

Supplemental Information

SUPPLEMENTAL INFORMATION 1

EP INTERVENTION

The ICDS scheme launched in 1975 is the world's largest early childhood program for birth to 6 years offering integrated services through 1.4 million centers.^{9,45} The program is based on a life cycle approach and provides 6 services including supplementary nutrition, preschool education, nutritional and health education, immunization, health checkups and referral services. The centers are run by AWWs together with AWHs, women from local communities who more generally are tasked with mobilizing community support for better care of young children, girls, and women. The curriculum framework for preschool children was developed to promote holistic development through play-based learning and focuses on SR and development of positive attitudes toward education. They aim to contribute to universalization of primary education, by providing children with necessary preparation for primary schooling and offering care for younger siblings, thus freeing older ones, especially girls, to attend school. The National Education Policy (2020²⁸) has focused attention on learning in the foundational years and has emphasized the importance of preschool education; however, there is considerable variation in quality and very few studies documenting the effects of the preschool education component in AWCs.^{9,10}

To implement the EP intervention, designed to complement and enhance the existing AWC preschool education and to improve implementation, we collaborated closely with the Odisha government and ICDS. We obtained approval by

the Department of Women and Child Development and Mission Shakti from the government of Odisha to conduct quarterly orientation sessions of AWWs and AWHs in the 216 AWCs (66 for Salepur, 102 for Soro, and 48 for Bolangir). The Pratham mentors worked closely with the AWWs and AWHs to enhance the preschool education component. The total number of Pratham mentors was 108 (33 for Salepur, 51 for Soro, and 24 for Bolangir) for the 96 treatment villages. This approach has 2 important advantages. First, it builds on existing infrastructure seeking to improve both child care practices and skills of women (Pratham mentors) who already have some formal child care experience and strong links with local communities. Second, the ICDS are important stakeholders if early and/or late interventions are to become part of governmental programming. If successful, our interventions could be blueprints for scalable child-development programs.

ENHANCED CURRICULUM

The starting point for the EP curriculum was the existing ICDS curriculum for Odisha state. We conducted a census in 2017 to identify all preschool centers in each sample villages: 216 centers in treatment and 217 in control. The intervention was implemented in all centers in treatment villages, regardless of whether target children were attending or not. We used this opportunity not only to observe the structural characteristics of the centers, but also the quality of interactions between teachers and children, teachers' characteristics, and the attendance of children. Furthermore, we designed and adapted a questionnaire to measure all these outcomes. We drew on the extensive experience of the Odisha

government working with young children in India. The goal was to ensure that the enhanced curriculum had maximum buy-in from current AWWs and AWHs, as well as promoting the children's optimal development and being appropriate for the sociocultural context.

The ICDS curriculum, based on the National Early Childhood Care and Education Curriculum framework,²⁸ focuses on a holistic approach to promote development in different domains, experiential learning, multilingualism, and inclusive practices.^{28,46} We added executive function activities and teaching additional concepts such as size, shape, color, position, quantity, difference, and similarity throughout the daily routine. Attention was paid to improve teacher-child interactions by encouraging 2-way conversations, using open-ended questions, making learning activities playful, referencing the children's own backgrounds and experiences, using frequent positive feedback, and taking time to greet the parents and children on arrival and departure daily. Some new activities were introduced, and the daily schedule of activities reinforced. The pedagogical approach was based on the sociocultural theory of Vygotsky.⁴⁷ The use of scaffolding and building from easy to difficult activities helped ensure that activities fell within each child's proximal zone of development.⁴⁷ We introduced some methods from Tools of the Mind to assist in learning,³⁰ using pictures of an ear to encourage listening, putting a finger on lips to stop talking, and linking colors and shapes to familiar objects. We also promoted socioemotional development by encouraging sharing, taking turns, and helping others, as well as teaching empathy, often through stories.

Activity corners were set up daily in each AWC and included looking at books, pretend or role play (eg, “doll house”), construction (blocks, puzzles), and arts (finger painting, drawing, music). For part of the day, children chose their activities and were encouraged to explore materials independently and learn through play. There was at least 1 structured learning session in groups daily, and we added some early literacy and numeracy activities. The early literacy activities included storytelling, story making, picture reading, and letter-sound activities. To address the multilingualism, teachers were instructed to use the home language along with the state language. The focus of early numeracy activities was to develop foundation skills to understand and apply the math concepts in everyday life. Learning objectives included recognizing and understanding numbers, counting, estimation, measurement, comparison, sorting, understanding and creating patterns, and so forth. There was also singing and story time every day; we introduced

dialogic reading methods³¹ emphasizing language skills. We promoted meaningful conversations during the breakfast and lunch time between children and with adults, keeping in mind the principles of activity-based learning. The Reach Up curriculum was used as a further resource for new activities.²⁷

MENTORS AND IMPLEMENTERS

During training, mentors and super-mentors received the EP curriculum, a toy manual, an activity manual that explains the objective and how to implement each activity, and a handbook to provide general knowledge on the EP. Training materials are available upon request.

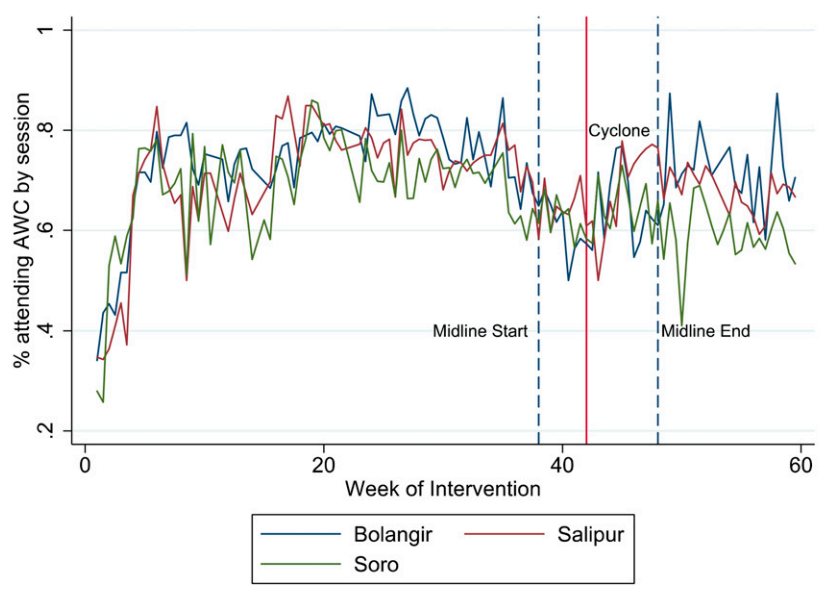
MATERIALS

We contextualized the material such as story books, picture card, flash card, etc, to address the sociocultural diversity in the 3 districts. A lending library of books was introduced in each AWC, which allowed children to borrow books

from the centers weekly from the third month of the intervention.

SUPPLEMENTAL INFORMATION 2

Attendance to the program is crucial because our aim is that children are exposed to the intervention as much as possible. For this reason, we monitor attendance by keeping weekly records. Supplemental Figure 2 reports the average percentage of children attending AWCs with EP each week. The attendance rate was, on average, 60% per week, with some periods having very low or almost 0 attendance rates. In some cases, this was because of the session not happening at all. This is mainly because of local festivities, weather shocks, and holidays. Conditional on a session occurring, (ie, the AWC is open), the average attendance rate per week is 80% (Supplemental Figure 2). The main reasons for absenteeism were weather shocks and child health. Also, during festivities and summer holidays, children traveled to visit their relatives. In some cases, they stayed longer than the festivities’ time, reducing attendance.



SUPPLEMENTAL FIGURE 2

Attendance conditional on EP session occurring in AWCs.

SUPPLEMENTAL TABLE 5 Enrollment and Attendance at AWC (%)

	<i>N</i>	Control	EP	Difference EP
Enrolled at an AWC	1162	0.58 (0.49)	0.69 (0.46)	0.11*** (0.04)
Attended a private preschool last week	1162	0.18 (0.38)	0.15 (0.36)	−0.03 (0.03)
Not enrolled at an AWC	1308	0.13 (0.33)	0.10 (0.30)	−0.03 (0.02)

SDs in parenthesis. *P* values calculated on the basis of robust SEs.*** *P* < .01; ** *P* < .05; * *P* < .1.**SUPPLEMENTAL TABLE 6** Outcome Scores Means and Standard Deviations by Treatment Group at Follow-up of Late Trial

	Control	Only ES	Only EP	ES and EP
Child Outcomes and Parenting Knowledge				
IQ scaled score	75.88 (10.38)	77.22 (10.53)	77.71 (10.39)	79.39 (10.88)
IQ subscales scaled scores				
Verbal comprehension	77.64 (8.45)	78.84 (8.35)	79.00 (8.49)	80.53 (9.04)
Visual spatial	77.46 (8.54)	77.49 (9.13)	78.31 (9.41)	79.11 (9.20)
Working memory	78.82 (11.78)	79.81 (11.74)	80.28 (11.30)	80.15 (11.20)
Processing speed	87.36 (14.99)	88.38 (15.73)	89.08 (15.83)	90.83 (16.48)
SR	62.54 (24.37)	63.46 (23.50)	67.39 (24.77)	66.75 (26.12)
Parenting knowledge: adapted KIDI	38.32 (4.50)	38.26 (4.52)	38.13 (4.57)	38.68 (4.53)
Home environments				
FCI, activities	3.30 (2.00)	3.79 (2.01)	3.56 (2.00)	3.69 (2.06)
FCI, materials	5.28 (2.35)	5.53 (2.70)	5.57 (2.42)	5.53 (2.58)
Adapted EC-HOME	17.32 (3.37)	17.79 (3.14)	17.71 (3.50)	17.88 (3.46)
Home environments: adapted EC-HOME subscales				
Acceptance	2.68 (1.07)	2.63 (1.06)	2.75 (1.04)	2.65 (1.11)
Responsivity	3.66 (1.17)	3.65 (1.16)	3.63 (1.24)	3.67 (1.16)
Physical environment	4.28 (0.89)	4.30 (0.93)	4.20 (0.94)	4.31 (0.91)
Language stim.	4.37 (0.91)	4.52 (0.79)	4.50 (0.85)	4.47 (0.81)
Academic stim.	2.33 (1.92)	2.69 (1.90)	2.63 (1.92)	2.78 (1.99)
Teacher–children interaction quality				
Teacher–children interaction quality	5.50 (1.56)	—	6.01 (1.54)	—
Positive climate	10.73 (2.51)	—	11.35 (2.56)	—
Negative climate	5.12 (1.31)	—	5.20 (1.59)	—
Instructional learning formats	6.33 (1.89)	—	7.08 (2.04)	—
Concept development	4.74 (1.56)	—	5.19 (1.64)	—
Quality of feedback	11.22 (2.79)	—	12.22 (2.69)	—
Language modeling	5.10 (1.53)	—	5.42 (1.53)	—

SDs are in parentheses. EC-HOME, Early Childhood Home Observation for the Measurement of the Environment; KIDI, Knowledge of Infant Development Inventory; stim., stimulation; —, not applicable.

SUPPLEMENTAL TABLE 7 Treatment Effects on IQ subscales

	Verbal Comprehension	Visual Spatial	Working Memory	Processing Speed
Only ES	0.200 (0.073) [0.048]	0.129 (0.077) [0.434]	0.106 (0.067) [0.444]	0.076 (0.079) [0.470]
Only EP	0.153 (0.074) [0.226]	0.218 (0.074) [0.033]	0.142 (0.063) [0.169]	0.100 (0.076) [0.470]
EP and ES	0.264 (0.083) [0.014]	0.243 (0.071) [0.006]	0.106 (0.069) [0.444]	0.101 (0.080) [0.470]
<i>N</i>	1283	1283	1283	1229

Estimated coefficients are expressed in SDs of the control group. Sample size includes all target children who completed the IQ (adapted WPPSI-IV) at follow-up. Processing Speed index is assessed only for children aged 4 years and above. Clustered SEs in parenthesis. The SEs (reported in parentheses) and the 2-tailed *P* values (reported in square brackets) are calculated using the bootstrap (5000 replications), allowing for clustering at the village level and for stratification used in the randomization protocol. The *P* values are also corrected for multiple (12) hypotheses testing using the Romano-Wolf step-down method.⁴⁵ Covariates included: child's sex; tester fixed effects; baseline age in months; Ages & Stages Questionnaires, Third Edition; mother's education and Raven's score; and preschool interaction quality at baseline late trial. IQ refers to intelligence measured as the scaled score using the adapted WPPSI-IV. All subscales are scaled score.

SUPPLEMENTAL TABLE 8 Treatment Effects on Teacher–Children Interaction Quality Subscales

	Positive Climate	Negative Climate	Instructional Learning Formats	Concept Development	Quality of Feedback	Language Modeling
EP	0.172 (0.116) [0.260]	0.168 (0.149) [0.263]	0.350 (0.117) [0.010]	0.368 (0.097) [0.001]	0.395 (0.108) [0.001]	0.275 (0.103) [0.021]
<i>N</i>	186	186	186	186	186	186

Estimated coefficients are expressed in SDs of the control group. To recover the impact of the teacher–children interaction quality subscales, we compare the treated versus control for the late trial only. Sample size includes all AWCs observed using the preschool assessment tool at follow-up (1 per village) to assess teacher–children interaction quality. The SEs (reported in parentheses) and the 2-tailed *P* values (reported in square brackets) are calculated using the bootstrap (5000 replications), allowing for clustering at the village level and for stratification used in the randomization protocol. The *P* values are also corrected for multiple (6) hypotheses testing using the Romano-Wolf step-down method.⁴⁵ Covariates included: child's sex; tester fixed effects; baseline age in months; Ages & Stages Questionnaires, Third Edition; mother's education and Raven's score; and preschool quality at baseline late trial.

SUPPLEMENTAL TABLE 9 Preschool Observations by Treatment Group at Follow-up of Late Trial

	<i>N</i>	Control	EP	Difference EP
No. of children enrolled	187	14.3 (4.9)	15.0 (5.8)	0.8 (0.8)
No. of classrooms	187	0.9 (0.5)	0.9 (0.5)	0.0 (0.1)
Frequent parental participation	183	2.8 (1.5)	2.8 (1.4)	0.0 (0.2)
Enough space for children	182	0.8 (0.4)	0.8 (0.4)	−0.1 (0.1)
Classroom is clean	186	2.6 (1.1)	2.4 (1.0)	−0.2 (0.2)
Growth chart on the walls	181	0.6 (0.5)	0.7 (0.5)	0.1 (0.1)
Displays at eye-level of children	178	0.5 (0.5)	0.6 (0.5)	0.1* (0.1)
Children's work displayed	177	0.2 (0.4)	0.5 (0.5)	0.3*** (0.1)
Children sit on chairs or clean mat	186	0.7 (0.5)	0.9 (0.3)	0.2*** (0.1)
Water source: private tap	180	0.3 (0.5)	0.2 (0.4)	−0.1 (0.1)
Water source: public stand	180	0.3 (0.5)	0.4 (0.5)	0.0 (0.1)
Water source: handpump	180	0.4 (0.5)	0.3 (0.5)	0.0 (0.1)
There is no water	180	0.0 (0.2)	0.1 (0.3)	0.0 (0.0)
There is a toilet	175	0.2 (0.4)	0.2 (0.4)	0.0 (0.1)

SDs in parenthesis in columns 2 and 3. Robust SEs in parentheses allowing for clustering and stratification in column 4. *P* values calculated on the basis of robust SEs.

*** *P* < .01; ** *P* < .05; * *P* < .1.

SUPPLEMENTAL TABLE 10 Treatment Effects on Home Environments: Adapted EC-HOME Subscales

	Acceptance	Responsivity	Physical environment	Language Stim.	Academic Stim.
Only ES	−0.035 (0.063) [0.980]	0.019 (0.055) [0.993]	0.102 (0.074) [0.672]	0.154 (0.069) [0.255]	0.186 (0.065) [0.060]
Only EP	−0.004 (0.060) [0.998]	−0.096 (0.054) [0.527]	−0.018 (0.078) [0.994]	0.092 (0.061) [0.657]	0.099 (0.065) [0.657]
ES and EP	−0.100 (0.063) [0.651]	0.002 (0.048) [0.998]	0.045 (0.068) [0.979]	0.122 (0.066) [0.503]	0.199 (0.057) [0.006]
<i>N</i>	1264	1264	1264	1264	1264

Estimated coefficients are expressed in SDs of the control group. Sample size includes all mothers who completed the adapted Early Childhood Home Observation for the Measurement of the Environment at follow-up in column 3. Clustered SEs in parenthesis. The SEs (reported in parentheses) and the 2-tailed *P* values (reported in square brackets) are calculated using the bootstrap (5000 replications), allowing for clustering at the village level and for stratification used in the randomization protocol. The *P* values are also corrected for multiple (15) hypotheses testing using the Romano-Wolf step-down method.⁴⁵ Covariates included: child's sex; tester fixed effects; baseline age in months; Ages & Stages Questionnaires, Third Edition; mother's education and Raven's score; and preschool interaction quality at baseline late trial. EC-HOME, Early Childhood Home Observation for the Measurement of the Environment; Stim., stimulation.