of pedagogy, and parents supported to understand their value in establishing a foundation for future learning.

In addition, our analysis identified that, in Rajasthan, a mother's education level, often seen as a proxy for socioeconomic status, not only helps children to get into private schools but could also have other advantages. For instance, Virkram et al. (2018) found that Indian mothers with higher education levels also have a higher chance of accessing jobs with greater flexibility, thus enabling more time with their children. Psychosocial factors could also play a part as highly educated mothers in low-and middle-income countries (LMICs) tend to have greater autonomy in health (Moursund & Kravdal, 2003; Woldemicael & Tenkorang, 2010). Although there is limited research in this area for LMICs, more education may also translate to greater autonomy in maternal parenting, which is in turn associated with greater academic outcomes according to empirical evidence from high-income countries (Bindman et al., 2015; Ghosh & Rausch, 2020; Joussemet et al., 2005).

Some of these findings align with the challenges addressed by the 2020 NEP, for instance, improving the pedagogy of ECEC. However, our results also highlight that the inequalities resulting from the implicit transfer of educational advantage from mothers cannot be easily resolved by ECEC provision. To draw more insights on the mechanisms behind learning disparities during the transition between ECEC and primary school, future research should examine the quality of ECEC in more detail and the impact of moving across different school types. Overall, as the benefits of ECEC continue to be extolled, further research must examine opportunities to maximise opportunities for those families with less formal education.

Note

1. The ASER Centre was established in 2008 as anautonomous assessment, survey, evaluation and research unit of the nongovernment organisation Pratham Education Foundation. Beginning in 1996,Pratham has worked with children in thousands of villages and urban slumsacross India. For much of this period, the focus of this work has been onhelping children master basic skills in reading and arithmetic.
2. Information distinguishing ECEC from primary school was not collected at age 4.

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No potential conflict of interest was reported by the authors.

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