Early Childhood Education, Parental Social Networks, and Child Development*

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Abstract

We conducted a field experiment involving two early childhood programs in rural Bangladesh over two years, resulting in a rich dataset on parental investment, child outcomes, and social interactions. Our findings show that both programs significantly improved children's cognitive and non-cognitive development. Moreover, we observed spillover effects on children from untreated families in villages where other children received treatment. To understand the mechanisms behind these results, we developed a theoretical model demonstrating that connections between untreated parents and those who received the home visit intervention positively impact the outcomes of untreated children. Consistent with this theoretical prediction, we found that children of untreated families connected to families that received the intervention benefited more from the spillover effects. These novel findings highlight the crucial role of parental social networks in influencing early childhood development by facilitating the exchange of effective parenting practices within communities. Beyond providing policy and theoretical insights, our research design offers a framework for causal inference on other forms of social interaction effects on parental investment and human capital formation.

Keywords: Early childhood education, home visits, parental social networks, spillovers.
JEL Classification codes: D85, I25, O53.

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1 Introduction

The Sustainable Development Goals (SDG 4.2) emphasize the importance of ensuring that all children have access to quality pre-primary education by 2030. Despite the substantial evidence of the benefits of early childhood education (Currie, 2001; Currie and Almond, 2011; Duncan et al., 2023), access remains persistently low in many developing countries. According to UNICEF, more than 175 million children are not engaged in pre-primary education, with only 1 in 5 young children enrolled in low-income countries.[1] This lack of access to early learning opportunities can have long-lasting implications for the cognitive and socioemotional development of children and contribute to broader educational and economic inequalities (Cunha and Heckman, 2007; Grantham-McGregor et al., 2007; Attanasio, 2015). Addressing development gaps through effective early childhood interventions is crucial for promoting equitable child development, in particular, as early investments can enhance the returns of subsequent investments (Cunha and Heckman, 2008; Cunha et al., 2010; Attanasio et al., 2020b,a).

Yet, addressing such gaps goes well beyond simply understanding the treatment effects of programs. Insights from sociology, for example, teach us that our social surroundings hold great import in the formation of human capital (Coleman, 1988; Putnam, 1993; Schuller, 2000; Sheldon, 2002). Importantly, the sociology literature shows that an understanding of the interplay between social interactions and human capital formation holds promise for addressing the opportunity and racial gaps observed in child outcomes.

Our work embraces these relationships to provide insights into both the efficacy of a unique set of early childhood programs as well as the effect of parental social interactions on child outcomes. To induce random variation in parental investment and child outcomes, we design, implement, and evaluate two early childhood programs on children's outcomes and parental investments in rural Bangladesh—a low-resource setting with limited access to formal early childhood education. The design of these programs draws on child development theories and integrated elements from established early childhood initiatives, such as the Perry Preschool program and the Chicago Heights Early Childhood Centre (CHECC) project. The goal of these programs was to nurture a range of skills, ensuring that children are adequately prepared for primary school. Our interventions leverage a cluster randomized controlled trial (RCT) involving roughly 7,000 children across 222 villages.

The first program, the "Preschool program", is a formal pre-school program that provides early education to children on a daily basis. The second program, "Home visit", aims at improving parenting practices via weekly home visits by trained teachers. In addition to evaluating the two programs separately, our research design allows us to assess the effectiveness of combining the pre-school program with home visits, which we do in a third treatment arm. A key feature of our experimental design is that, in the treatment arm concerning the Home visit program, we varied the intensity of the treatment (the share of families receiving the home visits in the village), which enables us to assess possible spillover effects of this program on children of untreated families within these

[1] Source: https://www.unicef.org/education/early-childhood-education.

villages.

Our paper offers several key findings regarding the impact of early childhood interventions in rural Bangladesh. First, we find substantial improvements on measures of cognitive and non-cognitive development for children receiving the interventions, with effect sizes of about 0.5 standard deviations. Interestingly, these improvements are comparable across the two types of interventions, the pre-school and the home-visit program, and no additional benefits were observed when the programs were combined. Furthermore, our heterogeneity analysis indicates that children who initially had weaker outcomes experienced the most significant improvements from the early childhood education programs. The finding that the home-visit program replicates the effects of the preschool program is particularly noteworthy, given that preschool provides additional elements such as social interaction with peers and structured play. The absence of differences in outcomes between the two programs may suggest that these unique elements are less impactful than expected, influence unmeasured domains, or yield benefits that emerge later in life.

A second key area of results relates to the social side of human capital accumulation. We uncover evidence of substantial *spillover effects* within villages assigned to the home visit program, exploiting that in these villages we varied the share of families in our sample receiving this intervention. We find that children from families not directly receiving the intervention also experience improvements in villages where other families are treated (0.2 SD). This suggests the presence of positive externalities potentially mediated through peer effects among children or through parents' social networks.

To provide insights into the social side of human capital formation, we investigate the relatively under-explored idea that *parents' networks* can serve as a crucial channel for disseminating information about effective parenting practices, which, in turn, benefit children's development. To this end, we develop a theoretical model that shows that parents make investment choices around their parenting practices based on their own characteristics and by the average investment effort of other connected parents. Importantly, the model predicts that parents experience more significant spillover effects from treated parents than from untreated ones, which leads to higher education outcomes for their children.

To test these predictions, we generate data on parental social networks within participating villages collected at baseline and investigate whether connections between untreated parents and parents who received the home visit intervention have a positive impact on the outcomes of children of untreated parents. Our results are consonant with the theory, revealing that untreated children whose parents are connected to parents who received the intervention experience greater developmental benefits. More specifically, the impact is higher for the average parental practices of treated families, confirming that spillover effects are stronger from families who have been treated (i.e., received home visits). These novel findings underline the crucial role of parental social networks in influencing children's early childhood development by facilitating the exchange of information regarding effective parenting practices within communities. Furthermore, our results highlight the potential for leveraging parental networks to enhance the spread of beneficial practices and improve

overall developmental outcomes of children.

Our study relates to several important lines of literature. First, we add to the growing literature evaluating early childhood interventions in developing countries (Özler et al. (2018); Dean and Jayachandran (2019); Grantham-McGregor et al. (2020); Andrew et al. (2020); Heckman et al. (2020); Chandra et al. (2021); Araujo et al. (2021); Sylvia et al. (2021); Attanasio et al. (2022a,b); Justino et al. (2022); Andrew et al. (2024); Bos et al. (2024) among others).[2] We provide evidence of substantial developmental gains from early childhood education programs obtained through a large-scale RCT (N=7,000) in a low-resource, rural setting in which formal early childhood education is still underdeveloped. Our findings indicate that, in such contexts, interventions targeting children in preschool settings or parents through home visits are equally effective in enhancing children's cognitive and noncognitive outcomes.

We also show that home visits can generate positive spillover effects on untreated children within the same communities, an idea that has received limited previous attention in contexts similar to ours. While List et al. (2023) provide evidence of neighborhood spillover effects of early childhood interventions, our study takes a further step by measuring parent to parent social ties and using randomization to identify the causal effects of these connections. Moreover, we introduce a theoretical framework to illustrate how these social ties mediate parenting practices, offering a novel perspective on the mechanisms driving spillover effects.

Second, we contribute to the literature on parenting influence on children's education outcomes (Cochran and Brassard, 1979; Agostinelli, 2018; Sheldon, 2002; Boucher et al., 2023; DeGendre et al., 2024).[3] This literature has focused on the various parenting styles and estimated different models of children's accumulation of cognitive and noncognitive skills in response to parental inputs (see e.g., Doepke and Zilibotti, 2017). In particular, Agostinelli et al. (2024) examine the interaction between parents and children where children's skill accumulation depends on both parental inputs and peers, and parents can affect with whom children can interact. Our approach is different but complementary to the existing literature. We focus on how the social networks of parents influence their parenting investment efforts, which, in turn, influence their children's developmental outcomes. This perspective emphasizes the significance of social networks in shaping parental practices and children outcomes, highlighting a crucial, yet often overlooked, dimension of parental influence.

The rest of this paper is organized as follows. The next section presents the background on the context, the early childhood programs and our experimental design. Section 3 describes the data collected and the sample used in our study. Section 4 presents the main impacts of the interventions on children's outcomes, while Section 5 discusses the effects on parenting practices. Section 6 explores the role of parental networks in influencing children's outcomes. Section 7 discusses the costs associated with implementing the early childhood programs. Finally, Section 8 offers some concluding remarks.

[2] See Evans et al. (2024) for a recent systematic review of the evidence of the impact of childcare interventions on children's outcomes in low- and middle-income countries.

[3] See the literature overviews by Doepke et al. (2019), Doepke and Zilibotti (2019), and García and Heckman (2023).

2 Context, programs, and experimental design

2.1 Early childhood education in Bangladesh

In Bangladesh, children start primary school at age 6. The government introduced a one-year pre-primary education program (for children aged 5 and older) in 2014, focusing on developing children's ability to read, write, and memorize. Nearly all government primary schools now offer one year of free pre-primary education (PPE) with the PPE curriculum and textbooks developed by the National Curriculum and Textbook Board (NCTB). Although the government is the largest provider of early childhood education (ECE), non-government providers, including private pre-schools and kindergartens, private religious schools, NGO preschools, and community-based schools, collectively account for almost half of all ECE provision in Bangladesh.

Prior to our intervention, there was no publicly available formal pre-school education for children aged 3 to 5 in Bangladesh. However, some NGOs and private providers offered pre-schooling programs targeting this age group. Despite some improvements, access to pre-primary education (PPE) remains a challenge in Bangladesh, and the country lags behind other countries in South Asia (Bhatta et al., 2020).

There are notable disparities in access to PPE across socioeconomic groups and geographic areas. Children from poorer families are significantly less likely to be enrolled in pre-school or to be in school at all. According to the Household Income and Expenditure Survey (HIES) 2016-17, only 30% of 5-year-olds from the poorest families were enrolled in pre-school. Children from rural areas are also less likely to be enrolled in pre-primary classes. According to the Multiple Indicator Cluster Survey (MICS), in 2012-13, around 80% of children aged 3-5 years who were not attending pre-school or other grades were from rural areas, while the more recent 2019 MICS reports less than 1 in 5 children of 3 to 5-year-old (17.8%) in rural areas are attending PPE.

2.2 The Early Childhood Programs

Our intervention took place in two rural districts of Bangladesh, Khulna and Shatkhira (see Figure A1). The project was conducted in collaboration with the Global Development Research Initiative (GDRI), a local non-government organization (NGO). The intervention targeted 3-5 year old children (36 months to 60 months old in February 2017) and consisted of two early childhood programs: a Preschool program and a Home Visit program. The design of these programs was informed by contemporary child development theories, and incorporated elements from existing early childhood programs, such as the Perry Preschool program and the Chicago Heights Early Childhood Centre (CHECC) project (Fryer et al., 2015, 2020). In addition, the authors (local University teachers who held degrees and specializations in early childhood education) consulted the local curriculum developed by the National Curriculum and Textbook Board (NCTB) and the lesson delivery plan developed by BRAC. They drew on their professional experience in education in Bangladesh to analyze the needs of local children and include context-appropriate content and components. For instance, age-

appropriate life skills, such as maintaining cleanliness, drinking pure water, and practicing healthy sanitation and water safety measure were introduced in the curriculum to prepare children to live and thrive in society. The overarching aim of these programs was to develop a number of age-appropriate skills among children to ensure that their development is balanced with both cognitive and non-cognitive aspects, and thus prepare them for primary school. The intervention spanned 2 years, from February 2017, when the first assessment was carried out until January 2019, when the endline assessment took place (see Figure 2 for a detailed timeline).

Preschool program This program provided early education to children in a formal preschool setting. The preschool centers were established within rented spaces in the village, ensuring adequate facilities and safety measures (e.g., avoiding locations near ponds, lakes, or dense bushes). Each center was set up with careful consideration of the children's safety and comfort.[4]

The curriculum focused on the development of cognitive, social, physical/motor, and emotional abilities, including language, basic numeracy, creativity, and life skills. Educational activities were divided into six sections: physical activities, critical conversations, creative activities, language development and literacy, fundamental play, and math/science. This structure ensured comprehensive development in all necessary areas for children of this age. The curriculum's delivery was participatory, child-centered, and play-based, making attendance at the early childhood care center enjoyable and natural for children. More details about the daily activities in the preschool program are provided in Appendix B.

The curriculum followed a structured approach in which new content was introduced during the first three days of each week over the 9-month period (over 2 years). The remaining two days of the week were dedicated to reinforcing the materials from the initial three days, ensuring continuity and reinforcement of concepts. These materials were developed by local educators from the university, all of whom hold doctorates in education with specializations in early childhood education.

Each day began with daily assembly and exercise and concluded with a session where children were assigned an interesting homework activity. Every fourth week, the content delivered in the previous three weeks was revisited. Every eighth week, children were assessed by caregivers after another review of the content learned in the last seven weeks. Along with the detailed curriculum for each day, a Teachers' Guide was prepared separately for caregivers, which provided specific guidelines on learning content, delivery methods, and assessment procedures.

Children attended the program for 9 months (for two years), 5 days per week (Sunday-Thursday), for 3-4 hours per day. They were taught in groups of 15 by specially trained, locally recruited staff. Each centre had two teachers, with each teacher responsible for a group of 15 children.

Home Visit program This program consisted of weekly visits by teachers to parents' homes to help them enhance the learning environment for their children. These visits reflected the curriculum

[4]At the time of program initiation, there were no specific government regulations governing the establishment of childcare centers in these settings. Nevertheless, our partner NGO secured general approval from the government to run the program across the regions, which allowed us to operate without needing separate permits for each village location.

provided in the formal pre-school setting. A separate toolkit was prepared for teachers by the team who also developed the ECD curriculum and daily routine for the center. This toolkit was designed to align all center activities with the home visit schedule and corresponding activities, ensuring a cohesive approach to the children's development both at the center and at home. The goal was to improve parents' attitudes and behavior towards the development of their children and to increase their knowledge about effective child-rearing practices.

During each visit, teachers engaged both the children and their carers, demonstrating what to learn and how to learn. In addition, parents participated in monthly meetings with other parents in the village. These meetings were exclusively conducted for parents whose children were part of the treatment group. The program spanned 9 months (for two years), with parents attending one session per week, each lasting 2 hours. More details about the contents of the home visit program are provided in Appendix B.

Teachers conducting home visits were informed about activities happening at the centers during their monthly training session and were instructed to teach similar concepts during their visits. The program was also structured to ensure the home visits ran smoothly and effectively. Overall, the home visit program fosters a collaborative environment where parents and teachers work together to support the holistic development of children through structured home visits and engaging activities.

Teachers The teachers were recruited from the local communities and were trained by expert educators to prepare them for teaching the content and providing care for the children in the programs. All teachers were women who had completed at least high school education and had previous experience teaching or tutoring. Teachers were recruited from each village to ensure easy commuting and foster trust among parents who were familiar with them. These teachers had background in tutoring, teaching, or early childhood education. Recruitment was facilitated through local knowledge networks of GDRI, inviting applications from local graduates and selecting candidates based on their education and relevant experience. Given their local origins, they were compensated at a rate of $50 per month.

The recruited teachers underwent training conducted by university educators, some of whom also contributed to curriculum development. At the beginning, they received a comprehensive 5-day training session. Following this, they participated in monthly one-day training sessions focusing on materials, teaching/caregiving methodologies for the upcoming month, and addressing potential parental concerns. These sessions aimed to enhance their effectiveness in dealing with any issues that might arise.

All teachers in both the preschool and home visit programs received identical training, regardless of their specific duties, to ensure they were fully equipped to handle all aspects of their role, including interacting and engaging with parents. This uniform training approach not only ensured consistency in program content and delivery methods but also built sustainable capacity for running early childhood programs in these villages beyond the project's duration, potentially with support or contributions from the villages.

2.3 Experimental design

The project was carried out in 222 randomly selected remote villages in Bangladesh. In each village, we aimed to recruit about 30 households for the study. Randomization was carried out at the village level, and participating villages were randomly assigned to one of the following four treatment arms:

Treatment 1 (T1): Pre-school program. Children attended the Preschool program (40 villages).

Treatment 2 (T2): Home Visit only. Households received the House visit program (60 villages). In this treatment, we varied the number of households that received the treatment within each village, following a random saturation design (Baird et al., 2018). By varying the treatment intensity within a village, we are able to assess potential spillover effects of the program on untreated families. Specifically, in 20 villages, 10 households out of 30 received the treatment; in another 20 villages, 20 households received the treatment; and in the remaining 20 villages, all 30 household received the home visit intervention. Thus, treatment saturation varied between 33% and 100%.

Treatment 3 (T3): Pre-school program & Home Visit. In this treatment, we combined the two programs (40 villages). All children attended the Preschool program for 3 days a week. In addition, parents received a weekly Home visit. Note that as in T2, we varied the intensity of the Home visit intervention within villages.

Control group. Households in these 82 villages did not receive an early childhood intervention. However, they were invited to participate in various community-based events and activities throughout the year to foster engagement and reduce attrition from the program.

Figure 1 provides a summary of the experimental design and Table 1 an overview of how our sample is divided across the treatments, and within treatment between treated and untreated children, when applicable. Note that in T2 and T3, the difference between the number of untreated students (or half treated in the case of T3) and treated students is not very large, as we wanted to ensure that the number of untreated children in treated villages is sufficient to explore spillover effects.

Figure 1: Experimental design

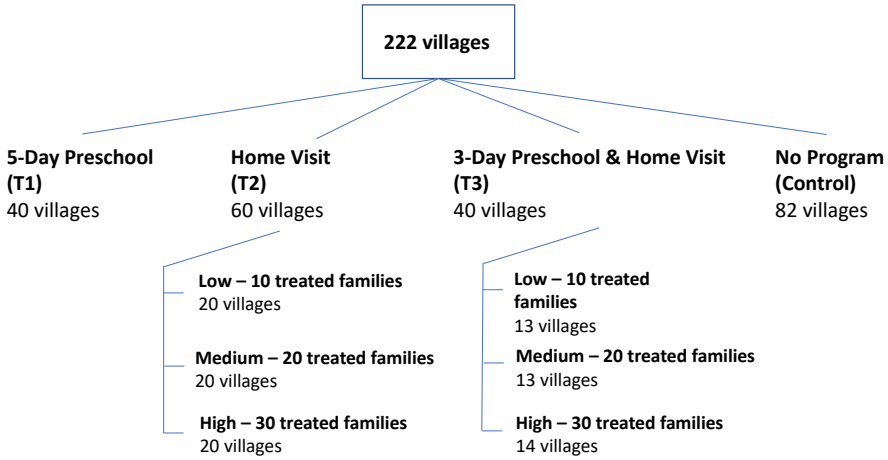


Table 1: Overview of experimental design

	T1	T2	T3	Control	Total
Treated students	1,413	1,118	739	-	3,270
Untreated students	-	771	-	2,222	2,993
Half treated students	-	-	653	-	653
Total	1,413	1,889	1,392	2,222	6,916
Treatment Saturation	100%	59.2%	53.1%		
No. of participated villages	40	60	40	82	222

Notes: In Column T3, treated students refer to children who receive both the Preschool program and the Home Visit program, while half-treated students refer to children who receive the Preschool program only.

Sampling The villages were selected from two districts in southwestern Bangladesh, chosen randomly. Several practical considerations influenced the choice of villages, such as ensuring accessibility during the rainy season, as children needed to commute to the centers in many areas. Subsequently, we identified treatment and control villages from this pool, where preschools could be established or home visits implemented. Note that these villages lacked any formal early childhood centers at the beginning of the intervention. Given the sufficient geographical distance between villages, we randomly chose these 222 villages from a pool of over 1200 villages in these districts.

In the sample villages, we surveyed households with children in the targeted age group who

expressed interest in participating if a program were to be offered. The recruitment process focused on identifying children based on their proximity to the village centers where the programs would be implemented. After determining a suitable central location within each village, we initiated outreach by informing the community and conducting door-to-door visits. Additionally, we leveraged local contacts to identify families with children within the targeted age group. We aimed to recruit about 30 families from each village, prioritizing those that were geographically closer to the center to ensure easy and consistent access for children, regardless of season, along with their parents or caregivers. This approach was essential because road infrastructure within the villages is generally poor, and geographical proximity was a practical way to address potential commuting challenges.[5]

The take-up rate, based on those surveyed, is nearly 100%. During the baseline survey for recruiting households with children in this age group, we did not encounter any households who declined to participate. This high level of participation is normal given that the programs were offered for free and there were no alternative options available.

Randomization We employ a two-stage randomized design. In particular, we first randomly assigned 222 villages into different treatment groups. Then, within villages assigned to two of the treatment groups (T2 and T3), we randomly assigned participating children to either receive treatment or act as a spillover sample (in T2), or to receive both pre-school and home visits or only pre-school (in T3). Note that only one child per participating family was recruited for the study.

3 Data

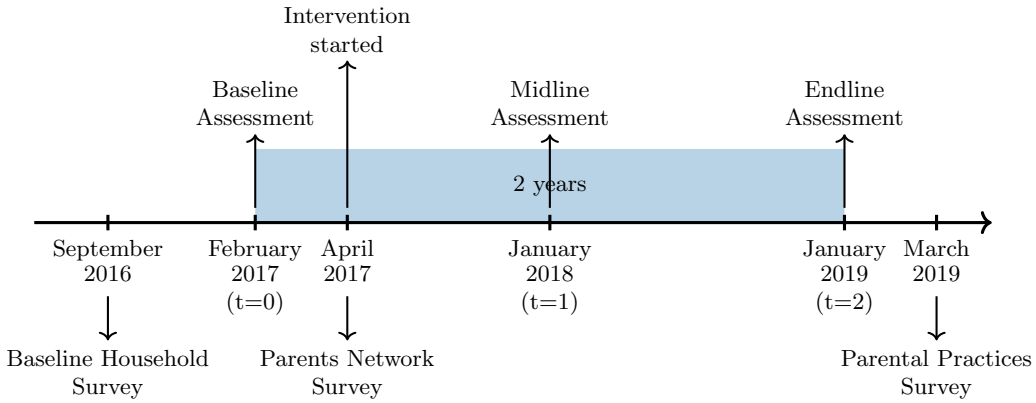
3.1 Measurement of outcomes

To evaluate the intervention, we collected measures of child development along multiple dimensions. The baseline assessment was carried out in February 2017, followed by a midline assessment in January 2018, and an endline assessment in January 2019, nearly two years after the baseline. Figure 2 provides the timeline of the intervention, highlighting when the assessments and other data collection activities took place.

The assessments were carried out by university graduates with degrees in education or related fields, such as psychology or educational psychology. Many assessors had prior experience with early childhood curriculum development or education, which ensured that they were well-equipped to handle the task. The assessments were conducted one-on-one with each child, typically in a familiar setting, either at the child's home or at the program center, depending on convenience and the child's comfort level. Mothers or primary caregivers were often present during these assessments—not to influence the child's responses but to help the child feel more at ease, thereby enabling more accurate and reliable evaluations.

[5]While we acknowledge that this sampling method may not yield a sample fully representative of all children in the villages, the selection of center locations was almost random, primarily based on the availability of a suitable rental space. Therefore, the children enrolled are likely to be similar to other children residing farther from the center.

Figure 2: Timeline



Cognitive skills We measure cognitive skills through Literacy and Numeracy Tests, which are adapted from the Woodcock-Johnson III Tests of Achievement (Woodcock et al., 2001, 2007). The Literacy Test covers basic concepts such as drawing pictures following instructions, oral expression such as describing pictures, and letter-word identification (identifying letter following descriptions. The Numeracy Test includes calculations and math fluency (counting numbers), problem solving and quantitative reasoning that involves language comprehension and simple mathematical calculations in applied problems. See Appendix D for details.

Noncognitive skills We measure noncognitive skills using assessments that include *Something's the Same* and *Operation Span*, which are taken from Blair and Willoughby Measures of Executive Functions (Willoughby et al., 2010, 2012). Something's the Same measures children's attention shifting by asking them to match items based on similarities along different dimensions such as color, shape, size, or type of items (animals, flowers, etc.). Operation Span assesses their working memory by showing them a line drawing of a house with an animal figure and a colored dot inside. The children then see only the outline of the house and are asked which animal and dot were inside. This task requires them to remember two pieces of information at once but focus on only one, overcoming interference from the other (e.g., color). See Appendix D for an example.

Composite scores We construct indices for cognitive and non-cognitive skills that are defined as the equally weighted average of z-scores of their components, a method similar to Kling et al. (2007). Specifically, cognitive skills measure children's academic abilities based on their performance on the Literacy and Numeracy Tests, while non-cognitive skills evaluate children's working memory and attention shifting based on the results from Something's the Same and Operation Span assessments.

ASQ test scores In addition to the indices that measure cognitive and noncognitive skills, we employ the Ages and Stages Questionnaires (ASQ-3) to evaluate children's performance in multiple dimensions. ASQ-3 is a well-recognized and widely-used tool which consists of a series question-

naires designed for caregivers and parents. These questionnaires are typically intended to monitor children's developmental progress before 5.5 years, in areas such as communication, gross and fine motor skills, problem-solving abilities, and personal-social domains. Details and examples for each of these areas can be found in Table A26 in the Appendix.

As can be seen from the descriptions of all the measurement tools in Table A26, there is an overlap between the ASQ performance measures and the indices for cognitive and noncognitive skills. Therefore, we use the ASQ test results as a robustness check for assessing children's intellectual abilities as well as their emotional and social skills. In addition, the ASQ provides a basis for further analysis of the program's impacts on motor skills.

3.2 Other data

Household survey We collected household data prior to the interventions, capturing baseline characteristics of both children and their parents. For children, these characteristics encompass age, gender, and baseline learning outcomes reflecting cognitive and non-cognitive skills. For parents, the data includes the age of both the father and mother, educational attainment (measured in years) for both parents, the father's occupation (whether he is a farmer or a day laborer), and household income.

Parent network data Since one of our research goals is to explore the education spillovers on children through their parents' social networks, our project designed a survey targeting parent-level interactions to identify their social connections. We collected the data prior to the intervention, so that the potential changes in network structure due to the intervention were not involved. Details of the definition of parents' social connections are provided in Section 6.

Survey of parental practices Given the potential influence of family background on children's learning outcomes, we also collected parents' responses to various questions related to their approaches to parenting at the endline. These questions address both practical aspects of care giving and understanding of parenting. Examples include "Did you hug and care for your child yesterday and today?" and "Do you usually criticize your child?". We construct seven indices, with each index defined as the equally weighted average of responses to related questions. These indices encompass: (i) interactions with children (e.g., teaching, singing, dancing, painting, and praying together), (ii) parental perceptions of the child (e.g., whether they perceive them as being incompetent or are frequently irritated by their behavior), (iii) parent-child closeness (e.g., emotional intimacy, mutual trust, and open communication), (iv) parental involvement in the child's learning (e.g., teaching basic calculations, helping them write their names, instilling common decency, and fostering life and social skills), (v) supportive upbringing and caring encouragement (e.g., refraining from criticism, respecting the child's interests, fostering a friendly and open communication style, taking care of the child's emotions, and encouraging the child to express their preferences and dislikes), (vi) food and nutrition (understanding of healthy diets and food safety), as well as (vii) perspectives on parenting

(e.g., encouraging autonomy, instilling discipline, respecting children's choices, fostering independence). In addition, we created a composite index that aggregates these seven measures into an overall summary measure of parenting practices. Summary statistics and the list of survey questions underpinning the indices can be found in Tables A21 and A22 and Section E in the Appendix.

3.3 Descriptive statistics and balance tests

As mentioned above, the baseline household survey was carried out prior to the intervention. Table A1 in the Appendix provides summary statistics of children's and parents' characteristics, along with balance tests. Our sample of children is balanced in terms of gender, with an average age of about 41 months. Parents' ages are approximately 35 for fathers and 27 for mothers. Fathers have an average of 6 years of education, while mothers have about 7 years. In terms of occupation, slightly more than half of the fathers are farmers or day laborers, and the average household income is approximately 12,000 Taka (about $110 USD).

Table A2 reports pairwise comparisons of characteristics across the four treatment arms. Some differences in parents' characteristics emerge, though these differences are economically small, and all these characteristics will be accounted for in the regression analysis.

Table A3 reports balance tests between treated and untreated children in T2, while Table A4 reports balance tests between children selected to receive both programs and those who received only the Home Visit program in T3, respectively. With the exception of age (treated children are older by about one month, on average), no significant differences are observed in any of the remaining characteristics across treated and untreated children.

We also evaluate the balance across the three treatment groups in terms of care-givers' characteristics, such as teaching time, education, marital status, and personal income. Table A6 presents these results, where we see no statistically significant difference between the teachers across different treatments.

3.4 Attrition

Naturally, some children missed the follow-up midline and endline assessments, primarily due to absence on the assessment day. Specifically, out of 6,026 children who attended the 4 tests (Literacy Test, Numeracy Test, Oparation Span, and Something Same) at baseline, 119 (1.97%) have missing test scores at midline, and 287 (4.76%) have missing test scores at endline (see Appendix Table A8). The proportion of children with missing endline test scores is relatively low and similar among control and treatment groups. Moreover, the characteristics of children with missing scores do not differ significantly across treatment groups (see Appendix Table A9).

4 Results

4.1 Impacts on treated children

We start by evaluating the direct effects of the early childhood programs, that is, the impacts on treated children in treated villages. To do so, we estimate the following specification:

$$y_{i,v,t} = \alpha_0 + \beta_1 T1_v + \beta_2 T2_v + \beta_3 T3_v + \gamma y_{i,v,0} + X'_{i,v,t}\delta + \epsilon_{i,v,t}, \quad (1)$$

where $y_{i,v,t}$ is the outcome of child i (measures of cognitive and noncognitive skills), in village v, assessed at time t (baseline, midline—1 year after the baseline, or endline—2 years after the baseline). The treatment indicators $T1_v$, $T2_v$, and $T3_v$ are indicators denoting whether village v was assigned to the pre-school program, the home visit program, or the combined program, respectively. Baseline outcomes ($y_{i,v,0}$) and a range of child and household characteristics ($X_{i,v,t}$), including child gender, child age, father (mother)'s age, father (mother)'s education, father's occupation, household income, and district fixed effect are included as controls.[6] We cluster errors ($\epsilon_{i,v,t}$) at the village level.

To obtain the treatment effects of the interventions on treated children, we estimate Equation (1) in a sample that consists of treated children in treatment villages and all children in control villages. Our key parameters of interest, β_1, β_2, and β_3 capture the impact of the pre-school program, the home visit program, and the combined pre-school plus home visit program, respectively.

Table 2 displays the results. Columns (1) to (3) present results on *cognitive skills*, while Columns (4) to (6) report results on *noncognitive skills*. Several interesting findings emerge.

First, as expected, columns (1) and (4) show that there are no systematic differences across any of the treatment arms at baseline. This provides reassurance that there are no systematic differences in the outcomes of the children ahead of our intervention.

Second, when we assess the impacts on cognitive skills at midline and endline, in columns (2) and (3), we find that the treatment effects are overall larger at the endline compared to the midline. This suggests that prolonged engagement with the interventions leads to progressively greater developmental benefits.

Third, the size of the treatment effects is large, about 0.48 SD, and remarkably similar across $T1$, $T2$ and $T3$. Pairwise tests reported at the bottom of the table indicate that there are no statistically significant differences in the treatment effects across treatment groups. This suggests that pre-school and home-visits are equally effective for the development of children's cognitive skills. The lack of additional benefits from the combined program (T3) suggests that pre-school and home-visits might target overlapping skill domains or that diminishing returns occur when both interventions are deployed simultaneously.

Similar patterns are evident for noncognitive skills, as shown in columns (4) to (6) of Table 2. In this case, we also observe that the improvements increase with the duration of the programs. At the endline, the improvements are around 0.5 SD, and the treatment effects are again indistinguishable

[6] We explore robustness of our key results to exclusion of baseline outcomes in Appendix Tables A11 and A16.

across treatments.

Given that our study involves three different treatments and two outcome measures, it is necessary to adjust for multiple hypothesis testing (List et al., 2019). We address this issue by calculating family-wise adjusted p-values using the step-down procedure described by Westfall and Young (1993). The statistical significance of the treatment effects on both cognitive and non-cognitive skills remains robust when employing family-wise adjusted p-values to account for multiple hypothesis testing.

The improvements of each aspect of cognitive skills (that is, literary and numeracy) and noncognitive skills (that is, working memory and attention shifting) are reported in Table A12 in the Appendix. For cognitive skills, the magnitude of the effects is bigger for literacy while, for noncognitive skills, attention shifting shows the most improvement.

The effect sizes of the programs considered here are large but comparable to similar early childhood interventions (e.g., Justino et al. (2022)).

Table 2: Impacts on treated children

	Cognitive skills			Noncognitive skills		
	Pre	Mid	End	Pre	Mid	End
	(1)	(2)	(3)	(4)	(5)	(6)
T1	0.008	0.282***	0.487***	-0.005	0.238***	0.515***
	(0.050)	(0.041)	(0.049)	(0.047)	(0.037)	(0.046)
	[1.00]	[0.00]	[0.00]	[1.00]	[0.00]	[0.00]
T2	-0.012	0.247***	0.481***	0.006	0.148***	0.543***
	(0.050)	(0.043)	(0.053)	(0.057)	(0.042)	(0.052)
	[1.00]	[0.00]	[0.00]	[1.00]	[0.01]	[0.00]
T3	-0.026	0.234***	0.480***	0.005	0.139***	0.563***
	(0.051)	(0.048)	(0.047)	(0.048)	(0.042)	(0.046)
	[0.97]	[0.00]	[0.00]	[1.00]	[0.01]	[0.00]
$y_{i,v,0}$		0.265***	0.158***		0.169***	0.108***
		(0.016)	(0.014)		(0.015)	(0.016)
Obs.	5,391	5,289	5,080	5,391	5,289	5,080
$T1 = T2$	0.712	0.426	0.918	0.838	0.039	0.593
$T1 = T3$	0.528	0.224	0.897	0.818	0.022	0.320
$T2 = T3$	0.791	0.802	0.991	0.986	0.844	0.707
$T1 = T2 = T3$	0.816	0.574	0.991	0.966	0.032	0.607

Notes: The sample includes all treated children in T1, T2, and T3 and all children in control group. Column (1) and (4) include the children who have results for the 4 composite scores at baseline. Column (2) and (5) include the children who have results for 4 composite scores at midline, in addition to baseline. Column (3) and (6) include the children who have results for 4 composite scores at endline, in addition to baseline and midline. The specification also includes the following controls: child gender, child age, dummy that indicates if father is a farmer or day laborer, household income, and district fixed effect. ***p$<$ 0.01, **p$<$ 0.05, *p$<$ 0.1 using conventional inference (i.e., not adjusting for multiple outcomes). Family-wise p-values (Westfall and Young, 1993) reported in square brackets are estimated using 1000 bootstraps. Standard errors are clustered at village level.

Do Home Visits improve the outcomes of children attending Preschool? So far, the comparison of treatment effects across $T1$, $T2$ and $T3$ suggests that the positive impacts of pre-school and home visits on children's outcomes are very similar. Our experimental design offers an alternative way to investigate how these two programs interact by focusing on children in $T3$ villages. Recall that in $T3$, every treated child was offered the pre-school program. In addition, a randomly selected subset was also offered the home visit program. In other words, treated children in $T3$ either received both programs (fully-treated) or were offered only the pre-school program (half-treated). Therefore, we can evaluate whether home visits confer any added-value for children attending preschool by comparing the outcomes of fully-treated and half-treated children.

Table 3 presents the results on a sample that includes children in $T3$ and children in the control arm as a reference group. For cognitive skills, we see that the treatment effect on fully-treated children is slightly larger than that on half-treated in both mid-line and end-line (columns 2 and 3). However, a pairwise test indicates that there is no statistically significant difference between the two types of children. In line with this evidence, we find that there is also no significant difference between treatment effects on fully and half-treated children on noncognitive skills (columns 5 and 6).

These findings reinforce the conclusion stated above that the preschool and home visit programs achieve similar improvements in both children's cognitive and noncognitive skills, with no evidence that home visits offer supplementary benefits for children already exposed to a preschool program.

There are various possible reasons for why the combined treatment (T3) does not offer additional benefits over T1 and T2. First, the intensity of T3 is not a simple combination of T1 and T2. Children in T3 attend preschool for three days a week, compared to five days a week in T1, and they receive shorter home visits than those in T2. Second, both T1 and T2 individually lead to substantial gains in children's cognitive and non-cognitive skills. It is possible that these improvements are approaching the maximum benefit achievable within the measured domains, resulting in a "ceiling effect" that limits the potential for additional gains from the combined treatment. Finally, the skills emphasized in the preschool program may already be addressed effectively through the home visits, leaving little additional room for the combined treatment to create added impact.

Heterogeneity Next, we investigate whether these positive impacts vary based on children's and household characteristics. Specifically, we analyze potential heterogeneity in the effects by examining child gender, baseline learning performance, household income, and maternal education level. The results of this analysis are presented in Table A15 in the Appendix.

The findings reveal no statistically significant difference in the learning gains concerning both cognitive and noncognitive skills by child's gender, indicating that early childhood education programs yield benefits for children irrespective of gender. We also find that children with weaker academic foundations exhibit greater gains from the intervention (T1 to T3) in both cognitive and noncognitive skills, as compared to their peers who started with stronger learning performance. Furthermore, we observe an overall trend of more significant progress for children coming from

Table 3: Impacts on fully and half-treated children in T3

	Cognitive skills			Noncognitive skills		
	Pre	Mid	End	Pre	Mid	End
	(1)	(2)	(3)	(4)	(5)	(6)
Fully-treated (FT)	-0.041	0.274***	0.495***	-0.023	0.159***	0.580***
	(0.056)	(0.057)	(0.051)	(0.055)	(0.051)	(0.051)
	[0.78]	[0.00]	[0.00]	[0.91]	[0.02]	[0.00]
Half-treated (HT)	0.001	0.187***	0.467***	0.048	0.112**	0.551***
	(0.060)	(0.053)	(0.051)	(0.056)	(0.051)	(0.048)
	[0.98]	[0.01]	[0.00]	[0.76]	[0.15]	[0.00]
$y_{i,v,0}$		0.244***	0.156***		0.139***	0.076***
		(0.019)	(0.020)		(0.021)	(0.022)
Obs.	3,105	3,043	2,917	3,105	3,043	2,917
FT = HT	0.462	0.130	0.519	0.201	0.421	0.472

Notes: The sample includes all the children in T3 (Preschool + Home Visit) and all the children in control group. Column (1) and (4) include the children who have results for the 4 composite scores at baseline. Column (2) and (5) include the children who have results for 4 composite scores at midline, in addition to baseline. Column (3) and (6) include the children who have results for 4 composite scores at endline, in addition to baseline and midline. Fully-treated refers to the children that receive both preschool session and home visit. Half-treated refers to the children that receive preschool sessions only. The specification also includes the following controls: child gender, child age, dummy that indicates if father is a farmer or day laborer, household income, and district fixed effects. ***p$<$ 0.01, **p$<$ 0.05, *p$<$ 0.1 using conventional inference (i.e., not adjusting for multiple outcomes). Family-wise p-values (Westfall and Young, 1993) reported in square brackets are estimated using 1000 bootstraps.

economically disadvantaged families (defined as below-median household income), as opposed to those from more financially secure households. These two findings highlight the positive impacts of early childhood education programs for children experiencing academic and social-economic disadvantages. Finally, regarding maternal education, our results suggest that children whose mothers are more educated (have completed primary education) tend to experience stronger developmental gains in non-cognitive skills, echoing patterns reported in Özler et al. (2018).

4.2 Spillover effects

Spillovers on untreated children in $T2$. Given the evidence of clear positive impacts of the home visit program on treated children, we next turn our attention to evaluating whether this program had spillover effects on untreated children within $T2$ villages. To this end, we estimate Equation (1) on a subsample that consists of untreated children in treatment villages ($T2$) and all the children in control villages. By comparing the outcomes of untreated children in villages where some children received treatment ($T2$) to those in villages where no children received treatment (C), we can measure any indirect benefits, or spillovers, that the untreated children might receive from the presence of treated children in their village. These spillovers could occur through various channels. For example, untreated children might benefit from playing and interacting with treated children who may have improved behaviors or skills. Additionally, parents in households that receive home visits could share effective practices with other parents in the village, thus benefiting untreated children indirectly. We explore this potential mechanism in more detail in Section 6.

Table 4 presents estimates of the spillover effects of the home visit program on untreated children. Columns (1) and (4) display the children's outcomes prior to the intervention, where we see no systematic differences. In line with the pattern observed regarding treatment effects on treated children in Table 2, the size of the spillover effect is overall greater at the endline compared to the midline for both cognitive skills (0.138 SD at midline and 0.218 at endline) and noncognitive skills (0.097 at midline and 0.236 at enline). The spillover effects on the different components of cognitive and noncognitive skills are shown in Table A18. Moreover, Table A19 presents estimates of the spillovers in the home visit treatment by saturation level, from which we note that the size of the spillovers increases with treatment saturation.

One might consider that the intensity of treatment, when assessing spillovers, could be influenced by the proportion of treated households relative to the total number of eligible households in the village. To address this concern, we include the total number of eligible children in the village as a control variable in our analysis (see Appendix Table A17). The results indicate that the estimated spillover effects do not differ substantially.

To summarize, we find that both pre-school sessions and home visits yield substantial improvements for the children who *directly* receive the treatment. In addition, the home visit program generates significant *spillovers* to untreated children who live in treated villages.

Table 4: Spillover effects of home visits on outcomes of untreated children

	Cognitive skills			Noncognitive skills		
	Pre	Mid	End	Pre	Mid	End
	(1)	(2)	(3)	(4)	(5)	(6)
T2	-0.009	0.138**	0.218***	-0.002	0.097**	0.236***
	(0.060)	(0.052)	(0.066)	(0.062)	(0.044)	(0.062)
	[0.97]	[0.03]	[0.01]	[0.97]	[0.09]	[0.00]
$y_{i,v,0}$		0.268***	0.204***		0.175***	0.078***
		(0.025)	(0.025)		(0.023)	(0.022)
Obs.	2,475	2,429	2,327	2,475	2,429	2,327

Notes: The sample includes untreated children in T2 (Home Visit) and all the children in control group. Column (1) and (4) include the children who have results for the 4 composite scores at baseline. Column (2) and (5) include the children who have results for 4 composite scores at midline, in addition to baseline. Column (3) and (6) include the children who have results for 4 composite scores at endline, in addition to baseline and midline. The specification also includes the following controls: child gender, child age, dummy that indicates if father is a farmer or day laborer, household income, and district fixed effects. ***p$<$ 0.01, **p$<$ 0.05, *p$<$ 0.1 using conventional inference (i.e., not adjusting for multiple outcomes). Family-wise p-values (Westfall and Young, 1993) reported in square brackets are estimated using 1000 bootstraps. Standard errors are clustered at village level.

Spillover effects on siblings and cousins. Another type of possible spillover effect associated with these early childhood programs are the possible indirect impacts on the siblings and cousins of treated children. These siblings and cousins, while not direct recipients of the treatment, live in an environment that may be influenced by the interventions. It is important to note that the cousins considered in our study live within the same household as the treated children, which is typical in the rural areas of Bangladesh where extended families tend to live under one roof. Thus, despite not being the treated child's biological siblings, their shared living environment functionally equates them to siblings. For brevity in the subsequent sections, the term "siblings" encompasses both biological siblings and cousins.

When assessing spillover effects on siblings, we follow the approach in Carneiro et al. (2023) and compare the outcomes of siblings in treated villages to those of siblings in control villages.[7] The spillover effects on siblings for each treatment arm are presented in Table 5. We observe significant positive effects on siblings, in terms of both cognitive and noncognitive skills, across all treatments. Compared to siblings in the control group, the cognitive skill improvement for siblings is 0.398 SD in T1, 0.302 SD in T2 and 0.353 in T3, and the noncognitive skill improvement for siblings is 0.372 SD in T1, 0.361 SD in T2 and 0.376 in T3. Pairwise t-tests indicate that no significant difference exists in the size of these impacts on siblings across treatments, which aligns with the patterns found in the direct treatment effects on treated children in Table 2.

[7] We present balance checks on baseline characteristics of siblings in Table A7 in the Appendix. The siblings' individual- and household-level characteristics at baseline are generally balanced.

Table 5: Spillover effects on siblings and cousins at endline

	Cognitive skills	Noncognitive skills
T1	0.398***	0.372***
	(0.066)	(0.072)
	[0.00]	[0.00]
T2	0.302***	0.361***
	(0.085)	(0.081)
	[0.00]	[0.01]
T3	0.353***	0.386***
	(0.081)	(0.092)
	[0.00]	[0.00]
Obs.	1,305	1,305
$T1 = T2$	0.284	0.896
$T1 = T3$	0.589	0.881
$T2 = T3$	0.610	0.809
$T1 = T2 = T3$	0.552	0.971

Notes: The sample includes the siblings and cousins of all children who have the 4 learning outcomes at endline. The specification also includes the following controls: child gender, child age, dummy that indicates if father is a farmer or day laborer, household income, and district fixed effect. ***p< 0.01, **p< 0.05, *p< 0.1 using conventional inference (i.e., not adjusting for multiple outcomes). Family-wise p-values Westfall and Young (1993), reported in square brackets are estimated using 1000 bootstraps. Standard errors are clustered at village level.

4.3 ASQ results

We examine the robustness of our results concerning both the impacts of the interventions on treated children and spillovers on untreated children by employing an alternative measure of children's outcomes, the ASQ-3. As previously highlighted in Section 3, the ASQ-3 is widely used to monitor children's developmental progress, covering similar domains to the cognitive and noncognitive indices we use in our baseline analysis.

Table 6 and Table 7 present the results for the treatment effects on treated children and spillovers effects on untreated children, respectively. The sample includes children for whom we have information on both cognitive and noncognitive indices, as well as ASQ-3 test scores. Consistent with our previous findings on the direct effects concerning both cognitive and noncognitive skills, we observe statistically significant improvements across all treatment arms when using the overall ASQ test scores. Effect sizes are sizeable, reaching or even exceeding 0.4 SD, and statistically indistinguishable across treatments.

For spillover effects on untreated children, the results indicate positive impacts on ASQ-3 test scores in both midline (0.16 SD) and endline (0.11 SD), however, only the midline effect is statistically significant.

We next investigate the impacts on each component of ASQ test. Table A14 in the Appendix

presents the effects on each component for treated children, revealing that all treatment arms generate substantial improvements across all components including gross motor, fine motor, language, problem solving and personal social skills. In terms of spillovers, Table A20 in the Appendix indicates improvements on language and problem solving at endline. It is noteworthy, that the language and problem solving components overlap with the cognitive and noncognitive indices, reinforcing the patterns observed in these two indices.

Table 6: Direct effects on learning outcomes measured by ASQ scores

	Cognitive skills			Noncognitive skills			ASQ scores		
	Pre	Mid	End	Pre	Mid	End	Pre	Mid	End
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
T1	0.001	0.279***	0.489***	0.015	0.226***	0.514***	0.003	0.283***	0.388***
	(0.048)	(0.042)	(0.052)	(0.047)	(0.037)	(0.048)	(0.061)	(0.050)	(0.051)
T2	-0.017	0.262***	0.491***	0.007	0.135***	0.549***	0.003	0.253***	0.365***
	(0.049)	(0.045)	(0.055)	(0.057)	(0.045)	(0.051)	(0.064)	(0.053)	(0.053)
T3	-0.015	0.240***	0.483***	0.003	0.133***	0.571***	0.006	0.273***	0.437***
	(0.050)	(0.047)	(0.049)	(0.048)	(0.043)	(0.047)	(0.059)	(0.054)	(0.055)
$y_{i,v,0}$		0.267***	0.167***		0.167***	0.104***		0.160***	0.146***
		(0.016)	(0.015)		(0.016)	(0.016)		(0.015)	(0.014)
Obs.	4,876	4,776	4,578	4,876	4,776	4,578	4,876	4,776	4,578
$T1 = T2$	0.589	0.882	0.645	0.709	0.044	0.557	0.983	0.515	0.647
$T1 = T3$	0.623	0.773	0.953	0.415	0.035	0.849	0.892	0.257	0.342
$T2 = T3$	0.971	0.710	0.678	0.526	0.968	0.712	0.884	0.683	0.184
$T1 = T2 = T3$	0.832	0.924	0.884	0.716	0.044	0.838	0.986	0.522	0.398

Notes: The sample includes all treated children in T1, T2, and T3 and all children in control groups. Column (1), (4) and (7) include the children who have results for the 4 composite scores and ASQ scores at baseline. Column (2), (5) and (8) include the children who have results for 4 composite scores and ASQ scores at midline, in addition to baseline. Column (3), (6) and (9) include the children who have results for 4 composite scores and ASQ results at endline, in addition to baseline and midline. The specification also includes the following controls: child gender, child age, dummy that indicates if father is a farmer or day laborer, household income, and district fixed effects. ***p$<$ 0.01, **p$<$ 0.05, *p$<$ 0.1. Standard errors are clustered at village level.

Table 7: Spillover effects on learning outcomes (T2) measured by ASQ scores

	Cognitive skills			Noncognitive skills			ASQ scores		
	Pre	Mid	End	Pre	Mid	End	Pre	Mid	End
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
T2	0.005	0.145***	0.223***	0.023	0.0967**	0.232***	0.0425	0.160**	0.107
	(0.060)	(0.054)	(0.070)	(0.062)	(0.046)	(0.064)	(0.067)	(0.064)	(0.069)
$y_{i,v,0}$		0.277***	0.210***		0.173***	0.0803***		0.131***	0.168***
		(0.0251)	(0.0260)		(0.0236)	(0.0243)		(0.0233)	(0.0244)
Obs.	2,258	2,213	2,120	2,258	2,213	2,120	2,258	2,213	2,120

Notes: The sample includes all treated children T2 (Home visit), and all children in control groups. The specification also includes the following controls: child gender, child age, dummy that indicates if father is a farmer or day laborer, household income, and district fixed effects. ***p$<$ 0.01, **p$<$ 0.05, *p$<$ 0.1. Standard errors are clustered at village level.

5 Mechanisms: Impacts on parental practices

Having documented substantial positive impacts of the interventions on children's outcomes, we now turn to the role of parental practices as a potential mechanism for these impacts. Given the significant influence parents have on children's development, we investigate how parental perspectives and practices on effective upbringing may change, whether through direct interactions during home visit sessions or conversations with their children about their experiences in the pre-school sessions.

To this end, we construct seven indices (see Section E in the Appendix for details), which we use to assess whether the interventions have altered parental practices in treated households relative to control households. We also construct an overall index of parental practices, which is an average of the underlying seven sub-indices.

Table 8 reports results on parental practices. Column (1) indicates that all treatments resulted in increases in overall parental investments at the endline. Among the treatments, we observe that home visits (T2) exert a stronger influence on parents than the early childhood or the combined program. The equality tests at the bottom of the table show that the difference between T2 and T1 is statistically significant (p-value = 0.002), while the difference between T2 and T3 is not (p-value = 0.102). This greater impact on parental practices observed in T2 compared T1 could be attributed to the fact that T2 incorporates home visits, a more direct form of parent communication, in contrast to T1 which exclusively focuses on pre-school sessions. Looking across the individual components, the largest improvements occur in "Interactions with child", "Food and nutrition", and "Positive parenting".

Table 8: Improvements on parent's investment for parents of treated children

	(1) Overall measure	(2) Interactions with child	(3) Closeness with child	(4) Perception of child	(5) Involvement in child's learning	(6) Supportive upbringing	(7) Food & nutrition	(8) Positive parenting
T1	0.361***	0.348***	0.101*	0.093	0.211**	0.124*	0.283***	0.219***
	(0.057)	(0.104)	(0.0516)	(0.068)	(0.099)	(0.071)	(0.037)	(0.071)
T2	0.550***	0.577***	0.141***	0.225***	0.290***	0.247***	0.338***	0.339***
	(0.053)	(0.074)	(0.051)	(0.061)	(0.073)	(0.0652)	(0.032)	(0.064)
T3	0.474***	0.419***	0.157***	0.180***	0.280***	0.221***	0.293***	0.285***
	(0.060)	(0.102)	(0.0595)	(0.069)	(0.0992)	(0.068)	(0.041)	(0.072)
Obs.	4,897	4,897	4,897	4,897	4,897	4,897	4,897	4,897
T1=T2	0.002	0.035	0.463	0.064	0.444	0.124	0.110	0.103
T1=T3	0.102	0.589	0.377	0.261	0.581	0.237	0.805	0.418
T2=T3	0.220	0.124	0.799	0.507	0.919	0.730	0.225	0.465

Notes: The sample includes all treated children in T1, T2, and T3 and all children in control groups who have results for the 4 composite scores at baseline, midline and endline, as well as their parental investment information. All parental outcome indices are standardized relative to control households. The specification also includes the following controls: child gender, child age, dummy that indicates if father is a farmer or day laborer, household income, and district fixed effects. ***p< 0.01, **p< 0.05, *p< 0.1. Standard errors are clustered at village level.

Next, we examine whether there are spillovers on the parental investment of parents of untreated children within T2 villages, which received the home visit treatment. In Table 9, we see that the

parental practices of untreated families also improve significantly. This finding indicates that home visits can effectively enhance parents' perspectives on child-rearing, not only for treated families but also for untreated families through spillover effects. In the next section, we delve into whether parents networks can mediate these spillover effects by facilitating the spread of information and practices related to child-rearing within communities and thus further amplify the benefits of the intervention.

Table 9: Improvements on parent's investment for parents of untreated children in T2

	(1) Overall measure	(2) Interactions with child	(3) Closeness with child	(4) Perception of child	(5) Involvement in child's learning	(6) Supportive upbringing	(7) Food & nutrition	(8) Positive parenting
T2	0.582***	0.652***	0.115**	0.278***	0.385***	0.246***	0.313***	0.315***
	(0.055)	(0.081)	(0.057)	(0.059)	(0.080)	(0.073)	(0.045)	(0.069)
Obs.	2,232	2,232	2,232	2,232	2,232	2,232	2,232	2,232

Notes: The sample includes all untreated children in T2 (Home visit), and all children in control group who have results for the 4 composite scores at baseline, midline and endline, as well as their parental investment information. All parental outcome indices are standardized relative to control households. The specification also includes the following controls: child gender, child age, dummy that indicates if father is a farmer or day laborer, household income, and district fixed effects. ***p< 0.01, **p< 0.05, *p< 0.1. Standard errors are clustered at village level.

6 Do parent social networks influence the outcomes of children?

6.1 A theoretical framework

In order to gain more intuition about the mechanisms at work, let us develop a simple theoretical model building on the framework in Ballester et al. (2006), Calvó-Armengol et al. (2009), and Boucher et al. (2024).

6.1.1 Benchmark model

Consider a finite set of students $\mathcal{N} = \{1, \ldots, n\}$ and a finite set of parents $\mathcal{P} = \{1, \ldots, n\}$, where each student has exactly one parent such that $|\mathcal{N}| = |\mathcal{P}| = N$. We keep track of social connections *between parents* in network $\mathbf{g}$ through its adjacency matrix $\mathbf{G} = [g_{ij}]$, where $g_{ij} = 1$ if nodes i and j ($i \neq j$) are connected and $g_{ij} = 0$ otherwise. We assume that $g_{ii} = 0$. Thus, $\mathbf{G}$ is a zero-diagonal symmetric square matrix. We can define the *row-normalized* network $\widetilde{\mathbf{g}}$, whose adjacency matrix is $\widetilde{\mathbf{G}} = [\widetilde{g}_{ij}]$. Each element is given by $\widetilde{g}_{ij} := g_{ij}/d_i$, where $d_i = \sum_{j=1}^{j=n} g_{ij}$ is the degree (number of links) of parent i.

Parents embedded in the parental network $\mathbf{g}$ decide how much parental investment (or simply effort) to put in their child's education (see Table 10 for the definition of parental investment in our dataset). We denote by $p_{i,v,t}$ the parental effort level of parent i in village v at time t. Let $\mathbf{p}_{v,t} = (p_{1,v,t}, ..., p_{n,v,t})'$ be the vector of parental effort profiles. Each parent i selects an effort level $p_{i,v,t} \geq 0$, aiming to maximize their payoff $U_i(\mathbf{p}_{v,t}, \mathbf{g})$ that depends on the effort profile $\mathbf{p}_{v,t}$ and on

the underlying parental network $\mathbf{g}$ in the following way:

$$U_{i,v,t}(\mathbf{p}_{v,t}, \mathbf{g}) = \underbrace{\left(\alpha_0 + \pi^p_{i,v,t} + \beta \sum\nolimits_{j \in \mathcal{P}} \widetilde{g}_{ij} p_{j,v,t}\right) p_{i,v,t}}_{\text{payoff}} - \underbrace{\tfrac{1}{2}\left(p_{i,v,t}\right)^2}_{\text{cost}}, \tag{2}$$

where $\alpha_0 > 0$ is a positive constant, $\pi^p_{i,v,t} := X^p_{i,v,t}\delta + \varepsilon^p_{i,v,t}$ corresponds to the observable ($X^p_{i,v,t}$) and unobservable ($\varepsilon^p_{i,v,t}$) characteristics of parent i, and $\beta \geq 0$.[8] This utility function has a standard cost-payoff structure. The marginal payoff is given by $\alpha_0 + \pi^p_{i,v,t} + \beta \sum_{j=1}^n \widetilde{g}_{ij} p_{j,v,t}$. The parameter $\beta \geq 0$ is the *spillover* coefficient, which captures strategic complementarities in parental investment. Observe that $\bar{p}_{-i,v,t} = \sum_{j=1}^n \widetilde{g}_{ij} p_{j,v,t}$ is the *average* investment of parents who are directly connected to parent i. The cost part of the utility function (2) is a *direct* cost of exerting effort given by $\frac{1}{2}\left(p_{i,v,t}\right)^2$. The first-order condition leads to the following expression for parental effort:

$$p_{i,v,t} = \alpha_0 + \beta\, \bar{p}_{-i,v,t} + X^p_{i,v,t}\delta + \varepsilon^p_{i,v,t}. \tag{3}$$

Let us now define the education production function of child i. For simplicity, we abstract from the child's own effort and focus on the impact of parent i's investment effort on their child's educational outcomes.[9] The education production function of student i is then given by:

$$y_{i,v,t} = p_{i,v,t} + \pi^c_{i,v,t}, \tag{4}$$

where $y_{i,v,t}$ represents the education outcome of child i, that is, the cognitive or non-cognitive skills of child i, and $\pi^c_{i,v,t}$ captures the *exogenous heterogeneity* of child i's "productivity" in education activities. The term $\pi^c_{i,v,t}$ is defined as:

$$\pi^c_{i,v,t} = \gamma y_{i,v,0} + X^c_{i,v,t}\delta + \varepsilon^c_{i,v,t}, \tag{5}$$

where, as in the empirical analysis, $y_{i,v,0}$ is the baseline education outcome measured at $t = 0$ (cognitive and noncognitive skills), $X^c_{i,v,t}$ denotes the child's observable characteristics, and $\varepsilon^c_{i,v,t}$ is an error term. By plugging (3) and (5) into (4), and denoting $\varepsilon_{i,v,t} := \varepsilon^p_{i,v,t} + \varepsilon^c_{i,v,t}$ and $X_{i,v,t} := X^c_{i,v,t} + X^p_{i,v,t}$ (the observable characteristics of both children and parents), we obtain:

$$y_{i,v,t} = \alpha_0 + \beta\, \bar{p}_{-i,v,t} + \gamma y_{i,v,0} + X_{i,v,t}\delta + \varepsilon_{i,v,t}. \tag{6}$$

In other words, the education outcomes of child i depend on their baseline education outcome $y_{i,v,0}$, observable characteristics $X_{i,v,t}$, which include both the characteristics of the children $X^c_{i,v,t}$ and those of their parents $X^p_{i,v,t}$, and the average investment $\bar{p}_{-i,v,t}$ of the parents to whom child i's parents are connected.

[8] The superscripts p and c stand for "parent" and "child", respectively.

[9] While abstracting from peer effects between children for simplicity, it is straightforward to incorporate them into this framework.

6.1.2 Treated versus untreated children

Consistent with our experimental design, the populations of children and parents are (exogenously) divided between treated (T) and untreated (NT) children and parents, i.e., $\mathcal{N} = \{1, \ldots, n\} = \mathcal{N}^T + \mathcal{N}^{NT}$ and $\mathcal{P} = \{1, \ldots, n\} = \mathcal{P}^T + \mathcal{P}^{NT}$. Denote by $\mathbf{G}^{Inter} = \left[g_{ij}^{Inter}\right]$ the adjacency matrix representing only the *inter-type links* between parents, that is, only links between treated (T) and untreated (NT) parents. Similarly, denote by $\mathbf{G}^{Intra} = \left[g_{ij}^{Intra}\right]$ the adjacency matrix representing only the *intra-type links*, which include links between treated (T) and other treated (T) parents, as well as links between untreated (NT) parents and other untreated (NT) parents. Obviously, $\mathbf{G}^{Inter} + \mathbf{G}^{Intra} = \mathbf{G}$, where $\mathbf{G}$ is the full adjacency matrix of all connections. For simplicity and without loss of generality, we order the parents/children such that the first n^T rows of the $\mathbf{G}$ matrix correspond to the type$-T$ parents/children and the last n^{NT} rows correspond to the type$-NT$ parents/children, with $n = n^T + n^{NT}$.

Using (2), the utility function of treated and untreated parents is given by:

$$U_{i,v,t}^{T}(\mathbf{p}_{v,t}, \mathbf{g}) = \left(\alpha_0^T + \pi_{i,v,t}^{p}\right) p_{i,v,t}^{T} - \frac{1}{2}\left(p_{i,v,t}^{T}\right)^2 + \frac{\beta}{d_i}\left[\theta \sum_{j=1}^{n} g_{ij}^{Intra} p_{i,v,t}^{T} p_{j,v,t}^{T} + \sum_{j=1}^{n} g_{ij}^{Inter} p_{i,v,t}^{T} p_{j,v,t}^{NT}\right], \tag{7}$$

$$U_{i,v,t}^{NT}(\mathbf{p}_{v,t}, \mathbf{g}) = \left(\alpha_0^{NT} + \pi_{i,v,t}^{p}\right) p_{i,v,t}^{NT} - \frac{1}{2}\left(p_{i,v,t}^{NT}\right)^2 + \frac{\beta}{d_i}\left[\sum_{j=1}^{n} g_{ij}^{Intra} p_{i,v,t}^{NT} p_{j,v,t}^{NT} + \theta \sum_{j=1}^{n} g_{ij}^{Inter} p_{i,v,t}^{NT} p_{j,v,t}^{T}\right], \tag{8}$$

where $\theta > 1$, $\beta^T = \beta\theta > 0$ and $\beta^{NT} = \beta > 0$. Indeed, this specification implies that the spillover effects from treated parents are *stronger* than from untreated parents, that is, the intensity of the spillover effects from treated and untreated parents are $\beta\theta$ and β, respectively, with $\beta\theta > \beta$, since $\theta > 1$.

6.1.3 Parental investment equilibrium

The best-reply functions for the treated and untreated parents are respectively given by

$$p_{i,v,t}^{T} = \alpha_0^T + \beta\, \bar{p}_{-i,v,t}^{T} + X_{i,v,t}^{p}\delta + \varepsilon_{i,v,t}^{p}, \tag{9}$$

$$p_{i,v,t}^{NT} = \alpha_0^{NT} + \beta\, \bar{p}_{-i,v,t}^{NT} + X_{i,v,t}^{p}\delta + \varepsilon_{i,v,t}^{p}, \tag{10}$$

or, equivalently,

$$p_{i,v,t}^{T} = \alpha_0^T + \beta\theta\, \frac{\sum_{j=1}^{n} g_{ij}^{Intra} p_{j,v,t}^{T}}{d_i} + \beta\, \frac{\sum_{j=1}^{n} g_{ij}^{Inter} p_{j,v,t}^{NT}}{d_i} + \pi_{i,v,t}^{p}, \tag{11}$$

$$p_{i,v,t}^{NT} = \alpha_0^{NT} + \beta\, \frac{\sum_{j=1}^{n} g_{ij}^{Intra} p_{j,v,t}^{NT}}{d_i} + \beta\theta\, \frac{\sum_{j=1}^{n} g_{ij}^{Inter} p_{j,v,t}^{T}}{d_i} + \pi_{i,v,t}^{p}. \tag{12}$$

In matrix form, we have

$$\mathbf{p}_{v,t} = \boldsymbol{\alpha_0} + \boldsymbol{\pi}^{\boldsymbol{p}}_{\boldsymbol{v,t}} + \beta \mathbf{A}^{Intra}\mathbf{D}\mathbf{G}^{Intra}\mathbf{p}_{v,t} + \beta \mathbf{A}^{Inter}\mathbf{D}\mathbf{G}^{Inter}\mathbf{p}_{v,t},$$

where

$$\mathbf{D} = \begin{pmatrix} 1/d_1 & 0 & \dots & 0 \\ 0 & 1/d_2 & \dots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \dots & 1/d_n \end{pmatrix}, \quad \mathbf{A}^{Intra} = \begin{pmatrix} \theta & 0 & \dots & 0 \\ 0 & \theta & \dots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \dots & 1 \end{pmatrix}, \quad \mathbf{A}^{Inter} = \begin{pmatrix} 1 & 0 & \dots & 0 \\ 0 & 1 & \dots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \dots & \theta \end{pmatrix}.$$

Observe that $\mathbf{D}$ is a diagonal matrix where on the diagonal (cell (i,i)), we have the inverse of the degree of i, that is, $1/d_i$. $\mathbf{A}^{Intra}$ is a diagonal matrix where, on the diagonal, the first n^T rows have a θ while the remaining n^{NT} rows have a 1. For $\mathbf{A}^{Inter}$, it is exactly the opposite, that is, on the diagonal, the first n^T rows have a 1 while the remaining n^{NT} rows have a θ. Denote by $\mu_1(\mathbf{A})$, the largest eigenvalue of matrix $\mathbf{A}$. We have the following result:

Proposition 1. *If* $\beta\mu_1\left(\mathbf{A}^{Intra}\mathbf{D}\mathbf{G}^{Intra} + \mathbf{A}^{Inter}\mathbf{D}\mathbf{G}^{Inter}\right) < 1$*, the parent's peer effect game has a unique interior Nash equilibrium in pure strategies given by:*

$$\mathbf{p}_{v,t} = \left(\mathbf{I} - \beta\mathbf{A}^{Intra}\mathbf{D}\mathbf{G}^{Intra} - \beta\,\mathbf{A}^{Inter}\mathbf{D}\mathbf{G}^{Inter}\right)^{-1}\left(\boldsymbol{\alpha_0} + \boldsymbol{\pi}^{\boldsymbol{p}}_{\boldsymbol{v,t}}\right). \tag{13}$$

Proof: We need to show that $\mathbf{I} - \mathbf{B}$ is non-singular (i.e. invertible), where $\mathbf{B} \equiv \beta\mathbf{A}^{Intra}\mathbf{D}\mathbf{G}^{Intra} - \beta\,\mathbf{A}^{Inter}\mathbf{D}\mathbf{G}^{Inter}$. We know that $\mathbf{I}-\mathbf{B}$ is non-singular if $\beta\mu_1\left(\mathbf{A}^{Intra}\mathbf{D}\mathbf{G}^{Intra} + \mathbf{A}^{Inter}\mathbf{D}\mathbf{G}^{Inter}\right) < 1$ (see, e.g., Meyer (2000), page 618). The interiority of the solution is straightforward since we assumed that $\alpha_0 > 0$ and $\pi^p_{i,v,t} > 0$, for all i. ∎

6.2 Testing the main prediction of the model

Our model makes a key prediction: the educational investment effort of a parent is positively influenced by the average investment effort of their treated connections. This prediction is captured by equation (12). Denoting $\alpha_0 := \alpha_0^{NT}$ and $\beta' := \beta\theta$, this equation can be written as

$$p^{NT}_{i,v,t} = \alpha_0 + \beta\,\bar{p}^{NT}_{-i,v,t} + \beta'\,\bar{p}^{T}_{-i,v,t} + X_{i,v,t}\delta + \varepsilon_{i,v,t}, \tag{14}$$

where $\bar{p}^{NT}_{-i,v,t} := \left(\sum_{j=1}^{n} g^{Intra}_{ij} p^{NT}_{j,v,t}\right)/d_i$ is the average parental practices of untreated families and $\bar{p}^{T}_{-i,v,t} := \left(\sum_{j=1}^{n} g^{Inter}_{ij} p^{T}_{j,v,t}\right)/d_i$ is the average parental practices of treated families.

To test this prediction, we leverage data on parental social networks collected prior to the intervention. This enables us to explore whether social ties between treated and untreated parents serve as a mechanism behind these spillovers. We focus on T2 villages (60 villages in total) where some children were treated while others were not, allowing us to construct parent social networks between treated and untreated families.

Definition of parent network connections The network survey contained questions to gauge the level of interaction between each pair of participating families within a village. This included questions about whether households borrow money from each other and if they seek help from one another when a family member falls ill. We used these responses to establish network links among families, following a similar methodology as in (Banerjee et al., 2013, 2024).[10] Specifically, we defined parents from families i and j in village v as linked, i.e., $g_{ij,v} = 1$, if either family answered "yes" to at least one of the following questions: (1) Would you borrow 100 Taka from them if needed? and (2) Would you ask them for help if someone from your family got sick?[11]

Empirical results The results from the estimation of Equation (14) are presented in Table 10. The analysis reveals a positive correlation between the investments of connected families, including both treated and untreated groups. As predicted by the model, the effect is more pronounced in treated families compared to untreated ones (i.e., $\beta' := \beta\theta > \beta$), although the difference is not statistically significant for the overall measure. These findings support the idea that effective parental practices are transmitted from treated to untreated families within village communities.

Table 10: Parental Investment: Associations between connected parents

	(1) Overall measure	(2) Interactions with child	(3) Closeness with child	(4) Perception of child	(5) Involvement in child's learning	(6) Supportive upbringing	(7) Food & nutrition	(8) Positive parenting
$\bar{p}^{T}_{-i,v,t}$	0.226**	0.179**	0.140**	0.246*	0.212**	0.211***	0.158*	0.339***
	(0.087)	(0.085)	(0.060)	(0.124)	(0.081)	(0.072)	(0.084)	(0.060)
$\bar{p}^{NT}_{-i,v,t}$	0.132*	0.162	0.052	0.225**	0.415***	0.218**	0.348***	0.381***
	(0.067)	(0.099)	(0.103)	(0.086)	(0.075)	(0.103)	(0.075)	(0.078)
Constant	-0.355	2.104*	-0.886	-0.955	-0.730	-1.108	0.746	-0.0150
	(0.854)	(1.168)	(1.006)	(0.769)	(0.824)	(1.020)	(0.583)	(0.804)
$\bar{p}^{T}_{-i,v,t} = \bar{p}^{NT}_{-i,v,t}$	0.433	0.915	0.05	0.91	0.00	0.01	0.162	0.741
Obs.	520	520	520	520	520	520	520	520

Notes: The sample includes all untreated children in T2 (Home visit) who have results for the 4 composite scores at baseline, midline and endline, as well as their parental investment information. All parental investment indices are standardized relative to control households. The specification also includes the following controls: child gender, child age, dummy that indicates if father is a farmer or day laborer, household income, and district fixed effects. ***p< 0.01, **p< 0.05, *p< 0.1. Standard errors are clustered at village level.

6.3 Impact on the educational outcomes of children

Given that parents' networks play a key role in transmitting good parental practices, we seek to investigate whether this has an impact on children's outcomes. Specifically, we aim to determine if the education production function of untreated children is influenced by the treated parents who are connected to the untreated parents of the child in question.

[10] Houndetoungan et al. (2023) explore the factors influencing network formation in this parent network dataset, with a particular focus on the role of children's gender.

[11] As a sensitivity check, we employ an additional measure of social connection: "Did you visit his house last month?" The results, presented in Table A24 in the Appendix, are consistent with our primary findings.

Spillovers effects on untreated children via parents' network To examine whether parents' networks impact the outcomes of untreated children, we focus on untreated children's exposure to treatment through their parents' connections with treated families. We measure this exposure by the number of treated families that child i's parents have a direct link with. Specifically, for a child i in village v, exposure to treatment via parents' network for $i \in NT$ and $j \in T$, is defined as $N^T_{i,v,0} = \sum_{j=1}^{n} g_{ij,v,0}$. Table A23 in the Appendix presents summary statistics for the variable $N^T_{i,v,0}$, showing that the median number of links to treated families is 4. Figure A3 in the Appendix plots the density of $N^T_{i,v,0}$.

To assess the spillover effects on children through their parents' social connections, we estimate the following specification:

$$y_{i,v,t} = \alpha_0 + \phi N^T_{i,v,0} + \lambda N^{total}_{i,v,0} + \gamma y_{i,v,0} + X_{i,v,t}\delta + \varepsilon_{i,v,t}, \tag{15}$$

where $N^{total}_{i,v,0}$ denotes the total number of families, regardless of treatment status, that child i's family has a direct link with. We are interested in the coefficient ϕ, capturing the impact of the number of links with treated families on the outcomes of untreated children. Given that in T2, treated students are randomly selected, we expect that, conditional on the total number of links, the number of links to treated families is random. This randomization allows for causal identification of the impact of the number of links to treated families on the outcomes of untreated students (Borusyak and Hull, 2023). A similar identification strategy has been used to identify spatial spillover effects of interventions, see for example, Miguel and Kremer (2004), Oster and Thornton (2012), and List et al. (2023). The specification also includes baseline outcomes $y_{i,v,0}$, as well as children and parent characteristics $X_{i,v,t}$. The standard errors are clustered at the village level.

Empirical results The results of the estimation of equation (15) are presented in Table 11. We find that family ties have a positive impact on cognitive skills at midline but not on noncognitive skills. At the endline, impacts are detectable on both skill domains. Specifically, each link is associated with an improvement of 0.026 SD for cognitive skills and 0.037 SD for noncognitive skills. This implies that the spillover effect for a family with a median number of links is 0.10 SD for cognitive skills and 0.15 SD for noncognitive skills. Given that the overall impact of the home visit program on untreated children is about 0.2 SD for both cognitive and noncognitive skills (see Table 4), these findings suggest that parental networks contribute significantly to these observed spillover effects.

This analysis provides empirical evidence that social interactions among parents is a crucial mechanism for transferring knowledge of educational practices obtained through the home visit program.

Table 11: Impact of parent networks on outcomes of untreated children

	Pre		Mid		End	
	(1) Cognitive	(2) Noncognitive	(3) Cognitive	(4) Noncognitive	(5) Cognitive	(6) Noncognitive
$N^{T}_{i,v,0}$	0.024	0.011	0.018*	-0.007	0.026*	0.037**
	(0.018)	(0.017)	(0.011)	(0.016)	(0.014)	(0.016)
$N^{total}_{i,v,0}$	-0.002	-0.001	-0.004	0.006	0.006	0.008
	(0.013)	(0.011)	(0.007)	(0.008)	(0.009)	(0.011)
$y_{i,v,0}$			0.334***	0.234***	0.263***	0.087***
			(0.048)	(0.039)	(0.042)	(0.030)
Constant	-3.725***	-2.992**	-2.013*	-1.483	-2.964**	-0.769
	(0.948)	(1.203)	(1.000)	(0.953)	(1.185)	(1.078)
Observations	623	623	607	607	573	573

Notes: The sample includes untreated children in T2 (Home Visit). Column (1) and (4) include the children who have results for the 4 composite scores at baseline. Column (2) and (5) include the children who have results for 4 composite scores at midline, in addition to baseline. Column (3) and (6) include the children who have results for 4 composite scores at endline, in addition to baseline and midline. The specification also includes the following controls: child gender, child age, dummy that indicates if father is a farmer or day laborer, household income, and district fixed effects. ***p<0.01, **p<0.05, *p<0.1. Standard errors are clustered at village level.

7 Costs of the early childhood programs

In this section, we consider the costs associated with each of the three early childhood programs that we evaluate in this study. The currency unit used below is USD.

The preschool program (T1) was implemented across 40 villages. Two caregivers were assigned to each preschool, collectively catering to 30-40 children. Caregivers received a monthly compensation of $50. Additional expenses included center rental fees ($15 per month/centre), a one-time setup expenditure of $250 per center, and a monthly maintenance cost of $5 per center over nine months for two years.

The home visit program (T2) was implemented in 60 villages, with varying levels of treatment intensity ranging from 10 to 30 households per village. Caregivers conducting home visits also received a monthly compensation of $50, with each tasked with visiting 10 children weekly. In addition, each caregiver received an additional $5 monthly for commuting expenses.

Treatment 3 (T3), which combined the Preschool and Weekly Home Visit Programs, was implemented in 40 villages. This hybrid model entailed three days of preschool activities, supplemented by a weekly home visit in each family by a caregiver in the remaining two days of the week. In T3, caregivers conducted hour-long home visits, attending to 10 children over those two days. Their commuting costs for the home visits were also covered similarly to those in T2. In T3, caregivers received an average monthly compensation of $50, varying between $40 and $60 depending on the number of students included in the home visits for each caregiver.

In summary, for T1 and T3, expenditures encompassed salaries, rental fees, a one-time center setup cost, and monthly centre maintenance costs during the operation of the projects (9 months

each year over 2 years). T2 involved similar salary costs for caregivers with additional commuting expenses (also present in T3), but did not involve setting up the pre-school centre or pre-school operating cost.

T1 covered 1413 children in 40 villages, while T3 covered 1392 children in 40 villages, and T2 included 1118 students from 60 villages. Therefore, the average cost per village was $2,500 for T1, $1890 for T2, and $2,590 for T3. When examining per-child expenses, T1 cost $70.8, T3 cost $74.4, and T2 cost $101.4. The per-child cost in T2 was approximately 40% higher than T1, reflecting increased expenses associated with longer home visits, including commuting and a more individualized approach. The marginally higher cost in T3 compared to T1 reflects the combined resources of 3 days of pre-schooling and shorter, 1 hour home visits, indicating a more integrated yet slightly more expensive model.

There are also additional costs related to training and curriculum development. As mentioned, all teachers underwent an initial 5-day intensive training followed by a monthly day-long training session. The trainers, highly qualified and recruited from local university faculties of education, were compensated for their time in training and developing the training manual. All teachers were trained on the same days, with different sections of the training focusing specifically on either home visits or early childhood centers. The total training costs, including venue hires, transportation, and logistics (e.g., food, snacks, etc.), amounted to $45,000. These costs were equally shared across treatment arms on a pro-rata basis depending on the number of teachers in each treatment. In addition, local educational experts and university teachers specializing in early childhood education developed the curriculum. We paid them a total of $60,000 for developing the curriculum for both programs. Since this is a one-time fixed cost, it will not need to be incorporated in scaling up the program. We allocated this cost across treatment arms in the same way as the training cost. Combining training and curriculum development costs, we spent $750 per center/area, which is equivalent to approximately $21.50 per student in T1 and T3, and $42.25 per student in T2. Including these costs, the per-student total costs in T1, T2, and T3 are $92, $142, and $96, respectively.

Overall, considering both impact and cost per student, we can conclude that while all three interventions generate similar impacts on early childhood development outcomes, T1 and T3 offer more cost-effective solutions per child compared to T2. This suggest that integrating pre-school with home visits (as we do in T3) might provide the best balance of cost and comprehensive early childhood education. However, scalability considerations may favor T2 despite its higher per-child cost, as the potentially higher risk of failure at scale for T1 might justify the investment in T2. T1 faces challenges associated with vertical scaling, such as a decline in teacher quality as schools expand. On the other hand, the reliance on parental involvement and potential spillovers in T2 may help sustain its effectiveness at scale.

Following Kremer et al. (2013), we compare the cost-effectiveness of our intervention ($74.4 per child in the case of T3) with other early childhood development programs in similarly disadvantaged contexts. Appendix Table A25 summarizes the costs and impacts of other studies that evaluated early childhood development programs. Although not directly comparable in terms of content and

design, our intervention is one of the most cost-effective early childhood development programs recently implemented in developing countries. Our estimates indicate that for every $100 spent in the combined program (T3), our intervention could achieve improvements of 0.63 SD in literacy, 0.65 SD in numeracy, 0.65 SD in cognitive skills and 0.62 SD in child development measured by ASQ scores.

8 Conclusion

This paper provides an evaluation of two early childhood programs in rural Bangladesh using a large-scale RCT in a setting where formal early childhood education is still underdeveloped. Our interventions include a Preschool program offering formal daily pre-school education, and a Home visit program focused on enhancing parenting practices through weekly teacher visits to parents' homes. We find that both programs significantly improve children's cognitive and non-cognitive skills, with effect sizes of approximately 0.5 standard deviations. When comparing the two treatments, their impacts appear similar in size, suggesting that in contexts where formal early childhood provision might not be feasible, home visits can serve as a valuable alternative. Despite the preschool offering additional elements such as peer interaction and structured play, our results suggest that these components may have less immediate impact than anticipated, may influence unmeasured areas, or their benefits could emerge later in life.

We also find significant spillover effects on untreated children in villages with the home visit program, indicating positive externalities through peer interactions among children and the dissemination of effective parenting practices within the community. Our findings highlight the critical role of *parental social networks* in transmitting good parenting practices and fostering child development. Children from untreated families who were connected to families receiving the intervention experienced greater developmental benefits, illustrating how information about effective parenting can spread through community networks.

These results emphasize the importance of considering parental networks when designing early childhood programs. Given the evidence of spillover effects, researchers should focus on identifying areas where a critical mass of parents can generate positive externalities. Targeting these networks in the design and randomization of interventions could enhance their reach and impact (Islam et al., 2024; Alan and Kubilay, forthcoming, 2024; Airoldi and Christakis, 2024). This is an avenue we plan to explore in future research.

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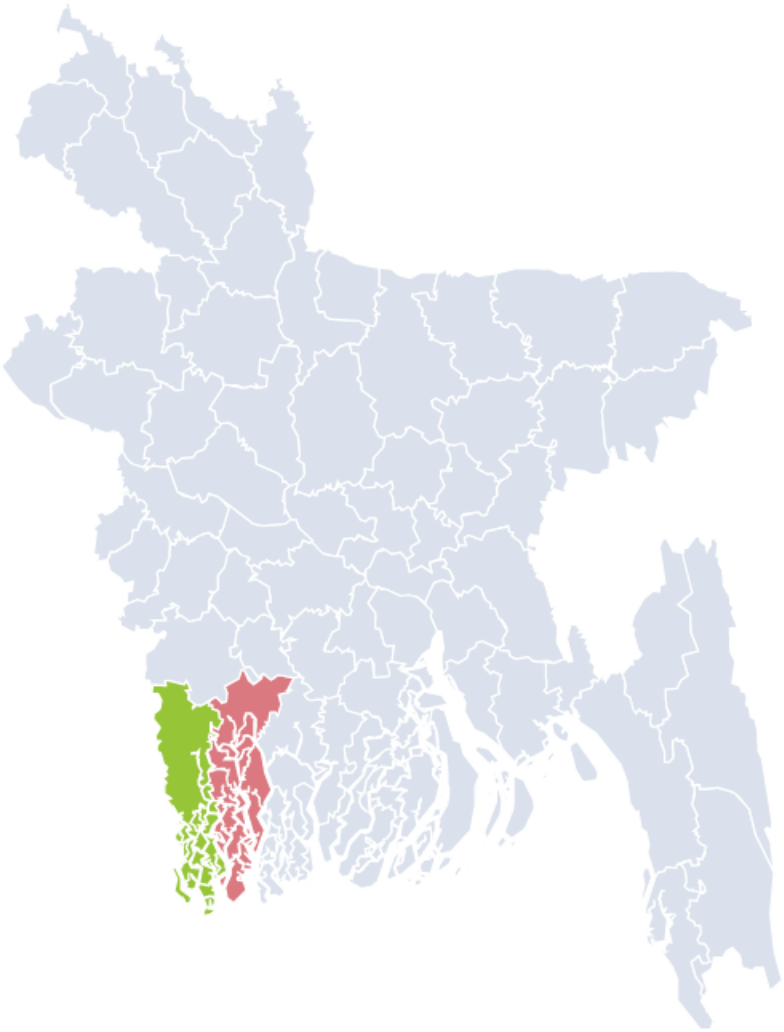
Appendix

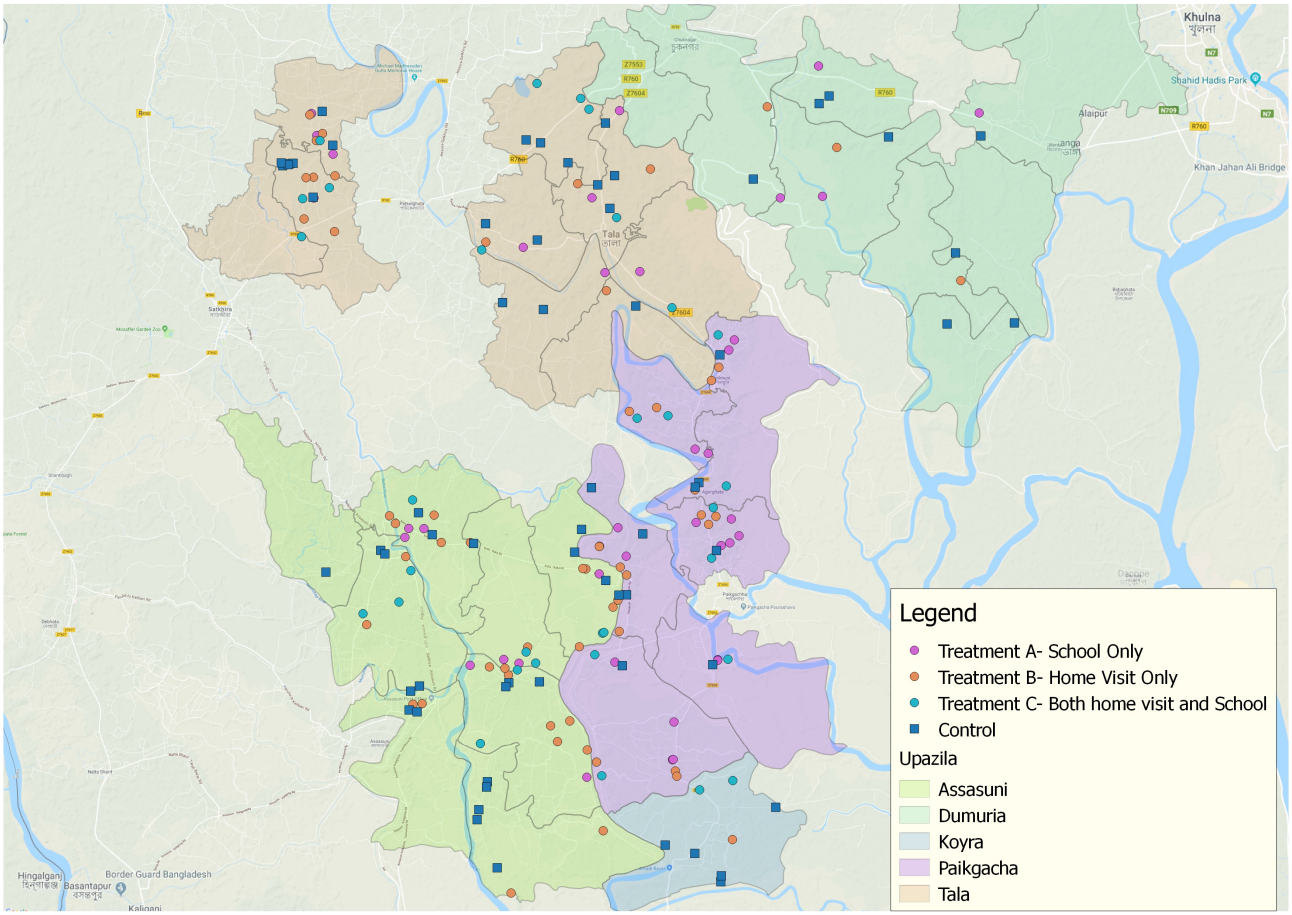
A Maps

Figure A1: Location of the program



Note: The ECD project took place in two districts: Satkhira (green color) and Khulna (red color).

Figure A2: Map of the participating villages



Note: The participating villages are randomly selected from two districts: Satkhira and Khulna.

B Details about the Early Childhood Programs

B.1 Pre-school program

Daily Routine: A typical day at the centre involved the following activities with the children:

***Daily Assembly and Exercise*:** This 20-minute warm-up session involves children socializing, meeting, and greeting each other. They line up for free-hand physical exercises and sing the national anthem in chorus. The session ends with a group discussion under the theme "know ourselves," helping children understand their identity, family, and environment.

***Critical Conversations*:** This 20-minute session focuses on socio-emotional development. Children respond thoughtfully to questions designed to develop self-regulation and critical thinking skills. It helps them organize their thoughts, express their opinions independently, and build confidence in peer interactions.

***Morning Infrastructure Meetings/Life Skills/Creative Activity*:** A 30-minute session aimed at developing life skills for navigating the natural environment and modern society. Each week, students acquire specific skills useful for daily life. The session also fosters creativity through arts and crafts, singing, and dancing.

***Literacy and Language*:** This 30-minute session aims to develop language skills, divided into two parts focusing on Bangla and English. Activities include singing rhymes, reading stories, role play, and interactive exercises, helping children build an age-appropriate vocabulary bank.

***Fundamental Play and Free Play*:** This session is divided into two parts. In the first half, children engage in theme-based play guided by their carer, which strengthens cognitive, social, and emotional skills, as well as fine and gross motor skills. It ensures that students experience self-regulation and cooperation while playing with others and develop social skills such as teamwork, respect for others, and patience. The second half is for free play, where children play at their own pace, practicing social skills and engaging in imaginative play to enhance their creativity.

***Maths, Science, and Environment*:** This 35-minute session is dedicated to developing an elementary understanding of science and numeracy. It encourages children to think like scientists and mathematicians, and develop problem-solving skills by relating their learning to everyday life. Content is delivered through interactive and joyful activities, helping children understand the world beyond their center.

B.2 Home visit program

Some particular aspects of the home visit program include:

***Story Pack*:** Teachers coordinate with parents to schedule home visits, bringing a Story Pack filled with rhymes, storybooks, materials, and toys. Over a week, parents read the stories and engage in related activities with their child.

***Let's Play Together*:** Teachers demonstrate how everyday activities and local games can stimulate learning, raising parental awareness of the educational value of play. These sessions aimed to foster collaboration between teachers and parents, enhancing the child's cognitive development.

***Playing at Home*:** Teachers engage in songs, games, and storytelling with the child and parents. They discuss the child's progress and preferences, suggesting ways parents can support their child's learning. Teachers provide materials that parents can borrow to continue the activities.

***Story Library*:** A story library is established to encourage reading and play at home. Teachers assist parents in storytelling, involving the child in creative activities related to the stories. Story Packs are kept at home for a week to facilitate repeated engagement with the materials.

***Parent-Teacher Discussions*:** Regular discussions between parents and teachers at the beginning and at the end of each weekly session to provide a platform for sharing the child's preferences, development, and any concerns. These conversations help the teacher tailor educational approaches and strengthen the parent-teacher relationship, ensuring a cohesive support system for the child's growth.

C Additional figures and tables

C.1 Balance checks

Table A1: Summary Statistics

	T1 (1)	T2 (2)	T3 (3)	Control (4)
Panel A: Children characteristics and learning outcomes at baseline:				
Child gender	0.51	0.51	0.48	0.51
Child age	41.22	41.02	40.92	40.87
Cognitive skills	0.09	0.03	0.01	0.04
Noncognitive skills	0.03	0.00	0.01	0.01
Obs.	1238	1683	1265	1840
Panel B: Parent characteristics:				
Father age	34.50	33.89	33.86	34.48
Mother age	27.28	26.92	26.63	27.35
Father education	6.21	5.76	5.81	6.05
Mother education	7.14	6.61	6.89	6.88
Father farmer/day laborer	0.51	0.54	0.57	0.58
Household income	12,606	12,429.33	12,202.35	11,979.41
Obs.	1218	1661	1240	1819

Notes: The sample includes all children who have the 4 learning outcomes at baseline. Columns (1) to (4) show the mean value in each group. Child gender is a dummy that equals to 1 for girls, and 0 for boys. Child age refers to the age in month at baseline. Father (Mother) age is the age in year at baseline. Father (Mother) education is the number of years of education. Father farmer/day laborer is a dummy that equals to 1 if father is a farmer or day laborer, and 0 if not. Household income is the monthly household income in Taka. ***p$<$ 0.01, **p$<$ 0.05, *p$<$ 0.1.

Table A2: Balance checks

	T1=T2 (1)	T1=T3 (2)	T2=T3 (3)	T1=C (4)	T2=C (5)	T3=C (6)
Panel A: children' characteristics and learning outcomes at baseline:						
Child gender	0.436	0.239	0.629	0.772	0.584	0.318
Child age	0.451	0.307	0.705	0.164	0.491	0.840
Cognitive skills	0.088	0.043	0.628	0.162	0.689	0.388
Noncognitive skills	0.422	0.498	0.915	0.419	0.957	0.951
Panel B: Parents' characteristics:						
Father age	0.010	0.012	0.905	0.932	0.007	0.009
Mother age	0.084	0.002	0.113	0.711	0.018	0.000
Father education	0.006	0.025	0.728	0.315	0.045	0.138
Mother education	0.000	0.070	0.029	0.040	0.024	0.915
Father farmer/day laborer	0.246	0.005	0.060	0.001	0.015	0.753
Household income	0.492	0.113	0.362	0.010	0.056	0.348

Notes: The sample includes all children who have the 4 learning outcomes at baseline. Each column shows the respective p-value of two-sample t-test, e.g., Column (6) shows that the mean of T3 equals to the mean of Control. Child gender is a dummy that equals to 1 for girls, and 0 for boys. Child age refers to the age in month at baseline. Father (Mother) age is the age in year at baseline. Father (Mother) education is the number of years of education. Father farmer/day laborer is a dummy that equals to 1 if father is a farmer or day laborer, and 0 if not. Household income is the monthly household income in Taka. ***p<0.01, **p<0.05, *p<0.1.

Table A3: Balance checks: treated and untreated children in T2

	Treated children (1)	Untreated children (2)	T=U (3)
Panel A: Children characteristics and learning outcomes at baseline:			
Child gender	0.48	0.52	0.117
Child age	41.26	40.62	0.064
Cognitive skills	0.05	0.00	0.331
Noncognitive skills	0.02	-0.02	0.338
Obs.	1,048	635	
Panel B: Parent characteristics:			
Father age	33.94	33.80	0.643
Mother age	27.02	26.77	0.347
Father education	5.63	5.93	0.190
Mother education	6.53	6.75	0.229
Father_farmer/day laborer	0.540	0.529	0.659
Household income	12550.73	12227.57	0.378
Obs.	1,037	624	

Notes: The sample includes children that have 4 learning outcomes at baseline in T2. Column (3) shows the p-value that the population means of treated children (T) are equal to the mean of untreated children (UT). Child gender is a dummy that equals to 1 for girls and 0 for boys. Child age refers to the age in months at baseline. Father (Mother) age is the age in years at baseline. Father (Mother) education is the number of years of education. Father farmer/day laborer is a dummy that equals 1 if the father is a farmer or day laborer, and 0 if not. Household income is the monthly household income in Taka. ***p<0.01, **p<0.05, *p<0.1.

Table A4: Balance checks: fully treated and half treated children in T3

	Fully Treated children (1)	Half treated children (2)	FT=HT (3)
Panel A: Children characteristics and learning outcomes at baseline:			
Child gender	0.49	0.49	0.944
Child age	41.50	40.24	0.003
Cognitive skills	0.03	-0.01	0.409
Noncognitive skills	0.00	0.01	0.873
Obs.	684	581	
Panel B: Parents' characteristics:			
Father age	33.78	33.96	0.604
Mother age	26.60	26.66	0.813
Father education	5.82	5.80	0.899
Mother education	6.86	6.94	0.685
Father_farmer/day laborer	0.570	0.572	0.924
Household income	12012.77	12423.04	0.241
Obs.	667	573	

Notes: The sample includes all children in T3 that have 4 learning outcomes at baseline. Column (3) shows the p-value that the population means of fully treated children (FT) are equal to the mean of half treated (HT) children. Child gender is a dummy that equals to 1 for girls, and 0 for boys. Child age refers to the age in months at baseline. Father (Mother) age is the age in years at baseline. Father (Mother) education is the number of years of education. Father farmer/day laborer is a dummy that equals to 1 if the father is a farmer or day laborer, and 0 if not. Household income is the monthly household income in Taka. ***p$<$ 0.01, **p$<$ 0.05, *p$<$ 0.1.

Table A5: Balance checks: untreated children in T2, half-treated children in T3 and control

	UT in T2 (1)	HT in T3 (2)	Control (3)	UT=HT=C (4)
Panel A: children' characteristics and learning outcomes at baseline:				
Child gender	0.52	0.49	0.51	0.528
Child age	40.62	40.24	40.87	0.137
Cognitive skills	0.00	-0.01	0.04	0.377
Noncognitive skills	-0.02	0.01	0.01	0.711
Obs.	635	581	1,840	
Panel B: Parents' characteristics:				
Father age	33.79	33.96	34.48	0.036
Mother age	26.77	26.66	27.35	0.005
Father education	5.93	5.79	6.05	0.457
Mother education	6.74	6.93	6.88	0.599
Father_farmer/day laborer	0.53	0.57	0.58	0.108
Household income	12227.57	12423.04	11979.41	0.332
Obs.	624	573	1,819	

Notes: The sample includes untreated children in T2, half-treated children in T3, and all children in the control group who have 4 learning outcomes at baseline. Column (4) shows the p-value of the test that the population means of these groups are equal. One-way Anova tests are conducted to compare the group means for continuous variables. Chi-square tests are conducted to compare the group means for indicator variables. Child gender is a dummy that equals to 1 for girls, and 0 for boys. Child age refers to the age in months at baseline. Father (Mother) age is the age in years at baseline. Father (Mother) education is the number of years of education. Father farmer/day laborer is a dummy that equals to 1 if the father is a farmer or day laborer, and 0 if not. Household income is the monthly household income in Taka. ***p$<$ 0.01, **p$<$ 0.05, *p$<$ 0.1.

Table A6: Balance checks of teachers'/care-givers' characteristics

	T1 (1)	T2 (2)	T3 (3)	T1=T2=T3 (4)
Teaching time	1.16	1.11	1.21	0.156
Education	5.43	5.30	5.40	0.708
Housewife	0.85	0.83	0.81	0.756
Married status	0.28	0.28	0.18	0.388
Personal income	2727.27	1803.23	1661.90	0.183
Household income	13767.05	12024.19	13047.62	0.178
Obs.	88	124	84	

Notes: The sample includes teachers/caregivers in treated groups. Column (4) shows the p-value of the test that the population means of these groups are equal. One-way Anova tests are conducted to compare the group means for continuous variables. Chi-square tests are conducted to compare the group means for indicator variables. Teaching time is the years that teacher worked in this project. Education is the number of years of education. Housewife is the indicator that equals to 1 if the teacher is a housewife, and 0 if having other jobs. Married status is the categorical variable. Personal income and household income are the monthly personal and household income in Taka, respectively. ***p$<$ 0.01, **p$<$ 0.05, *p$<$ 0.1.

Table A7: Balance checks of siblings and cousins' characteristics

	T1 (1)	T2 (2)	T3 (3)	Control (4)	T1=T2=T3=C
Child gender	0.49	0.45	0.47	0.51	0.632
Child age	45.51	44.21	41.05	39.56	0.000
Father age	35.08	35.04	35.11	34.65	0.786
Mother age	27.92	27.98	27.59	27.64	0.685
Father education	5.74	5.80	6.05	5.89	0.743
Mother education	6.79	7.09	6.86	6.51	0.259
Father farmer/day laborer	0.58	0.56	0.54	0.62	0.263
Household income	13364.26	24209.80	13253.06	13845.66	0.693
Obs.	1,305	1,305	1,305	1,305	

Notes: The sample includes the siblings and cousins of main sample children who have the 4 learning outcomes at endline. Column (4) shows the p-value of the test that T1=T2=T3=Control. Child gender is a dummy that equals to 1 for girls, and 0 for boys. Child age refers to the age in month at baseline. Father (Mother) age is the age in year at baseline. Father (Mother) education is the number of years of education. Father farmer/day laborer is a dummy that equals to 1 if father is a farmer or day laborer, and 0 if not. Household income is the monthly household income in Taka. ***p$<$ 0.01, **p$<$ 0.05, *p$<$ 0.1.

C.2 Attrition analysis

Table A8: Overview of missing endline scores

	T1	T2	T3	Control	Total
Baseline & endline scores available	1179	1601	1194	1765	5739
Missing endline scores	59	82	71	75	287
Total sample	1238	1683	1265	1840	6026
Missing percentage	4.77%	4.87%	5.61%	4.08%	4.76%

Notes: The sample includes all children who have the 4 learning outcomes at baseline. Missing endline scores refers to the observations lacking any of 4 learning outcomes at endline. The Chi Square test (P value: 0.2642) shows that there is no statistically significant difference in missing endline scores across treatment groups.

Table A9: Balance checks for children leaving the sample across treatments

	T1	T2	T3	Control	T1=T2=T3=Control
Panel A: Children's characteristics:					
Child gender	0.51	0.55	0.44	0.57	0.371
Child age	41.85	41.51	39.68	41.92	0.265
Cognitive skills	0.30	0.15	-0.02	0.08	0.316
Non cognitive skills	0.13	0.07	-0.07	0.08	0.590
Panel B: Parents' characteristics:					
Father age	33.95	32.37	32.94	34.15	0.090
Mother age	26.83	25.95	25.65	27.19	0.067
Father education	6.43	6.57	5.18	5.99	0.226
Mother education	7.37	6.76	7.05	6.93	0.762
Father farmer/day laborer	0.53	0.59	0.65	0.71	0.152
Household income	13496.4	11911.8	12323.0	11482.3	0.233
Obs.	59	82	71	75	287

Notes: The sample includes children who have baseline but missing endline result for at least one of the 4 learning outcomes. Child gender is a dummy that equals to 1 for girls, and 0 for boys. Child age refers to the age in month at baseline. Father (Mother) age is the age in year at baseline. Father (Mother) education is the number of years of education. Father farmer/day laborer is a dummy that equals to 1 if father is a farmer or day laborer, and 0 if not. Household income is the monthly household income in Taka.

C.3 Direct treatment effects

Table A10: Direct effects on learning outcomes

	Cognitive skills			Noncognitive skills		
	Pre	Mid	End	Pre	Mid	End
	(1)	(2)	(3)	(4)	(5)	(6)
T1	-0.005	0.280***	0.487***	-0.007	0.225***	0.515***
	(0.051)	(0.042)	(0.049)	(0.048)	(0.038)	(0.046)
T2	-0.017	0.242***	0.481***	0.003	0.141***	0.543***
	(0.050)	(0.044)	(0.053)	(0.058)	(0.043)	(0.052)
T3	-0.026	0.224***	0.480***	0.004	0.125***	0.563***
	(0.052)	(0.048)	(0.047)	(0.050)	(0.043)	(0.046)
$y_{i,v,0}$		0.271***	0.158***		0.176***	0.108***
		(0.016)	(0.014)		(0.016)	(0.016)
Obs.	5,080	5,080	5,080	5,080	5,080	5,080

Notes: The sample includes all treated students in T1, T2, and T3, as well as all students in control schools whose test scores are available at baseline, midline, and enline. The specification also includes the following controls: child gender, child age, a dummy that indicates if the father is a farmer or day laborer, household income, and district fixed effects. ***p<0.01, **p<0.05, *p<0.1. Standard errors are clustered at village level.

Table A11: Direct effects on learning outcomes without controlling for baseline scores

	Cognitive skills			Noncognitive skills		
	Pre	Mid	End	Pre	Mid	End
	(1)	(2)	(3)	(4)	(5)	(6)
T1	-0.005	0.282***	0.486***	-0.007	0.237***	0.514***
	(0.051)	(0.043)	(0.049)	(0.048)	(0.037)	(0.045)
T2	-0.017	0.243***	0.478***	0.003	0.149***	0.543***
	(0.050)	(0.044)	(0.052)	(0.058)	(0.043)	(0.051)
T3	-0.026	0.229***	0.476***	0.004	0.139***	0.563***
	(0.052)	(0.049)	(0.046)	(0.050)	(0.043)	(0.044)
Obs.	5,391	5,289	5,080	5,391	5,289	5,080

Notes: The sample includes all treated students in T1, T2, and T3 and all students in control group. Column (1) and (4) include the children who have results for the 4 composite scores at baseline. Column (2) and (5) include the children who have results for 4 composite scores at midline, in addition to baseline. Column (3) and (6) include the children who have results for 4 composite scores at endline, in addition to baseline and midline. The specification also includes the following controls: child gender, child age, a dummy that indicates if the father is a farmer or day laborer, household income, and district fixed effects. ***p<0.01, **p<0.05, *p<0.1. Standard errors are clustered at village level.

Table A12: Direct effects on each component of cognitive and noncognitive skills

	literacy			Numeracy			Cognitive skills		
	Pre	Mid	End	Pre	Mid	End	Pre	Mid	End
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
T1	0.035	0.293***	0.558***	-0.020	0.272***	0.415***	0.008	0.282***	0.487***
	(0.054)	(0.052)	(0.072)	(0.051)	(0.040)	(0.042)	(0.050)	(0.041)	(0.049)
T2	0.016	0.258***	0.536***	-0.039	0.236***	0.424***	-0.012	0.247***	0.481***
	(0.052)	(0.051)	(0.077)	(0.052)	(0.045)	(0.047)	(0.050)	(0.043)	(0.053)
T3	-0.017	0.230***	0.472***	-0.035	0.237***	0.487***	-0.026	0.234***	0.480***
	(0.057)	(0.057)	(0.069)	(0.049)	(0.048)	(0.043)	(0.051)	(0.048)	(0.047)
$y_{i,v,0}$		0.201***	0.131***		0.251***	0.127***		0.265***	0.158***
		(0.015)	(0.016)		(0.016)	(0.013)		(0.016)	(0.014)
Obs.	5,391	5,289	5,080	5,391	5,289	5,080	5,391	5,289	5,080
	Working memory			Attention shifting			Noncognitive skills		
	Pre	Mid	End	Pre	Mid	End	Pre	Mid	End
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
T1	-0.072	0.254***	0.437***	0.062	0.226***	0.595***	-0.005	0.238***	0.515***
	(0.054)	(0.052)	(0.044)	(0.055)	(0.047)	(0.064)	(0.047)	(0.037)	(0.046)
T2	0.003	0.147***	0.488***	0.009	0.150***	0.598***	0.006	0.148***	0.543***
	(0.066)	(0.056)	(0.048)	(0.060)	(0.045)	(0.067)	(0.057)	(0.042)	(0.052)
T3	-0.027	0.135**	0.511***	0.037	0.144***	0.616***	0.005	0.139***	0.563***
	(0.059)	(0.060)	(0.050)	(0.053)	(0.044)	(0.060)	(0.048)	(0.042)	(0.046)
$y_{i,v,0}$		0.145***	0.106***		0.094***	0.057***		0.169***	0.108***
		(0.016)	(0.015)		(0.014)	(0.015)		(0.015)	(0.016)
Obs.	5,391	5,289	5,080	5,391	5,289	5,080	5,391	5,289	5,080

Notes: The sample includes all treated children in T1, T2, and T3 and all children in control groups. Literacy and numeracy are the two components of cognitive skills while working memory and attention shifting are the two components of noncognitive skills. The specification also includes the following controls: child gender, child age, a dummy that indicates if the father is a farmer or day laborer, household income, and district fixed effects.***p$<$ 0.01, **p$<$ 0.05, *p$<$ 0.1. Standard errors are clustered at village level.

Table A13: Effects on untreated children in T2 and half treated children in T3

	Cognitive skills			Noncognitive skills		
	Pre	Mid	End	Pre	Mid	End
	(1)	(2)	(3)	(4)	(5)	(6)
Untreated in T2 (UT)	-0.013	0.139***	0.218***	-0.008	0.098**	0.236***
	(0.060)	(0.052)	(0.066)	(0.062)	(0.045)	(0.062)
Half treated in T3 (HT)	0.006	0.191***	0.466***	0.052	0.114**	0.550***
	(0.061)	(0.053)	(0.051)	(0.057)	(0.051)	(0.047)
$y_{i,v,0}$		0.266***	0.184***		0.160***	0.074***
		(0.021)	(0.021)		(0.021)	(0.020)
Obs.	3,056	2,997	2,856	3,056	2,997	2,856
UT = HT	0.797	0.399	0.000	0.383	0.774	0.000

Notes: The sample includes untreated children in T2 (Home Visit), half treated children in T3 (Preschool + Home Visit) and all the children in control villages. Fully-treated refers to the children that receive both preschool session and home visit. Half-treated refers to the children that receive preschool session only. The specification also includes the following controls: child gender, child age, a dummy that indicates if the father is a farmer or day laborer, household income, and district fixed effects. ***p$<$ 0.01, **p$<$ 0.05, *p$<$ 0.1. Standard errors are clustered at village level.

Table A14: Direct effects on ASQ performance with respective observations of each component

	Gross motor			Fine motor			Language		
	Pre	Mid	End	Pre	Mid	End	Pre	Mid	End
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
T1	-0.013	0.083	0.184***	-0.015	0.292***	0.368***	-0.060	0.251***	0.310***
	(0.060)	(0.051)	(0.057)	(0.056)	(0.044)	(0.052)	(0.051)	(0.061)	(0.049)
T2	0.037	0.076	0.170***	0.018	0.265***	0.367***	0.027	0.227***	0.312***
	(0.060)	(0.047)	(0.058)	(0.055)	(0.050)	(0.051)	(0.053)	(0.056)	(0.049)
T3	0.030	0.079*	0.253***	0.014	0.249***	0.402***	-0.048	0.305***	0.397***
	(0.055)	(0.046)	(0.057)	(0.054)	(0.048)	(0.054)	(0.054)	(0.058)	(0.052)
$y_{i,v,0}$		0.049***	0.055***		0.127***	0.114***		0.065***	0.070***
		(0.012)	(0.013)		(0.014)	(0.013)		(0.013)	(0.013)
Obs.	5,520	5,419	5,329	5,520	5,419	5,329	5,520	5,419	5,329
	Problem Solving			Personal social domains			Overall		
	Pre	Mid	End	Pre	Mid	End	Pre	Mid	End
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
T1	-0.050	0.318***	0.371***	-0.069	0.184***	0.247***	-0.056	0.304***	0.397***
	(0.048)	(0.051)	(0.042)	(0.059)	(0.043)	(0.047)	(0.061)	(0.048)	(0.052)
T2	0.042	0.220***	0.378***	0.014	0.187***	0.235***	0.036	0.258***	0.391***
	(0.051)	(0.051)	(0.046)	(0.062)	(0.048)	(0.054)	(0.061)	(0.052)	(0.053)
T3	-0.023	0.244***	0.401***	-0.004	0.194***	0.306***	-0.011	0.288***	0.463***
	(0.048)	(0.056)	(0.047)	(0.050)	(0.047)	(0.050)	(0.058)	(0.054)	(0.053)
$y_{i,v,0}$		0.174***	0.164***		0.091***	0.070***		0.160***	0.144***
		(0.016)	(0.014)		(0.014)	(0.016)		(0.014)	(0.014)
Obs.	5,520	5,419	5,329	5,520	5,419	5,329	5,520	5,419	5,329

Notes: The sample includes all treated children in T1, T2, and T3 and all children in control groups. The specification also includes the following controls: child gender, child age, a dummy that indicates if the father is a farmer or day laborer, household income, and district fixed effects. ***p<0.01, **p<0.05, *p<0.1. Standard errors are clustered at village level.

Table A15: Heterogeneity in treatment effects on children's learning outcomes

	Gender			Baseline performance			Household income			Mother education		
	Girl	Boy	Diff.	Above median	Below median	Diff.	Above median	Below median	Diff.	Finished primary	Unfinished primary	Diff.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A: Cognitive skills												
T1	0.480***	0.484***	-0.043	0.405***	0.561***	-0.157**	0.452***	0.509***	-0.057	0.499***	0.436***	0.063
	(0.060)	(0.062)	(0.059)	(0.062)	(0.064)	(0.069)	(0.068)	(0.057)	(0.066)	(0.057)	(0.067)	(0.062)
T2	0.440***	0.535***	-0.095	0.430***	0.549***	-0.119*	0.447***	0.523***	-0.076	0.505***	0.433***	0.072
	(0.058)	(0.058)	(0.061)	(0.057)	(0.060)	(0.062)	(0.062)	(0.053)	(0.060)	(0.053)	(0.068)	(0.067)
T3	0.469***	0.491***	-0.022	0.412***	0.552***	-0.140**	0.423***	0.531***	-0.108*	0.496***	0.436***	0.059
	(0.051)	(0.059)	(0.058)	(0.053)	(0.062)	(0.067)	(0.059)	(0.050)	(0.055)	(0.048)	(0.070)	(0.065)
Obs.	2,532	2,548	5,080	2,543	2,537	5,080	2,609	2,471	5,080	1,524	3,556	5,080
Panel B: Noncognitive skills												
T1	0.589***	0.499***	0.090	0.550***	0.536***	0.014	0.486***	0.594***	-0.108	0.576***	0.467***	0.109*
	(0.058)	(0.058)	(0.068)	(0.062)	(0.057)	(0.063)	(0.064)	(0.058)	(0.066)	(0.057)	(0.061)	(0.061)
T2	0.488***	0.543***	-0.055	0.572***	0.454***	0.117*	0.458***	0.566***	-1.079*	0.548***	0.425***	0.123*
	(0.054)	(0.055)	(0.058)	(0.060)	(0.048)	(0.058)	(0.052)	(0.057)	(0.059)	(0.050)	(0.068)	(0.070)
T3	0.593***	0.533***	0.060	0.541***	0.584***	-0.044**	0.486***	0.633***	-0.147**	0.565***	0.552***	0.013
	(0.052)	(0.053)	(0.048)	(0.053)	(0.057)	(0.061)	(0.061)	(0.049)	(0.062)	(0.053)	(0.066)	(0.075)
Obs.	2,532	2,548	5,080	2,537	2,543	5,080	2,609	2,471	5,080	1,524	3,556	5,080

Notes: The sample includes all treated students in T1, T2, and T3 and all students in control schools. Column 1 reports treatment effects only among girls, and column 2 reports treatment effects only among boys; column 3 reports the difference between columns 1 and 2 (the coefficient on the interaction between treatment and gender indicator). Column 4 reports treatment effects only among the children whose baseline learning performance were above the median (stronger performance), and column 5 reports treatment effects only among the children whose baseline learning performance were below the median (weaker performance); column 6 reports the difference between columns 4 and 5. Column 7 reports treatment effects only among the children whose household income was above the median, and column 8 reports treatment effects only among the children whose household income was below the median; column 9 reports the difference between columns 7 and 8. Column 10 reports treatment effects only among the children whose mother has finished primary education, and column 11 reports treatment effects only among the children whose mother has not finished primary education; column 12 reports the difference between columns 10 and 11. The specification also includes the following controls: child gender, child age, a dummy that indicates if the father is a farmer or day laborer, household income, and district fixed effects. ***p< 0.01, **p< 0.05, *p< 0.1. Standard errors are clustered at village level.

C.4 Spillover effects

Table A16: Spillover effects of home visits without controlling for baseline scores

	Cognitive skills			Noncognitive skills		
	Pre	Mid	End	Pre	Mid	End
	(1)	(2)	(3)	(4)	(5)	(6)
T2	-0.009	0.140**	0.217***	-0.002	0.098**	0.237***
	(0.060)	(0.057)	(0.068)	(0.062)	(0.045)	(0.063)
Obs.	2,475	2,429	2,327	2,475	2,429	2,327

Notes: The sample includes untreated children in T2 (Home Visit) and all the children in control group. Column (1) and (4) include the children who have results for the 4 composite scores at baseline. Column (2) and (5) include the children who have results for 4 composite scores at midline, in addition to baseline. Column (3) and (6) include the children who have results for 4 composite scores at endline, in addition to baseline and midline. The specification also includes the following controls: child gender, child age, a dummy that indicates if the father is a farmer or day laborer, household income, and district fixed effects. ***p<0.01, **p<0.05, *p<0.1 using conventional inference (i.e., not adjusting for multiple outcomes). Standard errors are clustered at village level.

Table A17: Spillover effects of home visits controlling for the total number of eligible children

	Cognitive skills			Noncognitive skills		
	Pre	Mid	End	Pre	Mid	End
	(1)	(2)	(3)	(4)	(5)	(6)
T2	-0.024	0.140***	0.232***	-0.015	0.090**	0.250***
	(0.060)	(0.053)	(0.064)	(0.061)	(0.044)	(0.059)
$N_v^{eligible\ children}$	0.017***	-0.003	-0.013**	0.014**	0.007**	-0.013**
	(0.005)	(0.005)	(0.006)	(0.006)	(0.003)	(0.005)
Obs.	2,475	2,429	2,327	2,475	2,429	2,327

Notes: The item $N_v^{eligible\ children}$ refers to the village-level total number of eligible children (those within our focus age group) at baseline. The sample includes untreated children in T2 (Home Visit) and all the children in control group. Column (1) and (4) include the children who have results for the 4 composite scores at baseline. Column (2) and (5) include the children who have results for 4 composite scores at midline, in addition to baseline. Column (3) and (6) include the children who have results for 4 composite scores at endline, in addition to baseline and midline. The specification also includes the following controls: child gender, child age, a dummy that indicates if the father is a farmer or day laborer, household income, and district fixed effects. ***p<0.01, **p<0.05, *p<0.1 using conventional inference (i.e., not adjusting for multiple outcomes). Standard errors are clustered at village level.

Table A18: Spillover effects on each component of cognitive and noncognitive skills

	literacy			Numeracy			Cognitive skills		
	Pre	Mid	End	Pre	Mid	End	Pre	Mid	End
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
T2	-0.003	0.111*	0.278***	-0.015	0.166***	0.159**	-0.009	0.138***	0.218***
	(0.063)	(0.064)	(0.086)	(0.063)	(0.051)	(0.062)	(0.060)	(0.052)	(0.066)
$y_{i,v,0}$		0.213***	0.175***		0.248***	0.189***		0.268***	0.204***
		(0.025)	(0.025)		(0.024)	(0.023)		(0.025)	(0.025)
Obs.	2,475	2,429	2,327	2,475	2,429	2,327	2,475	2,429	2,327
	Working memory			Attention shifting			Noncognitive skills		
	Pre	Mid	End	Pre	Mid	End	Pre	Mid	End
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
T2	-0.003	0.039	0.220***	-0.002	0.155***	0.253***	-0.00	0.097**	0.236***
	(0.075)	(0.060)	(0.064)	(0.063)	(0.050)	(0.078)	(0.062)	(0.044)	(0.062)
$y_{i,v,0}$		0.162***	0.104***		0.100***	0.0143		0.175***	0.078***
		(0.023)	(0.022)		(0.022)	(0.022)		(0.023)	(0.022)
Obs.	2,475	2,429	2,327	2,475	2,429	2,327	2,475	2,429	2,327

Notes: The sample includes untreated children in T2 (Home Visit) and all the children in control villages. Literacy and numeracy are the two components of cognitive skills while working memory and attention shifting are the two components of noncognitive skills. The specification also includes the following controls: child gender, child age, a dummy that indicates if the father is a farmer or day laborer, household income, and district fixed effects.***p<0.01, **p<0.05, *p<0.1. Standard errors are clustered at village level.

Table A19: Spillover effects on learning outcomes (T2): different saturation

	Cognitive skills			Noncognitive skills		
	Pre	Mid	End	Pre	Mid	End
	(1)	(2)	(3)	(4)	(5)	(6)
T2_10	-0.042	0.0524	0.184*	0.005	0.057	0.203**
	(0.085)	(0.068)	(0.097)	(0.088)	(0.058)	(0.085)
T2_20	-0.041	0.208***	0.208***	-0.049	0.112**	0.220**
	(0.088)	(0.066)	(0.077)	(0.075)	(0.046)	(0.089)
T2_30	0.185**	0.331***	0.367***	0.063	0.220*	0.394***
	(0.080)	(0.071)	(0.085)	(0.092)	(0.115)	(0.119)
$y_{i,v,0}$		0.266***	0.201***		0.175***	0.077***
		(0.025)	(0.025)		(0.023)	(0.022)
Obs.	2,475	2,429	2,327	2,475	2,429	2,327

Notes: The sample includes untreated children in T2 (Home Visit) and all the children in control villages. In the villages where child i resides, T2_10, T2_20 and T2_30 are the indicators representing the random selection of 10, 20, and 30 families, respectively, to receive home visit intervention. The specification also includes the following controls: child gender, child age, a dummy that indicates if the father is a farmer or day laborer, household income, and district fixed effects. ***p<0.01, **p<0.05, *p<0.1.

Table A20: Spillovers on ASQ performance with respective observations of each component

	Gross motor			Fine motor			Language		
	Pre	Mid	End	Pre	Mid	End	Pre	Mid	End
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
T2	0.006	0.005	0.080	0.087*	0.170***	0.058	0.0124	0.140**	0.142**
	(0.062)	(0.047)	(0.073)	(0.052)	(0.060)	(0.063)	(0.055)	(0.062)	(0.060)
$y_{i,v,0}$		0.035*	0.035		0.077***	0.116***		0.036**	0.096***
		(0.018)	(0.021)		(0.020)	(0.022)		(0.018)	(0.021)
Obs.	2,705	2,650	2,612	2,705	2,650	2,612	2,705	2,650	2,612
	Problem Solving			Personal social domains			Overall		
	Pre	Mid	End	Pre	Mid	End	Pre	Mid	End
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
T2	0.040	0.207***	0.137**	0.00	0.149***	0.041	0.041	0.180***	0.122*
	(0.057)	(0.063)	(0.059)	(0.067)	(0.058)	(0.065)	(0.064)	(0.060)	(0.066)
$y_{i,v,0}$		0.159***	0.177***		0.070***	0.067***		0.115***	0.157***
		(0.022)	(0.023)		(0.022)	(0.023)		(0.021)	(0.024)
Obs.	2,705	2,650	2,612	2,705	2,650	2,612	2,705	2,650	2,612

Notes: The sample includes untreated children in T2 (Home Visit) and all the children in control villages. The specification also includes the following controls: child gender, child age, a dummy that indicates if the father is a farmer or day laborer, household income, and district fixed effects. ***p<0.01, **p<0.05, *p<0.1. Standard errors are clustered at village level.

C.5 Improvements on parental practices

Table A21: Summary Statistics of the parental practice measures (for treated children)

Measure	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	SD	Obs.
Overall measure	-4.079	-0.150	0.385	0.326	0.945	2.289	0.915	4,897
Interactions with child	-1.982	-0.652	0.235	0.316	1.121	3.781	1.108	4,897
Closeness with child	-3.490	0.002	0.002	0.118	0.875	0.875	0.881	4,897
Perception of child	-5.695	0.033	0.474	0.113	0.474	0.915	0.859	4,897
Involvement in child's learning	-2.615	-0.672	0.299	0.184	0.946	1.594	1.016	4,897
Supportive upbringing	-2.548	-0.551	0.305	0.150	0.876	2.017	0.969	4,897
Food & nutrition	-3.429	0.514	0.514	0.183	0.514	0.514	0.743	4,897
Positive parenting	-2.854	-0.324	0.238	0.203	0.800	1.644	0.835	4,897

Notes: The sample includes all treated children in T1, T2, and T3, along with all children in the control group who have data for the four composite scores at baseline, midline, and endline, as well as information on parental investment. All parental outcome indices are standardized relative to control households.

Table A22: Summary Statistics of the parental practice measures (for untreated children)

Measure	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	SD	Obs.
Overall measure	-4.079	-0.329	0.296	0.163	0.802	2.238	0.972	2,232
Interactions with child	-1.982	-0.652	0.235	0.183	1.121	3.781	1.067	2,232
Closeness with child	-3.490	-0.871	0.002	0.056	0.875	0.875	0.952	2,232
Perception of child	-5.695	0.033	0.474	0.074	0.474	0.915	0.931	2,232
Involvement in child's learning	-2.615	-0.672	0.299	0.103	0.946	1.594	0.978	2,232
Supportive upbringing	-2.548	-0.551	0.020	0.081	0.876	2.017	0.982	2,232
Food & nutrition	-3.429	-0.274	0.514	0.058	0.514	0.514	0.936	2,232
Positive parenting	-2.854	-0.324	0.238	0.094	0.800	1.644	0.940	2,232

Notes: The sample includes untreated children in T2, along with all children in the control group who have data for the four composite scores at baseline, midline, and endline, as well as information on parental investment. All parental outcome indices are standardized relative to control households.

C.6 Exposure to treated families ($N^T_{i,v,0}$)

Figure A3: Density plot of the exposure to treated families ($N^T_{i,v,0}$)

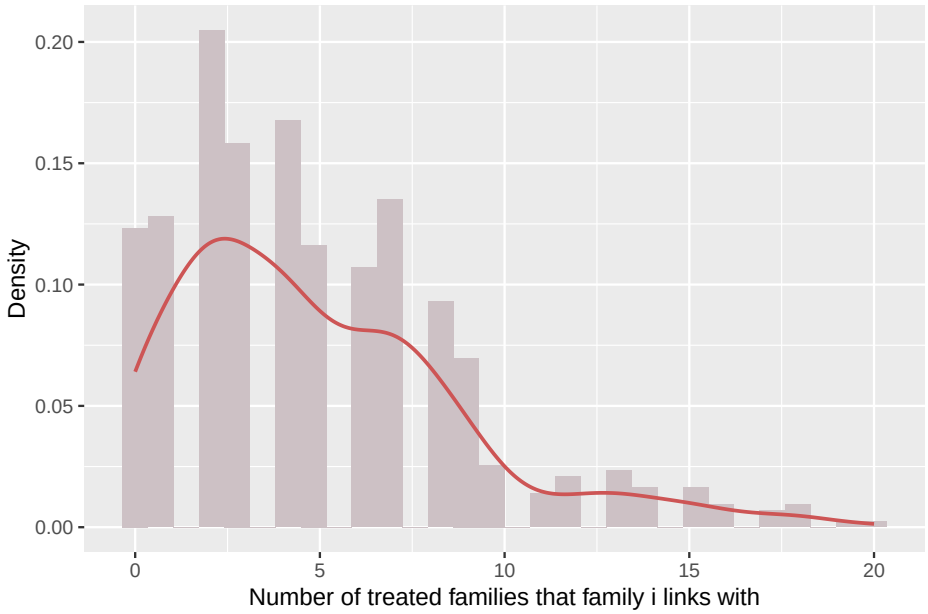


Table A23: Summary Statistics of the exposure to treated families ($N^T_{i,v,0}$)

Measure	Min.	1st Qu.	Median	Mean	3rd Qu.m	Max.	SD	Obs.
$N^T_{i,v,0}$	0	2	4	5.033	7	20	3.927	573

Table A24: Sensitivity check: Impact of parent networks on outcomes of untreated children

	Pre		Mid		End	
	Cognitive	Noncognitive	Cognitive	Noncognitive	Cognitive	Noncognitive
$N_{i,v,0}^{(treated)}$	0.022	0.012	0.021	-0.009	0.027*	0.038*
	(0.020)	(0.019)	(0.013)	(0.019)	(0.016)	(0.019)
$N_{i,v,0}^{(total)}$	0.001	0.002	-0.005	0.008	0.009	0.001
	(0.014)	(0.012)	(0.009)	(0.009)	(0.010)	(0.013)
$y_{i,v,0}$			0.336***	0.233***	0.267***	0.087***
			(0.048)	(0.039)	(0.041)	(0.030)
Constant	-3.744***	-2.989**	-2.009**	-1.480	-2.954**	-0.780
	(0.936)	(1.191)	(1.000)	(0.952)	(1.196)	(1.102)
Observations	623	623	607	607	573	573

Notes: The sample includes untreated children in T2 (Home Visit). Column (1) and (4) include the children who have results for the 4 composite scores at baseline. Column (2) and (5) include the children who have results for 4 composite scores at midline, in addition to baseline. Column (3) and (6) include the children who have results for 4 composite scores at endline, in addition to baseline and midline. The specification also includes the following controls: child gender, child age, a dummy that indicates if the father is a farmer or day laborer, household income, and district fixed effects. ***p$<$ 0.01, **p$<$ 0.05, *p$<$ 0.1. Standard errors are clustered at village level.

Table A25: Costs comparison with other early childhood programs

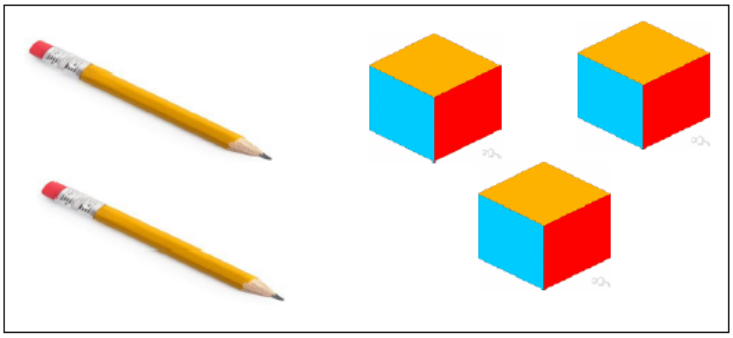
Study	Intervention	Duration	Children	Region	Cost/child	Findings	Effect size/US$100
This paper	Preschool sessions and home visit	18 months	3-5 years	Bangladesh	US$74 per child	↑ 0.47 SD, 0.49 SD, 0.48 SD, 0.46 SD in literacy, numeracy, cognition and child development	↑ 0.63 SD, 0.65 SD, 0.65 SD, 0.62 SD in literacy, numeracy, cognition and child development
Özler et al. (2018)	Learning supplies, teacher & parenting training	Varied by treatmens, 5-6 weeks for each training	3-5 years	Malawi	US$93 per child	↑ 0.19 SD in language skills	↑ 0.20 SD in language skills
Dillon et al. (2017)	Game-based preschool curriculum	4 months	3-7 years	India	US$53 per child	↑ 0.25 SD in math skills	↑ 0.47 SD in math skills
Andrew et al. (2024)	low-cost training for existing teachers	13 months	18 months-5 years	Colombia	US$47 per child	↑ 0.16 SD in cognitive skills	↑ 0.34 SD in cognitive skills
Justino et al. (2022)	Parents meetings, home visit, and learning supplies	17 weeks	6-24 months	Rwanda	US$76 per child	↑ 0.38 SD in child development	↑ 0.50 SD in child development

D Assessment

D.1 Examples of main tests and overview of measurement tools

Numeracy Test This test assesses children's basic numeracy skills. Children are shown various pictures, each containing items in differing quantities. For instance, in the picture provided below, children are asked to count the number of pencils displayed.

Figure A4: An example from Numeracy Test



Question: How many pencils are there?

Literacy Test This test is carried out individually or in teams. Each child is provided with a pen and paper and instructed to draw one of the following: a flower, a fish, a tree, or the sun. The children have 5 minutes to complete their drawing. They cease drawing when the assessor signals to stop.

Figure A5: An example from Literacy Test

Picture-1

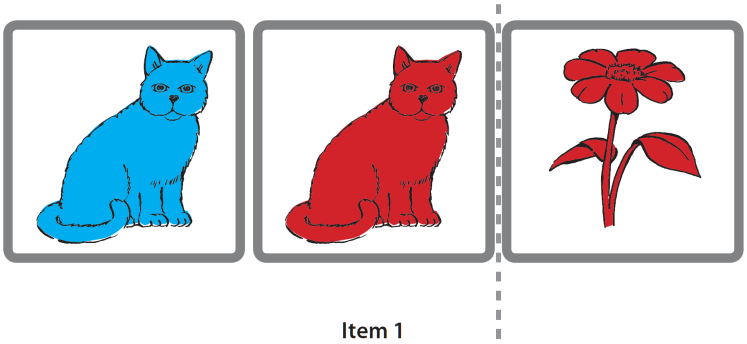
Picture-2

Picture-3

Picture-4

Something's the Same In this game, the assessor presents the child with pages containing various pictures. These pictures differ in size, color, and type. The children are asked to identify the pair of pictures that are identical in either size, color, or appearance.

Figure A6: An example from Something's the Same



Operation Span Children are shown a line drawing of a house that includes an animal figure and a colored dot within it. The assessor then turns to a page displaying only the outline of the house and asks the children to recall which animal is in the house. A similar question is asked about the colored dot. This task challenges the children to remember two details simultaneously while focusing on just one, thus managing interference from the other detail (i.e., the color). The children participate in a sequence of trials: one for a single-house, two for two-house, two for three-house, and two for four-house scenarios.

Figure A7: An example from Operation Span

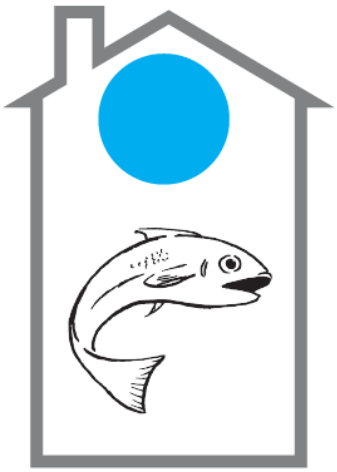


Table A26: Overview of assessment tools

Name of assessment	Areas of assessment	Mode of assessment
Ages and Stages Questionnaire - III	a. Language skill	Ability to perform at age specific communication level such as following simple instructions without repetition, describing things, describing action using right tense, subject-verb agreement, being able to tell one's name, etc.
	b. Fine & gross motor skill	Performance of age specific activities to determine gross and fine motor skills, such as jumping, throwing, climbing, drawing, writing, bead stringing, standing on one foot, holding a pen or pencil, using scissors etc.
	c. Problem solving skill	Answering age specific questions correctly/nearly correctly, building structures using building blocks, being able to repeat after assessor two or three digit numbers, identifying different shapes and size, role playing, counting up to certain number, following simple instruction etc.
	d. Personal-Social Domain	Achieving age specific abilities around self-regulation, compliance, communication, adaptive functioning, interaction with people.
	e. Parental observation	Parents' observation on gross and fine motor skills, physical development, communication and psychosocial aspects.
Literacy test (WJ-III adapted)	Basic concepts	Drawing pictures following instructions
	Picture vocabulary, Language development, Lexical knowledge	Describing picture following instructions, difficulties increases as test progresses (words to sentences)
	Letter-word identification	Identifying letter following instructions
Numeracy test (WJ-III adapted)	Calculation, Mathematics, Math achievement	Counting numbers following instructions and descriptions
	Math Fluency, Mathematics, Math achievement, Math facility	-
	Applied problems, Quantitative reasoning, Math achievement, Math knowledge	Problem solving involving language comprehension and simple mathematical calculation
Something's the Same (Blair and Willoughby)	Attention shifting	Children are asked to match items that share similarity along different dimensions such as color, shape, size or type of items, e.g., animals, flowers etc.
Operation span (Blair and Willoughby)	Working memory	Children are shown line drawing of an animal figure and a colored dot, both of which are within the line drawing of a house. The assessor then turn to a page that only shows the outline of the house, and ask them which animal was/lived in the house. Similar question are asked regarding color dot within the house. It requires children to remember two pieces of information at the same time but activate only one overcoming interference from the other (i.e., color in this case). The children go through one 1-house, two 2-house, two 3-house, and two 4-house trails.

E Parental practices survey

Interactions with child

I_SC_30 Did you take your child to the library last year?
I_SC_33 Do you sing rhymes or songs to your child?
I_SC_35 Do you play with your child?
I_SC_42_1A Do you help your child learning - letter?
I_SC_42_1B Do you help your child learning - colour?
I_SC_42_1C Do you help your child learning - shapes and sizes?
I_SC_42_1D Do you help your child learning - calculation?
I_SC_48_1B Do you spend time with children every week - play sports?
I_SC_48_2B Do you spend time with children every week - music?
I_SC_48_3B Do you spend time with children every week - painting?
I_SC_48_4B Do you spend time with children every week - dancing?
I_SC_48_5B Do you spend time with children every week - acting in the plays?
I_SC_48_6B Do you spend time with children every week - religious (e.g., Quran reading, pray)?

Parent-child closeness I_SB_1: Did you hug and care your child yesterday and today?
I_SB_2: Suppose your child is hurt or sad, will you take him/her to somewhere, or try to care him/her?
I_SB_3 Do you feel good about talking/discussing with your child?
I_SB_4 Did your child eat with everyone in the family yesterday?
I_SB_8 Does your child try to attract your attention when you are busy with household chores?
I_SB_9 When your child wants to learn or do something new, do you help/try to do that together?
I_SB_11 You never rebuke, punish, and beat your child.
I_SB_12 When your child does something you don't like, you will move him from there, tell him not to do that, explain why and hope that he will listen.
I_SB_13 When your child does well or learns something good, you always give him credit, prizes or encourage him.

Parent's perception of child

I_SB_5 You never call your child "useless" or think he won't be able to accomplish anything.
I_SB_6 You never think everything your child does is wrong.
I_SB_7 You do not think your child often annoys you a lot.

Involvement in child's learning

I_SB_16 Do you ask or encourage your child to pack their belongings/clothes/toys?
I_SB_19 Do you teach children common decency such as greeting to others, saying thank you for other's help, saying sorry when doing wrong, etc.

I_SB_20 If the child likes something such as food, new toys, clothes, shoes, books, etc., do you teach him to praise or say something good?
I_SC_42_1A Do you help your child learning - letter?
I_SC_42_1B Do you help your child learning - colour?
I_SC_42_1C Do you help your child learning - shapes and sizes?
I_SC_42_1D Do you help your child learning - calculation?
I_SC_42_1E Did you spend time helping him to learn maths through shopping?
I_SC_42_1F Did you spend time helping him to practice life skills?
I_SC_42_1G Did you spend time helping him learn to practice social skills?
I_SC_42_1H Did you spend time helping him learn to say and write his own name?
I_SC_42_1I Did you spend time helping him to recite rhymes or practice music?
I_SC_42_1J Did you spend time helping him to draw pictures?

Supportive upbringing
I_SB_26_1 You never or rarely criticize your child.
I_SB_26_2 Your child always wants to help you with household chores.
I_SB_26_3 You always talk to him like a very good friend.
I_SB_26_4 You never ignore his emotions.
I_SB_26_5 Your child always tells you what he likes and dislikes to do.
I_SB_26_6 If he does something you don't like, you never beat him.
I_SB_26_7 Your child always tells you the things he likes and dislikes.
I_SB_26_8 You never or rarely inhibit or forbid what he wants or likes to do.
I_SB_26_9 If he bother or insist unnecessarily at work, you always explain it to him and it works.
I_SB_26_10 Your child trusts you.
I_SB_26_11 You always help him with any problems he has.
I_SB_26_12 You never get annoyed when your child asks something new or unknown to you.
I_SB_26_13 You always treat him patiently.
I_SB_26_14 You encourage him to share his belongings with others.
I_SB_26_15 You encourage him to use the best of his ability.
I_SB_26_16 You never or rarely think that your child won't be able to study much, so there's no need to spend time or put effort into it.

Food & nutrition
I_SC_52 Do you know what a balanced diet is?
I_SC_53 Do you regularly give the child a balanced diet which contains enough protein, carbohydrates, sugars, white manure, vitamins and water?
I_SC_54 Can you at least sometimes afford the food by child's taste?
I_SC_55 Do you know what safe water is?
I_SC_56 Do you use safe water regularly?

Positive parenting

I_SC_58_1 Children should be given the freedom to explore and learn on their own.

I_SC_58_2 It is very important to bring children into discipline, e.g., watching TV for one hour every day, playing outside for two hours in the afternoon.

I_SC_58_3 Children have their own choices or preferences, parents should not prioritizing their choices over those of the child.

I_SC_58_4 Children should be encouraged to find their own likes and dislikes, which develops their personalities.

I_SC_58_5 Children should be allowed to do something on their own.

I_SC_58_6 Children should be taught how to do their own works.

I_SC_58_7 Children should have their own opinions and points of view, instead of always following those from their parents or teachers.

I_SC_58_8 Children should not be raised under strict rule and discipline.

I_SC_58_9 Parents should learn child care.

I_SC_58_10 Parents can benefit from learning child care, as their child's upbringing and development may differ from their own childhood experiences.

I_SC_58_11 It is better not to rebuke and beat the child regularly. I_SC_58_12 The child's anger should not be dismissed, however, if it occurs, parents should help the child to comprehend and manage it.

I_SC_58_13 It is beneficial to provide the child with what they need, promoting their balanced and appropriate development.

I_SC_58_14 A healthy level of respect and understanding can be cultivated in the child when they recognize the importance of honouring their parents.

I_SC_58_15 Parents should refrain from using physical discipline on their child, even in moments when they may not immediately find alternative ways to manage their own frustration.

I_SC_58_16 Parents should be good friends with their children.

I_SC_58_17 Parents should avoid engaging in both intensive verbal arguments and physical fights in front of the child.