

EARLY CHILDHOOD EDUCATION IN INDIA: A POSSIBLE INVESTMENT IN BETTER OUTCOMES? A QUANTITATIVE ANALYSIS USING YOUNG LIVES INDIA

Sabilah Eboo Alwani

University of Cambridge, Cambridge, United Kingdom

se384@alumni.cam.ac.uk

This paper explores the relationship between early childhood education and academic outcomes for children in India by estimating the ability of preschool participation at age 5 to predict results on major cognitive assessments at age 12. Initially looking at differences in means, it moves on to utilise regression analysis first in an uncontrolled model, and then in a model which controls for both gender and maternal education, as these have been deemed important inputs for academic attainment in the wider literature on human capital development. The sample used for this research is constructed from Young Lives (India), which from 2002 to 2017 surveyed two cohorts of children across Andhra Pradesh and Telangana, with a pro-poor sampling strategy. Surprisingly, the results of the analysis find that participation in early childhood education had a negligible effect on test scores, even when controlling for gender and maternal education. Meanwhile, maternal education emerged as a strong predictor of test results. These findings contradict much of the existing evidence that demonstrates associations between early childhood education and cognitive development, and, in turn, improved economic outcomes. Accordingly, it raises questions about the generalisability of the existing evidence and the quality of India's ECE offering. The premise, method and findings of this paper are divided into nine sections, including an introduction, an explanation of Human Capital as the paper's conceptual framework, a literature review, an overview of the context of ECE in India, a section on the paper's data and variables, a methods section, an overview of the results, a discussion, and conclusions.

Keywords: Early childhood education, India, Longitudinal research, Academic outcomes, Poverty alleviation

Introduction

Research Context and Foundation

Research over the past half-century has demonstrated that the period of early childhood is the most critical phase in human development, and that the foundational capacities established during this time can beget improved outcomes across the life course (Black et al., 2016; Shonkoff and Phillips, 2000). Access to early childhood care, health and education (*ECCE*)¹ has been shown to nurture these capacities by enabling children to achieve improved cognitive outcomes (Attanasio, Meghir and Nix, 2015; Engle et al., 2007). Numerous studies have linked preschool² participation to increased earnings and progress toward poverty alleviation (see Black et al., 2016; Engle et al., 2007; Heckman, 2006 and Shonkoff and Richter, 2013). The subsequent literature, including Goal 1 of the Dakar Framework for Action (Education for All), and Sustainable Development Goal 4.2³, has crystallised early childhood education (*ECE*)⁴ as a critical lever for economic outcomes. But much of this evidence comes from developed countries, which have very different economic, cultural, and political contexts than those of low-and-middle income (*LAMI*) countries (Levin and Schwartz, 2006). This raises the question of how applicable the existing evidence is to those contexts (Woodhead, 2009; Yoshikawa and Nieto, 2013). This paper explores the relationship between ECE and cognitive outcomes for a sample of children in India, to determine whether India's ECE programmes are capitalising on this critical period and whether the nature of the relationship between these variables matches wider patterns.

To date, research on ECE in India has been limited, and the Indian government has acknowledged that its ECE services are not up to standard (Alcott et al., 2018; Government of India, 2013). But with India's rapidly growing economy and extensive early years infrastructure (Alcott et al., 2018), it offers interesting parameters for the assessment of ECE's role. This paper's findings are intended to contribute to the limited evidence and offer analysis that could be useful in improving India's ECE provision.

The primary aim of this paper is to estimate the ability of preschool participation to predict cognitive outcomes, as they have been widely linked to improved economic opportunities. However, researchers on Indian early education have pointed out the need to go beyond establishing the simple effects of ECE (Kaul et al., 2017). In order to respond to this suggestion, I also consider two factors which have been identified in the literature as important to India's educational experience: gender⁵ and maternal education.

Drawing from the body of evidence on ECE, I test the hypothesis that preschool participation should emerge as a good predictor of cognitive outcomes. This hypothesis is tested using Indian students who

¹ ECCE summarises the inputs and processes that create the building blocks of later social, cognitive, emotional and economic development (Kaul et al., 2017).

² Preschool is used within this paper interchangeably with ECE.

³ Stipulates early childhood development, care and education for all children by 2030 (UNESCO, 2000).

⁴ ECE refers to regularly attended education in a setting outside of a child's home for children aged 3-5, during the period immediately preceding primary school (Woldehanna and Gebremedhin, 2012).

⁵ In India, 25% of girls are out of school, and 17% of girls have never been to school at all. As these girls grow into motherhood, there are further intergenerational consequences ("Education Statistics - All Indicators", 2018).

participated in early childhood education, from the Young Lives (YL) study⁶. Young Lives is a renowned study on childhood poverty⁷ consisting of quantitative and qualitative layers, undertaken to inform effective policy and interventions for children (Early Childhood Development: informing policy and making it a priority, 2018; Vennam et al., 2009).

The indicators selected to represent ‘early childhood education’ and ‘cognitive development’ are preschool participation at age 5 and test score results on the Peabody Picture Vocabulary Test (PPVT) and mathematics assessment (taken from the Trends in International Mathematics and Science Study or TIMSS) at age 12. These types of tests are in line with widely used indicators of cognitive development from related studies (see Cunha et al., 2006; Singh and Mukherjee, 2018; Woldehanna and Gebremedhin, 2012).

The research questions addressed are as follows:

1. Is early childhood education a good predictor of scores on the PPVT and maths tests?
2. Do boys who attended preschool fare better than girls on these tests?
3. Do children with educated mothers fare better on these tests?
4. Once gender and maternal education are controlled, is preschool a useful predictor of test scores?

These four research questions called for the use of empirical data, recorded as categorical and continuous variables. Accordingly, my methodological approach necessitated quantitative analysis⁸, for which I employed statistical modelling to estimate the relationships between these variables.

Human Capital as a Conceptual Framework

Early Investments and Future Returns

The human capital perspective on early childhood offers useful theoretical parameters for exploring the economic justification for investment in early childhood education. Human Capital Theory (HCT) posits that early investments in education boost overall educational attainment (Heckman, 2011), and that ultimately education generates future returns (Becker, 1964 and Schultz, 1988). HCT thus informs and underpins this paper with these two notions, and helps to connect it to the vast literature on early

⁶ As education research in India has sometimes been hampered by unreliable data (Kingdon, 1996), YL’s study offered rare information collected with rigorous sampling and response management procedures, resulting in good quality data with minimal attrition (Singh and Mukherjee, 2016; Young Lives, 2017).

⁷ There are two limits to generalisability due to usage of YL’s data. The first is geographic: participants were only from one (later two) states: Andhra Pradesh and Telangana. Together these comprise only 7% of India’s population (“Young Lives India”, 2019). The second limitation is due to YL’s purposive sampling, employed to explore poorer communities (Attanasio, Meghir and Nix, 2015). However, the YL team limited bias by including households across the socioeconomic spectrum and ensuring a large data set (Kumra, 2008; Young Lives Survey Design and Sampling in India, 2014).

⁸ Whilst the original YL research also included qualitative data, its use for a mixed methods approach was not possible due to access constraints.

investments in human capital. It also provides the foundation for this paper's hypothesis by theorising that ECE should contribute to improved academic outcomes.

The notion that education generates future returns represents the initial conception of education by human capital theorists. Originally, the theory posited that educational attainment was a measure of cognitive development, which is ultimately of interest because of its link to economic returns: education economists showed that cognitive ability⁹ was an important determinant of labour market outcomes¹⁰ (Heckman, 1995).

Meanwhile, the notion that early investments maximise academic attainment, explored particularly in the research of James Heckman and Flavio Cunha, was predicated upon the idea of a 'time profile' in which early investments offered a longer period to realise future returns (Becker, 1962 and 1964; Mincer, 1958). Cunha et al. demonstrated the value of looking at childhood as two distinct time periods, showing that the rate of return (*RoR*) to a dollar of investment made in early childhood was higher than for the same dollar invested later (2006).

Human Capital and Women's Education

Whilst human capital theory does not offer much on gender and ECE specifically, its framework for gender and wider education is robust. The writings of Paul Schultz in particular advocated for the importance of educating women, especially as a strategy for poverty alleviation (1993), and served as the foundation for other work endorsing this instrumental view (see Herz and Sperling, 2016; King and Hill, 1993). Other major thinkers on human capital have also endorsed this perspective; Erik Hanushek (2008) highlighted that gender equality in education was a human capital investment with important economic outcomes, and Harry Patrinos (2008) undertook specific econometric methodologies to calculate the rates of return to women's education. The implications from the related literature are that women's education is instrumental to a range of intergenerational social benefits (Unterhalter, 2007). Accordingly, HCT offers a lens through which to interpret the potential impact of maternal education (encompassing both 'gender' and 'maternal education') as an input to desirable economic outcomes, which could complement or cloud the role of preschool in those same outcomes.

Literature Review

ECE and its Related Policy Context

The origination of early childhood development (*ECD*)¹¹ as an area of study was neurological research

⁹ Measures of cognitive ability commonly included test scores or years of schooling (Rosenzweig and Wolpin, 1994). For example, researchers such as Denison (1985), Barro (1989), and Becker (1964) used years of schooling to 'explain' variance in per capita earnings distributions.

¹⁰ These outcomes were calculated via their rate of return (*RoR*), and education economists demonstrated that the *RoR* to schooling was a critical factor in individual income as well as GDP (Harmon and Walker, 1995).

¹¹ *ECD* is "A multifaceted concept from an ecological framework that focuses on the child's outcome (development), which depends on characteristics of the child and the context, such as health, nutrition, protection, care and/or education." (Britto, Engle and Super, 2013).

highlighting the rapid pace of brain development during the first years of life (Karloly et al., 1998; Young, 2007). The amalgamation of other evidence on child development from neuroscience, psychology, sociology and health collectively highlighted the importance of the early years for cognitive development, and shortlisted a number of critical inputs including education (Campbell et al., 2001; Heckman, 2011; Kohlberg, 1968 and Shonkoff and Phillips, 2000). A landmark study which helped to catalyse global policy engagement was an ECD-focused series in *The Lancet*, which quantified the loss of development potential and impact on long-term outcomes for children who lacked strong starts in education, nutrition and material stability. Consequently, ECD became tied to international agendas proposing human capital approaches to development. Many studies on ECD captured ‘development’ indicators through measures related to schooling, such as test scores or grade completion. Schooling-related development studies found consistently that early education helped to shape opportunities across the life course, including improving educational attainment, earnings and market competitiveness (Becker, 1993; Carneiro and Heckman, 2003; Cunha et al., 2006; Cunha and Heckman, 2007 and Heckman, 2011)¹². Therefore, the Education for All initiative inscribed ECCE as its ‘bedrock’ (Strong Foundations: Early Childhood Care and Education, 2006). Additionally, under the Sustainable Development Goals (SDGs), investment in ECE was seen not only as tackling inequality but also poverty alleviation (Morabito, Vandenbroeck and Roose, 2013; Richter et al., 2016). In this way, ECE came to have its own significance for development agendas linked to poverty reduction and socioeconomic mobility (Nadeau et al., 2011).

Gaps in Evidence

Longitudinal studies from the US¹³ have found ECE to be a successful predictor of both academic attainment and economic outcomes (Campbell and Ramey, 1994; Currie and Thomas, 1995). In particular, the Abecedarian Study (Campbell and Ramey, 1994) and the HighScope Perry Pre-School Project (Currie, 2001; Heckman, 2011) from the US and the Effective Provision of Preschool Education Study from the UK became widely cited because they involved experimental research. Grouped with these were the ongoing results of two landmark ECCE programmes, HeadStart, launched in the USA in the 1960s, and Sure Start, its later British counterpart in the 1990s (Woodhead, 2006). This group of studies confirmed that ECE improved cognitive abilities and served as a strong foundation for academic success (Black et al., 2016). They also concluded that the most effective time to invest in education to equalise initial differences¹⁴ in endowments was the early years (Currie, 2001).

However, though comprehensive, the evidence being primarily from developed countries is potentially problematic: there has been a noted lack of evaluation of preschool programs in developing countries (Currie, 2001; Woldehanna and Gebremedhin, 2012)¹⁵. This gap in the literature points to the hegemony

¹² A number of studies on the effects of early intervention programs on economic outcomes is summarised neatly by Cunha (Cunha et al., 2006).

¹³ See Belfield, Nores and Schweinhart, 2006; DeCicca and Smith, 2013; Engle et al., 2007; Goodman and Sianesi, 2005; Heckman and Masterov, 2007; Magnuson et al., 2004 and Sylva et al., 2011 for examples from the US and Europe.

¹⁴ A large portion of the research on ECE underpinned by human capital tested the hypothesis that interventions in early education could remediate circumstantial disadvantages for children (Woodhead, 2006).

¹⁵ The noted paucity of global evidence on ECD outcomes has given rise to an important World Bank initiative entitled SABER-ECD, which now collects, analyses, and disseminates related information. There is growing evidence from LAMI countries; see Grantham-McGregor et al., 2007; Rao et al., 2013 and the 2016 Lancet series on economic outcomes linked to early years investments (Engle et al., 2011).

of existing evidence¹⁶. The implications of this are that international policies are being informed by findings from a narrow group of contexts.

ECE Literature from India

This evidence gap¹⁷ extends to ECE research on India. Only a small body of evidence¹⁸ on the association between preschool participation and developmental outcomes exists, but it is cross-sectional rather than experimental, and limited in examination of longitudinal effects. Most of it also covers only particular regions or states, and is therefore limited in generalisability. For example, Arora, Bharti and Mahajan (2006) were able to link preschool participation to higher cognitive development, but their sample was limited to urban slums in Jammu city. A few cover wider geographies but are stock-taking studies, such as CECED's 2013 review (Indian Ministry of Women and Child Development, 2013). A small number show the effect of preschool on primary school outcomes such as retention or school readiness (Kaul et al., 1993; NCERT, 1996). Others examine the comparative effects of government versus private pre-primary¹⁹. But overall, the research is still limited, with longitudinal and more complex evidence particularly scarce (Kaul et al., 2017). Aside from the comprehensive (but geographically limited) data from YL India, the only other sizeable evidence on ECE is from the ASER Centre, which publishes an 'Annual Status of Education' report (Early Childhood Development: informing policy and making it a priority, 2018) and, most recently, the India Early Childhood Education Impact (IECEI) study²⁰.

Perhaps closest to my research is the recent study by Singh and Mukherjee (2018), which takes YL data to examine the effect of private preschool on cognitive achievement and subjective wellbeing at age 12, but uses propensity score matching where this paper utilises OLS regression. While some of the findings overlap, their paper looks only at private ECE provision, and is therefore not able to comment on ECE in India more widely.

Evidence on Gender and Maternal Education

Historically, gender has been a regular predictor of disparity in educational and economic outcomes in India (Asadullah and Yalonetzky, 2012; Boserup, 1970 and Kaul et al., 2017). But other evidence suggests that this disparity is lessening; official statistics show almost identical enrolment for boys and girls in ECE and primary ("Education Statistics - All Indicators", 2018), and in some studies, gender is no longer found a significant contributor to academic outcomes (Streuli, Vennam and Woodhead, 2011; Vennam et al., 2009). But other evidence argues that gender may affect the extent to which Indian children benefit from ECE (Garcia, Heckman and Ziff, 2018; Magnuson et al., 2016). Therefore, evidence is mixed²¹.

¹⁶ One of the few exceptions includes the compendium published by Engle and colleagues highlighting the status of ECD globally, though this covers not only education but also health and social welfare (Britto, Engle and Super, 2013).

¹⁷ Alcott et al., 2018; Chopra, 2012; Kaul et al., 2017; Kaul and Sankar, 2009 and Singh and Mukherjee, 2017 have all documented this scarcity.

¹⁸ See Arora et al., 2006; Datta et al., 2010; Nagajara and Anil, 2014 and Shabana et al., 2013 for examples.

¹⁹ See Kingdon, 1996; Pratham, 2010; Singh and Mukherjee, 2017 and Tooley and Dixon, 2003.

²⁰ However, even the IECEI is limited as it only covers a four-year period.

²¹ The importance of measuring gender's impact is also evidenced by the regular disaggregation of outcomes such as enrolment, grade completion, and test scores by gender across global education research (Handbook on Measuring Equity in Education, 2018).

I have consequently included gender as a control variable within this study, as further research may help to clarify.

Tied to the notion of gender is that of maternal education. There is a significant body of literature that demonstrates the intergenerational persistence of economic status²². Mothers' education in particular has been associated with higher earnings and better educational outcomes for children (Aakvik et al., 2003; Rosenzweig and Wolpin, 1994). Studies using data from YL India have also shown association between maternal education and the completion of secondary school, which itself is linked to improved economic opportunities in other research (Singh and Mukherjee, 2015). This body of evidence supports the idea that maternal education has a role to play in the intergenerational transmission of human capital (Galab, Reddy and Himaz, 2008; Richter et al., 2016). It has therefore been included as a variable of interest within this paper (Question 3).

Context of ECCE in India

Overview of Policies and Infrastructure

The provision of early childhood services in India has long been conceptualised as an investment in human capital (Mohite and Bhatt, 2008; Streuli, Vennam and Woodhead, 2011). This notion of ECCE informed India's National Policy for Children and its launch in 1974 of the Integrated Child Development Services (ICDS), today the world's largest publicly funded early childhood system. Through the ICDS, India provides universal access to health, nutrition and education services (Alcott et al., forthcoming; Indian Ministry of Women and Child Development, 2013). The operating infrastructure for these services includes 1.3 million *anganwadi* centres (preschools), which served over 104.5 million beneficiaries in 2014, from expectant mothers to children (Kaul et al., 2017; Richter et al., 2016).

But pre-primary enrolment in India is still only at 12.9% despite the sizeable infrastructure ("Education Statistics - All Indicators", 2018). Moreover, evidence shows that the *anganwadis* are poor providers of early childhood education, due to insufficient teacher training, substandard facilities and lack of regulation²³ (Rao and Kaul, 2017; Singh and Mukherjee, 2018). Poor quality pre-primary provision has precipitated widespread lack of school readiness: evidence indicates that pre-literacy and pre-numeracy skills at age 5 are vastly below expected levels (Beyond Basics, 2018; Save the Children, 2009). As a result, disillusioned parents seek other options such as low-cost private preschools²⁴ (Alcott et al., forthcoming; Kaul et al., 2017 and Streuli, Vennam and Woodhead, 2011).

The Indian government has made improving ECE a priority by strengthening the policy framework; India's twelfth Five-Year Plan (2012-2017) shifted attention toward early education (Singh and

²² see Asadullah and Yalonetzky, 2012; Hauser and Logan, 1992 and Solon, 1999 for examples.

²³ *Anganwadis* are noted to have poorly trained workers, with basic education. Moreover, qualitative research from YL shows that teachers generally seem disinterested and disengaged.

²⁴ Private preschools range from low-cost to highly-priced, but almost all promise English medium instruction, which parents see as a path to upward socioeconomic mobility (Indian Ministry of Women and Child Development, 2013, though research shows more boys than girls are sent to private preschool (Streuli, Vennam and Woodhead, 2011).

Mukherjee, 2017; Streuli, Vennam and Woodhead, 2011). Its 2013 National Early Childhood Care and Education Policy was specifically to expand the educational component of the ICDS, coupled with the National Curriculum Framework and Quality Standards for ECE (Kaul et al., 2017). However, while these demonstrate the political will to enhance the ICDS, the system still suffers from lack of resources, direction, and governance (Richter et al., 2016). Consequently, there remains a large gap between policy and practice, with lack of research on the specificities impeding the ability to optimise. (Alcott et al., forthcoming).

The Context of Andhra Pradesh

The state of Andhra Pradesh has a complex set of challenges²⁵. It has a long-established government-run ECCE system but also a growing trend of private schooling (Asadullah and Yalonetzky, 2012). Yet students fall vastly below the expected levels of attainment (Singh and Mukherjee, 2016).

In many cases, children in Andhra Pradesh are first generation learners; this was the case for more children than not in the YL India sample (Streuli, Vennam and Woodhead, 2011). This has an impact on maternal education's ability to improve outcomes for this generation. Secondly, the rapid growth of private schools is attracting parents with English-medium teaching, resonating with wider national patterns. The government of Andhra Pradesh is therefore under pressure to compete, and is now moving toward English-medium instruction in some secondary schools (Streuli, Vennam and Woodhead, 2011).

Overall, educational disparity in Andhra Pradesh is decreasing (Asadullah and Yalonetzky, 2012). However, the trends discussed above show that education in Andhra Pradesh is characterised by differentiation of preschool experiences by wealth status, location, gender, and parental education (Streuli, Vennam and Woodhead, 2011). These provide an important backdrop for this paper and justification for the examination of gender and maternal education's roles.

Data

Construction of the Sample

This paper draws from the YL study in India, which surveyed families from undivided Andhra Pradesh (later Andhra Pradesh and Telangana). The sample used is the younger cohort²⁶, comprised of 2,000 children aged 1 at the start of the survey in 2002²⁷. Within this sample, only children who participated in both Rounds 2 and 4 were included, as critical data was needed from both rounds. Finally, my sample included only children for whom responses to the key predictor variable of preschool participation were recorded²⁸. Table 1 offers descriptive statistics on all variables.

²⁵ Comprising just under 10% of India's population, Andhra Pradesh is largely rural, but home to the capital of India's IT sector, Hyderabad. Telugu is its major language, spoken by 85% of the population (Vennam et al., 2009).

²⁶ Selected because information on both preschool participation at age 5 and test score results at age 12 was collected.

²⁷ The original sample sizes were n=2,011 in Round 1, n=1,950 in Round 2, n=1,930 in Round 3, and n=1,915 in Round 4 (Singh and Mukherjee, 2016).

²⁸ Though constraining the sample in this way could have introduced some bias, the non-response count on this question was low.

Table 1: Frequencies and Percent of Sample for Each Input Variable

Variable	<i>n</i>	%
Gender		
Male	890	53.5
Female	775	46.5
Total	1665	100
Preschool		
Participated	946	56.8
Did not participate	719	43.2
Total	1665	100
Mother's Education		
Some education	836	50.2
No education	826	49.6
Total	1665	100

Source: Young Lives data, Round 2

Variable Selection and Description

Early Childhood Education (ECE)

The core concept of this paper is early childhood education. It is therefore the primary explanatory variable of this study (Question 1)²⁹. In the YL surveys, parents were asked whether their child was attending preschool. ‘Preschool’ was thus encoded as a binary variable for this study³⁰. In my sample, 56.8% of children were attending preschool during Round 2, when they were approximately aged 5.

It is important to note that local educational policies have different ages of entry for primary school, sometimes leading to early entry or nonlinear trajectories between preschool and primary³¹. This duality of eligibility posed a challenge to the estimation of this variable, but as it proved difficult to calculate or minimise, responses were taken at face value.

Cognitive Outcomes

Cognitive outcomes, as measured by academic performance, were selected as the main outcome variable for this study because of their strong link within the literature to desirable socioeconomic returns. Academic performance is therefore intended to be interpreted as a medium-term indicator of whether the return on investment in ECE is likely to be favourable.

Whilst there are a variety of ways of quantifying academic performance, test scores are most common. Most often, these are children’s scores on comprehension, reading or maths assessments³². In the case of YL,

²⁹ It should not be assumed that I consider ECE to be the only explanatory variable accounting for cognitive development. Variance not explained by these models could be due to genetic endowment (see Todd and Wolpin, 2004), parental education, SES, or other inputs.

³⁰ See Meghir and Rivkin (2011) for a discussion of methodologies for binary education choice, as analysed by Heckman, LaLonde and Smith, 1999.

³¹ Despite the RTE Act’s stipulation that children should enter Grade 1 at age 5-6, only at age 8 does correct enrolment by age stabilise (Kaul et al., 2017).

³² Using test scores could constrict the meaning of ‘cognitive ability’ as outcomes from a range of subjects are not included;

results on only a small selection of tests are recorded, of which I used two: one verbal reasoning test (PPVT) and one maths test (Attanasio, Meghir and Nix, 2015). Scores from two tests were included in this paper's model in order to offer a broader scope of analysis and comparison. Amongst this sample, children's mean score on the PPVT was 75.8% (SD = 13.61%), and mean score on the maths test was 44.6% (SD = 22.7%).

Gender

Literature suggests that ECCE interventions have the potential to compensate for the gender biases that have historically affected Indian education systems (Magnuson et al., 2016; Morabito, Vandenberg and Roose, 2013). Consequently, I examined whether gender was associated with preschool attendance for this sample³³, as well as whether it was associated with variation in score results (Question 2). I also included gender as a control variable in the multivariate OLS regressions to determine whether it made up any part of preschool's ability to predict results on the PPVT and maths tests (Question 4).

Maternal Education

Human capital research has positioned women's education as an intergenerational asset, by which parents' education³⁴ is a determinant of their children's cognitive development³⁵. In research from India specifically, mother's education has been shown to be positively associated with children's educational outcomes (Jeong, Kim and Subramanian, 2018). Taking the lead of other research such as the IECEI, which grouped mother's education into larger brackets (Kaul et al., 2017), I recoded this variable as binary³⁶ for the purposes of this study (Question 3), with mothers falling either into having 'some' education, meaning anything including primary and upwards, or 'none'³⁷.

Statistical Methods

I selected three methodologies based upon precedent³⁸, constraints from the data and possibilities for further research. Firstly, I compared mean test scores of the major groups (preschool attendance, gender and maternal education level). This offered an initial picture of any significant differences. Secondly,

however, maths, comprehension, and reading are usually deemed the most critical skills to assess and are also the most comparable amongst educational studies.

³³ Descriptive statistics on this paper's sample show that 57.8% of boys were attending preschool, while 55.7% of girls were attending. Of the children who were attending preschool, 54.3% were boys and 45.7% were girls.

³⁴ Not accounting for other education levels in the household presented a risk for bias. But as the majority of literature cites mother's education as a paramount factor, I opted to follow this precedent.

³⁵ See Andrabi, Das and Khwaja, 2012; Asadullah and Yalonetzky, 2012; Becker, Murphy and Tamura, 1990; Black et al., 2005 and Magnuson, 2007.

³⁶ One fundamental issue in estimating the effect of maternal education is unmeasured abilities, or 'endowments', of children (Rosenzweig and Wolpin, 1994). Because this is a highly complex matter to calculate, this paper did not account for bias resulting from endowments.

³⁷ Amongst this sample, 49.6% of mothers reported having no education, while 50.2% of mothers reported having completed some education. Of the children attending preschool, 43.4% had mothers without any education, and 56.6% had mothers with some education.

³⁸ Meghir and Rivkin (2011) provided a useful review of methodologies used in the economics of education. A number of these have been used to identify 'causal' relationships, but as this paper is not evaluating the results of experimental research, these models would not be appropriate to replicate in this context. However, they offer important conceptual background.

I conducted linear regression as an uncontrolled estimation of preschool's ability to predict score outcomes. Thirdly, I utilised multivariate ordinary least squares (*OLS*) regression to estimate preschool's ability to predict score outcomes, but with gender and mother's education as conditions.

My bivariate analysis included Chi-square and t-tests³⁹, as well as looking at resulting values for r , r^2 and other measures of effect size. I used Chi-square tests to determine whether gender and maternal education covaried with preschool participation⁴⁰. T-tests were used to determine whether the independent variables (preschool participation, and subsequently gender and maternal education) were associated with test score outcomes.

My multiple regression utilised *OLS* to estimate coefficients⁴¹. The method of least squares was used to estimate the parameters associated with each of the explanatory variables. Each model was then assessed for its goodness of fit.

Limitations

The first limit to the methodology results from the complexity of measuring the impact of genetic endowments (Rosenzweig and Wolpin, 1994). Calculating abilities that are passed down from parents presents a challenge because there is no directly corresponding variable or piece of data to represent the presence or lack of 'endowment', or any more nuanced level of endowed ability. Calculating endowment would need its own method or study in which parents' schooling would be controlled alongside child's early schooling, for example, but such further exploration was outside the remit of this study. However, other studies similar to this paper have also proceeded without considering endowment, not least other YL papers such as Singh and Mukherjee (2018), so there is a precedent for examining the primary and secondary research questions without having to account for endowment.

The second limit to the chosen methods is the issue presented by endogeneity in the form of omitted variable bias (the remaining assumptions for linear regression were met)⁴². This paper included only two variables as controls: maternal education and gender. But literature on ECE highlights socioeconomic status (*SES*) as another important predictor variable⁴³ of both preschool participation and academic attainment (Woodhead, 2009). Therefore, the absence of *SES*, or other related variables, within the model could have confounded results⁴⁴ and also affected the ability to interpret results as causal (Schonemann

³⁹ The level of statistical significance used was a p value of $< .05$. All tests were two-tailed.

⁴⁰ Yates' correction was applied to mitigate against Type 1 errors, as variables were dichotomous. (Field, 2009).

⁴¹ Woldehanna and Gebremedhin (2012) used propensity score matching substantiated with *OLS* and *IV* regression to estimate the effects of pre-school attendance on cognitive development in Ethiopia with YL data. As it uses data from the same wider study on the same topic type, it provided a good reference point for my use of *OLS* methodology. See Loeb et al., 2005 from the US context for other examples of use of *OLS* on a similar topic.

⁴² The assumption regarding multicollinearity could have presented an issue, given there was a correlation shown between mother's education and preschool. However, Field (2012) advises that this assumption is only problematic if any of the input variables correlate highly, above .8 or .9. This was not the case.

⁴³ Relatedly, as *SES* is a known correlative of other variables within the models, this represents a violation of the assumption of no correlation with external variables. However, problems of correlation within the error term were checked for using the Durbin-Watson test (Durbin and Watson, 1950).

⁴⁴ Other variables such as location, nutritional status, birth order and caste could also have been 'omitted variables' (Singh and Mukherjee, 2018), but were not included to reduce overburdening the model and detracting from the research question.

and Steiger, 1976). However, despite limiting causal interpretation, because YL oversampled from poor communities and households (Kumra, 2008), the results still offer an opportunity to examine the relationship between the chosen variables within a more focused socioeconomic bracket.

One way to reduce the model's biases would be to build a multivariate model that includes a greater selection of predictor variables (such as SES or an estimation of genetic endowment), which could improve the validity of the results by showing, through partial correlations, which coefficients contribute the most to the model, as well as improving the model overall⁴⁵. However, such a model would still not indicate causality, and might be overly cumbersome. I therefore maintained the selection of two variables which past research has deemed particularly important for the intergenerational transmission of human capital.

Results

The goal of the regression analysis was to estimate the role of preschool in predicting test score outcomes of children in Andhra Pradesh at age 12. The findings show that, for this sample, preschool participation and gender were ineffective predictors of test score outcomes, but maternal education emerged as a significant predictor of test scores.

Question 1: Was Early Childhood Education a Good Predictor of Test Scores?

Initial results indicated that preschool participation did not have a statistically significant impact on PPVT scores, but did on maths scores, yet with only a small effect size. Figures 1a and 1b below depict mean scores on each test by children who did and did not attend preschool.

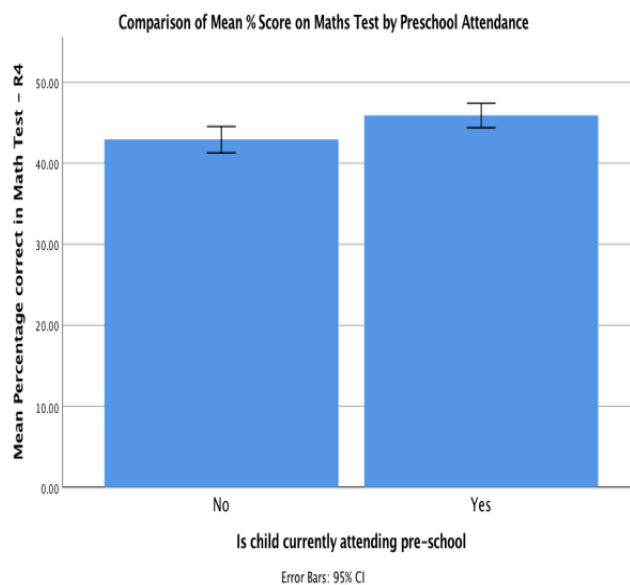


Figure 1a: Comparison of mean percent score on Maths test by preschool attendance (L).

Source: Young Lives India, Rounds 2 and 4.

⁴⁵ Another way to limit these biases would be to conduct further research utilising differential effects. This methodology could be used to compare each input variable's explanatory potential, which could help to correct unobserved biases associated with both variables (Rosenbaum, 2006).

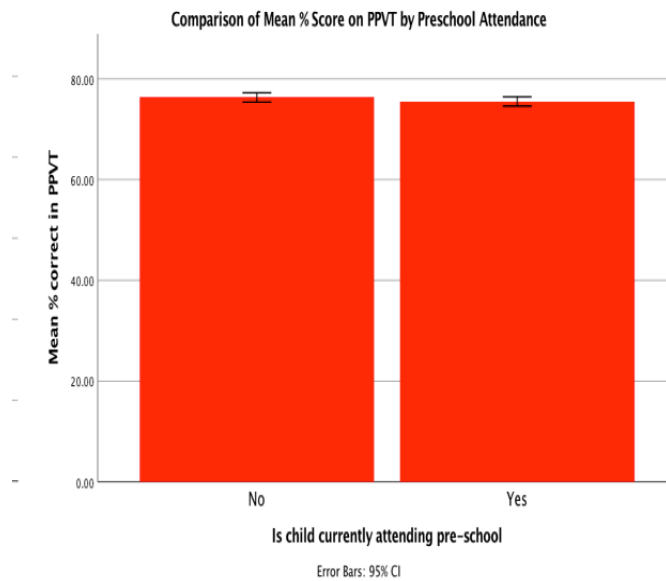


Figure 1b: Comparison of mean percent score on PPVT by preschool attendance (R).

Source: Young Lives India, Rounds 2 and 4.

These results contradict the existing body of evidence on ECE. Possible explanations could have to do with bias in the model due to endogeneity, or with the homogenisation of ‘preschool’ as a single ‘treatment’ rather than a further disaggregated variable. Table 2 below summarises the findings.

Table 2: Summary of Test Score Means Compared by Preschool Attendance

Is child currently in preschool?		
Test	Yes	No
PPVT		
n	942	718
Mean Score	75.49	76.31
SD	14.27	12.69
t = 1.23	r = -.030	Cohen's d = .06
p value = .220	r-squared = .0009	df = 1658
Maths	Yes	No
n	918	706
Mean Score	45.89	42.91
SD	23.27	22.03
t = -2.62	r = .065**	Cohen's d = .13
p value = .009**	r-squared = .004	df = 1622

** indicates statistical significance at 1% level

Source: Young Lives India, Rounds 2 and 4.

Question 2: Did Boys Who Attended Preschool Fare Better Than Girls on These Tests?

Subgroup analysis by gender revealed that boys were not more likely than girls to score higher on either the PPVT or maths test. Additionally, differences in preschool participation rates for boys and girls were not significant. This confirms analysis from YL India conducted by Streuli, Vennam and Woodhead (2011) and also mirrors World Bank data which indicates that pre-primary enrolment across India is now essentially on par (“Education Statistics - All Indicators”, 2018). Table 3 below summarises the findings from the gender subgroup analysis, and Figures 2a and 2b below illustrate that there was no significant difference between mean test scores.

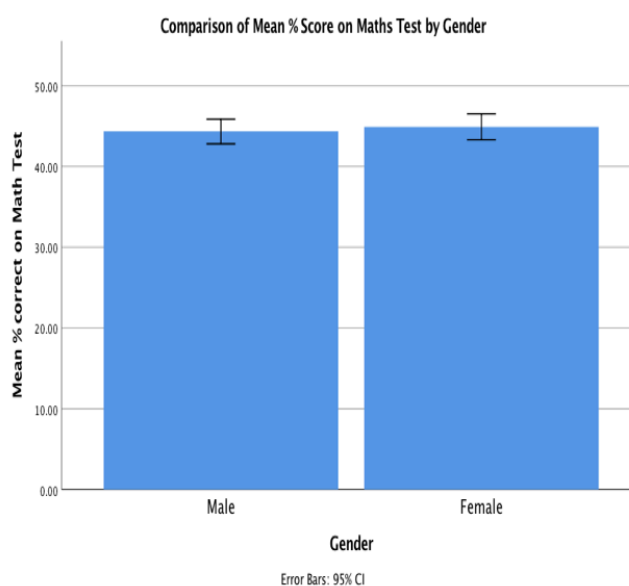


Figure 2a: Comparison of mean percent score on Maths test by gender (L)
Source: Young Lives India, Rounds 2 and 4.

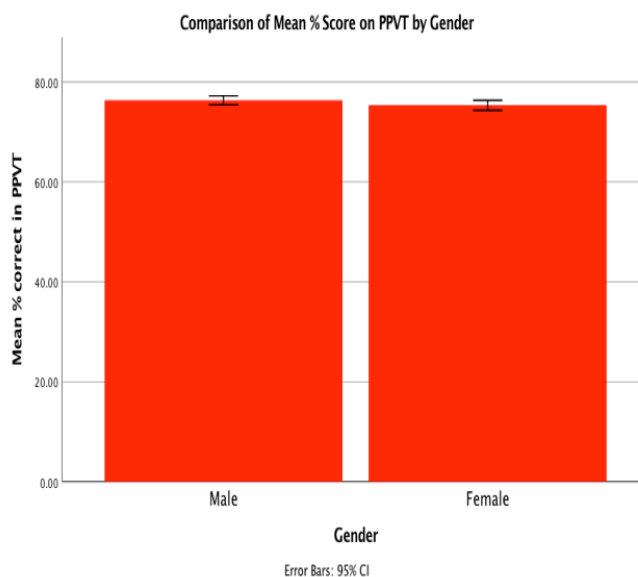


Figure 2b: Comparison of mean percent score on PPVT by gender (R)
Source: Young Lives India, Rounds 2 and 4.

Table 3: Summary of Test Score Means Compared by Gender

Gender		
Test	M	F
PPVT		
n	886	774
Mean Score	76.31	75.32
SD	13.18	14.09
$t = 1.47$ $r = -.036$ $p \text{ value} = .142$ $r\text{-squared} = .001$ $df = 1658$		
Maths		
n	871	753
Mean Score	44.33	44.89
SD	23.06	22.47
$t = -.497$ $r = .012$ $p \text{ value} = .619$ $r\text{-squared} = .000$ $df = 1622$		

Source: Young Lives India, Rounds 2 and 4.

Question 3: Did Children With Educated Mothers Fare Better on These Tests?

As illustrated by Figures 3a and 3b below, analysis found statistically significant differences between test scores for children whose mothers were educated and those whose were not⁴⁶. The results are summarised in Table 4. Effect sizes as measured by r also showed a medium effect.

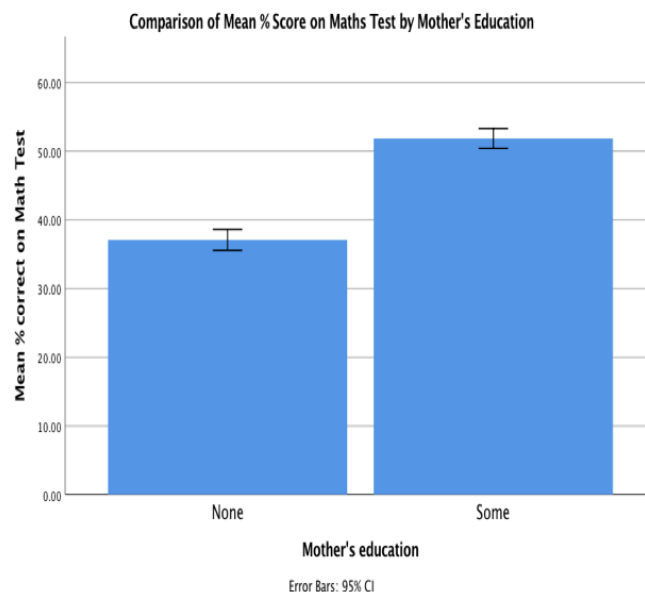


Figure 3a: Comparison of mean percent score on Maths test by mother's education (L).

Source: Young Lives India, Rounds 2 and 4.

⁴⁶ However, due to the issue of external variables, it is possible that there was some bias in the coefficient for maternal education resulting from a correlation between SES and maternal education, and between SES and preschool participation.

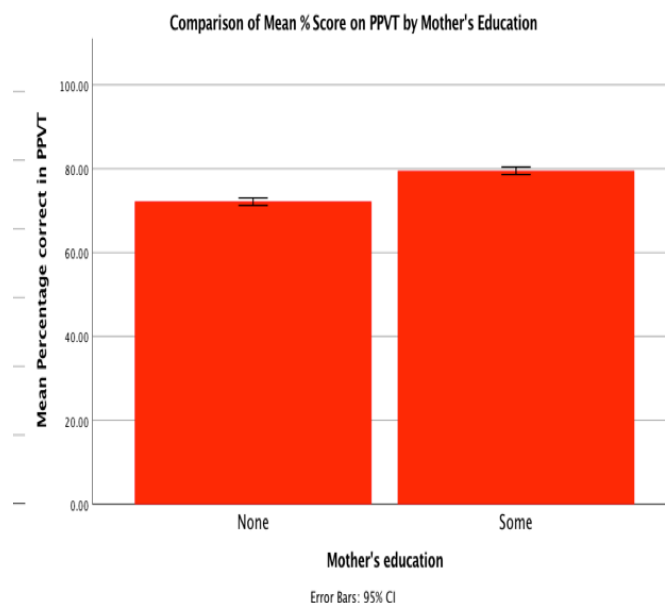


Figure 3b: Comparison of mean percent score on PPVT test by mother's education (R)
 Source: Young Lives India, Rounds 2 and 4.

Table 4: Summary of Test Score Means Compared by Maternal Education

Maternal Education Level		
Test	None	Some
PPVT		
n	823	834
Mean Score	72.16	79.52
SD	13.08	13.16
$t = -11.42$ $r = .270^{**}$ $p \text{ value} = .000^{**}$ $r\text{-squared} = .073$ $df = 1655$		
Maths		
n	792	829
Mean Score	37.01	51.84
SD	21.66	21.39
$t = -13.81$ $r = .325^{**}$ $p \text{ value} = .000^{**}$ $r\text{-squared} = .105$ $df = 1619$		

** indicates statistical significance at 1% level

Source: Young lives India, Rounds 2 and 4.

Results also revealed that the proportion of children that were not attending preschool was significantly higher amongst families with uneducated mothers. Mothers with some education were also more likely to have children attending preschool than not.

Question 4: Once Gender and Maternal Education Were Controlled, Was Preschool a Useful Predictor of Test Scores?

The results of the multivariate regression indicated that gender and preschool did not offer much value as predictors, but maternal education did. The models for predicting PPVT and maths scores are summarised in Table 5 below:

Table 5: Multivariate Model Summaries for Predicting Maths and PPVT Scores

Model Summary for Predicting PPVT Scores						
Variable	Coefficient	95% Confidence Interval	S.E.	t-ratio	sig.	
Preschool attendance	-0.073	(-3.29, -0.72)	0.66	-3.05	.002**	
Gender	-0.043	(-2.44, 0.08)	0.64	-1.83	0.067	
Mother's education	0.282	(6.39, 8.94)	0.65	11.81	0.000	
<i>F</i> = 47.87**		<i>F</i> sig = .000**	<i>r</i> = .28	<i>r-squared</i> = .08		
Model Summary for Predicting Maths Scores						
Variable	Coefficient	95% Confidence Interval	S.E.	t-ratio	sig.	
Preschool attendance	0.013	(-1.54, 2.74)	1.09	0.55	0.581	
Gender	0.006	(-1.81, 2.40)	1.07	0.28	0.783	
Mother's education	0.322	(12.55, 16.79)	1.08	13.55	.000**	
<i>F</i> = 63.62**		<i>F</i> sig = .000**	<i>r</i> = .33	<i>r-squared</i> = .11		

** indicates statistical significance at 1% level

Source: Young lives India, Rounds 2 and 4.

Summary of PPVT Model Findings

The PPVT model was found to be a ‘good fit’ for estimating test score outcomes. However, surprisingly, the model showed that preschool attendance had a negative, statistically significant coefficient in the conditional relationship. This is best interpreted as a ‘negligible’ finding. Meanwhile, gender was shown to have a slightly negative coefficient in the PPVT model, but the significance value of the t-test indicated that it was not a significant contributor, confirming the results of the bivariate analysis. Lastly, the model’s results showed that mother’s education had a highly significant correlation ($p = .000$) with test outcomes for the PPVT. In fact, it was the only variable in this model with a positive part correlation (.279). Therefore, though the model as a whole was found to be a good method of estimation, the goodness of fit came primarily from the coefficient for maternal education.

Summary of Maths Test Model Findings

In the bivariate analysis, linear regression showed a statistically significant association between preschool participation and maths test results. The findings of that analysis were consistent with those of Singh and Mukherjee, who also found that preschool was associated with improved maths scores (2017). However, results from the multivariate model showed that the conditional association (with gender and maternal education controlled) was no longer statistically significant. As with the PPVT model, maternal

education provided the bulk of the model's ability to predict maths score outcomes. Though the F-test results found this model to be a 'good predictor' of maths scores, it is important to note that the r-squared value demonstrates that the model could only account for 11% of the variance in score results, and also that the original research question (Question 1) was about whether ECE (not the other conditional variables) was a useful way to estimate score outcomes, which this model indicates it was not.

Conclusion of Results

Overall, though both models were 'good fits', the findings did not support the original hypothesis that ECE would be a good predictor of test score outcomes. Correlation between preschool and maths results was found significant at the bivariate level; however, once gender and maternal education were conditioned out, the coefficient was no longer significant. The correlation coefficients themselves were small, indicating that interpreting a statistically 'strong' association should be done with caution, even when p-values are very small (<.001). Effect sizes were negligible in some cases, and only small-to-medium in others. R² values showed that no variation in PPVT outcomes and only 4% in maths outcomes could be explained by preschool participation, meaning that variance in outcomes is likely to be better explained, or further explained, by other predictor variables not included in the model. Lastly, the lion's share of the 'predicting' comes from the wrong variable - mother's education. These results contradict copious evidence supporting preschool's positive effect on academic attainment.

Discussion

Three major themes emerged from this paper's findings. The first was that preschool was not a valuable predictor of test scores amongst this sample, supporting the idea that the Indian evidence base for ECE needs further substantiation⁴⁷ in order to improve services and policies. The second was that maternal education has significant value as a predictor of academic outcomes, confirming other evidence⁴⁸ of its role in intergenerational educational attainment. The third was that gender disparity appears to be reducing in scope. These themes help to substantiate the evidence base on early education in India and clarify areas of progress and residual challenges.

Preschool Was Not a Good Predictor of Academic Outcomes

Surprisingly, the findings indicated that children amongst this sample who participated in ECE did not achieve well academically. These findings resonate with only a limited body of existing evidence. For example, the significant association between preschool and maths in the bivariate analysis was consistent with other YL research in Peru, Ethiopia and Vietnam (Early Childhood Development: informing policy and making it a priority, 2018). The overall conclusion that preschool did not 'make a difference' mirrors other results on ECE in India reported by Chopra (2012), Pattnaik (1996) and Manhas and Qadiri (2010). Reports from ASER (Beyond Basics, 2018) and Save the Children

⁴⁷ See Alcott et al., 2018; Kaul and Sankar, 2009; Kaul et al., 2017 and Singh and Mukherjee, 2017 for other documentation of this need.

⁴⁸ See Andrabi, Das and Khwaja, 2012; Becker, Murphy and Tamura, 1990; Black, Devereux and Salvanes, 2005; Black et al., 2005; Magnuson, 2007; Rosenzweig and Wolpin, 1994 and also Jeong, Kim and Subramanian, 2018 for evidence from India, and Singh and Mukherjee, 2015 for evidence using YL India data.

(2009) also reported low attainment on pre-literacy and pre-numeracy skills for 5-year-olds, which indicates inadequate preschooling. However, the results contradict the majority of evidence on ECE.

Two possibilities emerge as to why these findings do not match the patterns. Firstly, problems could have arisen with the transition from data collection to variable construction which obscured important indicators. Secondly, the wider evidence body itself might not be heterogeneous enough to account for variation in patterns on ECE.

Recapitulating the first reason, it is possible that problems with construction of the primary explanatory variable obscured variation because responses to ‘is the child currently attending preschool?’ were not readily disaggregated by private versus public. Given evidence that preschool type has been associated with variations in attainment (Alcott and Rose, 2015; Beyond Basics, 2018; Chopra, 2012 and Singh and Mukherjee, 2015 and 2018), this would have offered a valuable condition⁴⁹.

Additionally, it is possible that families’ responses to the question used for variable construction (either a ‘yes’ or ‘no’ to ‘is child attending preschool?’) obscured early entry to primary after attending ECE by the time Round 2 took place (see Alcott et al., forthcoming)⁵⁰.

A useful methodological approach to combat the potential threat of inconclusive findings based on these possibilities could therefore entail conducting regression analysis that disaggregates preschool experience by type (as in the research conducted by Singh and Mukherjee, 2018), or also by other determinants of quality. Such research might reveal under what circumstances, or in what conditions, ECE in India matches wider patterns of positive association with academic outcomes.

Recapitulating the second reason, it is possible that this is the case because wider patterns are not diverse enough. Literature authenticating this possibility comes from Woodhead (2006), who noted that there is a distinct lack of literature from LAMI countries on ECE’s role in academic attainment, and also from Woldehanna and Gebremedhin (2012). Most ECE studies have had certain commonality in terms of the relative quality of ECE provision, ambient notions of education, patterns of parental cognition, or issues of gender. Thus, there is a possibility that patterns on ECE in LAMI countries could be different from those in developed contexts, but it is difficult to corroborate this without further evidence.

If patterns in LAMI contexts were to differ from the wider evidence body, as these findings indicate may be the case, it is likely that ‘quality of ECE’ divides them. This conclusion is based on evidence from Rao and Kaul, who found that anganwadis offered insufficient pre-primary education (2017) and Kaul et al. (2017) who noted that even private pre-primary is developmentally inadequate. Accordingly, overall poor quality ECE provision in India could be contributing to lack of statistically significant results.

⁴⁹ However, documented issues with ‘nonlinearity’ of early educational trajectories might have complicated this anyway, as many children have been shown to complete some government as well as some private preschool (Alcott et al., 2018).

⁵⁰ The YL team should have mitigated against this response bias, given ‘early entry’ is a documented phenomenon. Perhaps a question such as ‘did this child complete at least two full years of ECE between the ages of 3-5?’ would have allowed for a more accurate analysis of the effects of preschool on attainment.

The Role of Gender in Predicting Attainment Appears to be Diminishing

These findings demonstrate that gender is not a good estimator of academic attainment (Question 2). They corroborate existing evidence on multiple fronts: evidence that gender does not play a role in estimating a range of education-related outcomes has also been found using YL India data by Vennam et al. (2009) and again by Streuli, Vennam and Woodhead (2011). Meanwhile, official World Bank data (“Education Statistics - All Indicators”, 2018) supports this paper’s findings on preschool participation rates and also offers a backdrop to the evidence on equal attainment.

These results speak to the long-established international focus on reaching gender parity in education, which has been a particular priority since the inception of the Millennium Development Goals (MDGs) (“United Nations Millennium Development Goals”, 2018). They also suggest that efforts made by the Indian government to redress gender disparity in education, such as launching the National Programme of Education for Girls at Elementary Level, are making a difference (Streuli, Vennam and Woodhead, 2011). And whilst these results do not support the views of Kaul et al. (2017) that gender in education is still a point of disparity in India, or evidence from Magnuson et al. (2016) or Garcia, Heckman and Ziff (2018) who indicate that girls in some instances benefit less from pre-primary education⁵¹, they represent an important finding that demonstrates progress is being made.

Maternal Education Was a Useful Predictor of Attainment

Results on maternal education (Question 3)⁵² found it to be a strong predictor of academic outcomes amongst this sample. These findings support wide-ranging evidence from the human capital tradition that investing in mothers’ education pays intergenerational dividends (see Andrabi, Das and Khwaja, 2012; Becker, Murphy and Tamura, 1990; Black et al., 2005; King and Hill, 1993; Magnuson, 2007; Rosenzweig and Wolpin, 1994 and Schultz, 1993). They also corroborate evidence from India that maternal education has an important role to play in educational attainment (Jeong, Kim and Subramanian, 2018; Kaul et al., 2017 and Singh and Mukherjee, 2015). These findings provide clear evidence of the intergenerational nature of maternal education as an ‘endowment’.

Conclusions

Theory and literature both indicate that participating in early education should improve overall attainment by providing children with the skills to succeed academically. However, much of the evidence available is from developed contexts, which have very different parameters of experience. The aim of this study was to explore the impact of preschool participation on academic attainment for children in

⁵¹ A complexity in these findings could arise from the possibility that variation between preschool type and gender was masked by the methodology involved in documenting preschool attendance, which did not account for private versus public. For example, other research, including qualitative research from YL India, has indicated that parents are more likely to invest in private education for sons (Woodhead et al., 2009).

⁵² Because ‘maternal education’ was recoded for this paper as a binary variable, it is interesting to note that having any education at all made a difference to variation in test score outcomes on both tests. This is an important point for policymaking in India, as the country still has an adult female literacy rate of only 59% and a large quantum of first generation learners (“Literacy rate, adult female”, 2018).

India⁵³, which is of interest because of educational attainment's link to important socioeconomic outcomes. This research problem was addressed through layers of quantitative analysis, including the creation of multivariate models controlling the possible influences of gender and maternal education.

Despite being able to successfully create multivariate models that were good estimators of test results, upon interpretation of the results, little to no association was found between preschool participation and academic outcomes. These findings highlight firstly that ECE in India is facing issues of quality and secondly that evidence on ECE is being generalised because it is convincing, and because there is not sufficient evidence from elsewhere to change this. Accordingly, this paper argues that ECE policies for LAMI countries should rely not just on precedent but take into consideration localised evidence. It also argues against viewing 'preschool' as a monolithic or uniform experience, because a plausible explanation for the inconclusive findings is that 'preschool' was not disaggregated. However, considering all preschool experiences as 'uniform' for this sample also had value, because it demonstrated that as a group preschools in Andhra Pradesh are not of good enough quality to enhance cognitive outcomes. This evidence underscores the need to continue reforming ECE services in India (Streuli, Vennam and Woodhead, 2011).

India's government therefore needs to redress inadequate pre-primary services, particularly in light of the increasing competitiveness of the private market. Other researchers have also cited the need for a regulatory body to help with governing quality standards (Chopra, 2012). Increasing the effectiveness of India's ECE models can best be accomplished by garnering more reliable, relevant evidence to inform their improvement.

In this vein, this paper has been an endeavour to help substantiate the limited evidence body on ECE in India, provide nuance to existing debates on topics such as gender, and increase awareness of the limits of generalisability of existing ECE literature⁵⁴. Though the findings are, in themselves, not generalisable, their importance lies in their departure from the results of other research showing ECE's effectiveness.

References

- Aakvik, A., Salvanes, K. and Vaage, K. (2003). Measuring heterogeneity in the returns to education in Norway using educational reforms. In *C.E.P.R. Discussion Papers: No. 4088*.
- Alcott, B. and Rose, P. (2015). Schools and learning in rural India and Pakistan: Who goes where, and how much are they learning?. In *Prospects*, 45, pp.345-363.
- Alcott, B., Banerji, M., Bhattacharjea, S., Ramanujan, P., and Nanda, M. (2018). One stepforward, two steps

⁵³ In order to determine how existing ECE services can be improved, further research into what elements or types of ECE covary with improved outcomes should be explored (Engle et al., 2007; Engle et al., 2011 and Yoshikawa and Nieto, 2013).

⁵⁴ Another opportunity for further research could be to widen the models in this paper by adding other highly pertinent predictor variables, thereby increasing the validity of the analysis. Using partial correlation could improve understanding of which variables are truly playing an explanatory role (Kline, 2004). This could also help to reduce some of the omitted variable bias or endogeneity (Woolridge, 2016). Making use of propensity score matching, as used by Woldehanna and Gebremedhin (2012), could also offer experimental-style research for comparing the effects of various input variables.

- back: transitions between home, pre-primary and primary education in rural India. In *Compare: A Journal of Comparative and International Education*. Retrieved from: DOI 10.1080/03057925.2018.1527214
- Alcott, B., Bhattacharjea, S., Ramanujan, P., & Nanda, M. (Forthcoming). Participation trends in early childhood education programmes: Who goes where and why? In *Early childhood education in India: findings from a cohorts study* (S. Bhattacharjea & V. Kaul, eds). Springer.
- Andrabi, T., Das, J. and Khwaja, A. (2012). What did you do all day? Maternal education and child outcomes. In *Journal of Human Resources*, 47(4).
- Arora, S., Bharti, S., and Mahajan, A. (2006). Evaluation of non-formal pre-school educational services provided at Anganwadi Centres (Urban Slums of Jammu City). In *Indian Journal of Social Science*, 12(2), pp.135-137.
- Asadullah, M. and Yalonetzky, G. (2012). Inequality of educational opportunity in India: Changes over time and across states. In *World Development*, 40(6), pp.1151-1163.
- Attanasio, O., Meghir, C. and Nix, E. (2015). Human capital development and parental investment in India. In *Cowles Foundation Discussion Papers*. New Haven, CT: Cowles Foundation for Research in Economics, Yale University.
- Barro, R. (1989). *Economic growth in a cross section of countries*. Working paper no. 3120. Cambridge, Mass. NBER.
- Becker, G. (1962). Investment in human capital: A theoretical analysis. In *Journal of Political Economy*, 70(5), pp.9-49.
- Becker, G. (1964). Human Capital: A Theoretical and empirical analysis, with special reference to education. In *National Bureau of Economic Research*, New York. Distributed by Columbia University Press.
- Becker, G. (1993). *Human Capital*. 3rd ed. Chicago: University of Chicago Press.
- Becker, G., Murphy, K. and Tamura, R. (1990). Human capital, fertility, and economic growth. In *Journal of Political Economy*, 98(5, Part 2), pp.S12-S37.
- Belfield C., Nores, M., Barnett, W., and Schweinhart, L. (2006). The High/Scope Perry Preschool program: Cost-benefit analysis using data from the age-40 followup. In *Journal of Human Resources*, 41(1), pp.162–90.
- Ben-Porath, Y. (1967). The production of human capital and the life cycle of earnings. In *Journal of Political Economy*, 75(1), pp.352-365.
- Beyond Basics. (2018). *Annual Status of Education Report (Rural) 2017*. New Dehli: ASER Centre.
- Black, M., Walker, S., Fernold, L. and Andersen, C. (2016). Early childhood development coming of age: science through the life course. In *The Lancet*, 389(10064), pp.77-90.
- Black, S., Devereux, P. and Salvanes, K. (2005). Why the apple doesn't fall far: Understanding intergenerational transmission of human capital. In *The American Economic Review*, 95(1), pp.437-449
- Boserup, E. (1970). *Woman's role in economic development*. London: Earthscan.
- Britto, P., Engle, P. and Super, C. (2013). Early childhood development: Translating research to global policy. In P. Britto, P. Engle and C. Super, ed., *Handbook of Early Childhood Development Research and its Impact on Global Policy*. Oxford: Oxford University Press, pp.3-23.
- Britto, P., Engle, P. and Super, C. ed., (2013). *Handbook of Early Childhood Development Research and its Impact on Global Policy*. Oxford: Oxford University Press.
- Bryman, A. (2014). *Social Research Methods*. 4th ed. Oxford: Oxford University Press, pp.312-315.
- Campbell, F. and Ramey, C. (1994). Effects of early intervention on intellectual and academic achievement: A follow-up study of children from low-income families. In *Child Development*, 65, pp.684-698.

- Carneiro, P. and J. Heckman. (2003). *Human Capital Policy*. Cambridge, MA: MIT Press.
- Chopra, N. (2012). A study of early childhood education programmes in Dehli, India. In *International Journal of Early Years Education*, 20(2), pp.159-174.
- Cohen, J. (1988). *Statistical Power Analysis for the Behavioural Sciences*. 2nd ed. New York:Lawrence Erlbaum Associates.
- Cunha, F. and Heckman, J. (2007). The technology of skill formation. In *American Economic Review*, 97(2), pp.31-47.
- Cunha, F., Heckman, J., Lochner, L. and Masterov, M. (2006). Interpreting the evidence on life cycle skill formation. In: E. Hanushek and F. Welch, ed., *Handbook of the Economics of Education*. New York: Elsevier.
- Currie, J. (2001). Early childhood education programs. In *Journal of Economic Perspectives*, 15(2), pp.213–38.
- Currie, J. and Thomas, D. (1995). Does a head start make a difference?. In *American Economic Review*, 85(3), pp.341-64.
- Das, J. and Zajonc, T. (2010). India shining and Bharat drowning: Comparing two Indian states to the worldwide distribution in mathematics achievement. In *Journal of Development Economics*, 92(2), pp.175-187.
- Datta, S., Boratne, A., Cherian, J., Joice, Y. and Vignesh, J. (2010). Performance of anganwadi centres in urban and rural area: a facility survey in coastal South India. In *Indian Journal of Maternal and Child Health*, 12(4), pp. 9.
- Dearden, L., Stephen, M. and Howard, R. (1997). Intergenerational mobility in Britain. In *Economic Journal*, 107(440), pp.47-66.
- DeCicca, P. and Smith, J. (2013). The long-run impacts of early childhood education: Evidence from a failed policy experiment. In *Economics of Education Review*, 36, pp.41-59.
- Denison, P. (1985). *Trends in American economic growth*. Washington, DC: The Brookings Institution, pp.1929-1982.
- Durbin, J. and Watson, G. (1950). *Testing for serial correlation in least squares regression*. *Biometrika*, 37(3-4), pp.409-428.
- Early Childhood Development: informing policy and making it a priority. (2018). In *Young Lives Impact Case Study*. Oxford: Young Lives.
- Education Statistics - All Indicators. DataBank*. (2018). Retrieved from: https://databank.worldbank.org/Data/indicator/UIS.E.0.T?id=c755d342&report_nam =EdStats_Indicators_Report&populartype=series
- Engle, P., Black, M., Behrman, J., Mello, M., Gertler, P., Kapiriri, L., Martorell, R., Young, M. and the International Child Development Steering Group. (2007). Child development in developing countries 3: Strategies to avoid the loss of developmental potential in more than 200 million children in the developing world. In *The Lancet*, 369, pp.229–42.
- Engle, P., Fernald, L., Alderman, H., Behrman, J., O’Gara, C., Yousafzai, A., Cabral de Mello, M., Hidrobo, M., Ulkuer, N. and Ertem, I. (2011). Strategies for reducing inequalities and improving developmental outcomes for young children in low income and middle income countries. In *The Lancet*, 378 (9799), pp.1339-1353.
- Field, A. (2009). *Discovering Statistics Using SPSS*. 3rd ed. London: SAGE.
- Galab, S., Reddy, P. and Himaz, R. (2008). *Young Lives Round 2 Survey Report Initial Findings: Andhra Pradesh, India*. Oxford: Young Lives.
- Garcia, J., Heckman, J. and Ziff, A. (2018). Gender differences in the benefits of an influential early childhood program. In *European Economic Review*, 109, pp.9-22.
- Garcia, J., Heckman, J., Ermini, D. and Prados, M. (2016). The life-cycle benefits of an influential early childhood

- program. In *NBER Working Papers*. National Bureau of Economic Research
- Goodman, A. and Sianesi, B. (2005). Early education and children's outcomes: How long do the impacts last?. In *Institute for Fiscal Studies*. 26(4), pp.513–48
- Gormley Jr., W., Phillips, D., Newmark, K., Welti, K. and Adelstein, S. (2011). Social emotional effects of early childhood education programs in Tulsa. In *Child Development*, 82(6), pp.2095-2109.
- Government of India, Ministry of Law and Justice (2009). *The Right of Children to Free and Compulsory Education Act*. New Dehli: Government of India Press.
- Government of India. (2013). *National Early Childhood Care and Education Policy*. Ministry of Women and Child Development. New Delhi: GoI.
- Grantham-McGregor, S., Cheung, Y., Cueto, S., Glewwe, P., Richter, L., Strupp, B., and the international Child Development Steering Group. (2007). Developmental potential in the first 5 years for children in developing countries. In *The Lancet*, 36, pp. 60–70.
- Handbook on Measuring Equity in Education*. (2018). Montreal: UNESCO Institute for Statistics.
- Hanushek, E. (2008). Schooling, gender equity, and economic outcomes. In: M. Tembon and L. Fort, ed., *Girls' Education in the 21st Century*. Washington, D.C.: The World Bank.
- Harmon, C. and Walker, I. (1995). Estimates of the economic return to schooling for the United Kingdom. In *The American Economic Review*, 85(5), pp.1278-1286.
- Hauser, R. and Logan, J. (1992). How not to measure intergenerational occupational persistence. In *American Journal of Sociology*, 97(6), pp.1689-711.
- Heckman, J. (1995). Lessons from the bell curve. In *Journal of Political Economy*. 103(5), pp.1091
- Heckman, J. (2006). Skill formation and the economics of investing in disadvantaged children. In *Science*, 312(5782), pp.1900-1902.
- Heckman, J. (2011). The economics of inequality: The value of early childhood education. In *American Educator*, 35(1), pp.31-35.
- Heckman, J. and Masterov, D. (2007). The productivity argument for investing in young children. In *Applied Economic Perspectives and Policy*, 29(3), pp.446–493.
- Herz, B. and Sperling, G. (2016). *What Works in Girls' Education*. Washington, D.C.: The Brookings Institution.
- Indian Ministry of Women and Child Development (2013). *National early childhood care and education (ECCE) Curriculum Framework*.
- Jeong, J., Kim, R. and Subramanian, S. (2018). How consistent are associations between maternal and paternal education and child growth and development outcomes across 39 low-income and middle-income countries?. In *Journal of Epidemiology and Community Health*, 72(5).
- Karoly, L., Greenwood, P., Everingham, S., Houbé, J., Kilburn, M., Rydell, C., Sanders, M. and Chiesa, J. (1998). *Investing in our children: What we know and don't know about the costs and benefits of early childhood interventions*. Santa Monica, CA: RAND.
- Kaul, V. and Sankar, D. (2009). Early Childhood Care and Education in India. In *Education for All - Mid-Decade Assessment*. New Dehli: National University of Educational Planning and Administration (NUEPA).
- Kaul, V., Bhattacharjea, S., Chaudhary, A., Ramanujan, P., Banerji, M. and Nanda, M. (2017). *The India Early Childhood Education Impact Study*. Dehli: CECED, Ambedkar University Dehli, and ASER Centre.
- Kaul, V., Ramachandran, C. and Upadhyaya, G. C. (1993). *Impact of Early Childhood Education on Retention in Primary Grades: A Longitudinal Study*.

- King, E. and Hill, A. (1993). *Women's Education in Developing Countries*. Baltimore: Published for the World Bank [by] the Johns Hopkins University Press.
- Kingdon, G. (1996). Private schooling in India: Size, nature, and equity-effects. In *Economic and Political Weekly*, 31(51), pp.3306-3314.
- Kline, R. (2004). *Principles and Practice of Structural Equation Modelling*. 2nd ed. New York: The Guilford Press, p.29.
- Kohlberg, L. 1968. Early education: A cognitive-developmental view. In *Child Development*, pp.1013-1062.
- Kumra, N. (2008). *An assessment of the Young Lives sampling approach in Andhra Pradesh, India*. Young Lives Technical Notes. Oxford, England: Young Lives.
- Leibowitz, A. (1974). Home Investments in Children. In *Journal of Political Economy*, 82(5), pp.1111-31.
- Levin, H. and Schwartz, H. (2006). *Costs of early childhood care and education programmes*. Background paper prepared for the Education for All Global Monitoring Report 2007 Strong foundations: early childhood care and education. New York: National Center for the Study of Privatization in Education and UNESCO.
- Literacy rate, adult female*. (2018). Retrieved from: <https://data.worldbank.org/indicator/SE.ADT.LITR.FE.ZS?view=chart>.
- Loeb, S., Bridges, M., Fuller, B., Rumberger, R. and Bassok, D. (2005). How much is too much? The influence of pre-school centers on children's social and cognitive development. In *Economics of Education Review*, 26(1), pp.52–66.
- Magnuson, K. (2007). Maternal education and children's academic achievement during middle childhood. In *Developmental Psychology*, 43, pp.1497–151.
- Magnuson, K., Kelchen, R., Duncan, G., Schindler, H., Shager, H. and Yoshikawa, H. (2016). Do the effects of early childhood education programs differ by gender? A meta-analysis. In *Early Childhood Research Quarterly*, 36, pp.521-536.
- Magnuson, K.A., Meyers M., Ruhm, C.J. and Waldfogel, J. (2004) Inequality in pre-school education and school readiness. In *American Educational Research Journal*, 41(1), pp.115–57.
- Manhas, S. and Qadiri, F. (2010). A comparative study of preschool education in early childhood education centres in India. In *Contemporary Issues in Early Childhood*, 11(4).
- Marope, P. and Kaga, Y. (2015). *Investing against Evidence: The Global State of Early Childhood Care and Education*. Paris: UNESCO.
- Meghir, C. and Rivkin, S. (2011). Econometric Methods for Research in Education. In: E.Hanushek, S. Machin and L. Woessmann, ed., *Handbook of the Economics of Education*. New York: Elsevier.
- Mincer, J. (1958). Investment in Human Capital and Personal Income Distribution. In *Journal of Political Economy*, 66(4), pp.281-302.
- Mohite, P. and Bhatt, N. (2008). From home to school: Mapping children's transition in the Indian context. In *Research in Comparative and International Education*, 3(3), pp.308-316.
- Morabito, C., Vandenbroeck, M. and Roose, R. (2013). 'The Greatest of Equalisers': A critical review of international organisations' views on early childhood care and education. In *Journal of Social Policy*, 42(3), pp.451-467.
- Mulligan, C. (1999). Galton versus the human capital Approach to inheritance. In *Journal of Political Economy*, 107(6), pp.184- 224.
- Nadeau, S., Elder, L., Kataoka, N., Neuman, M. and Valerio, A. (2011). *Investing in Young Children: An Early Childhood Development Guide for Policy Dialogue and Project Preparation*. Washington, D.C.: The World Bank.

- Nagaraja, G. and Anil, M. (2014). A sociological study of children irregularity and dropout from Anganwadi Centre of Kolar district, Karnataka State. In *International Journal of Health Sciences and Research*, 4(3), pp.23-28.
- NCERT. (1996). *Identifying Numeracy and Reading Readiness Levels of Entrants to Grade I: A Synthesis. Report under DPEP*, Department of Elementary Education. New Delhi.
- Patrinos, H. (2008). Returns to education: The gender perspective. In: M. Tembon and L. Fort, ed., *Girls' Education in the 21st Century*. Washington, D.C.: The World Bank.
- Pattnaik, J. (1996). Early childhood education in India: History, trends, issues, and achievements. In *Early Childhood Education Journal*, 24(1), pp.11-16.
- Pratham (2010). *Annual Status of Education Report, 2009*. New Delhi, India: Pratham and ASER Centre.
- Rao, N. and Kaul, V. (2017). India's integrated child development services scheme: challenges for scaling up. Child: Care, In *Health and Development*, 44(1), pp.31-40.
- Rao, N., Sun, J., Wong, J., Weekes, B., Ip, P., Shaeffer, S., Young, M., Bray, M., Chen, E. and Lee, D. (2013). *Early Childhood Development and Cognitive Development in Developing Countries: A Rigorous Literature Review*. London: DFID.
- Richter, L., Daelmans, B., Lombardi, J., Heymann, J., Lopez Boo, F., Behrman, J., Lu, C., Lucas, J., Perez-Escarnilla, R., Dua, T., Bhutta, Z., Stenberg, K., Gertler, P. And Darmstadt, G. (2016). *Investing in the foundation of sustainable development: pathways to scale up for early childhood development*. Retrieved from: [https://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(16\)31698-1/fulltext](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(16)31698-1/fulltext).
- Rosenbaum, P. (2006). Differential effects and generic biases in observational studies. In *Biometrika*, 93(3), pp.573–586.
- Rosenzweig, M. and Wolpin, K. (1994). Are there increasing returns to the intergenerational production of human capital? Maternal schooling and child intellectual achievement. In *The Journal of Human Resources*, 29(2), pp.670-693
- Save the Children. (2009). *Situational Analysis: Early Childhood Development in India*. India, New Delhi: Save the Children.
- Schonemann, P. H. and Steiger, J. H. (1976). Regression component analysis. In *British Journal of Mathematical and Statistical Psychology*, 29, pp.175-189.
- Schultz, T. (1988). Education Investments and Returns. In: H. Chenery and T. Srinivasan, ed., *Handbook of Development Economics Volume 1*. Amsterdam: Elsevier, pp.543 630.
- Schultz, T. (1993). Investments in the schooling and health of women and men: quantities and returns. In *Journal of Human Resources*, 23(4), pp.694-734.
- Shabana, K., Mohhamad, B., Sushil, D., Mahajan, H. and Muneer, M. (2013). A cross sectional study on client satisfaction and utilization of ICDS services in Kashmir Division of Jammu and Kashmir State. In *Indian Journal of Public Health Research and Development*, 4(4), pp.206.
- Shonkoff, J. and Phillips, D. (Eds) (2000). *From Neurons to Neighborhoods: The Science of Early Childhood Development*. Washington D.C., USA: National Academy Press.
- Shonkoff, J. and Richter, L. (2013). The powerful reach of early childhood development: A science-based foundation for sound investment. In: P. Britto, P. Engle and C. Super, ed., *Early Childhood Development Research and its Impact on Global Policy*. Oxford: Oxford University Press, pp.24-34.
- Singh, R. and Bangay, C. (2014). Low fee private schooling in India – More questions than answers? Observations from the Young Lives longitudinal research in Andhra Pradesh. In *International Journal of Educational Development*, 39, pp.142–50.

- Singh, R. and Mukherjee, P. (2015). *Determinants of Successful Completion of Secondary Education: Evidence from Andhra Pradesh*. *Young Lives Working Paper 143*, Oxford: Young Lives.
- Singh, R. and Mukherjee, P. (2016). *Education Trajectories: From Early Childhood to Early Adulthood in India*. Oxford, England: Young Lives.
- Singh, R. and Mukherjee, P. (2017). *Comparison of the Effects of Government and Private Preschool Education on the Developmental Outcomes of Children: Evidence from Young Lives India*. Oxford, England: Young Lives.
- Singh, R. and Mukherjee, P. (2018). Effect of preschool education on cognitive achievement and subjective well-being at age 12: evidence from India. In *Compare: A Journal of Comparative and International Education*, pp.1-19.
- Solon, G. (1999). Intergenerational mobility in the labor market. In: O. Ashenfelter and D. Card, ed., *Handbook of Labor Economics*. Amsterdam: Elsevier Science, pp.1761-1800.
- Streuli, N., Vennam, U. and Woodhead, M. (2011). *Increasing choice or inequality? Pathways through early education in Andhra Pradesh, India*. The Hague, The Netherlands: Bernard van Leer Foundation.
- Strong Foundations: Early Childhood Care and Education. (2006). In *EFA Global Monitoring Report*. Paris: UNESCO.
- Sylva, K., Melhuish, E., Sammons, P., Siraj-Blatchford, I. and Taggart, B. (2011) Pre-school quality and educational outcomes at Age 11: Low quality has little benefit. In *Journal of Early Childhood Research*, 9(2), pp.109-124.
- Todd, P. and Wolpin, K. (2004). On the specification and estimation of the production function for cognitive achievement. In *Economic Journal*, 113(485), pp.F3–33.
- Tooley, J. and Dixon, P. (2003). *Private Schools for the Poor: A Case Study from India*. Reading: CfBT.
- UNESCO (2000). Dakar Framework for Action: Education for All. In *Meeting Our Collective Commitments. World Forum on Education*, Dakar, Senegal, 26-28 April, 2000, UNESCO, Paris.
- United Nations Millennium Development Goals*. (2018). Retrieved from: <http://www.un.org/millenniumgoals>.
- Unterhalter, E. (2007). *Gender, Schooling and Global Social Justice*. New York: Routledge.
- Vennam, U., Komanduri, A., Cooper, E., Crivello, G. and Woodhead, M. (2009). *Early Childhood Education Trajectories and Transitions: A Study of the Experiences and Perspectives of Parents and Children in Andhra Pradesh, India*.
- Woldehanna, T. and Gebremedhin, L. (2012). *The Effects of Pre-school Attendance on the Cognitive Development of Urban Children aged 5 and 8 Years: Evidence from Ethiopia*. Oxford: Young Lives.
- Woodhead, M. (2006). *Changing perspectives on early childhood: theory, research and policy*. Paper commissioned for the EFA Global Monitoring Report 2007, Strong foundations: early childhood care and education.
- Woodhead, M. (2009) *Pathways Through Early Childhood Education in Ethiopia, India and Peru: Rights, Diversity and Equity*. Oxford: Young Lives.
- Woodhead, M., Ames, P., Vennam, U., Abebe, W. and Streuli, N. (2009). *Equity and quality? Challenges for early childhood and primary education in Ethiopia, India and Peru*. Working Paper 55, The Hague: Bernard van Leer Foundation.
- Woolridge, J. (2016). *Introductory Econometrics: A Modern Approach*. 6th ed. Boston: CENGAGE Learning.
- World Inequality Database on Education • India*. (2018). Retrieved from: <https://www.educationinequalities.org/countries/india/#?dimension=all&group=all&year=latest>.
- Yoshikawa, H., and Nieto, A., (2013). Paradigm shifts and new directions in research on early childhood development programs in low and middle income countries. In Britto, P.R., Engle, P.L. and Super, C. (2013), *Handbook of early childhood development research and its impact on global policy* (pp.487-497). Oxford: Oxford University Press.

Young Lives (2017). *Cohort Maintenance – Tracking and Attrition. A Guide to Young Lives Research.* [online] Oxford: Young Lives. Retrieved from: <http://www.younglives.org.uk/sites/www.younglives.org.uk/files/Guide-toYLRResearch-S12-CohortMaintenance.pdf>.

Young Lives Survey Design and Sampling in India. (2014). *Young Lives*. Retrieved from: <https://www.younglives.org.uk/content/young-lives-survey-design-and-sampling-andhra-pradesh-india>.

Young, M. ed., (2007). *Early child development from measurement to action: a priority for growth and equity*. Portland: The World Bank.

Young Lives India. (2018). Retrieved from <https://www.younglives-india.org>.